TIMARU
DISTRICT COUNCIL
Te Kaunihera ā-Rohe
o Te Tihi o Maru

20 August 2024

Timaru District Council
C/- Pattle Delamore
PO Box 389
Christchurch 8140

Email: isobel.stout@pdp.co.nz

Dear Isobel,

Land Use Consent No. 102.2024.64.1
Land use consents to remediate Peel Forest landfill
Dennistoun Road, Peel Forest

I advise that a decision has been made by the Planning Manager dated 20 August 2024 to limited notify application **No. 102.2024.64.1** for land use consents to remediate the former Peel Forest Landfill pursuant to Section 95D of the RMA because potential adverse effects have been found to be more than minor on some specified parties.

The decision with the officer's recommendation is attached with this letter.

The next step if you wish to proceed is to request a notification deposit. After that is paid we will endeavour to notify the application to the affected parties as soon as possible. We are mindful that ECAN is also concurrently considering its position on notification for the regional consents and we will liaise with ECAN about its approach and the possible joint notification of the consents.

The decision with the officer's recommendation is attached with this letter.

If you have any queries on this matter, please contact me at the details listed below.

Yours faithfully,

Alex Wakefield
Team Leader Consents and Compliance
Email: alex.wakefield@timdc.govt.nz

TIMARU
DISTRICT COUNCIL
Te Kaunihera ā-Rohe
o Te Tihi o Maru

Decision of Timaru District Council
Land use consent No. 102.2024.64.1

Acting under a delegated authority from Timaru District Council, I have considered the application by Timaru District Council for land use consents to remediate the old Peel Forest landfill within the Rural 1 Zone at Dennistoun Road, Peel Forest and the recommendation made by the planning consultant.

Notification Decision

The consultant's report considered the application in respect to the notification steps prescribed by sections 95A-95G of the Act and recommended that the application be processed on a limited notification basis because:

- In relation to Section 95D of the Act, the proposed land use activity will not have adverse effects on the environment that are more than minor;

In relation to Section 95E of the Act, the proposed land use activity will have potential adverse effects on identified persons and those effects will be minor or more than minor on persons located at the following properties:

45 Dennistoun Road	55 Dennistoun Road
47 Dennistoun Road	57 Dennistoun Road
49 Dennistoun Road	105 Dennistoun Road
53 Dennistoun Road	1174 Peel Forest Road

Having reviewed the assessment and recommendation in the officer's report, I concur with the conclusions reached and agree with the recommendation.

Acting under the delegated authority from Timaru District Council, I have decided, pursuant to sections 95A-95D of the Resource Management Act 1991, that the application be processed on a limited notification basis.

H. Barrell

Hamish Barrell
Planning Manager Consents & Compliance

Date: 20 August 2024

OFFICERS REPORT ON A RESOURCE CONSENT APPLICATION
(s95A and 95B)
OF THE RESOURCE MANAGEMENT ACT 1991

Consent No:	102.2024.64.1
Applicant:	Timaru District Council
Application:	1. Application under section 88 of the Resource Management Act 1991 (RMA) for vegetation clearance and earthworks and associated activities to remove the entire contents (18,000m^3) of a closed landfill for disposal at Redruth Landfill, Timaru. 2. Land use consent for soil disturbance under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES-CS).
Location:	Dennistoun Road, Peel Forest
Zoning:	Operative Timaru District Plan: Rural 1 Proposed Timaru District Plan: GRUZ
Legal Description:	Survey Office Plan 3144 (landfill) and LOT 3 DP 343513 (Contractor's yard)
Activity Status:	Discretionary Activity
Lodgement date:	1 May 2024

This report has been prepared under section 42A of the Resource Management Act 1991 to document the assessment of the subject resource consent application. This report also constitutes the reasons for the decision as required under section 113 of the RMA.

Introduction

The Timaru District Council (TDC) has applied for consents from Environment Canterbury (ECAN) and the Timaru District Council (TDC) for a number of regional and district resource consents.

<u>ECAN Consents:</u>

1. A land use consent under the Canterbury Land and Water Regional Plan (LWRP) for vegetation clearance as a restricted discretionary activity pursuant to Rule 5.169;
2. A land use consent under LWRP for earthworks as a restricted discretionary activity pursuant to Rule 5.175;
3. A discharge permit under the LWRP for the associated discharge of contaminants (namely sediment); as a restricted discretionary activity pursuant to Rule 5.94B.

<u>District Council Consents:</u>

4. A land use consent under the Operative Timaru District Plan (OTDP) to excavate soil etc as a discretionary activity pursuant to Rule D1-3.4.;
5. A land use consent under the OTDP to set up a contractor's depot as a discretionary activity pursuant to Rule D1-3.6.;
6. A land use consent under the Proposed Timaru District Plan (PTDP) to carry out earthworks as a restricted discretionary activity pursuant to Rule SASM-R1(2);
7. A land use consent from the Timaru District Council (TDC) under the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES-CS), as a restricted discretionary activity pursuant to Regulation 10.

The site is designated in the Operative Timaru District Plan (OTDP) by TDC for landfill purposes (designation 84). The application stated that TDC has waived this requirement under s176A(2)(c). In response to a s92 request the applicant has confirmed that that statement is incorrect. There has been no waiver.

The applicant has confirmed that it relies on S176A (2) (a) RMA (not s176A(2)(c)) and that the proposed public work, project, or work has been otherwise approved under this Act on the basis that TDC is applying for resource consent to approve works in the designated site and hence an Outline Plan is not necessary.

The application has been prepared by Pattle Delamore Partners and it includes the document *Resource Consent and Assessment of Environmental Effects – Peel Forest Closed Landfill Removal and Restoration* dated April 2024 and submitted as part of the application.

The applicant has provided a full description of the proposal in the AEE that forms part of the application. A DSI (Detailed site Investigation) is part of the application.

There are 10 Appendices addressing technical issues in support of the application including proffered conditions, a letter from Aoraki Environmental recording iwi support for the application, and a statutory assessment document.

The AEE has a detailed description of the proposal at section 4.0 and includes a plan showing an indicative layout of the proposed contractor's yard. (**Figure 1**). The description is taken from the Remediation Action Plan attached to the application as Appendix F:

The entire landfill contents are to be removed from the site and transported to a Class 1 disposal facility in Timaru (Redruth). The risk of further loss of landfill contents in future floods will then be reduced to zero. After the removal works, the site will be recontoured and planted in native species so that no further work or maintenance is required. No public access will be formed, no facilities provided, and the land will remain in the ownership of the Crown.
A contractor's yard is necessary for temporary infrastructure such as a site office, toilets/lunchroom and storage of equipment and materials to support the removal of landfill contents and earthworks. Land immediately adjacent to the landfill site (approximately 6,000m2) is to be leased for this purpose and will be graded and stabilised during the work period. The combined work sites, yard, and landfill will be securely fenced for the duration of the work. Upon completion of all works, the leased area will be returned to pasture and the rehabilitated former landfill will be landscaped and planted.

Figure 1: Indicative layout of contractor's yard (AEE Fig 3)

This description of the site and the proposal is considered adequate and is adopted for the purpose of this report with the following additional assessment or clarifications:

1. An RFI under s92 of the RMA was sent to the applicant on 21 May 2024. Responses to the RFI questions were received on 7 June, 24 June and 25 June 2024.
2. Two expert reviews were commissioned relating to noise and traffic effects. The TDC Environmental Health Officers confirmed that the NES contaminated land matters had been appropriately addressed in the application.
3. By email on 15 July 2024 the Council confirmed that all the information required under those requests had been provided.

Location maps

Figure 2: Orange arrow is the site

Figure 3: The site (from the AEE Fig 2)

Description of the Environment

The Peel Forest landfill operated at the eastern end of Dennistoun Road atop a gulley adjacent to the Rangitata River from 1962 until 2004, when the Timaru District Council formally closed it as a landfill.

The AEE at section 3.0 describes the site and surrounding environment. Key features include:

1. Denniston Road is a local road and is sealed for about 200m from the intersection with Peel Forest Road (a Collector Road under the PTDP). The remainder of the road to the site is a single lane shingle formation.
2. The dwelling at 105 Dennistoun Road is serviced by a public potable water supply.
3. The site sits within a farmed landscape used for rural production activities.
4. The Rangitata River is immediately east of the site.
5. Near to the intersection of Dennistoun Road and Peel Forest Road, and north of that intersection and east along Peel Forest Road are residential properties.
6. There is a large Open Space Zone site at the SE corner of the Dennistoun/ Peel Forest Road intersection.

The arrangement of these nearby land use activities in relation to the landfill site is shown in **Figure 4** below.

Figure 4: Nearby dwellings (Source: Proposed Timaru District Plan):White star is landfill site.

The nearest dwelling to the site is zoned Rural 1/GRUZ and accessed off Dennistoun Road approximately 35 metres north of the proposed landfill pit to be excavated.

At the SE corner of Dennistoun and Peel Forest Roads is a large Rural 1/OSZ parcel and on the NE corner is land zoned RES 3/SETZ.

The site is located within an area of significance to Ngāi Tahu. A letter from Aoraki Environmental Limited in Appendix I to the AEE sets out the runaga’s involvement in and support for the proposal.

Planning Framework

Operative Timaru District Plan (OTDP)

The subject site is zoned Rural 1 in the OTDP **(Figure 5)** and the proposed activity status of the consents applied for has been assessed by the applicant at section 5 of the AEE.

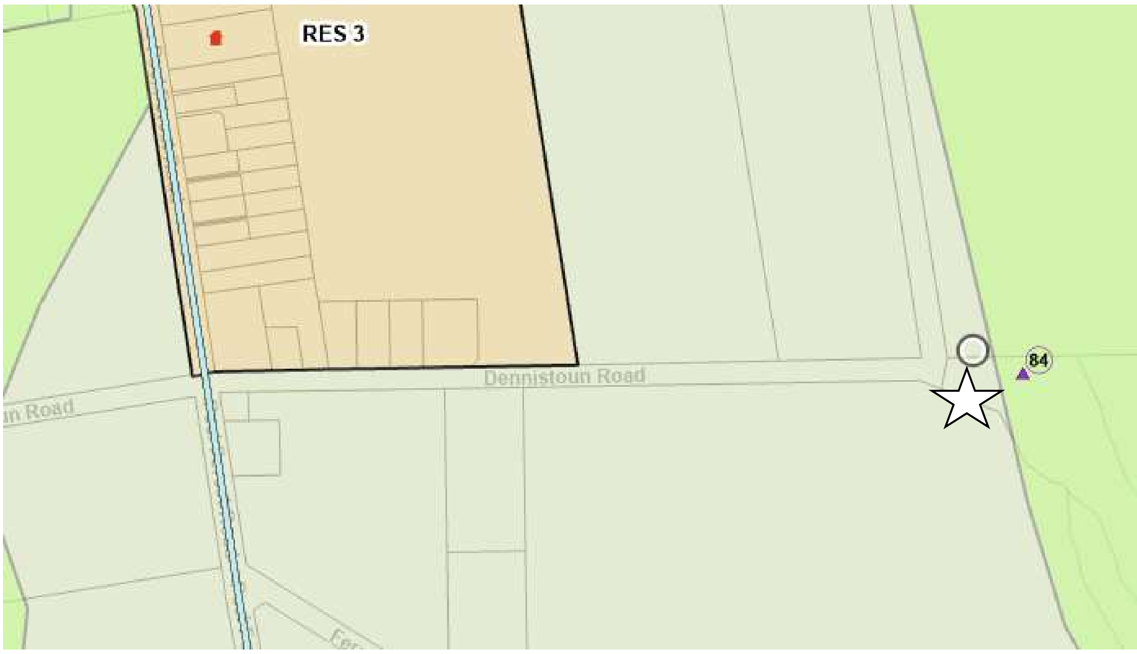

Figure 5: Operative District Plan zones: White star is application site

That assessment is adopted here. In summary consent is required for the landfill activity for these reasons:

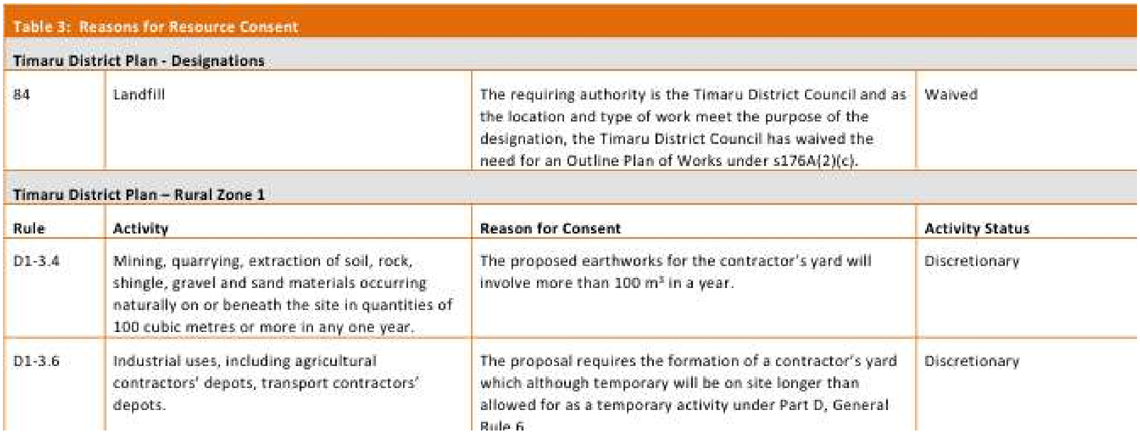

Table 3: Reasons for Resource Consent

Timaru District Plan - Designations			
84	Landfill	The requiring authority is the Timaru District Council and as the location and type of work meet the purpose of the designation, the Timaru District Council has waived the need for an Outline Plan of Works under s176A(2)(c).	Waived
Timaru District Plan – Rural Zone 1			
Rule	**Activity**	**Reason for Consent**	**Activity Status**
D1-3.4	Mining, quarrying, extraction of soil, rock, shingle, gravel and sand materials occurring naturally on or beneath the site in quantities of 100 cubic metres or more in any one year.	The proposed earthworks for the contractor's yard will involve more than 100 m³ in a year.	Discretionary
D1-3.6	Industrial uses, including agricultural contractors' depots, transport contractors' depots.	The proposal requires the formation of a contractor's yard which although temporary will be on site longer than allowed for as a temporary activity under Part D, General Rule 6	Discretionary

A RFI requested a full assessment of the OTDP and all relevant provisions (Rural 1 and district-wide matters).

Proposed Timaru District Plan

On 22 September 2022 the Timaru District Council publicly notified its proposed District Plan (PTDP). This application was lodged with the Council on 1 May 2024, and so the PTDP is relevant to consideration of the application.

The applicant has correctly identified that the SASM provisions are operative and its assessment of the PTDP was limited to those provisions.

A RFI requested a full assessment of the PTDP and all relevant provisions (GRUZ and district-wide matters) as they have effect and it is the weight to be accorded each that is important now that the plan process has entered the hearings phase.

The subject site is located within the General Rural Zone of the PTDP.

The applicant's assessment against the PTDP is set out in section 6 Table 3:

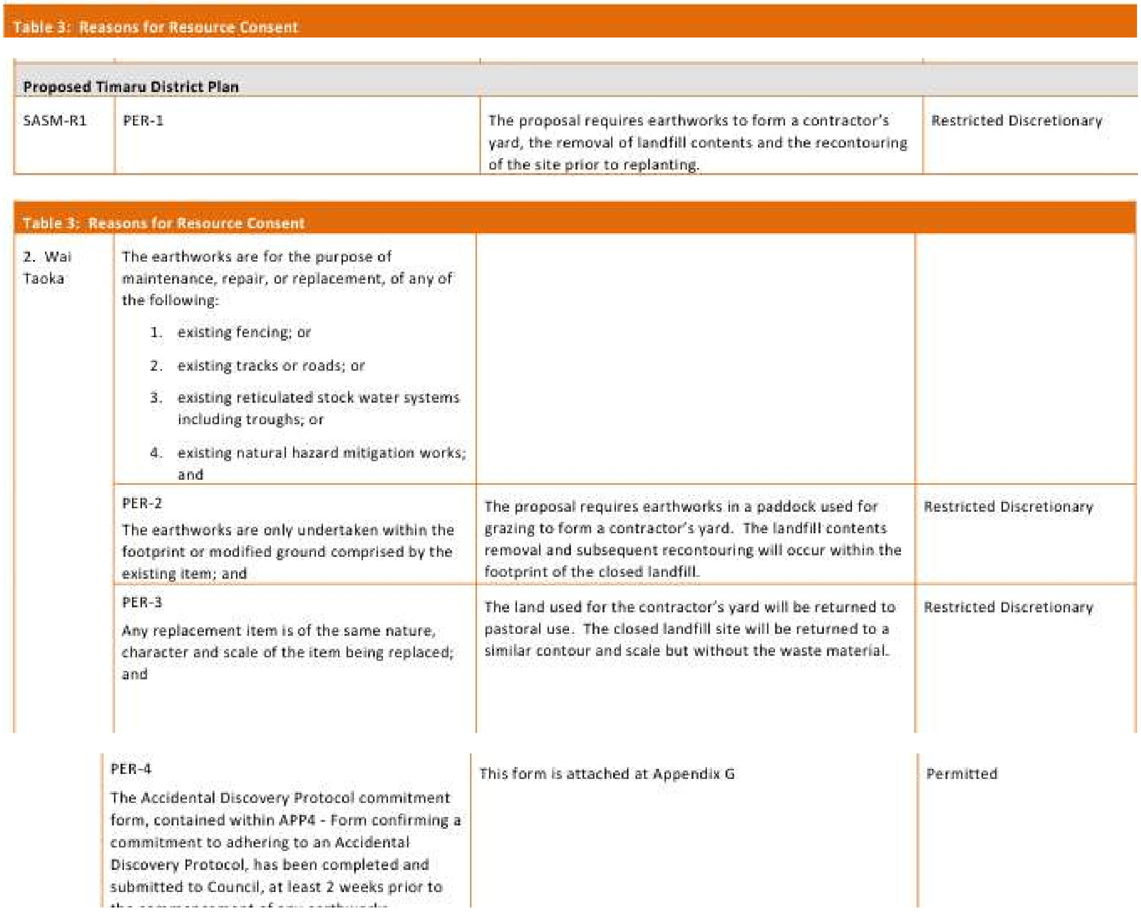

Table 3: Reasons for Resource Consent

Proposed Timaru District Plan			
SASM-R1	PER-1	The proposal requires earthworks to form a contractor's yard, the removal of landfill contents and the recontouring of the site prior to replanting.	Restricted Discretionary

Table 3: Reasons for Resource Consent

2. Wai Taoka	The earthworks are for the purpose of maintenance, repair, or replacement, of any of the following: 1. existing fencing; or 2. existing tracks or roads; or 3. existing reticulated stock water systems including troughs; or 4. existing natural hazard mitigation works; and		
	PER-2 The earthworks are only undertaken within the footprint or modified ground comprised by the existing item; and	The proposal requires earthworks in a paddock used for grazing to form a contractor's yard. The landfill contents removal and subsequent recontouring will occur within the footprint of the closed landfill.	Restricted Discretionary
	PER-3 Any replacement item is of the same nature, character and scale of the item being replaced; and	The land used for the contractor's yard will be returned to pastoral use. The closed landfill site will be returned to a similar contour and scale but without the waste material.	Restricted Discretionary
	PER-4 The Accidental Discovery Protocol commitment form, contained within APP4 - Form confirming a commitment to adhering to an Accidental Discovery Protocol, has been completed and submitted to Council, at least 2 weeks prior to	This form is attached at Appendix G	Permitted

National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011 (NESCS)

The site has previously been used for a Category G3 HAIL activity and is accordingly subject to the NESCS.

A flood event on 9 December 2019 exposed the toe of the landfill and there has been a number of investigations arising from that leading to this application. This history is set out in the AEE at section 2.2.

A Detailed Site Investigation (DSI) has been conducted for this site and is attached as Appendix C to the AEE.

A full Remediation Action Plan (RAP) in accordance with the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health is at Appendix F to the AEE.

Section 10.3 sets out how the proposal sits within the NESCS:

'When considering an application for a resource consent required by regulation 9, regulation 10, or regulation 11, the consent authority must have regard to any relevant provisions in the

district plan or proposed district plan, and the regional policy statement or proposed regional policy statement (RMA s 104).'

'In regulation 10, the NES has restricted its discretion to certain matters. As with regulation 9, provisions in the district plan or regional policy statement will only be relevant if they relate specifically to those matters. If granted, conditions may only be imposed on the consent for matters within the discretion of regulation 10 and the application can only be declined in relation to these matters.'

An assessment of the relevant regulations is set out at Appendix J Table 13.

Resource Management Act

Section 104 of the RMA requires a consent authority to have regard to several over-riding matters when considering an application for resource consent.

Section 104B of the RMA provides that a consent authority may grant or refuse an application for a discretionary activity and, if it grants consent, may impose conditions under s108.

Activity Status Determination

Overall, the application is being considered and processed as:

- **a discretionary activity** under the Operative Timaru District Plan
- **a restricted discretionary activity** under the Proposed Timaru District Plan
- a **restricted discretionary** activity under the NESCS.

Notification consideration under Sections 95A of the Resource Management Act (RMA)

Section 95A – Public Notification

Section 95A of the RMA requires a decision on whether or not to publicly notify an application. The following steps set out in this section, in the order given, are used to determine whether to publicly notify an application for a resource consent.

Step 1 – Mandatory public notification

The applicant has not requested public notification of the application (s95A(3)(a)).

Public Notification is not required as arising from a refusal by the applicant to provide further information or refusal of the commissioning of a report under section 92(2)(b) of the RMA (s95A(3)(b)).

The application does not involve exchange to recreation reserve land under section 15AA of the Reserves Act 1977 (s95A(3)(c)).

Therefore, public notification is not required by Step 1.

Step 2 – Public notification precluded

Public notification is not precluded by any rule or national environmental standard (s95A(5)(a)).

Therefore, public notification is not precluded (s95A(5)(b)).

<u>Step 3 – If not precluded by Step 2, public notification is required in certain circumstances</u>

Public notification is not specifically required under a rule or national environmental standard (s95A(8)(a)).

A consent authority must publicly notify an application if notification is not precluded by Step 2 and the consent authority decides, in accordance with s95D, that the proposed activity will have or is likely to have adverse effects on the environment that are more than minor (s95A(8)(b)).

<u>Effects that must / may be disregarded (s95D(a)-(e))</u>

Effects that <u>must</u> be disregarded:

- Effects on the owners or occupiers of land on which the activity will occur and on adjacent land (s95D(a)).
- Trade competition and the effects of trade competition (s95D(d)).

Effects that <u>may</u> be disregarded:

- An adverse effect of the activity if a rule or national environmental standard permits an activity with that effect (s95D(b) – referred to as the "permitted baseline".

<u>Permitted Baseline (s95D(b))</u>

The consent authority may disregard an adverse effect of the activity if a rule or national environmental standard permits an activity with that effect.

The applicant in its AEE does not make a case for a permitted baseline for the land use activities for which consent is required. It does at section 6.5 identify the range of permitted activities under the OTDP and the SASM status of the PTDP.

The site is subject to Designation 84 (Landfill) in the OTDP but this designation was not carried forward in to the PTDP.

The proposed activities involving preparatory site works (vegetation clearance and soil scraping/ stockpiling of soils) and the removal of the entire contents of the old landfill may fall under the landfill designation, but upon completion of the project with the landfill removed the site arguably is not consistent with its designated purposes in that the landfill will no longer exist. That is somewhat academic as s176A (2) (a) provides for the situation where the proposed public work, project, or work has been otherwise approved under this Act (assuming consent for this application is granted).

When the PTDP becomes operative the designation will no longer exist. T was not carried forward into the new plan.

The site is a closed landfill, so the existing effects are minimal above ground. There are no active management activities other that associated with investigations and some remedial activities after the 2019 flood event. The site is fenced and grassed. It has all the characteristics of the adjacent deer farm.

On that basis no permitted baseline is applicable to the proposal.

Section 95D – Are adverse effects likely to be more than minor?

A consent authority that is deciding, for the purpose of section 95A(8)(b), whether an activity will have or is likely to have adverse effects on the environment that are more than minor—

(a) must disregard any effects on persons who own or occupy—

  (i) the land in, on, or over which the activity will occur; or

  (ii) any land adjacent to that land; and

(b) may disregard an adverse effect of the activity if a rule or national environmental standard permits an activity with that effect; and

(c) N/A restricted discretionary activity, and

(d) must disregard trade competition and the effects of trade competition; and

(e) must disregard any effect on a person who has given written approval to the relevant application.

Noise effects

No Noise Assessment was prepared for the proposal. There are no proffered conditions relating to the management of noise effects.

The AEE relies on compliance with the construction noise standard NZS6803:1984 superseded by NZS6803:1999 to conclude at section 8.6 pp25-26 that noise effects will be less than minor:

The cumulative noise from the proposal will be no more than minor at 105 Dennistoun Rd, the nearest dwelling, when occupied. The construction noise will be nearly inaudible at other residential properties on Dennistoun Road and will therefore have no discernible impact on the local environment.

This conclusion was reviewed by Malcolm Hunt & Associates who has advised that:

Overall, as the proposed activities are likely to fully comply with the district plan noise limits applicable to permitted construction activities in the rural zone, potential noise effects of the proposed landfill excavation, sorting, transport and remediation activity are assessed as likely to be less than minor. We consider consent can be granted on noise grounds on the basis that the noise effects during the period of proposed works are not likely to be excessive or unreasonable at the closest dwelling…

The Hunt Report recommended several conditions of consent to manage noise effects.

Within a Rural Zone there are a wide range of potential noise and vehicle movement generators from permitted activities that would are an expected component of rural amenity and environmental quality. As well, the OTDP at 6.21.2.2 has exemptions for some rural activities:

Noise limits in any part of the Plan shall not apply:

(a) In any area or zone, to activities of a limited duration required by normal seasonal agricultural, horticultural and forestry practice, such as harvesting, provided that the

activity shall be no louder than necessary, and shall comply with the requirements of section 16 of the Resource Management Act 1991.

The proposed remediation activities at the Peel Forest Landfill do not easily fit within this exemption relating to short-term farming activities but there is recognition in the OTDP of how limited duration adverse noise effects are part of the ambient noise of a rural area. The proposed activities will be carried out over 9-12 months and although short term in a sense, this is not a similar timeframe to say harvesting a barley crop, silage production or cultivation.

The proposed activities and the noise they will generate for 105 Dennistoun Road in particular, and for other Dennistoun Road residences (**Figure 6**), are much more prolonged and not typical of what occurs in the rural area they sit in or are adjacent to. In that regard effects from noise will be different but, overall, less than minor. When considering the site context and circumstances of the activity the noise effects will not be unreasonable as confirmed by the Hunt Report. The project has a defined life of 9-12 months, there are proposed limitations on days and hours of operation being Monday - Friday, 0730 – 1800 hours, and compliance with the NZS Construction Noise standard all assist in mitigating noise effects.

Overall, the potential noise effects of the proposed landfill excavation, sorting, transport and remediation activity on the nearby dwelling and its occupants is likely to be less than minor assuming compliance with the construction noise standard NZS6803:1999.

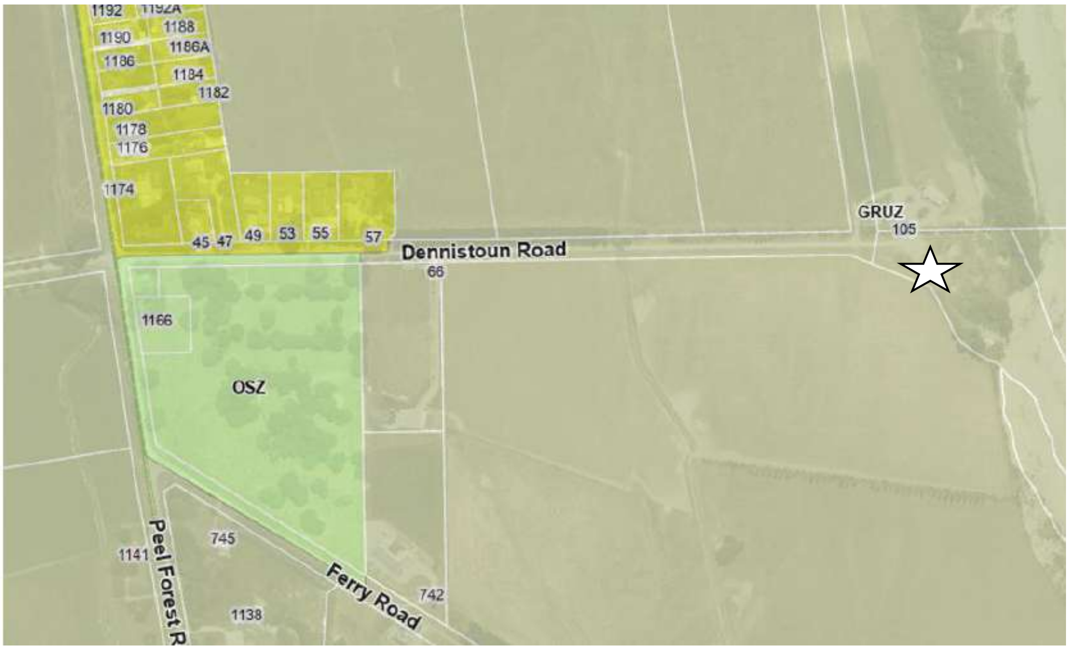

Figure 6: Adjacent properties

Traffic effects:

No Traffic Impact Assessment has been included in the AEE. There are no proffered conditions relating to the management of traffic effects despite some options set out in the Remediation Action Plan.

Dennistoun Road is classified as a local road under the OTDP and the PTDP. Peel Forest Road is a local road under the OTDP but a Collector Road under the PTDP.

A description of the traffic characteristics associated with the proposal is set out in the AEE at section 8.6 but there is no baseline information on existing vehicle counts for Dennistoun or Peel Forest Road.

A response to the RFI confirmed that at 8 March 2024 ADT for Dennistoun Road is 41 and for Peel Forest Road the ADT is 585 at the intersection with Dennistoun Road.

The AEE section 8.6 description notes that adverse effects associated with traffic and on-site machinery can include noise, vibration, and spillage of material on roads. It also highlights that the need for heavy vehicle access is likely to have an adverse effect on the road integrity particularly at the intersection of Dennistoun and Peel Forest Roads. No consideration is given to traffic effects on the amenity and quality of environment enjoyed by Res 3/SETZ zoned properties directly and potentially affected by the traffic movements.

Heavy vehicles travelling to Timaru and returning to the site can only use Peel Forest Road. There is no evidence in the AEE that the Dennistoun/ Peel Forest Road intersection is appropriate for the proposed activity. Rather the AEE relies on the fact that the Council as applicant and road controlling authority is aware that the proposed heavy vehicles are likely to have an adverse effect on the road integrity particularly at the intersection. The AEE suggests that this likely adverse effect can be appropriately managed by the TDC being able to liaise with the successful tenderer to monitor this intersection. With respect, that suggestion seems rather informal, uncertain and subject to a wide discretion by the applicant.

In response to the RFI the applicant provided tracking diagrams for truck and trailer units negotiating the intersection. The diagrams **(Figure 7)** clearly show two issues:

1. The vehicles will track beyond the existing seal formation making worse the existing evidence of seal edge break; and
2. The truck and trailer units will need to use the entire width of the Peel Forest Road and Dennistoun Road carriageway to successfully negotiate the intersection.

Figure 7: Vehicle tracking diagrams

The expert review by Stantec has, consequently, recommended some conditions relating to an upgrade of the intersection, a Construction Traffic Management Plan and signage.

The Remediation Action Plan at section 18.1 also suggested a number of measures (signage and temporary speed limits) to manage traffic effects that are not reflected in the AEE.

Traffic effects are potentially significant for this proposal: 18,000m^3 of material has to be taken off site over a 9–12 month period by five trucks doing three return trips/day and operating five days a week in daylight hours. The AEE does not estimate the number of truck movement required to clear the old landfill. It does calculate that the worst-case scenario for all vehicles accessing the site is an additional 46 vehicle movements each day and identifies the likely type of vehicles involved. The AEE does not describe the amount of traffic bringing material into the site although that will not be a significant number of vehicles.

The Stantec review summarised the traffic generation:

The works are expected to take 9-12 months and involve up to 46 vehicle movements per day inclusive of 30 truck and trailer movements. This represents 1,200 – 1,500 truck and trailer movements over the project duration.

The change in the traffic environment because of the volume and mix of heavy vehicles has two consequences:

1. A need to ensure that the road pavement is fit for purpose for such additional loading over the normal pavement life expectancy; and

2. A potential adverse effect on properties adjoining and using Dennistoun and Peel Forest Roads.

The increase in the number and characteristics of vehicle movements associated with the proposed activity on the site is significant in comparison with the existing environment and the level of vehicle movement associated with existing land uses. Regular users of Dennistoun and Peel Forest Roads will include those property owners having access to or frontage to the access roads and are those persons most likely to experience and have to manage this increase in traffic on a daily or regular basis for the life of the project.

The change in the traffic profile in terms of volumes and nature of vehicles has two potential effects for these properties:

1. It may create potential safety issues, and
2. For some properties (not all) there is a potential increase in annoyance from regular weekday heavy vehicle movements (on average one every 20 minutes) above what they currently experience that may well impact upon their residential amenity in a minor or more than minor way albeit for a fixed and limited time.

A relevant point of comparison as to the significance of heavy vehicle effects are the WHO Guidelines values that establish the onset of serious annoyance at a worst-case scenario of 10 heavy vehicle movements within an hour. This Peel Forest proposal is some way short of that level of traffic movement. That said, there is the prospect of at least some annoyance from heavy vehicle noise for occupants of dwellings close to Dennistoun Road over the life of the project.

The effect of the increased traffic is much less likely to be noted by occasional or non-local traffic.

In summary, the site can be adequately provided with appropriate physical access to the required standard, the intersection can be upgraded to accommodate the truck and trailer units, and the safety effects of slow turning heavy vehicles at the Dennistoun/Peel Forest intersection can be managed appropriately by traffic management measures.

The proposal is considered to result in potential adverse traffic effects on adjacent or nearby property owners that are minor or less than minor.

Landscape effects

The AEE at section 8.4 assesses visual and landscape effects.

The topography of the site is mostly flat with the actual landfill site mostly hidden from most public viewpoints being set in a gully running down to the Rangitata River and below surface level.

What will be visible is the structures and facilities that support the remediation activities. These will be consistent in form and scale with similar rural structures including the security (deer) fencing.

The site is not identified in the OTDP or PTDP as having any special landscape qualities reflected in a zoning or overlay response, nor in specific standards to protect landscape qualities. It is part of the Rural 1 Zone which is characterised as including:

… most of the plains and downland areas with the exclusion of Class I and Class II land. This zone provides for a wide range of primary production activities and other forms of economic activity which are not considered likely to adversely effect physical resources elsewhere in the District…

The overall conclusion of the AEE that [*t*]*he construction works will have a less than minor effect on visual amenity and landscape, however once the remediation is complete, due to the restoration and planting, there will be an overall positive effect on visual and landscape effects* is supported for this s95 report.

<u>Highly Productive Land</u>

That part of the site that is to be used as the contractor's yard is mapped as being within Land Use Class 2 (LUC2) by the New Zealand Land Resource Inventory.

The land that is identified as LUC 2 is deemed to be highly productive land, until such time as detailed mapping is undertaken and included in the Canterbury Regional Policy Statement.

No part of the application site is within the Rural 2 Zone under the OTDP, which is identified as having the most versatile land and which is provided with some protection through limitations on the development of land within this zone.

In relation to the proposed activity involving developing and using the contractor's yard, there will be no significant change to the future extent, pattern and nature of development possible on the LUC 2 land as the topsoil will be scraped and stored for re-use at the completion of the project.

The AEE conclusion that potential adverse effects in relation to highly productive land under the NPS-HPL are considered to be less than minor is accepted for this s95 Report:

Considering the temporary nature of the yard and that on completion of the project the land will be returned to its pastoral state, the loss of the site from productive use will have less than minor adverse effects on the soil resource.

Consideration of the proposal against the National Policy Statement on Highly Productive Land is not considered here but will be covered in a Section 104 assessment of relevant objectives and policies.

<u>Natural Hazards</u>

Part of the site nearest the Rangitata River is identified as being subject to natural hazards in the PTDP Natural Hazard layer in terms of Flood Assessment Area and Liquefaction Assessment Area (**Figure 8** cross hatch).

That position is well understood and forms part of the rationale for this project to remove a potential source of contamination from erosion of the landfill toe by flood waters. Once the project is completed this risk and its effects will not exist.

Any potential adverse effects from natural hazards is being managed by the project through this consent application. Any potential adverse effects will be less than minor.

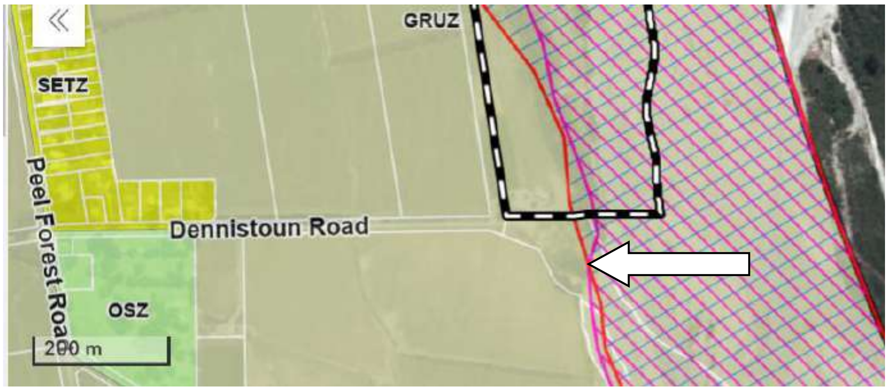

Figure 8: Natural hazard layers PTDP: White arrow is the site

Cultural Values SASM – Wāhi Taoka

Section 8.11 AEE explains that Aoraki Environmental Consultancy Ltd was contracted to assist in the development of the application. The section on whenua and awa has been written by it in consultation with Te Rūnanga o Arowhenua.

The Papatipu Rūnaka that represents Kāti Huirapa is Te Rūnanga o Arowhenua.

A detailed letter from Aoraki is at Appendix I.

Any potential adverse effects on iwi values are assessed by Aoraki as being minor or less than minor.

I accept that assessment for this s95 Report.

Summary – Effects on the Environment

On the basis of the above assessment, it is assessed that the proposed activity is likely to have adverse effects on the environment that are minor or less than minor. Therefore, public notification is not required under Step 3.

Step 4 – Public Notification in Special Circumstances

There are no special circumstances in relation to this application.

Notification consideration under Section 95B of the Resource Management Act

Section 95B – Limited Notification

Section 95B(1) requires a decision on whether there are any affected persons (under s95E). The following steps set out in this section, in the order given, are used to determine whether to give limited notification of an application for a resource consent, if the application is not publicly notified under section 95A.

Step 1: certain affected groups and affected persons must be notified

Determination under s95B(2)

The proposal does not affect protected customary rights groups, and does not affect a customary marine title group; limited notification is not required.

Determination under s95B(3)

Limited notification is not required under Step 1 as the proposal is not on or adjacent to, or may affect land subject to a statutory acknowledgement under Schedule 11, and the person to whom the statutory acknowledgement is made is/ is not determined an affected person under section 95E (s95B(3)).

The Aoraki Environmental Limited letter at Appendix I confirms that iwi have been involved in the preparation of the AEE and support the proposed consent application.

Step 2: if not required by Step 1, limited notification precluded in certain circumstances

Limited notification is not precluded under Step 2 as the proposal is not subject to a rule in the District Plan or is not subject to a NES that precludes notification (s95B(6)(a)).

Limited notification is not precluded under Step 2 as the proposal is not a controlled activity land use (s95B(6)(b)).

Step 3: if not precluded by Step 2, certain other affected persons must be notified

If limited notification is not precluded by Step 2, a consent authority must determine, in accordance with section 95E, whether the following are affected persons:

Boundary activity

The proposal is not a boundary activity where the owner of an infringed boundary has not provided their approval.

Any other activity

The proposed activity falls into the 'any other activity' category (s95B(8)), and the adverse effects of the proposed activity are to be assessed in accordance with section 95E.

Section 95E – Considerations in assessing adverse effects on Persons

> (1) *For the purpose of giving limited notification of an application for a resource consent for an activity to a person undersection 95B(4) and (9) (as applicable), a person is an affected person if the consent authority decides that the activity's adverse effects on the person are minor or more than minor (but are not less than minor).*
>
> (2) *The consent authority, in assessing an activity's adverse effects on a person for the purpose of this section,—*
>
> (a) *may disregard an adverse effect of the activity on the person if a rule or a national environmental standard permits an activity with that effect; and*
>
> (b) *must, if the activity is a controlled activity or a restricted discretionary activity, disregard an adverse effect of the activity on the person if the effect does not relate to a matter for which a rule or a national environmental standard reserves control or restricts discretion; and*
>
> (c) *must have regard to every relevant statutory acknowledgement made in*

> *accordance with an Act specified in Schedule 11.*
>
> *(3) A person is not an affected person in relation to an application for a resource consent for an activity if—*
>
> *(a) the person has given, and not withdrawn, approval for the proposed activity in a written notice received by the consent authority before the authority has decided whether there are any affected persons; or*
>
> *(b) the consent authority is satisfied that it is unreasonable in the circumstances for the applicant to seek the person's written approval.*
>
> *(4) Subsection (3) prevails over subsection (1).*

Persons who have provided written approval (s95E(3))

No private persons have provided written approval.

In a letter to the applicant on 15 July 2024 LINZ, acting as the Crown agent for Crown Property (the Rangitata River riverbed), wrote that:

LINZ are pleased to see Timaru District Council's ongoing commitment to managing the closed landfill located at the end of Dennistoun Rd, Peel Forest, following storm events and flooding of the neighbouring Rangitata River. We are very supportive of the remediation of the closed landfill taking place in line with the Remedial Action Plan you have provided our team.

Assessment: Effects on Persons

Taking into account the exclusions in sections 95E(2) and (3), the following is an assessment as to whether the activity will have or is likely to have adverse effects on persons that are minor or more than minor.

Effects on Nearby Properties

The AEE confirms at section 4.9 that the duration of the proposed activities will be between 9 - 12 months.

The source of potential adverse effects arises primarily from air discharges (to be addressed by ECAN consents), noise, effects on Dennistoun Road surface and a temporary change in the nature and frequency of heavy vehicle and heavy machinery movements to and from the site and within the site.

The applicant has prepared a Dust Management and Monitoring Plan attached to the AEE as Appendix D as a mitigation measure for discharges to air.

The Stantec expert review has recommended that a condition of any consent be for a Construction Traffic Management Plan. The Plan should include truck warning signage on Peel Forest Road and address how two-way vehicle movement will be managed on Dennistoun Road.

The existing landfill has been closed and there has been little activity associated with it since its closure in 2004. The proposal is introducing a new but temporary activity into the area and will be the source of some potential adverse effects: traffic, dust, and noise.

There is potential for some adverse effects on occupants of dwellings on or close to Dennistoun Road from the heavy vehicle movements in support of the proposed activities. The property at 105 Dennistoun Road that is 35m away from the excavation/ processing area is especially close to the excavation and processing/ loading area in the proposed contractor's yard (**Figure 1).** It is shielded by a hedge and its living areas face away to the north.

Other properties nearer the intersection of Peel Forest Road have access to Dennistoun Road. This local road is part sealed for the first 200m and will be used to access the landfill remediation activity and to cart the estimated 18,000m^3 of landfill waste to Timaru involving an estimated 1,200 – 1,500 truck and trailer movements over the project duration. Occupiers of these properties use a road that is characterised by a low level of traffic that will be subject to a significant change in the volume and mix of vehicles, and particularly the incidence of heavy vehicles (up to 30 per day five days a week for 9-12 months).

There is no alternative road access to the site, nor to Timaru.

Dennistoun Road as a physical resource is generally expected to be able to handle the expected change in traffic but the state of the road surface will need to be monitored and managed if deterioration occurs.

Potentially the most significant issue is the geometry and condition of the intersection of Dennistoun/ Mount Peel Road with heavy vehicle truck and trailer unit movements. Information provided in response to the RFI has been assessed by Stantec in its expert review. Stantec recommend several conditions to manage potential traffic effects. The effects of the change in their local road environment are likely to be minor or more than minor albeit run off a low vehicle volume base and being inserted into a presently benign rural environment.

Potential adverse effects are likely on the amenity, and on the health, safety and well-being of the local community in the immediate vicinity of the project site. it is considered that any adverse effects of the proposed activity are likely to have minor or more than minor effects on persons, including owners / occupiers of properties on Dennistoun Road, and on Peel Forest Road nearest the Dennistoun Road intersection.

The specific properties affected are identified in **Attachment 1** and are:

45 Dennistoun Road	55 Dennistoun Road
47 Dennistoun Road	57 Dennistoun Road
49 Dennistoun Road	105 Dennistoun Road
53 Dennistoun Road	1174 Peel Forest Road

Summary

On the basis of the above assessment, the proposed activity is likely to have adverse effects on identified properties that are minor or more than minor but no less than minor particularly with respect to traffic associated effects.

The potential effects on iwi cultural matters has been addressed in the supporting letter. Iwi support the project.

Decision: Effects on Persons (s95E(1))

In terms of section 95E of the RMA, and on the basis of the above assessment, identified persons are considered to be adversely affected to a minor or less than minor degree. Therefore, limited notification is required under Step 3.

Step 4 – Further Notification in Special Circumstances (s95B(10))

Special circumstances do not apply that require limited notification.

Notification Recommendation

A. That the application be processed on a **limited notified** basis in accordance with Sections 95A – 95G of the Resource Management Act 1991.

Reported and Recommendation by: Richard Johnson, Consultant Planner

Date: 25 July 2024

Attachment 1

Properties for Limited Notification

45 Dennistoun Road	55 Dennistoun Road
47 Dennistoun Road	57 Dennistoun Road
49 Dennistoun Road	105 Dennistoun Road
53 Dennistoun Road	1174 Peel Forest Road

Resource Consent and Assessment of Environmental Effects – Peel Forest Closed Landfill Removal and Restoration

Prepared for

Timaru District Council

April 2024

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REV	Date	Status/Purpose	Prepared By	Reviewed by	Approved
1	21/2/2024	Draft	Isobel Stout	Claire McKevitt	Hamish Peacock
2	24/4/2024	Final	Isobel Stout	Claire McKevitt	Hamish Peacock

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Isobel Stout

Reviewed by

SIGNATURE

Claire McKevitt

Approved by

Hamish Peacock

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Timaru District Council and Aoraki Environmental Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Timaru District Council for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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Appendices

Executive Summary

Pattle Delamore Partners (PDP) has been engaged by Timaru District Council to prepare resource consents to enable a contractor to remove the entire contents of a closed landfill on Dennistoun Road in the settlement of Peel Forest. The area and quantity of contaminated material to be excavated and removed offsite is approximately 5,000 m² and 18,000 m^3.

Severe flooding of the Rangitata River in 2019 cut away the southern bank and exposed some of the landfill contents, some of which fell to the riverbed some 25m below.

Emergency works removed the fallen material and secured the landfill from further erosion for the short term.

A resource consent is required for the complete removal of this material, under Sections 9 and 15 of the Resource Management Act 1991 (the Act) for the following activities:

- Land use consent for excavation – earthworks, vegetation clearance and backfilling (s9)
- Land use consent for soil disturbance under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES-CS)
- Discharge permit for construction phase stormwater (s15)

This report gives an overview of the existing environment, information as to how the proposed activities are to be carried out, and an assessment of the potential adverse effects as a result of this activity, which have been concluded to be less than minor given the proposed controls and mitigation.

This report also undertakes a planning assessment of all relevant rules, policies and objectives related to the proposal in accordance with Schedule 4 of the Act. This activity is considered a **restricted discretionary activity** under the Canterbury Land and Water Regional Plan, a **discretionary activity** under the Timaru District Plan and **restricted discretionary under the NES-CS**.

1.0 Introduction

Pattle Delamore Partners (PDP) has been engaged by Timaru District Council (TDC or “**the applicant**”) for the removal and remediation of a closed landfill at Dennistoun Road, Peel Forest (“**the site**”). A resource consent is required under Sections 9 and 15 of the Resource Management Act 1991 (RMA) for the following activities:

- A land use consent under the Canterbury Land and Water Regional Plan (LWRP) for vegetation clearance as a restricted discretionary activity pursuant to Rule 5.169;
- A land use consent under LWRP for earthworks as a restricted discretionary activity pursuant to Rule 5.175; and
- A discharge permit under the LWRP for the associated discharge of contaminants (namely sediment); as a restricted discretionary activity pursuant to Rule 5.94B; and
- A land use consent under the Timaru District Plan (TDP) to excavate soil etc as a discretionary activity pursuant to Rule D1-3.4.;
- A land use consent under the TDP to set up a contractor’s depot as a discretionary activity pursuant to Rule D1-3.6.;
- A land use consent under the Proposed TDP to carry out earthworks as a restricted discretionary activity pursuant to Rule SASM-R1(2) and
- A land use consent from the Timaru District Council (TDC) under the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES-CS), as a restricted discretionary activity pursuant to Regulation 10.

An Outline Plan of Works (OPW) is also required as the site is designated by TDC for landfill purposes. TDC has waived this requirement under s176A(2)(c) canterbury maps

Wide location

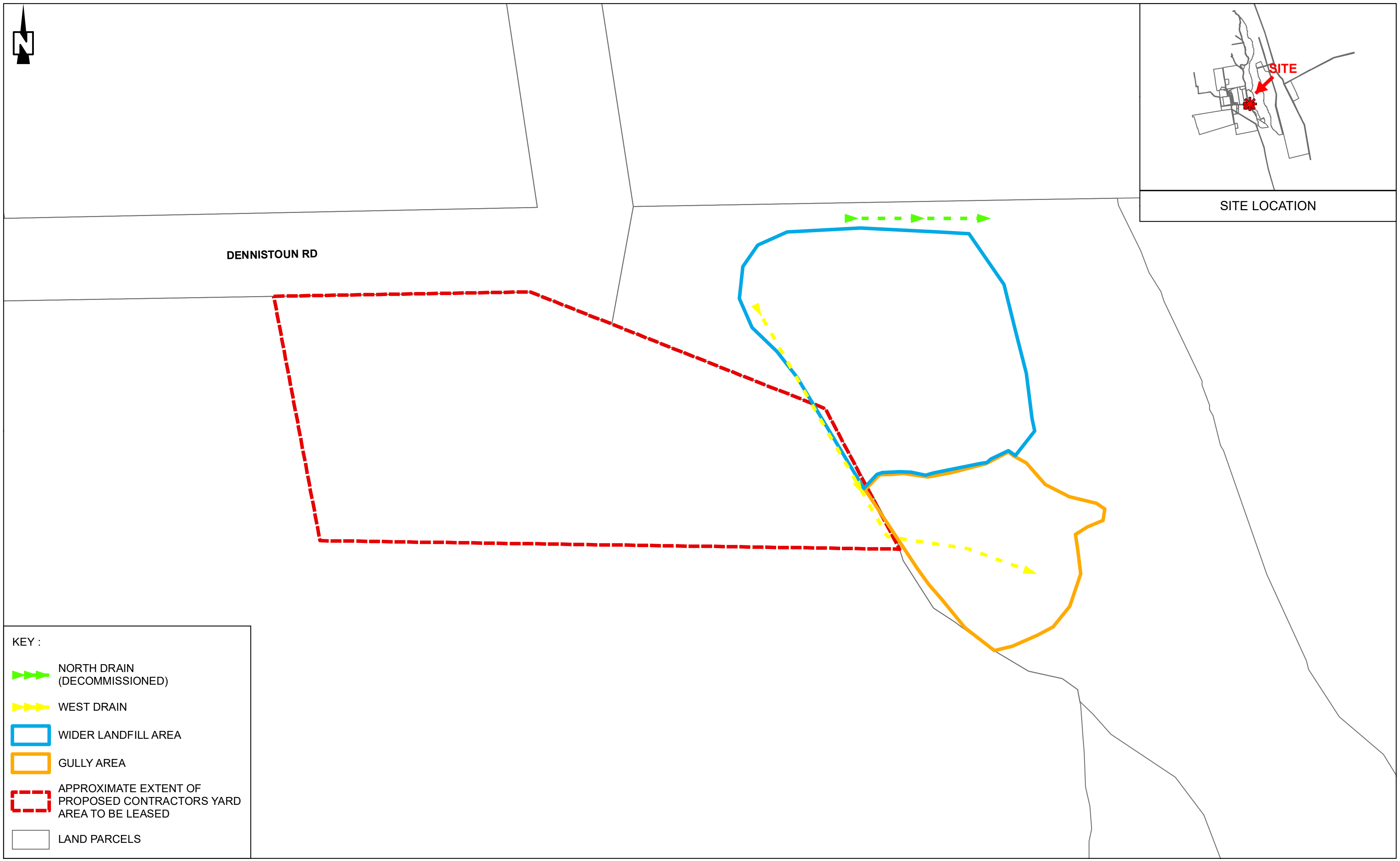
N

0 2 4 6 8 Kilometres

Scale: 1:150,000 @A3

Map Created by Canterbury Maps on 12/01/2024 at 3:43 PM

PEEL FOREST LANDFILL, DENNISTOUN ROAD, PEEL FOREST



SOURCE:
1. AERIAL IMAGERY (FLOWN 2021) SOURCED FROM CANTERBURY MAP PARTNERS ADMINISTERED BY ENVIRONMENT CANTERBURY.
2. CADASTRAL INFORMATION AND INSET SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

FIGURE 2 : PROPOSED APPROXIMATE EXTENT OF AREA TO BE LEASED FOR THE CONTRACTORS YARD

SCALE : 1:1,250 (A4)

0 5 10 20 30 40 50

METRES

PATTLE DELAMORE PARTNERS LTD

C02450Z008_RAP_FIG2.mxd 10/11/2023 ISSUE 1

The applicant's details are contained in Table 1. Current Certificates of Title for the site are provided in Appendix A. The locality is presented in Figure 1 and the site location and indicative layout are presented in Figure 2.

Table 1: Applicant and Property Details

Applicant	Timaru District Council
Site Address	Easternmost end of Dennistoun Road, Peel Forest
Legal Description	Survey Office Plan 3144 (landfill) and LOT 3 DP 343513 (Contractor's yard)
Site Area	Approximately 0.5 ha landfill, 0.6 ha Contractor's yard
Landowner	The Crown (landfill) and Graham Carr and Graham Carr Trustee Ltd (Contractor's yard)
Map Reference	-43.914011, 171.270839

2.1 Other Related Consents

TDC hold resource consent CRC950949 which provides for the discharge, into or onto the land, of leachate from the landfill, and to prevent surface water run-off entering the landfill. The consent commenced in December 2006, and expires on 19 December 2041. Conditions of consent require monitoring and evaluation of discharges from the closed landfill and to comply with the Closed Landfill Management Plan developed by Tonkin & Taylor in 2002. Once the proposed works to remediate the landfill are completed this consent will not be needed.

2.2 Background Information

The Peel Forest landfill operated at the eastern end of Dennistoun Road atop a gulley adjacent to the Rangitata River from 1962 until 2004, when the Timaru District Council formally closed it as a landfill. According to Environment Canterbury Listed Land Use Register (LLUR) (Appendix B) in 2005 the landfill measured 0.4 ha and with a fill volume of approximately 20,000 m^3 to a depth of 5 m. Natural contours in the surrounding area direct surface runoff over the landfill through the gully to the Rangitata riverbanks, approximately 30m directly below.

On 9 December 2019, the Rangitata River experienced a one in 20 year flooding event, creating a flow of around 2,300 m^3/s. Riverbank erosion at the toe of the terrace resulted in the failure of the cliff face, exposing rubbish and debris that was within 0.5 m of the surface. This was inspected by Council Officers and Environmental Consultants carrying out initial investigations. It was identified through test pitting that the edge of the eroding terrace was still approximately

10 m from the primary landfill area, with rubbish present only within the surficial layer of topsoil being exposed at this time.

Preliminary works were undertaken in December 2019 (Section 1.2.4 of the DSI Appendix C) to pull back some of the rubbish within the surficial soil layer (0.5 m depth) from the edge of the cliff and collect the loose rubbish that had fallen onto the riverbed.

3.0 Site and Surrounding Environment

3.1 Existing Infrastructure and Activities

The wider landfill site covers a total area of approximately 5000 m^2 from the end of Dennistoun Road to the edge of the land terrace above the Rangitata river.

The site is accessed off Dennistoun Road. Dennistoun Road is sealed for approximately 200 m from the intersection with Peel Forest Road. The remainder is unsealed for approximately 500 m ending at the site.

A 20mm PE-HD public water supply pipe runs in ground along Dennistoun Road to service the dwelling at 105 Dennistoun Road.

According to Canterbury Maps, the nearest water take for any purpose is K37/3094 and is noted as a public water supply some 1.5 km northwest of the site.

The nearest active discharge consents are for domestic septic tanks at 66 Dennistoun Road. The discharge consent at 105 Dennistoun Road is recorded as surrendered.

There is one dwelling at 105 Dennistoun Road, directly opposite the site. The remainder of the land surrounding the site is in pastoral use. The site and its surrounds are zoned Rural 1 under the Timaru District Plan.

3.2 Cultural Setting

The hapū who hold mana whenua in the Timaru District are Kāti Huirapa. The rohe of Kāti Huirapa extends over the area from the Rakaia River in the north to the Waitaki River in the south.

A review of the Canterbury Maps, Heritage New Zealand Pouhere Taonga Act 2014 and Archsite indicates that there are no cultural features or overlays intersecting or adjacent to the site listed in those resources. The site is listed as SASM 23 in the Proposed Timaru District Plan and the section ‘Sites and Areas of Significance to Māori’ is operative.

More detail on the cultural setting is provided in section 8.11.

3.3 Topography and Ground Conditions

The geological map for the area (Cox and Barrell, 2007; 1:250,000) reports that the site is underlain by Late Pleistocene 'light brownish grey river gravel, sand and silt within abandoned outwash plains or low to mid-level terraces'.

The soil type is listed on Canterbury Maps as '*Ruapuna stony silt, NZSC Description Acidic Firm Brown Soils*'. Land Use Capability is listed by Landcare Research as '*Class 4, Arable. Significant limitations for arable use or cultivation, very limited crop types, suitable for occasional cropping, pastoralism, tree crops and forestry'*...

The topography of much of the main landfill area is hummocky. The gully area slopes down from the main landfill area at an angle of approximately 22 degrees.

Environment Canterbury's Listed Land Use Register (LLUR) is a publicly available database of sites where hazardous activities and industries have been located throughout Canterbury. The LLUR states that the following Hazardous Activities and Industry List (HAIL) activities have occurred on the site:

- G3 – Landfill sites.

A copy of the LLUR report for the site is attached as Appendix B .

Several investigations have taken place on the landfill and its contents in response to the flood damage. These are included with the Detailed Site Investigation (Appendix C) which was undertaken in January 2023 and provides the majority of the data needed to understand the parameters of the waste in the landfill and the risks associated with its removal.

3.4 Ground and Surface Water

The aquifer beneath the site is identified as unconfined/semi-confined by the planning maps for the Canterbury Land and Water Regional Plan (LWRP).

The regional groundwater flow direction is expected to be in a general south easterly direction. Groundwater level was measured between 24.6 and 25.9 m bgl at the site at bores installed in 2020 close to the terrace edge (details in Appendix C).

The site is not located within a Community Drinking Water Protection Zone.

There are no active groundwater bores registered on Canterbury Maps on the site or within 1 km of the discharge area. There is a record of one bore, (K37/3143) approximately 500 m west of the site that is recorded as 'Not Drilled".

Two drains are present on site crossing the northern and western boundaries and directing overland flow over the terrace edge and down the gully respectively during stormwater events. The northern drain has recently been blocked off during remedial works to protect the northeastern terrace edge from further erosion.

The nearest surface water body to the site is the Rangitata River, located immediately east and flows to the southeast.

3.5 Meteorology and existing air quality

Meteorology, particularly the presence of both strong winds and dry conditions, can exacerbate dust emissions (the main air discharge) from excavation operations. Therefore, it is important to have a good understanding of the local wind conditions to assess potential air quality effects. The nearest meteorological station with records is at Orari and the data is presented in the DMP Appendix D.

In summary, the prevailing winds are north-westerly occurring approximately 15% of the time, with wind speeds rarely exceeding 3 m/s. The closest sensitive receiver is 105 Dennistoun Road, which is approximately 35 m away.

The landfill contents that have been exposed to date either by the flooding or by deliberate test pitting during the investigation have not been observed to be overly odorous. Whilst domestic putrescible refuse was disposed of here, most of the contents are non-putrescible materials such as plastic and metal.

4.0 Description of Proposal

This section is drawn from the Remediation Action Plan included within Appendix F.

The entire landfill contents are to be removed from the site and transported to a Class 1 disposal facility in Timaru (Redruth). The risk of further loss of landfill contents in future floods will then be reduced to zero. After the removal works, the site will be recontoured and planted in native species so that no further work or maintenance is required. No public access will be formed, no facilities provided, and the land will remain in the ownership of the Crown.

A contractor’s yard is necessary for temporary infrastructure such as a site office, toilets/lunchroom and storage of equipment and materials to support the removal of landfill contents and earthworks. Land immediately adjacent to the landfill site (approximately 6,000m^2) is to be leased for this purpose and will be graded and stabilised during the work period. The combined work sites, yard, and landfill will be securely fenced for the duration of the work. Upon completion of all works, the leased area will be returned to pasture and the rehabilitated former landfill will be landscaped and planted.

Figure 3: Indicative layout of contractor’s yard

The exact dimensions of the contractor’s yard and its layout, security fences, entrances and facilities etc. will be finalised in consultation with the successful tenderer.

The proposal requires the removal of some existing non-indigenous vegetation, discharge of construction-phase stormwater to land, earthworks over an unconfined or semiconfined aquifer, earthworks in a contaminated site and the use of rural land for a contractor’s yard all to support the removal of landfill contents.

4.1 Site Preparation (summarised from the Remedial Action Plan)

4.1.1 Contractor’s yard

The contractor’s yard will be prepared first. Security fencing and access will be installed and formed as necessary. The topsoil within the leased area will be sampled and tested for metals and asbestos to establish the baseline of any contaminants already present. The topsoil will be scraped aside and used as bunds or stockpiled to be returned to the yard site upon completion of the project and closure of the yard site. On completion of works, the topsoils will be tested again to ensure they have not been impacted by the proposal (e.g. potential spills) before being spread back on the land.

The contractor’s yard site will be graded and formed so that there is no overland stormwater runoff to the landfill site. The site will need to include a site office, staff hygiene facilities, water storage and staff parking. Aggregate may need to be imported to provide a suitable compacted working surface.

4.1.2 Landfill

Prior to any excavation of the landfill contents up to four soil samples within a few meters of the landfill perimeter will be sampled and submitted for semi quantitative asbestos analysis. This exercise will be repeated every three- or four-months during excavation to provide reassurance that fibres that may be in the landfill waste material are not being deposited beyond the site. There will be a final round of sampling at the site closure and project completion.

Existing fencing around the western edge of the landfill will be removed. Any areas of existing grasses and scrub will be cleared.

Specified asbestos work areas will be designated and erected within the contractor’s yard and landfill area as directed by the requirements of the Health and Safety at Work (Asbestos) Regulations 2016.

Stormwater flows will be constructed so that water is directed away from the landfill.

4.2 Landfill contents excavation

Approximately 18,000 m^3 or 28,800 tonnes of waste could be excavated and removed from the landfill. The tonnage will depend on the nature of the material. This does not include any soils surrounding the waste which may also need to be removed due to being impacted by leaching. The specific methodology and equipment used will be defined in consultation with the geotechnical engineer and lead contractor involved in the remedial work.

The Rangitata riverbed will be routinely inspected for waste materials that may have been inadvertently lost over the terrace edge during remedial excavation activities. Where practicable these waste materials will be hand-picked and removed from the riverbed.

Part of the contractor’s yard will be used to separate and wash down large greywacke cobbles and boulders, and larger inert objects (that can be readily cleaned of landfill waste materials) ahead of disposal of the majority of the waste to Redruth Landfill.

4.3 Contaminated land remediation

A full Remediation Action Plan (RAP) in accordance with the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health is at Appendix F.

In developing the remedial targets for the remediation, two key drivers have been considered:

- **Cultural/Social** - includes consideration for potential human health, environmental ethics and guardianship, and aesthetic impacts.
- **Environmental** - includes consideration for potential impacts to groundwater, surface water, ecology and natural resources/amenities.

The selected remediation targets have been developed to satisfy the key remediation drivers highlighted and are based on three remedial goals; maximal waste removal, validation and site reinstatement.

Maximal waste removal - The goal is to achieve complete removal of all visible landfill waste until natural underlying soils are encountered.

A remedial excavation over dig of up to 1 m could be implemented over parts of the excavation to remove underlying natural materials that could have been impacted by contaminant leaching from the main landfill body. It is expected that the majority if not all of the risks to cultural/social and environmental indicators will be eliminated by achieving this goal.

Landfill validation sampling – when remedial excavation of the waste is completed, soil samples will be collected from the base and sides of the excavation and analysed for key contaminants of concern. The soil remedial criteria have been selected as the benchmark for satisfactory remediation of contaminants concentrations within soils remaining in situ. The criteria were selected after consideration for the receptors (i.e., should waste and contaminants be released from the landfill) as follows:

- Protection of human health – although this land area is not intended to be routinely occupied, it is possible that people could occasionally be present (i.e., general public or maintenance workers).
- Protection of terrestrial biota – includes protection of soil microbes, invertebrates, plants and wildlife.
- Protection of ecological receptors – the remaining soils will continue to be vulnerable to erosion and could be mobilised during future storm and flood events and enter the Rangitata River system.

The full criteria are at Table 3 of the RAP in Appendix F.

4.4 Landfill contents picked from the toe and riverbed

During the 2019 flood, some landfill contents and cliff face materials landed on the riverbed. The proposal is to sort this material and remove landfill contents either by hand picking or using small machines which can access the riverbed. It is expected that this part of the proposal will take place close to the end of the excavation so that any larger material that may be lost during excavation will also be removed.

4.5 Validation of remedial work

Section 8.10 of the RAP (Appendix F) specifies targets for remediation. Visual and quantitative (soil quality analysis) checks will be used to confirm that the landfill has been remediated to these targets. Additional validation work (including soil quality analysis and landfill waste recovery) will be conducted on the contractor's yard and the toe of the terrace at the riverbed.

4.6 Site rehabilitation/recontouring

The final design and types of vegetation or plantings chosen for landscaping will be subject to consultation with TDC, Arowhenua and LINZ and agreed by the project partners. A large quantity of clean natural materials (i.e., soil and gravel) will need to be imported to facilitate reinstatement and landscaping of the site. The specific volume of materials needed is unknown but is likely to be less than the total volume of waste removed from the site. The final site surface will need to be suitable for re-establishment of vegetation and allow for stormwater conveyance to the Rangitata riverbed. Stormwater conveyance will be constructed as per the design advice and descriptions detailed in Appendix H.

4.7 Deconstruction of contractor's yard and site closure

Vehicle entry/exit points to the contractor's yard will be removed, with the material either placed within the remedial excavation (if testing deems it suitable) or disposed of at an appropriate facility with the required approval.

Validation soil sampling will be completed across the contractor's yard, after disestablishment, to ensure residual contaminants do not remain at concentrations that exceed those observed during initial benchmarking.

The topsoil will be placed back across the area and reseeded. Fencing will be reinstated or replaced.

4.8 Site Validation Reporting

The Site Validation Report (SVR) will document the remediation works from commencement to completion and conclude whether the stated objectives of the remediation programme have been achieved. Information about final remediation depths, extents, waste disposal volumes and tonnages, and implementation of site reinstatement will also be documented.

4.9 Hours of operation and duration of project

The total duration to remediate the site is expected to be between nine and twelve months. This remediation programme allows for project contingency due to events like heavy rain.

The hours of operation for excavation work and use of heavy equipment and transport are Monday to Friday, 0730-1800 hours to match the noise standards for construction in NZS6803. Quiet work such as security and administration can take place outside these hours if necessary.

5.0 Consideration of Alternative methods of earthworks and discharge

5.1 Introduction

An assessment of alternative methods of discharge, including discharging into any other receiving environment, is required under section 105 of the Resource Management Act 1991 (RMA) for any application seeking to discharge contaminants. An assessment of alternatives is also necessary for activities likely to have significant adverse effects.

Having regard to the AEE contained within Section 8.0 of this report and the supporting technical assessments, it is not considered that this proposal will have significant adverse effects. Therefore, an assessment of alternatives has only been completed in respect of the applications for the discharge of contaminants.

5.2 Discharges to air

Dennistoun Road is unsealed, and as heavy vehicles move up and down the road to access the site soils will be bared and exposed, generating dust. The location of the works is unchangeable, and it is not feasible to seal the road for the temporary works, therefore dust is unavoidable, however it can be mitigated. The Dust Management Plan included in Appendix D, details how dust will be mitigated during works. The mitigation proposed includes, but is not limited to:

- Ensuring an adequate water supply on site for dust suppression.
- Using water carts to dampen dust on Dennistoun Road.
- Loads leaving the site will be covered.

Prevention of the discharge of asbestos fibres will be closely monitored in accordance with the *Approved Code of Practice: Management and Removal of Asbestos* (WorkSafe NZ, 2016).

5.3 Discharges to land

While the landfill waste on the site is currently stable and legally consented, a Remedial Options Assessment found the best option is to remove the landfill. All contaminated material on the site will be excavated and removed and as such, the ongoing passive discharge of contaminants from this material will cease.

5.4 Conclusion

Overall, it is concluded that there are no feasible alternatives to the temporary earthworks or the methods of discharge to remove the waste. However, the works will avoid the ongoing passive discharges from the landfill.

6.0 Statutory Framework

6.1 Zoning/Key Features/Overlays

Table 2 provides a description of statutory planning zones and any overlays that apply for the relevant planning documents within the district.

Table 2: Zoning and Planning Map Features

Canterbury Land and Water Regional Plan	
Water Management Zone	Orari-Temuka-Opihi-Pareora
Overlays and Key Features	Rangitata-Orton Groundwater Allocation Zone
	Gorge to Arundel Surface Water Allocation Zone
	Semi-confined or unconfined aquifer
	Coopers Creek Catchment
	Alpine River Subregion
Timaru District Plan	
Zone	Rural 1
Designation	No. 84 for Landfill- Timaru District Council.
Proposed Timaru District Plan	
Overlay	Sites and Areas of Significance to Māori No. 23

6.2 Reasons for Resource Consent

Table 3 outlines the relevant LWRP, TDP and Proposed TDP rules under which consent is required. (A full assessment of the applicable rules is provided in Table 10 in the Statutory Assessment in Appendix J.)

Table 3: Reasons for Resource Consent

Resource Management (National Environmental Standard for the Assessing and Managing Contaminants in Soils to Protect Human Health) Regulations 2011			
Regulation	**Activity**	**Reason for Consent**	**Activity Status**
10	Soil disturbance	Contaminants are present that exceed a soil contaminant standard for a commercial/industrial or recreational land use.	Restricted Discretionary
Land and Water Regional Plan Rules			
Rule	**Activity**	**Reason for Consent**	**Activity Status**
5.94B	The discharge of construction-phase stormwater onto or into land in circumstances where a contaminant may enter groundwater that does not meet one or more of the conditions of Rule 5.94A is a restricted discretionary activity.	The proposed discharge of construction-phase stormwater to land will not meet conditions 1 and 4 of Rule 5.94A for the following reasons: Condition 1: The area of disturbed land from which the discharge is generated is more than 2 hectares (approximately 8 hectares). Condition 4: The discharge will be from contaminated land.	Restricted Discretionary
5.169	Vegetation clearance and earthworks outside the bed of a river or lake or adjacent to a wetland boundary but within:	The proposed earthworks will not meet condition 1(a)(i) of Rule 6.168 (b) being an area greater than 500 m^2. An area of approximately 8000 m^2 is to be excavated but not all of that lies within 5 m of the river.	Restricted Discretionary

Table 3: Reasons for Resource Consent

	(a) 10 m of the bed of a lake or river or a wetland boundary in Hill and High Country land and land shown as High Soil Erosion Risk on the Planning Maps; or (b) 5 m of the bed of a lake or river or a wetland boundary in all other land not shown as High Soil Erosion Risk on the Planning Maps or defined as Hill and High Country; and any associated discharge of sediment or sediment-laden water in circumstances where sediment may enter surface water that does not comply with one or more of the conditions in Rules 5.167 or 5.168 is a restricted discretionary activity.		
5.176	The use of land to excavate material that does not comply with one or more of the conditions of Rule 5.175 is a restricted discretionary activity.	The proposed earthworks do not comply with Rule 5.175 2(b)(ii) being over an unconfined or semi unconfined aquifer, of more than 100 m^3 in volume and within 50 m of a surface water body being the Rangitata River. The earthworks are adjacent to the river.	Restricted Discretionary

Table 3: Reasons for Resource Consent

Timaru District Plan - Designations			
84	Landfill	The requiring authority is the Timaru District Council and as the location and type of work meet the purpose of the designation, the Timaru District Council has waived the need for an Outline Plan of Works under s176A(2)(c).	Waived
Timaru District Plan – Rural Zone 1			
Rule	**Activity**	**Reason for Consent**	**Activity Status**
D1-3.4	Mining, quarrying, extraction of soil, rock, shingle, gravel and sand materials occurring naturally on or beneath the site in quantities of 100 cubic metres or more in any one year.	The proposed earthworks for the contractor’s yard will involve more than 100 m^3 in a year.	Discretionary
D1-3.6	Industrial uses, including agricultural contractors’ depots, transport contractors’ depots.	The proposal requires the formation of a contractor’s yard which although temporary will be on site longer than allowed for as a temporary activity under Part D, General Rule 6.	Discretionary
Proposed Timaru District Plan			
SASM-R1	PER-1	The proposal requires earthworks to form a contractor’s yard, the removal of landfill contents and the recontouring of the site prior to replanting.	Restricted Discretionary

Table 3: Reasons for Resource Consent

2. Wai Taoka	The earthworks are for the purpose of maintenance, repair, or replacement, of any of the following: 1. existing fencing; or 2. existing tracks or roads; or 3. existing reticulated stock water systems including troughs; or 4. existing natural hazard mitigation works; and		
	PER-2 The earthworks are only undertaken within the footprint or modified ground comprised by the existing item; and	The proposal requires earthworks in a paddock used for grazing to form a contractor’s yard. The landfill contents removal and subsequent recontouring will occur within the footprint of the closed landfill.	Restricted Discretionary
	PER-3 Any replacement item is of the same nature, character and scale of the item being replaced; and	The land used for the contractor’s yard will be returned to pastoral use. The closed landfill site will be returned to a similar contour and scale but without the waste material.	Restricted Discretionary

Table 3: Reasons for Resource Consent

	PER-4 The Accidental Discovery Protocol commitment form, contained within APP4 - Form confirming a commitment to adhering to an Accidental Discovery Protocol, has been completed and submitted to Council, at least 2 weeks prior to the commencement of any earthworks.	This form is attached at Appendix G	Permitted

6.3 Matters of discretion Environment Canterbury

Rule 5.94B relating to the discharge of construction-phase stormwater to land restricts Environment Canterbury's discretion to the following matters:

1. *The actual and potential effects of the discharge on the quality of surface water, aquatic ecosystems, Ngāi Tahu cultural values; and*
2. *The actual and potential effects of the discharge on the quality and safety of human and animal drinking water; and*
3. *The actual and potential adverse environmental effects of the quantity of water to be discharged on the banks or bed of a waterbody or on its flood carrying capacity, and on the capacity of the network to convey that discharge; and*
4. *The potential benefits of the activity to the applicant, the community and the environment.*

Rule 169 relating to the use of land to clear vegetation and carry out earthworks outside the bed of a river restricts Environment Canterbury's discretion to the following matters:

The exercise of discretion is restricted to the following matters:

1. *For forest harvesting, the harvesting method, location of haulage and log handling areas, access tracks, and sediment control; and*
2. *The actual and potential adverse environmental effects on soil quality or slope stability; and*
3. *The actual and potential adverse environmental effects on the quality of water in rivers, lakes, or artificial watercourse, or wetlands; and*
4. *The actual and potential adverse environmental effects on areas of natural character, outstanding natural features or landscapes, areas of significant indigenous vegetation, indigenous biodiversity and significant habitats of indigenous fauna, mahinga kai areas or sites of importance to Tangata Whenua; and*
5. *The actual and potential adverse environmental effects on the banks or bed of a waterbody or on its flood carrying capacity; and*
6. *The* actual and potential adverse environmental effects on transport networks, neighbouring properties or structures.

Rule 5.176 relating to the use of land to excavate material restricts Environment Canterbury's discretion to the following matters:

1. *The actual and potential adverse environmental effects on the quality of water in aquifers, rivers, lakes, wetlands; and*
2. *Any need for remediation or long-term treatment of the excavation; and*
3. *The protection of the confining layer and maintaining levels and groundwater pressures in any confined aquifer, including any alternative methods or locations for the excavation; and*
4. *The management of any exposed groundwater.*
5. *Any adverse effects on Ngāi Tahu values or on sites of significance to Ngāi Tahu, including wāhi tapu and wāhi taonga.*

These matters have guided the assessments and mitigation measures proposed in this AEE.

6.4 Matters of discretion Timaru Proposed Plan

Rule SASM-R1 Earthworks not including quarrying and mining

2. Wāhi Taoka and Wai Taoka
    1. whether Te Rūnanga o Arowhenua has been consulted, the outcome of that consultation, and the extent to which the proposal responds to, or incorporates the outcomes of that consultation; and
    2. whether a cultural impact assessment has been undertaken and the proposal's consistency with the values identified in SCHED6 – Schedule of Sites and Areas of Significance to Kāti Huirapa; and
    3. the potential adverse effects, including on sensitive tangible and/or intangible cultural values as identified through engagement with Te Rūnanga o Arowhenua; and
    4. effects on sites where there is the potential for koiwi or artefacts to be discovered, including consideration of the need to implement an accidental discovery protocol or have a cultural monitor present, and whether an accidental discovery protocol has been agreed with Te Rūnanga o Arowhenua; and
    5. whether there are alternative methods, locations or designs that would avoid or mitigate the impact of earthworks on the values associated with the site or area of significance; and
    6. the appropriateness of any mitigation measures proposed; and

7. whether the proposed activity provides an opportunity to recognise Kāti Huirapa culture, history and identity associated with the site/area, and any potential to:
    1. affirm the connection between mana whenua and place; or
    2. enhance the cultural values of the site/area; or
    3. provide for the relationship of Kāti Huirapa with their taoka; commensurate with the scale and nature of the proposal; and
8. any opportunities to maintain or enhance the ability of Kāti Huirapa to access and use the Site or Area of Significance; and
9. where the earthworks will remove indigenous vegetation, the nature of any effects on mahika kai and other customary uses; and
10. in respect of utilities, the extent to which the proposed utility has functional needs for its location.

These matters have guided the assessments and mitigation measures proposed in this AEE.

6.5 Permitted Activities

As required by RMA Schedule 4(3)(a), the following permitted activities in Table 4 are relevant to this proposal. Compliance with these rules is demonstrated in Table 9 of Appendix J.

Table 4: Summary of Permitted Activities

Canterbury Land and Water Regional Plan Rules	
Rule	**Activity**
5.163	The introduction or planting of any plant, or the removal and disturbance of existing vegetation in, on or under the bed of a lake or river and any associated discharge of sediment or sediment-laden water in circumstances where sediment may enter surface water…
5.177	The use of land for the deposition of more than 50 m3 of material in any consecutive 12 month period onto land which is excavated to a depth in excess of 5 m below the natural land surface and is located over an unconfined or semi-confined aquifer, where the seasonal high water table is less than 5 m below the deepest point in the excavation
Canterbury Air Regional Plan Rules	
7.32	The discharge of dust to air beyond the boundary of the *property* of origin from the construction of buildings, land development activities, unsealed surfaces or unconsolidated land…
7.47	The discharge of contaminants into air from the storage, transfer, *handling*, treatment or disposal of waste…

Table 4: Summary of Permitted Activities

Timaru District Plan	
Part D1-1.11	Road and bridge construction and maintenance within road reserves.
Part D1-1.12	Tracks or bridges outside of road reserves.
Part D1-1.19	Clearance, disturbance and trimming of vegetation which is not significant indigenous vegetation or significant habitats of indigenous fauna, or significant trees.
General Rule 6.10.2.1 (1)	Temporary buildings ancillary to a building or other construction project provided that: (a) No temporary building exceeds 50 square metres in area. (b) No temporary building remains on the site for longer than the duration of the project or twelve months, whichever is the lesser. (c) No temporary building exceeds the recession planes as set out in Appendix 2 of this Plan which apply to the site.
General Rule 6.18.2	Rule for filled sites (1) Any owner of land shall notify the Council when it is intended to place fill to a depth of 1 metre of more on any site so that the information can be entered on Council's Hazards Register.
General Rule 6.21.2.3	Construction Noise Rules – All Zones Construction noise in any zone shall not exceed the recommended limits in and shall be measured and assessed in accordance with the provision of the New Zealand Standard 6803P:1984. *The measurement and assessment of noise from construction, maintenance and demolition work.* Discretionary adjustments provided in Clause 6.1 of the Standard shall be mandatory within the District.

6.6 Summary of consents required

The Timaru District Council holds a discharge permit from Environment Canterbury for the discharge of leachate from the landfill CRC950949 that expires on 19 December 2041. This consent can be surrendered once the landfill waste is removed.

Overall, consent is required from Environment Canterbury under the LWRP and CARP as a **restricted-discretionary** activity.

Consent is required from TDC as a discretionary activity under the Timaru District Plan, and a restricted-discretionary activity under the Proposed Timaru District Plan and NES-CS. Taking a bundling approach as the activities overlap, the application should be assessed by TDC as a **discretionary activity**. However, the matters of discretion as outlined in section 6.4 have been used to guide the s.104 assessment.

For the avoidance of doubt, the applicant is seeking consent under the above rules and any other rules which may apply to the activity, even if not specifically noted.

6.7 Section 105 – Matters Relevant to Discharge Applications

In addition to the s.104 matters which a consent authority must have regard to, s.105(1) sets out additional matters, listed in Table 5, which must be considered when considering discharge applications.

Table 5: Section 105 Matters

Section 105 Matters	Comments
(a) the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and	See section 3.0 and 4.0.
(b) client's reasons for the proposed choice; and	See section 5.0.
(c) any possible alternative methods of discharge, including discharge into any other receiving environment	See section 5.0

In summary, in each case it is concluded the effects of the discharge would be less than minor and the proposed method of managing the effects of the discharge is the best practicable option.

6.8 Section 107 – Restriction to Grant Certain Discharge Permits

Section 107 of the RMA specifies certain circumstances in which the consent authority shall not grant a discharge permit if after reasonable mixing, the contaminant or water discharged (either by itself or in combination with the same, similar, or other contaminants or water), is likely to give rise to all or any of the following effects in the receiving waters detailed in Table 6.

Table 6: Section 107 Matters

Section 107 Matters	Comments
(a) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials.	See section 8.8
(b) Any conspicuous change in the colour or visual clarity.	See section 8.8
(c) Any emission of objectionable odour.	See section 8.7
(d) The rendering of fresh water unsuitable for consumption by farm animals.	See section 8.8
(e) Any significant adverse effects on aquatic life.	See section 8.8

In summary, none of those s.107 circumstances are present in any of the proposed discharges.

6.9 Section 123 - Term of Consent

Consent is sought for a term of five years based on the temporary nature of the works. As mentioned in Section 4.9, works are proposed to take nine to twelve months which the applicant intends to give effect to immediately. However, a five-year consent term is requested as a precautionary measure, to allow for any unforeseen delays in commencement, or if rehabilitation of the site requires additional work to ensure planting establishes and is fully stabilised.

7.0 Consultation

Public engagement with the wider community has been through Geraldine Community Board meetings, notices placed on the community notice board at Peel Forest and an information meeting held at the Peel Forest Community Hall 16 May 2023.

Aoraki Environmental Ltd has been the principal link between the applicant and Te Runanga o Arowhenua and have been involved in contributing to the AEE, specifically at section 8.11 and Appendix I.

8.0 Assessment of Environmental Effects

8.1 Introduction

The actual and potential effects associated with the range of activities (establishment of the contractor’s yard, removal of landfill material, recontouring of the landfill site and finally the removal of the yard) is assessed in sections 8.2 to 8.11.

Throughout these sections, the mitigation hierarchy has been applied to show how adverse effects will be avoided, remedied or mitigated.

The following effects of the activity are discussed below:

- Positive effects
- Effects on character and amenity values
- Visual and landscape effects
- Noise effects
- Transportation and traffic effects
- Effects on air quality
- Effects on water resources
- Effects on soil resources
- Effects on cultural values

Proposed draft conditions of consent to ensure the effects of the proposal are acceptable are included in Appendix H.

8.2 Positive/Beneficial Effects

A Remedial Options Assessment was completed following the Detailed Site Investigation conducted in January 2023. Four options were considered by TDC, Environment Canterbury and Te Rūnanga o Arowhenua:

- Take No Action.
- In-situ Management and Engineered Controls.
- Partial Removal of Landfill Body.
- Complete Removal of Landfill Body.

Consensus was reached that the option of complete removal offered the most advantages including:

- Greater confidence of contamination source removal.
- No long-term liability once remedial works completed.
- No requirement for ongoing monitoring or management of the contamination source site or river engineering works.
- No remaining source of contaminated landfill waste to cause adverse impacts to the receiving environment.
- Most likely to gain the support of the public.
- Opportunity to restore site to as close to its original state as is practicable.

Environmental effects - The permanent removal of a source of environmental contamination and the replanting of indigenous flora in its place is of clear benefit to the local area and the wider environment downstream.

Cultural effects - The proposal to restore an area of great significance to iwi is detailed by iwi at 8.11.

Social effects – the community has an opportunity with involvement with the proposal by raising plants and taking part in the restoration efforts.

8.3 Effects on character and amenity values

The surrounding environment includes the Rangitata River, Dennistoun Road with existing rural residential and pastoral use, and to the northwest, the settlement of Peel Forest. The area has a well-established rural character.

Amenity values associated with an area generally relate to an area’s landscape, the ambient noise environment and air quality values. The proposal is not particularly in character with the environment as it will bring a small-scale industry to the locality. The location of the proposal is not visible to the majority of residents nor is situated on a through road. A suite of mitigation measures to prevent off site effects is proposed in conditions. The activity will be temporary and is essential for the purpose of removing the landfill contents. Once the landfill contents have been removed, and the site remediated, the site will have representative rural character of the surrounding environment and have higher amenity than the existing situation. The proposal will have a temporary and negligible character or amenity impact on the settlement of Peel Forest.

8.4 Visual and landscape effects

Some of the earthworks and extraction activity will take place below the surrounding ground level, once works are below ground level, there will be little visual impact of this part of the project. The contractor’s yard will be visible from Dennistoun Road for the duration of the activity but will comprise a temporary set of structures and fencing of a nature not unusual in a rural setting. The site will not be visible from a public place or major road. Upon completion, the site will be contoured to allow for planting indigenous species. The void left after the removal of landfill contents will not be completely filled but contoured and stabilised. The planting will improve the visual aspect whilst acknowledging that the original landform has already been substantially altered. The Rangitata River is also likely to change the shape of the river edges as is the nature of braided rivers.

Most available views to the site are limited by the distance from most dwellings. The nearest dwelling that is located at 105 Dennistoun Road has its living spaces oriented north, away from the site. A nearly continuous hedgerow forms a visual barrier from the nearest dwelling to the work sites.

The construction works will have a less than minor effect on visual amenity and landscape, however once the remediation is complete, due to the restoration and planting, there will be an overall positive effect on visual and landscape effects.

8.5 Noise Effects

The proposal will generate noise from the digger/loader movements when used to remove topsoil and overburden material, construct bunds, extract the landfill contents, backfill and rehabilitate the site. Noise will also come from truck and trailer movements.

The proposal meets the definition of construction work for the purposes of the TDP, so the provisions of the construction noise standard NZS6803p1984 apply. This standard has been superseded by NZS6803:1999 and the tables of noise limits from both standards are reproduced below.

Table 7: Recommended upper limits for levels of construction work noise received in residential areas (adapted from Table 1 NZS6803:p1984)

	Noise level (dBA)								
	Weekdays			**Saturdays**			**Sundays and Public holidays**		
Time Period	L_{10}	L_{95}	L_{max}	L_{10}	L_{95}	L_{max}	L_{10}	L_{95}	L_{max}
0630-0730	60	45	70	**	**	**	**	**	**
0730-1800	75	60	90	75	60	90	**	**	**
1800-2000	70	55	85	**	**	**	**	**	**
2000-0630	**	**	**	**	**	**	**	**	**

Notes:

1. ***At these times the relevant provisions of NZS 6802 shall apply.*
2. *If construction work is of more than 18 weeks' duration the limits may be lowered by 5 dBA for the duration of the construction*

Table 8: Recommended upper limits for levels of construction work noise received at residential zones and dwellings in rural areas (adapted from Table 2 NZS6803:1999)

Time of week	Time period	Duration of work					
		Typical duration* (dBA)		Short-term duration** (dBA)		Long-term duration*** (dBA)	
		L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
Weekdays	0630-0730	60	75	65	75	55	75
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	75	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays and public holidays	0630-0730	45	75	45	75	15	75
	0730-1800	55	85	55	85	55	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75

Notes:

1. **"Short-term" means construction work at any one location for up to 14 calendar days*
2. ***"Typical duration" means construction work at any one location for more than 14 calendar days but less than 20 weeks"*
3. ***"Long-term" means construction work at any one location with a duration exceeding 20 weeks

Either of the sets of limits will be acceptable to assess compliance against as the standards are identical for work lasting longer than 20 weeks as is expected for this proposal.

The hours of operation for noisy equipment such as loaders and excavators will be restricted to 0730 to 1800, Mon-Fri and no work, other than that necessary for dust suppression or security, will take place on Saturdays, Sundays or Public Holidays. Construction noise is assessed outside buildings where there is an affected person and then at a point one metre from the wall most exposed to the sound. Where a building is unoccupied and there is no affected person no measurement need be made. The cumulative noise from the proposal will be no more than minor at 105 Dennistoun Rd, the nearest dwelling, when occupied. The construction noise will be nearly inaudible at other residential properties on Dennistoun Road and will therefore have no discernible impact on the local environment.

8.6 Traffic effects

Truck movements can cause adverse effects such as noise, vibration, and spillage of material on roads, that can be a source of nuisance to nearby residents. The proposal has trucks entering and leaving the site west of the dwelling at 105 Dennistoun Road, leaving clear access to the dwelling's driveway as the vehicles will not need to travel past. Equipment such as loaders and excavators will access the landfill across land between the landfill and the Contractor's yard and not on the road.

TDC is aware that the need for heavy vehicle access is likely to have an adverse effect on the road integrity particularly at the intersection of Dennistoun and Peel Forest Roads. TDC will be able to liaise with the successful tenderer to monitor this intersection.

An estimation of trip generation has been based upon the traffic movements generated by the emergency works after the flood.

Truck and trailers – 30 movements per day (estimating 5 vehicles doing three round trips to Redruth per day). This is a worst-case example, assuming material is ready to be loaded straight into trucks with pre-screening already completed. The likelihood is that processing material and waiting for extra lab results will slow the removal and not as many trucks will be needed.

Water truck - 2 movements (assumes 1 refill per day).

Site Staff Vehicles - 6 movements (assumes two plant/machinery operators and a site manager).

Maintenance – 2 movements (e.g. for machine breakdowns)

Consultants/Council/Stakeholder Visits – 6 movements (on occasions there may be LINZ or Aoraki Environmental staff on site for a meeting).

This equates to a conservative expected maximum of 46 movements in a day. As a guide for comparison, the proposed TDP at TRAN-S20 sets a number of 50 vehicle movements in a peak hour and 250 vehicle movements in a day as a threshold for requiring an integrated traffic assessment for an activity not specifically listed. Although this part of the proposed TDP is not operative this proposal does not fit any of the listed activities. This proposal will generate considerably fewer movements than this threshold.

Vehicles on the site will be well maintained, and turned off when not operating, thereby minimising noise and exhaust emissions.

Staff are trained in how to load road trucks to avoid spillage, and all laden trucks leaving the site will be covered.

As such, the traffic effects associated with the proposal will be less than minor and limited to daytime on weekdays.

8.7 Effects on Air

Soil disturbance activities across the landfill and contractor’s yard will be carried out in a manner that results in minimal dust generation, particularly since asbestos has been detected at concentrations that trigger Class B licensed asbestos work. In addition, exposed surface soils and the unsealed road leading to the site can be a source of dust generation during strong wind events, especially when tracked over by heavy machinery and trucks.

Dust control measures are laid out in a Dust Management Plan (Appendix D).

Dust is to be managed so that no nuisance dust from the excavation extends beyond the property boundary. The lead contractor is responsible for implementing dust mitigation measures. Measures include, but are not limited to:

- Advising all site workers of the need to minimise dust by the responsible operation of machinery;
- Visual monitoring of dust by Contractors on site;
- Maintaining a water supply on site (e.g., water cart, K-Line irrigation, etc.) for the dampening down of soils on a regular basis, particularly during hot/dry and windy periods, ensuring water application does not generate surface flow runoff. This applies to the landfill, contractor’s yard and the unsealed portion of Dennistoun Road which will support truck movements. If dusty conditions persist, consideration of applying a polymer (soil stabiliser such as Stonewall, or similar product) to the exposed surfaces shall be made by the lead contractor;
- Avoid the spreading of soil beyond the work areas by vehicle movements and daily tidying up of excavation works;
- Suspending dust generating activities when dust control measures become ineffective due to increased wind speed. The objective of these measures is to prevent visible dust emissions beyond the site boundary;
- Limiting vehicle access and speed (<5 km/hr) and controlling traffic movements to minimise dust generation and transport of affected soil on vehicle tyres; and,
- Any temporarily stockpiled soils (i.e., imported approved ‘clean’ fill) shall be kept damp or covered with a geotextile fabric (or similar) to prevent dust generation.

Previous airborne fibre monitoring (AFM) undertaken by PDP at the site during interim remedial and landfill characterisation works, have shown that when the excavation and removal activities are carried out in accordance with the management procedures and dust suppression measures outlined in the DMP and RAP, then asbestos fibres were not detected in air.

AFM will be undertaken during the disturbance of the landfill material to provide reassurance that the methods and controls being implemented are not generating potential airborne asbestos fibres. More detailed information is included in the RAP (Appendix F).

There is potential for some of the landfill contents to be odorous although little odour was observed during the emergency works or test pitting. The RAP in particular contains measures to control odour by covering or containing odorous material should it be encountered.

As mitigated by the DMP and RAP, the adverse effects on air will be less than minor.

8.8 Effects on water resources

Disturbance of the waste could potentially effect groundwater and surface water quality by generating new pathways for contamination.

The nearest natural waterbody to the site is the Rangitata River, which is on average, approximately 30m below the eastern most edge of the landfill site. The river is likely to be hydraulically connected to the regional groundwater system, however there is significant depth to the groundwater table from the deepest part of the landfill (approximately 15m) as shown in the bore logs. The earthworks and removal of landfill material are very unlikely to influence the Rangitata River via the groundwater.

The greatest risk to the Rangitata river is the release of landfill contents over the edge of the terrace. The RAP contains advice on the use of wind screen fences to trap any lightweight debris that may be blown off the site and monitoring of the riverbed so that any material lost over the edge is noted for retrieval as soon as possible.

There will be a variety of heavy equipment on site that will be diesel fuelled. The Lead Contractor is responsible for providing and maintaining an adequate spill response kit onsite. Any spill must be reported immediately.

Practicable steps will be implemented to ensure oil and fuel leaks are prevented from vehicles and machinery, including the following:

- Fuel will be stored securely or removed from the site overnight; and

- A spill kit, capable of absorbing the quantity of oil and petroleum products that may be spilt on site at any one time, will always be kept on site.

In the event of a spill of fuel or any other hazardous substance, the spill will be cleaned up as soon as practicable, the stormwater system shall be inspected and cleaned.

No stormwater from nearby land will flow into the landfill as the overland stormwater in the area will be directed using earth mounds and swales around both the contractor's yard and landfill areas. The exact location and dimensions will be confirmed with the contractor.

Direct rainfall will fall onto the landfill as it does now. Discharges from the landfill are covered by consent CRC950949. To ensure the effects are within accordance of that consent, stormwater will be managed during works by staging the excavation, covering opened ground when not being worked on and ahead of forecast heavy rain.

With mitigation measures in place the adverse effects on all water resources associated with the proposal will be less than minor.

8.9 Effects on soil resources

Topsoil and any subsoils removed from the contractor's yard prior to landfill excavation will be tested for contaminants prior to excavation. Once this baseline is recorded, soils will be stored separately to prevent degradation and erosion losses, prior to being reused to restore the site at the completion of works. Until the soils are stockpiled, there is a risk that spills from machinery could occur. The effects of such a spill are assessed in section 8.8, which concludes that given the mitigation measures adopted, adverse effects will be less than minor. There is no potential for soil contamination to occur through the storage of hazardous substances or refuelling as these activities will not take place within the site.

Likewise, the same mitigation measures will ensure potential adverse effects on soil resources are less than minor.

Machinery will be well maintained to limit the potential for any hydraulic fluid or fuel spills and a spill management plan based on the RAP shall be developed for the site. This will detail appropriate contingency measures in the form of operational practices, spill kits and staff training that will be in place to manage any hydraulic oil or fuel leak. All spill events will be recorded, including the volume of any spill and a record of any clean up action taken, with any contaminated soil being appropriately disposed of to an authorised off-site facility.

The proposal aims to minimise quantities of imported fill, reuse site won clean fill and design a finished contour that will hold soil, control stormwater flow, and prevent sediment runoff before it is planted.

The adverse effects from all parts of the proposal on soil resources are less than minor.

8.10 Effects on Highly Productive Soils

Canterbury Maps identifies the area to be used for the contractor's yard as having a land use capability classification of LUC2 which is considered highly productive soils in the context of the NPS-HPL. Considering the temporary nature of the yard and that on completion of the project the land will be returned to its pastoral state, the loss of the site from productive use will have less than minor adverse effects on the soil resource.

8.11 Cultural Effects

The hapū who hold mana whenua in the Timaru District are Kāti Huirapa. The rohe of Kāti Huirapa extends over the area from the Rakaia River in the north to the Waitaki River in the south. The Papatipu Rūnaka that represents Kāti Huirapa is Te Rūnanga o Arowhenua.

Kāti Huirapa worked and travelled extensively across South Canterbury and, as a result, they have historical and cultural connections with land and waterways throughout the Timaru District.

Aoraki Environmental Consultancy Ltd have been contracted to assist in the development of this application. This section has been written by them in consultation with Te Rūnanga o Arowhenua.

The Whenua and Awa

The site is adjacent to the Rangitata (Kāi Tahu pronunciation Raki-tata). It is an awa (river) of significance to Manawhenua, Te Rūnaka o Arowhenua and Kāi Tahu. Rakitata literally means the stairway to Ranginui the sky father. Rangi means heavens or sky father, signifying the ascension to the wananga, a place of learning and spirituality, where communion with the atua/gods can take place, and tata means close by.

The river was sometimes used by Kāi Tahu parties from Canterbury as part of a trail to Te Tai Poutini (the West Coast). The Rakitata and the land around it was an important mahinga kai for Canterbury Kāi Tahu. Weka and other forest birds were the main foods taken from the inland reaches of the Rangitata. Tutu berries were also taken along the waterway.

The value and significance of the Rangitata to Arowhenua has not changed despite factors such as ownership and loss of indigenous habitat meaning traditional practices of mahinga kai have diminished or cannot be undertaken. Arowhenua still, through activities such as participating in the development of this AEE and in the Rangitata revival programme undertake their role as kaitaiki for the water and the land.

The importance of the Rakitata is recognised through the Rangitata being a Statutory Acknowledgement area under the Ngāi Tahu Claims Settlement Act 1998. This recognises that the mauri (lifeforce) of the Rangitata represents the essence that binds the physical and spiritual elements of all things together, generating and upholding all life. All elements of the natural environment possess a life force, and all forms of life are related. Mauri is a critical element of the spiritual relationship of Ngāi Tahu Whānui with the river.

An opportunity to enhance the whenua and awa

The actions to remove the landfill at Peel Forest are supported by Arowhenua. At its core Arowhenua see this application to remediate the site is about removing something that should never have been there in the first place. Manawhenua have held concerns since the landfill was located on the site not just about the presence of the landfill site itself but the risk to the Rakitata from contamination both through leaching from the site and also, as has occurred erosion of the site. The removal of the landfill will enhance the area for generations to come.

Arowhenua acknowledge the partnership with the Timaru District Council in developing the remediation package that has led to this application being made. Arowhenua have worked alongside the Council since 2019 when it was noted that erosion was occurring on the site and there was a risk of contaminants from the landfill entering the Rakitata. Arowhenua worked alongside the Council on temporary measures to contain the site.

Specific controls and conditions for the site

Arowhenua support the measures proposed by the Timaru District Council to reduce the effects from the removal of the site on the water of the Rangitata.

Arowhenua support the area being replanted with species that would have been found in the area. The Rangitata Revival programme is enhancing works along the Rangitata and the removal of the landfill provides the opportunity for an area of planting that not only can be enjoyed by the community but can form part of a terrestrial ecological corridor for species. Arowhenua support ongoing actions to control weeds on the site.

Arowhenua request that if any public signage is located on the site, then there is an opportunity for Arowhenua to detail their relationship with the area.

Iwi Management Plan of Kāti Huirapa for the Area Rakaia to Waitaki (July 1992)

Arowhenua consider the removal of the Peel Forest landfill meets the policies of the Iwi Management Plan of Kāti Huirapa (the IMP). The IMP provides clear direction that there be no dumping of rubbish in or near rivers and that all rubbish and solid waste be removed from rivers.

The IMP seeks that access to mahika kai be maintained by the Crown and district and regional councils. However, it is acknowledged that access to the Rakitata river from this site is not safe or practical and would therefore prefer that actions are taken by the Council to prevent anyone accessing the water from this site.

The IMP further seeks that use, storage and transport of hazardous substances are controlled to ensure that they do not cause damage to the natural environment or place the environment or people at risk from contamination. Arowhenua acknowledge that the actions of excavation and handling waste on the site and in moving the waste from the site to Redruth will be done by qualified contractors under the provisions of strict conditions of this consent.

Proposed Timaru District Plan

The site is identified as wai taoka (no. 23) in the Proposed Timaru District Plan this section of which has been given legal effect to. This site recognises, as outlined above, the importance of the Rakitata river. The wai taonga status recognises that what happens on the land can affect the water. This proposal presents a positive effect for the Rakitata in that a contaminant source is being removed. Arowhenua also support the stormwater retention methods that will be used on the site during the removal of the landfill and its restoration to reduce contaminated overland flows entering the Rakaia.

8.12 Assessment of effects summary

Overall, it is considered that the potential adverse effects of this proposal on the environment will be temporary, and less than minor. Once the remediation is complete, the project will have overall positive effects on the physical environment, amenity of the area, soil quality, and mana whenua relationship with the whenua.

The temporary adverse effects will be mitigated through controlled hours of operation, additional planting, a range of dust suppression measures, site rehabilitation, community involvement, and careful planning of the project methodology.

9.0 Notification of Application

Sections 95A to 95F of the RMA set out requirements in relation to the public and limited notification of resource consent applications. Sections 95A, 95B, 95D and 95E have relevance to this application.

The steps in section 95A relate to whether public notification should be given. With regards to its requirements:

- Step 1: The applicant does not request public notification, section 95C is not relevant as this relates to requests for further information; and the application is not made jointly with one to exchange recreation reserve land. Therefore, public notification is not mandatory under section 95A(2)(a).
- Step 2: The application is not subject to a rule or national environmental standard that precludes public notification; and the application is not for a controlled activity, a subdivision of land, a residential activity, boundary activity or a prescribed activity. Therefore, public notification is not precluded under section 95A(4)(a).
- Step 3: The application is not subject to a rule or national environmental standard that requires public notification; and, as demonstrated in Section 5.0 of this report, the proposal will not or is not likely to have adverse effects on the environment that are more than minor in relation to section 95D. Therefore, the application need not be publicly notified under section 95A(7)(a).
- Step 4: No special circumstances are considered to exist in relation to the application that would warrant the application being publicly notified, therefore public notification is not required under section 95A(9)(a).

Therefore, in applying the tests set out under section 95A of the RMA, and having regard to the discussion below, it is considered that the application should not be publicly notified.

The steps in section 95B relate to whether limited notification should be given. With regards to its requirements:

- Step 1: There are no affected protected customary rights groups or customary marine title groups; and the proposed activity is not identified as being on, adjacent to, or affecting land that is the subject of a statutory acknowledgement. Therefore, there are no specific people or groups that are affected, to whom limited notification should be given under section 95B(4).
- Step 2: The application is not subject to a rule or national environmental standard that precludes limited notification; and the application is not for a controlled activity or a prescribed activity. Therefore, limited notification is not precluded under section 95B(5)(a).
- Step 3: The application is not for a boundary activity or a prescribed activity, but the consent authority must notify any other person they determine to be affected under section 95E.
- Under section 95E, no other properties have been identified as being affected to an extent that is minor. Therefore, limited notification is not required.
- Step 4: No special circumstances are considered to exist in relation to the application that would warrant limited notification, therefore limited notification is not required under section 95B(10)(a).

Therefore, in applying the tests set out under section 95B of the RMA, and having regard to the discussion below, it is considered that the application is not required to be notified.

Notwithstanding this, we note that Environment Canterbury and TDC have typically taken an approach of engaging surrounding owners and occupiers of the Peel Forest Community and Te Runaka o Arowhenua in the process of this AEE.

10.0 Statutory Assessment

This section provides an overview of the relevant provisions of the RMA and associated statutory plans governing the resource consents required to remove the landfill contents from the closed Peel Forest Landfill and rehabilitate the site. A full statutory assessment is provided in Appendix J.

The statutory planning documents under the RMA relevant to this application are:

- National Policy Statement for Freshwater Management 2020 (NPS-FW)
- National Policy Statement for Highly Productive Land 2022 (NPS-HPL)

- Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011(NES Contaminated Land)
- The Canterbury Regional Policy Statement (CRPS)
- The Canterbury Land and Water Regional Plan (LWRP)
- The Canterbury Air Regional Plan (CARP)
- The Timaru District Plan (TDP)
- The Proposed Timaru District Plan (PTDP)

The Statutory Assessment (Appendix J) concludes that the proposal to remove and rehabilitate the closed Peel Forest Landfill, together with the range of mitigation measures and management techniques is consistent with the policy framework of the relevant statutory documents. It is similarly concluded that granting consent would be consistent with the purpose of the RMA and its principles.

10.1 National Policy Statement for Freshwater Management 2020

The NPS-FM sets national bottom lines for ecosystem health and human health for recreation. It is aimed at stakeholders who intend to use and affect freshwater quality and quantity.

The objectives of the NPS-FM 2020 have reframed how water quality in New Zealand is to be managed. The single objective (Objective 1) of the NPS-FM is now to manage freshwater in a 3-tier hierarchy where '*natural and physical resources are managed in a way that prioritises:*

- *first, the health and well-being of water bodies and freshwater ecosystems*
- *second, the health needs of people (such as drinking water)*
- *third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.'*

This central focus is encapsulated in the concept of Te Mana o te Wai, which, as outlined in Section 1.3 of the NPS-FM, '*refers to the fundamental importance of water and recognises that protecting the health of freshwater also protects the health and well-being of the wider environment, it protects the mauri of the wai. Te Mana o te Wai is about restoring and preserving the balance between the water, the wider environment, and the community*'.

Objective 1 (above) and Policy 1 which require freshwater to be managed in a way that gives effect to Te Mana o te Wai are strong policy objectives designed to cease ongoing water degradation and manage catchments in an integrated way. It follows, that this application, which seeks to remove a contaminant source from entering the Rangitata aligns with Objective 1 (above) and Policy 1 by protecting the health and wellbeing of the Rangitata. Policy 3 is central to this matter in that '*freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments*.' Accordingly, the proposed discharge will be managed in an integrated manner to avoid adverse effects on all freshwater bodies.

Policy 2 requires the active involvement of iwi and hapū, and to ensure that Māori freshwater values are identified and provided for. TDC have engaged Aoraki Environmental since the emergency works on this project. Aoraki Environmental have actively been involved with this project and have authored section 8.11 of this assessment of environmental effects, showing their support for this proposal.

As the policies descend in the NPS-FM, they become more specific to local environments. Policy 5, 12 and 13 are considered to be specific to Regional Council planning requirements and not presently relevant[1]. With regard to Policies 7 and 8, the effects on river values are avoided by removing landfill contents before they can be lost into the river by erosion and will overall be improved by removing the risk of future waste lost to the river from erosion.

While achieving general consistency with the policies above, the proposed discharge is wholly consistent with Policy 15 which enables communities to provide for their economic well-being, including productive economic opportunities, in sustainably managing freshwater quality within limits.

PDP understands that Clause 3.22(1) and Clause 3.24(1) will form part of the Canterbury Land and Water Regional Plan (LWRP) in accordance with s.55 of the RMA (i.e. outside of the Schedule 1 (RMA) process as an administrative matter). As such, for all intents and purposes, it is considered these apply immediately. In response to this policy, the values that could apply to rivers and wetlands are identified in Appendix 1A and 1B of the NPS-FM. These are as follows:

Compulsory Values:

1. Ecosystem health
2. Human contact
3. Threatened species
4. Mahinga kai

Other values that must be considered:

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[1] Consistent with the final decision of the Expert Consenting Panel appointed under Clauses 2, 3, and 4 of Schedule 5 of the COVID-19 Recovery (Fast-Track Consenting) Act 2020 for the Matawii Water Storage Reservoir by Te Tai Tokerau Water Trust.

5. Natural form and character
6. Drinking water supply
7. Wai tapu
8. Transport and tauranga waka
9. Fishing
10. Animal drinking water
11. Irrigation, cultivation, and production of food and beverages
12. Commercial and industrial use

Overall, this application is considered to meet the objective and is wholly consistent with the policies by avoiding and mitigating the effects on water by taking an integrated approach.

Table 11 of Appendix J provides a more detailed assessment of the relevant NPS-FM objectives and policies as they relate to the discharge of construction phase stormwater.

10.2 National Policy Statement for Highly Productive Land

The National Policy Statement for Highly Productive Land 2022 (NPS-HPL) is about ensuring the availability of New Zealand's most favourable soils for food and fibre production, now and for future generations. The NPS-HPL provides direction to improve the way highly productive land is managed under the RMA.

As the CRPS is yet to identify highly productive land, clause 3.5(7) of the NPS-HPL applies with regards to what constitutes highly productive land being land zoned general rural or rural production; and LUC 1, 2, or 3 land; but which is not identified for future urban development; or subject to a Council initiated, or an adopted, notified plan change to rezone it from general rural or rural production to urban or rural lifestyle.

The land on which the contractor's yard is to be located is zoned Rural 1 and is LUC2, the policy provisions of the NPS-HPL have been considered.

Table 12 of Appendix J provides a more detailed assessment of the relevant NPS-HPL objectives and policies as they relate to the use of land for a contractor's yard.

Implementation part 3.9 seeks to *protect highly productive land from inappropriate use and development with subclause (2) outlining that a use or development of highly productive land is inappropriate except where at least one of the matters in subclause 3 applies.* Of relevance to this application, is the following:

(g) it is a small-scale or temporary land-use activity that has no impact on the productive capacity of the land:

Additionally, as the site will be restored using the soils removed during site preparation, it is considered the proposal is consistent with Clause 3.9 (3)(a) in that the activity *minimises or mitigates any actual loss or potential cumulative loss of the availability and productive capacity of highly productive land.*

10.3 Resource Management (National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011

The MfE Hazardous Industries and Activities List (HAIL) details activities and industries which have the potential to lead to soil contamination. The site area is a closed landfill considered to be Category G3 HAIL land (Appendix B).

The NESCS applies to certain activities conducted on HAIL land, including the disturbance and removal of soil on HAIL land.

The 'Users' Guide: NESCS Soil' specifically notes that:

- *'the NESCS does not contain any policy guidance'.*
- *'When considering an application for a resource consent required by regulation 9, regulation 10, or regulation 11, the consent authority must have regard to any relevant provisions in the district plan or proposed district plan, and the regional policy statement or proposed regional policy statement (RMA s 104).'*
- *'In regulation 10, the NES has restricted its discretion to certain matters. As with regulation 9, provisions in the district plan or regional policy statement will only be relevant if they relate specifically to those matters. If granted, conditions may only be imposed on the consent for matters within the discretion of regulation 10 and the application can only be declined in relation to these matters.'*

Full details of the status are in Table 13 Appendix J.

10.4 Canterbury Regional Policy Statement

The Canterbury Regional Policy Statement (CRPS) became operative on 15 January 2013 and sets out a policy framework for the region to achieve sustainable and integrated management of major natural and physical resources in Canterbury. The CRPS specifically expects protection of freshwater quality, and protection from adverse effects of contaminated land.

The key objectives and policies of the CRPS relating to this application are in Chapters 5, 7, 14 and 17 relating to land use and infrastructure, fresh water, air and contaminated land.

The site is defined as HAIL (G3) on the Listed Land Use Register, as a closed landfill. Details of the contamination on the site are provided in the PDP (2022) Detailed Site Investigation (Appendix C). This consent supports the removal of contaminated material and refuse and disposal to appropriate facility. Authorised clean material excavated from the site will be used as engineered back fill.

The RPS provides for appropriate use and development. The focus in the RPS is on protecting and enhancing environmental values and avoiding adverse effects as far as practicable and otherwise remedying or mitigating effects.

Table 14 of Appendix J provides a more detailed assessment of the relevant CRPS objectives and policies as they relate to the discharge of construction-phase stormwater and earthworks over and aquifer and within 5 m of a river.

In summary, the discharge of stormwater during the remediation process, and the excavation and removal of the waste is considered consistent with the CRPS objectives and policies.

The CRPS is primarily implemented through the LWRP, which is discussed in section 10.5.

10.5 Canterbury Land and Water Regional Plan

The LWRP became operative in December 2016 and was most recently amended by PC7 in November 2021. It provides for the management of land and water resources in the region including soil, rivers and streams, lakes, groundwater, and wetlands.

Tables 15 and 16 of Appendix J provides a more detailed assessment of the relevant LWRP objectives and policies as they relate to excavation over an aquifer and within 5 m of a river and discharge of construction phase stormwater from the activity. It is considered that the proposed discharge will be consistent with the relevant objectives and policies highlighting the temporary nature of the discharge and that all works will proceed in accordance with the RAP which provide mitigation measures for managing contaminated runoff.

It is considered that the application is consistent with the remaining LWRP objectives and policies.

10.6 Canterbury Regional Air Plan

The Canterbury Regional Air Plan (CARP) became operative from 31 October 2017. The relevant objectives and policies are discussed in Table 17of Appendix J.

Objective 5.6 seeks to ensure amenity values of the receiving environment are maintained and Policy 6.8 directs effects to be managed through a management plan. A draft Dust Management Plan has been prepared for the site.

Implementation of this plan will ensure the objectives and policies of the CARP are met.

10.7 Timaru District Plan

The Timaru District Plan (TDP) became operative on 8 March 2005. It provides for the control of any actual or potential effects of land use and subdivision. Land use effects can derive from, earthworks, contaminated land and noise amongst others.

Table 18 in Appendix J provides a more detailed assessment of the relevant TDP objectives and policies as they relate to infrastructure within the district.

The earthworks and construction of the contractor’s yard are consistent with the TDP objectives and policies.

10.8 Proposed Timaru District Plan

The Proposed Timaru District Plan (PTDP) was notified on 22 September 2022.

The chapter Historical and Cultural Values – Sites and Areas of Significance to Māori is operative.

Table 19 in Appendix J provides a more detailed assessment of the relevant PTDP objectives and policies with the greatest details afforded to sections of the Proposed Plan that are operative.

10.9 Te Rūnanga o Ngāi Tahu Freshwater Policy Statement

The focus of this Policy Statement is the management of freshwater resources within the Rohe of Ngāi Tahu. It outlines the environmental outcomes sought by Ngāi Tahu and the means by which Ngāi Tahu is seeking to work with the resource management agencies to achieve these outcomes. I consider the following policies relevant to the application:

- Mauri, Policies 1, 2, 3, and 4: It has been demonstrated throughout the AEE that effects on freshwater quality will be less than minor and as such consider the Mauri of the water resource protected and adverse effects mitigated and avoided.
- Mahinga kai, Policies 1, 2, 3, and 4: It has been demonstrated that the activity will not adversely affect freshwater quality of water bodies within the area of effects, therefore there will be no effects on mahinga kai.

10.10 Iwi Management Plan Of Kati Huirapa For The Area Rakaia To Waitaki: Part One – Land Water And Air Policies

The Iwi Management Plan of Kati Huirapa for the Area Rakaia to Waitaki: Part One – Land Water and Air Policies (the Iwi Plan) was prepared in 1992. The Iwi

Plan seeks to promote outcomes that seek to clean up all rivers, lakes, all waterways and all coastal waters:

- All sewage, all waste discharges out of the rivers, lakes, sea, all natural waters.
- All waters be the highest classified standard of water quality, with no waste discharges.
- No dumping of rubbish in or near rivers, lakes, sea, all natural waterways.
- All rubbish, solid waste be removed from rivers, coastline, wetlands, all natural waterways.
- All local authority waste disposal areas in wetlands, riverbeds and adjacent to rivers, lakes, coast, all natural waters, be phased out and relocated away from waterways, wetlands and coastal areas.

The proposal is well aligned with these outcomes, as it provides for the removal and relocation of waste from a former local authority facility adjacent to natural water to a more appropriate location.

The Iwi Plan also contains some policies of in respect of the life supporting capacity of water that are relevant to the proposal:

- The protection and restoration of natural habitats be encouraged.
- Where plantings are required to protect the margins for farmland adjacent to rivers, local native species should be used to restore habitats and depleted natural areas.
- The planting of flax and other native species which are a source of traditional materials be encouraged.

As described in the Geotechnical and Stormwater Management principles in Appendix I, the restored landform will allow for native plantings with specific species selected in consultation with Arowhenua.

The Iwi Plan seeks to continue the protection of the hills and mountains as sources of lifegiving waters, by natural native vegetation. The relevant policies in this regard relate to:

- No burning of native vegetation.
- No logging or clearance of native vegetation.

Minor vegetation clearance is proposed in respect of the activities, with the proposal to remove existing willow trees and other vegetation surrounding the western wetland area to enable restoration activities, and the clearance of the quarry site, prior to filling and the rehabilitation proposed as an integral component of this application. No native vegetation will be removed.

Finally, the Iwi Plan also requires any proposal to disturb ground where there is or was traditional or customary use of ancestral lands is referred to mana whenua first. Should bones or artefacts be disturbed, the Iwi Plan indicates that the Rūnanga should be contacted and tikanga Māori observed. This has been done.

On the basis of this assessment, the proposal is considered to accord with the outcomes promoted via the Iwi Plan.

10.11 Section 104C – Determination of Applications for Restricted Discretionary Activities

This is relevant for the Environment Canterbury consents only.

> *(1) When considering an application for a resource consent for a restricted discretionary activity, a consent authority must consider only those matters over which—*
>
> *(a) a discretion is restricted in national environmental standards or other regulations:*
>
> *(b) it has restricted the exercise of its discretion in its plan or proposed plan.*
>
> *(2) The consent authority may grant or refuse the application.*
>
> *(3) However, if it grants the application, the consent authority may impose conditions under section 108 only for those matters over which—*
>
> *(a) a discretion is restricted in national environmental standards or other regulations:*
>
> *(b) it has restricted the exercise of its discretion in its plan or proposed plan.*

In accordance with s.104C of the RMA, the applicant:

- requests the consent be granted;
- acknowledges that the consent authority’s discretion is limited to matters outlined in the LWRP, which have been assessed in section 10.5.
- requests conditions, as they relate to matters listed in the LWRP, be imposed (in accordance with s.108) that are fair and reasonable.

10.12 Part 2 - Purpose and Principles

Case law[2] has directed when decision making should employ “*an overall broad judgement*” in respect of resource consent applications. As found by the Court of

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[2] *RJ Davidson Family Trust v Marlborough District Council [2018] NZCA 316.*

Appeal, it would be “*appropriate and necessary*” to refer to Part 2 when considering consent applications, but only where there is doubt that a plan has been “*competently prepared*” under the RMA.

It is considered that in this particular case, the Environment Canterbury RMA Plans are sufficiently competent and have already given effect to Part 2. Furthermore, the directive nature of the NPS-FM policies has been assessed. Accordingly, Part 2 matters are adequately addressed by lower order documents which are included in the s.104 assessment and referring back to Part 2 wouldn’t "*add anything to the evaluative exercise*".

10.13 Statutory Assessment Conclusion

The proposed remediation of the site and associated discharge of construction-phase stormwater, supports the significant and demonstrable positive effects in terms of restoring the environment and contributing to climate change adaptation whilst sustaining the social and economic wellbeing of the community. Any actual or potential adverse effects can be appropriately avoided, remedied or mitigated through the proposed management plans and suggested consent conditions.

After considering all those matters relevant under Part 2, s.104, s.105 and s.107, it is considered granting the resource consents would promote the purpose of the RMA and would constitute sustainable management of natural and physical resources for the following reasons:

- It allows the use of natural and physical resources in a way which enable people and the community to provide for their social, cultural and economic wellbeing;
- It sustains the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations;
- It safeguards the life-supporting capacity of air, water and soil, ensures that adverse effects are appropriately avoided, remedied or mitigated;

It is demonstrably consistent with the relevant planning documents, including the discharge provisions in the LWRP and CARP.

11.0 Conclusion

Timaru District Council seeks a resource consent to discharge construction-phase stormwater to land and conduct earthworks associated with remediation, of a closed landfill at Peel Forest.

The application is for a restricted discretionary activity under the Canterbury LWRP, the NES-CS, and pTDP and a Discretionary Activity under the TDP. Section 6.3of the

AEE assesses the activity against the relevant matters of discretion set out in Rules 5.95B and 5.176 of the LWRP. Section 6.4 assesses the activity against the relevant matters of discretion set out in Rule SASM R1 of the pTDP.

The conclusion reached from the AEE and section 8.12 in particular, is that actual and potential effects, as mitigated, will be less than minor (and temporary) on the environment and no party is considered adversely affected. The effects of the proposal once complete, will be positive on the environment, community and mana whenua.

The conclusion reached from the assessment of the objectives and policy provisions, is that the proposal is consistent with the provisions. As such, this enables both Councils to process this application under a non-notified basis and should be granted.

12.0 References

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Appendix A: Certificates of title

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R.W. Muir
Registrar-General
of Land

Identifier	**178604**
Land Registration District	**Canterbury**
Date Issued	25 November 2004

Prior References
CB460/66

Estate	Fee Simple
Area	31.7050 hectares more or less
Legal Description	Lot 3 Deposited Plan 343513

Registered Owners

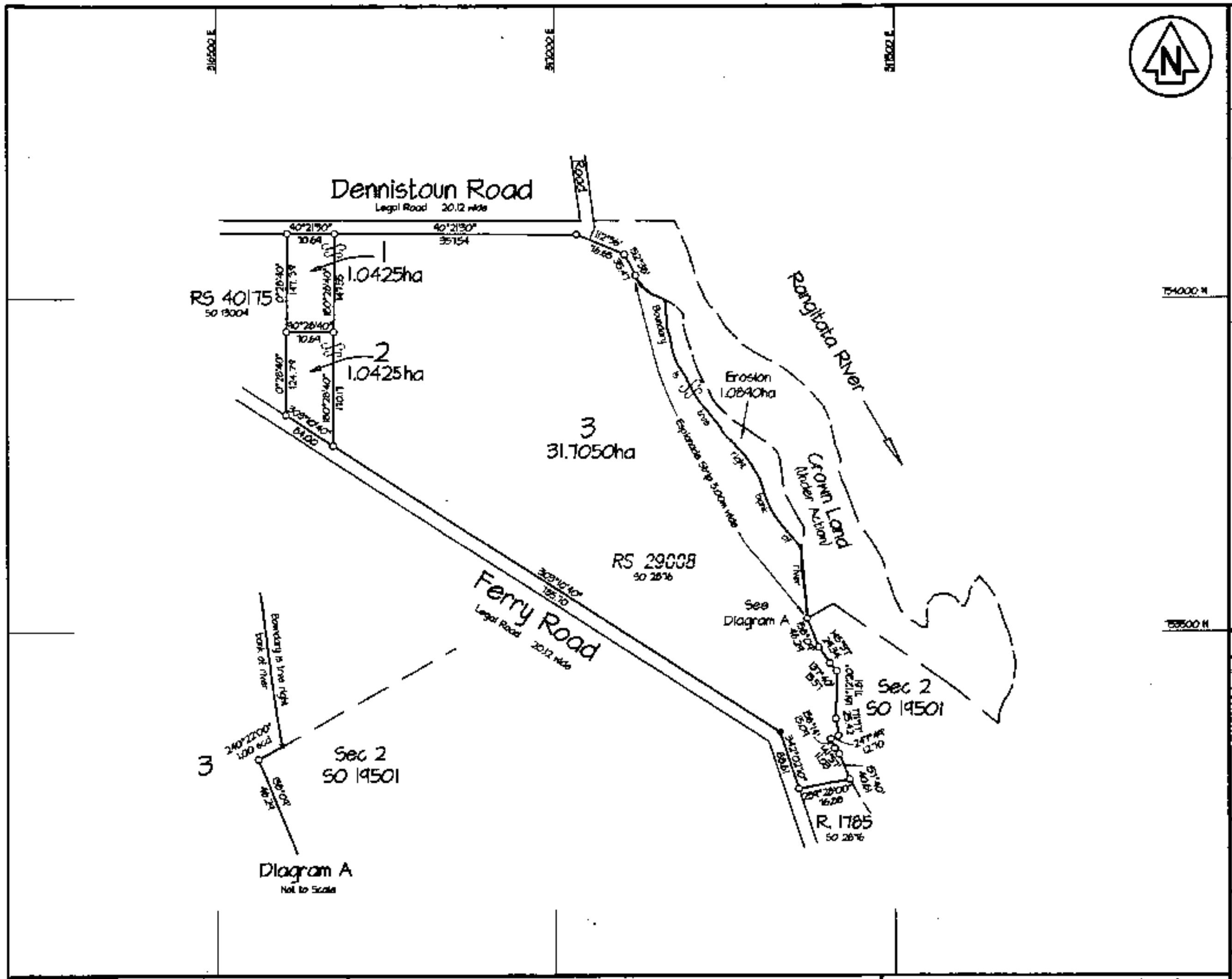
Graham Carr and Graham Carr Trustee Limited

Interests

6227900.1 Esplanade Strip Instrument pursuant to Section 232 Resource Management Act 1991 - 25.11.2004 at 9:00 am

6227900.3 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 25.11.2004 at 9:00 am

12029425.6 Mortgage to Westpac New Zealand Limited - 29.3.2021 at 2:43 pm



Approvals

Ian Smith IST SMITH
Registered Proprietor

I hereby certify that this plan was approved by the Timaru District Council pursuant to Section 223 of the Resource Management Act 1991 on this 10th day of ~~September~~ 2004.

Pursuant to Section 224(c) of the Resource Management Act 1991 I hereby certify that some conditions of the subdivision consent have been complied with to the satisfaction of the said Council and that consent notices have been issued in respect of those conditions that have not been complied with.

Chief Executive Officer / Authorised Officer

LT 343513 (Title Plan)

CERTIFICATE OF TITLE ALLOCATED	
LOT 1 178602	LOT 2 178603
LOT 3 178604	

CLASS OF SURVEY: Lots 1 & 2 - II
Lot 3 - III

Total Area 33.1900ha

Comprised in CT 460/66

I, Jayne Elizabeth Petrie
being a person entitled to practise as a licensed cadastral surveyor certify that:
(a) The surveys to which this dataset relates are accurate, and were undertaken by me or under my direction in accordance with the Cadastral Survey Act 2002 and the Surveyor-General's Rules for Cadastral Survey 2002/2
(b) This dataset is accurate and has been created in accordance with that Act and those Rules
Signed Jayne Petrie Date 1/10/04

Field Book .... p. .... Traverse Book ...... p. ......
Reference Plans DP 41401 SO's 2876, 13004, 19501

Examined .... Correct ....

Approved as to Survey by Land Information NZ on
29/10/2004

Deposited by Land Information NZ on
25/11/04

File
Received 8.10.04
Instructions

DP 343513

LAND DISTRICT Canterbury

Lots 1-3 being Subdivision of RS 29008

TERRITORIAL AUTHORITY Timaru District
Surveyed by Davis Ogilvie 20804
Scale 1:4000 Date July 2004

JDB APPROVED CN2000/2

Appendix B: LLUR Listing

Environment
Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Dear Sir/Madam

Thank you for submitting your property enquiry from our Listed Land Use Register (LLUR). The LLUR holds information about sites that have been used or are currently used for activities which have the potential to cause contamination.

The LLUR statement shows the land parcel(s) you enquired about and provides information regarding any potential LLUR sites within a specified radius.

Please note that if a property is not currently registered on the LLUR, it does not mean that an activity with the potential to cause contamination has never occurred, or is not currently occurring there. The LLUR database is not complete, and new sites are regularly being added as we receive information and conduct our own investigations into current and historic land uses.

The LLUR only contains information held by Environment Canterbury in relation to contaminated or potentially contaminated land; additional relevant information may be held in other files (for example consent and enforcement files).

Please contact Environment Canterbury if you wish to discuss the contents of this property statement.

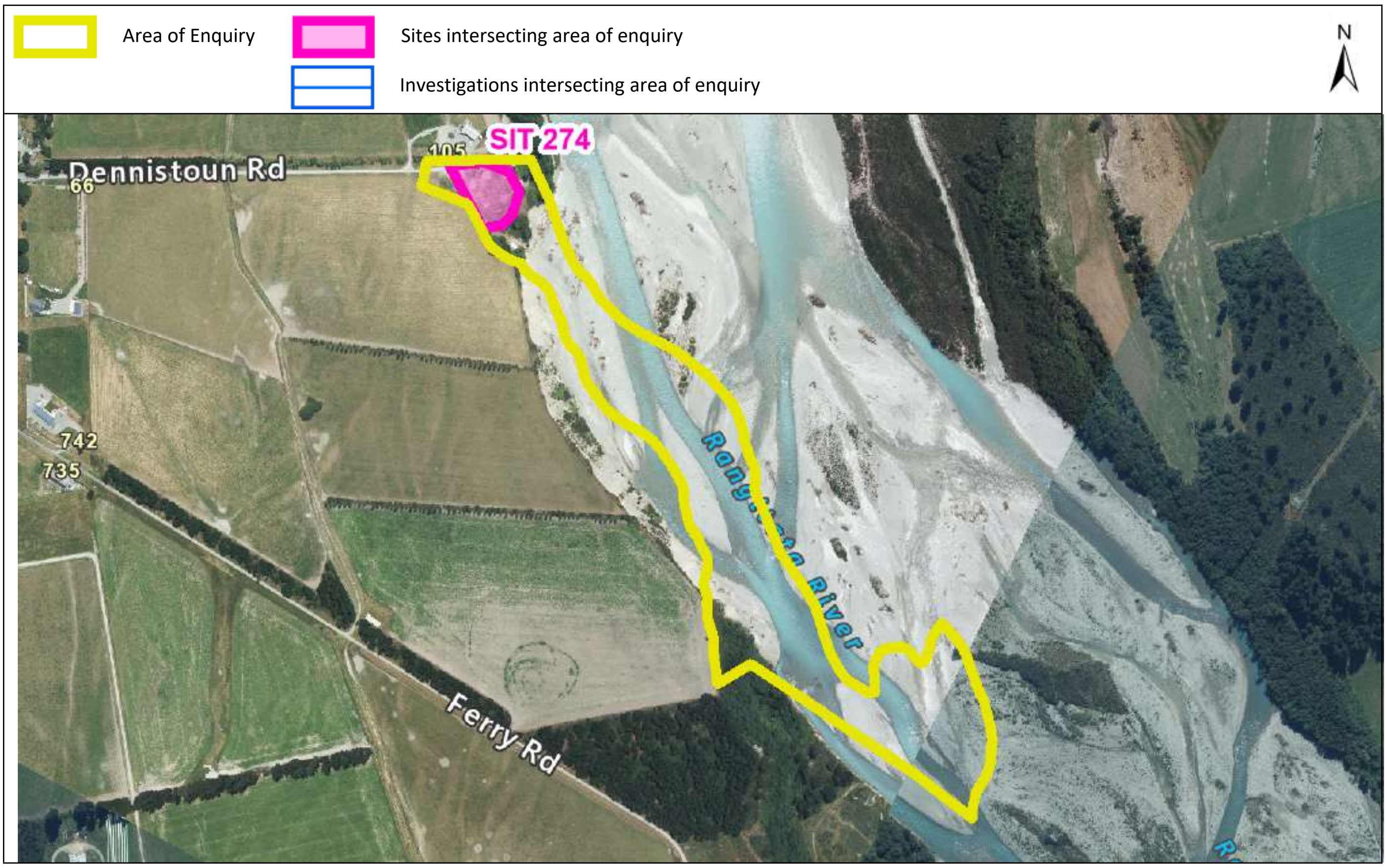
Yours sincerely

Contaminated Sites Team

Property Statement
from the Listed Land Use Register

Visit ecan.govt.nz/HAIL for more information or
contact Customer Services at ecan.govt.nz/contact/ and quote ENQ369452

Date generated: 18 February 2024
Land parcels: Crown Land (under action) Survey Office Plan 3144



The information presented in this map is specific to the property you have selected. Information on nearby properties may not be shown on this map, even if the property is visible.

Sites at a glance

▨ **Sites within enquiry area**

Site number	Name	Location	HAIL activity(s)	Category
274	Peel Forest Landfill	End of Dennistoun Road, Adjacent to Rangitata River	G3 - Landfill sites;	Not Investigated

More detail about the sites

Site 274: Peel Forest Landfill (Intersects enquiry area.)

Category: Not Investigated
Definition: Verified HAIL has not been investigated.

Location: End of Dennistoun Road, Adjacent to Rangitata River
Legal description(s): Crown Land (under action) Survey Office Plan 3144

HAIL activity(s):

Period from	Period to	HAIL activity
1960s	2002	Landfill sites

Notes:

4 Jul 2005

The fill volume is approximately 20,000 cubic metres, comprising domestic refuse 5 m thick. Landfill area is 0.4 ha, located in an old gully draining into Rangitata River.

8 Feb 2006

Discharge of landfill leachate to ground is managed by the Envrionemtn Canterbury consent CRC950949. The provisions for the closure of the landfill, ongoing monitoring and mitigation, are described in the management plan for the site ("Timaru District Council - Closed landfills Management Plan"). The main concern at Peel Forest is the potential for bank erosion, particularly as a new braid pattern developed next to the filled gully some time prior 2000. Timaru District Council has chosen to manage the risk through monitoring and investigation. Surface water from Rangitata River, both upstream and downstream of the Peel Forest Landfil, is to be monitoried for any adeverse effect, bl.

Investigations:

There are no investigations associated with this site.

Disclaimer

The enclosed information is derived from Environment Canterbury’s Listed Land Use Register and is made available to you under the Local Government Official Information and Meetings Act 1987.

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate assessment of the site. It is provided on the basis that Environment Canterbury makes no warranty or representation regarding the reliability, accuracy or completeness of the information provided or the level of contamination (if any) at the relevant site or that the site is suitable or otherwise for any particular purpose. Environment Canterbury accepts no responsibility for any loss, cost, damage or expense any person may incur as a result of the use, reference to or reliance on the information contained in this report.

Any person receiving and using this information is bound by the provisions of the Privacy Act 1993.

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Listed Land Use Register

What you need to know

Everything is connected

What is the Listed Land Use Register (LLUR)?

The LLUR is a database that Environment Canterbury uses to manage information about land that is, or has been, associated with the use, storage or disposal of hazardous substances.

Why do we need the LLUR?

Some activities and industries are hazardous and can potentially contaminate land or water. We need the LLUR to help us manage information about land which could pose a risk to your health and the environment because of its current or former land use.

Section 30 of the Resource Management Act (RMA, 1991) requires Environment Canterbury to investigate, identify and monitor contaminated land. To do this we follow national guidelines and use the LLUR to help us manage the information.

The information we collect also helps your local district or city council to fulfil its functions under the RMA. One of these is implementing the National Environmental Standard (NES) for Assessing and Managing Contaminants in Soil, which came into effect on 1 January 2012.

For information on the NES, contact your city or district council.

How does Environment Canterbury identify sites to be included on the LLUR?

We identify sites to be included on the LLUR based on a list of land uses produced by the Ministry for the Environment (MfE). This is called the Hazardous Activities and Industries List (HAIL)[1]. The HAIL has 53 different activities, and includes land uses such as fuel storage sites, orchards, timber treatment yards, landfills, sheep dips and any other activities where hazardous substances could cause land and water contamination.

We have two main ways of identifying HAIL sites:

- We are actively identifying sites in each district using historic records and aerial photographs. This project started in 2008 and is ongoing.
- We also receive information from other sources, such as environmental site investigation reports submitted to us as a requirement of the Regional Plan, and in resource consent applications.

[1] The Hazardous Activities and Industries List (HAIL) can be downloaded from MfE's website www.mfe.govt.nz, keyword search HAIL

How does Environment Canterbury classify sites on the LLUR?

Where we have identified a HAIL land use, we review all the available information, which may include investigation reports if we have them. We then assign the site a category on the LLUR. The category is intended to best describe what we know about the land use and potential contamination at the site and is signed off by a senior staff member.

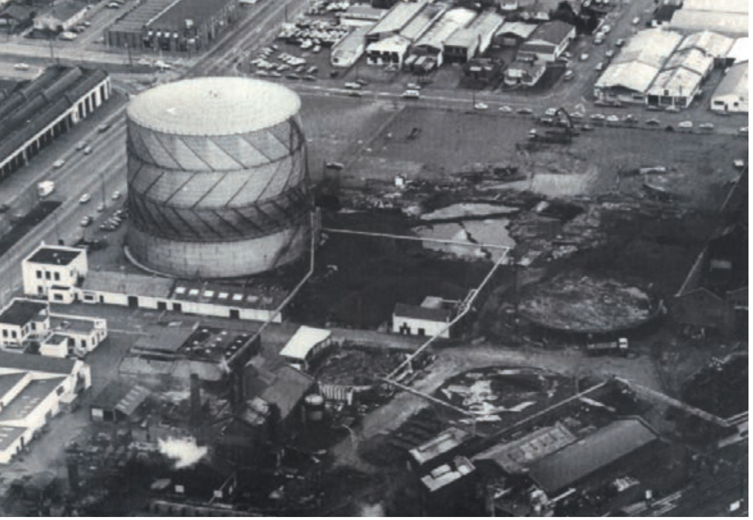
Please refer to the Site Categories and Definitions factsheet for further information.

What does Environment Canterbury do with the information on the LLUR?

The LLUR is available online at www.llur.ecan.govt.nz. We mainly receive enquiries from potential property buyers and environmental consultants or engineers working on sites. An inquirer would typically receive a summary of any information we hold, including the category assigned to the site and a list of any investigation reports.

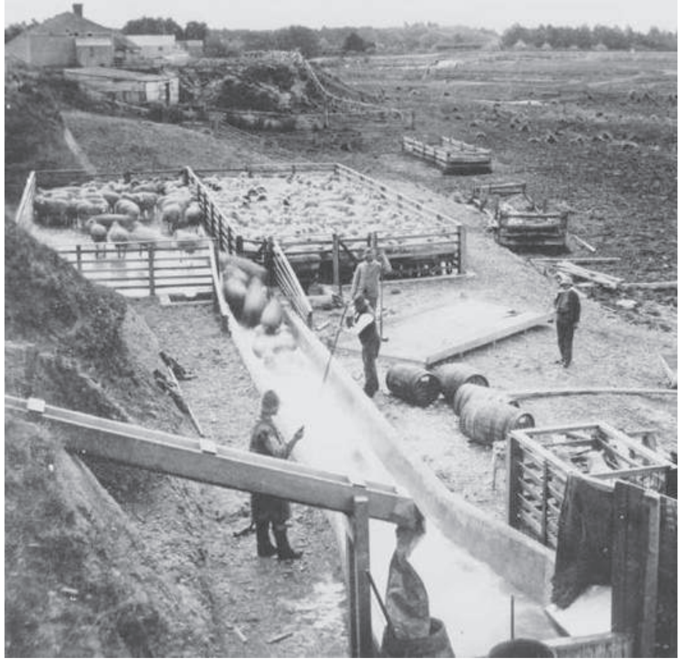
We may also use the information to prioritise sites for further investigation, remediation and management, to aid with planning, and to help assess resource consent applications. These are some of our other responsibilities under the RMA.

If you are conducting an environmental investigation or removing an underground storage tank at your property, you will need to comply with the rules in the Regional Plan and send us a copy of the report. This means we can keep our records accurate and up-to-date, and we can assign your property an appropriate category on the LLUR. To find out more, visit www.ecan.govt.nz/HAIL.



IMPORTANT!

The LLUR is an online database which we are continually updating. A property may not currently be registered on the LLUR, but this does not necessarily mean that it hasn't had a HAIL use in the past.



Sheep dipping (ABOVE) and gas works (TOP) are among the former land uses that have been identified as potentially hazardous. (Photo above by Wheeler & Son in 1987, courtesy of Canterbury Museum.)

My land is on the LLUR – what should I do now?

IMPORTANT! Just because your property has a land use that is deemed hazardous or is on the LLUR, it doesn't necessarily mean it's contaminated. The only way to know if land is contaminated is by carrying out a detailed site investigation, which involves collecting and testing soil samples.

You do not need to do anything if your land is on the LLUR and you have no plans to alter it in any way. It is important that you let a tenant or buyer know your land is on the Listed Land Use Register if you intend to rent or sell your property. If you are not sure what you need to tell the other party, you should seek legal advice.

You may choose to have your property further investigated for your own peace of mind, or because you want to do one of the activities covered by the National Environmental Standard for Assessing and Managing Contaminants in Soil. Your district or city council will provide further information.

If you wish to engage a suitably qualified experienced practitioner to undertake a detailed site investigation, there are criteria for choosing a practitioner on www.ecan.govt.nz/HAIL.

I think my site category is incorrect – how can I change it?

If you have an environmental investigation undertaken at your site, you must send us the report and we will review the LLUR category based on the information you provide. Similarly, if you have information that clearly shows your site has not been associated with HAIL activities (eg. a preliminary site investigation), or if other HAIL activities have occurred which we have not listed, we need to know about it so that our records are accurate.

If we have incorrectly identified that a HAIL activity has occurred at a site, it will be not be removed from the LLUR but categorised as Verified Non-HAIL. This helps us to ensure that the same site is not re-identified in the future.

Contact us

Property owners have the right to look at all the information Environment Canterbury holds about their properties.

It is free to check the information on the LLUR, online at www.llur.ecan.govt.nz.

If you don't have access to the internet, you can enquire about a specific site by phoning us on (03) 353 9007 or toll free on 0800 EC INFO (32 4636) during business hours.

Contact Environment Canterbury:

Email: ecinfo@ecan.govt.nz

Phone:
Calling from Christchurch: (03) 353 9007
Calling from any other area: 0800 EC INFO (32 4636)

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Everything is connected

Promoting quality of life through balanced resource management.

www.ecan.govt.nz E13/101

Listed Land Use Register

Site categories and definitions

When Environment Canterbury identifies a Hazardous Activities and Industries List (HAIL) land use, we review the available information and assign the site a category on the Listed Land Use Register. The category is intended to best describe what we know about the land use.

If a site is categorised as **Unverified** it means it has been reported or identified as one that appears on the HAIL, but the land use has not been confirmed with the property owner.

If the land use has been confirmed but analytical information from the collection of samples is not available, and the presence or absence of contamination has therefore not been determined, the site is registered as:

Not investigated:

- A site whose past or present use has been reported and verified as one that appears on the HAIL.
- The site has not been investigated, which might typically include sampling and analysis of site soil, water and/or ambient air, and assessment of the associated analytical data.
- There is insufficient information to characterise any risks to human health or the environment from those activities undertaken on the site. Contamination may have occurred, but should not be assumed to have occurred.

If analytical information from the collection of samples is available, the site can be registered in one of six ways:

At or below background concentrations:

The site has been investigated or remediated. The investigation or post remediation validation results confirm there are no hazardous substances above local background concentrations other than those that occur naturally in the area. The investigation or validation sampling has been sufficiently detailed to characterise the site.

Below guideline values for:

The site has been investigated. Results show that there are hazardous substances present at the site but indicate that any adverse effects or risks to people and/or the environment are considered to be so low as to be acceptable. The site may have been remediated to reduce contamination to this level, and samples taken after remediation confirm this.

Managed for:

The site has been investigated. Results show that there are hazardous substances present at the site in concentrations that have the potential to cause adverse effects or risks to people and/or the environment. However, those risks are considered managed because:

- the nature of the use of the site prevents human and/or ecological exposure to the risks; and/or
- the land has been altered in some way and/or restrictions have been placed on the way it is used which prevent human and/or ecological exposure to the risks.

Partially investigated:

The site has been partially investigated. Results:

- demonstrate there are hazardous substances present at the site; however, there is insufficient information to quantify any adverse effects or risks to people or the environment; or
- do not adequately verify the presence or absence of contamination associated with all HAIL activities that are and/or have been undertaken on the site.

Significant adverse environmental effects:

The site has been investigated. Results show that sediment, groundwater or surface water contains hazardous substances that:

- have significant adverse effects on the environment; or
- are reasonably likely to have significant adverse effects on the environment.

Contaminated:

The site has been investigated. Results show that the land has a hazardous substance in or on it that:

- has significant adverse effects on human health and/or the environment; and/or
- is reasonably likely to have significant adverse effects on human health and/or the environment.

If a site has been included incorrectly on the Listed Land Use Register as having a HAIL, it will not be removed but will be registered as:

Verified non-HAIL:

Information shows that this site has never been associated with any of the specific activities or industries on the HAIL.

Please contact Environment Canterbury for further information:

(03) 353 9007 or toll free
on 0800 EC INFO (32 4636)
email ecinfo@ecan.govt.nz

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Appendix C: Detailed Site Investigation

Peel Forest Closed Landfill – Detailed Site Investigation

Prepared for

Timaru District Council

September 2023

PATTLE DELAMORE PARTNERS LTD
Level 2, 134 Oxford Terrace
Christchurch Central, Christchurch 8011
PO Box 389, Christchurch 8140, New Zealand

Office +64 3 **345 7100**
Website **http://www.pdp.co.nz**
Auckland Tauranga **Hamilton** Wellington
Christchurch Invercargill

solutions for your environment

Quality Control Sheet

TITLE	Peel Forest Closed Landfill – Detailed Site Investigation
CLIENT	Timaru District Council
VERSION	Final
ISSUE DATE	29 September 2023
JOB REFERENCE	C02450100
SOURCE FILE(S)	C02450100R001.docx

DOCUMENT CONTRIBUTORS

Prepared by

SIGNATURE

Lucy Duffus

Reviewed by

SIGNATURE

Rowan Freeman

Approved by

Scott Wilson

Limitations:

This document has been prepared by Pattle Delamore Partners Limited (PDP) on the specific instructions of TDC for the limited purposes described in the document. PDP accepts no liability if the document is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

This document has been prepared by PDP on the basis of information provided by TDC and others (not directly contracted by PDP for the work), including but not limited to Environment Canterbury, Southern Geophysical and Christensen Consulting Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the document. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This document has been prepared based on a review of site history information, field data gathered by PDP and the results from laboratory analyses of up to 27 soil samples and seven bulk asbestos samples. The site conditions as described in this document have been interpreted from, and are subject to, this information and its limitations and accordingly PDP does not represent that its interpretation accurately represents the full site conditions.

The advice and opinions expressed in this document are based on the observation and sampling of a series test pits at the site. The geological and associated environmental conditions interpolated between the test holes are not guaranteed to be accurate.

The laboratory test results provide an approximation of the concentration of the tested analytes and are subject to the inherent limitations of the laboratory techniques used for the tests.

This assessment is limited to collection and analysis of soil samples from discrete sampling locations. Interpretations of subsurface conditions, including contaminant concentrations, are not guaranteed at distance away from the specific points of sampling.

If contaminants have been found at the site, it is possible that the contaminants could extend off-site, or that any contaminants existing on neighbouring sites might have contributed to the contamination that exists at the site. The presence or absence of contaminants off-site, and risks associated with any off-site contaminants, are not considered by this document.

The information contained within this document applies to sampling undertaken on the date stated in this document, or if none is stated, the date of this document. With time, the site conditions and environmental standards may change. Accordingly, the reported assessment and conclusions are not guaranteed to apply at a later date.

Executive Summary

Pattle Delamore Partners Limited (PDP) has been engaged by Timaru District Council (TDC) to undertake an investigation of the Peel Forest closed landfill located at the eastern end of Dennistoun Road, Peel Forest. The investigations have been undertaken between 2019 and 2023 in response to flood events in the Rangitata River causing instability and collapse of the 30 m high river terrace, resulting in landfill waste becoming exposed and released into the Rangitata Riverbed. This has been compounded by stormwater overland flow further eroding the face of the terrace exposing additional waste.

This report has been prepared to summarise the works undertaken to date to investigate the extent and nature of the landfill and any associated environmental effects. The findings of the investigations are to be used to inform the preparation of a remedial options assessment to identify the most suitable remedial strategy for the landfill.

The purpose of the investigation works was to:

- Assess readily available information about the landfill’s history;
- Determine the lateral and vertical extents of the landfill and estimate the volume of waste material in the landfill;
- Determine whether the landfill is generating landfill gas (LFG);
- Determine whether leachate generation within the landfill is having an effect on groundwater beneath the site;
- Characterise and understand the nature of the landfill waste (i.e., the physical composition of waste, and contaminant concentrations in soils that make up the landfill waste matrix); and
- Undertake a human health and environmental risk assessment for the landfill.

The site has been used as a municipal landfill from c.1962 to 2004 and received waste from the local and surrounding settlements. Historical aerial images from the 1960s suggest the areas of deep fill were originally at the head of the natural gully area, but over time waste was pushed into the gully from the main landfill area above. Since the landfill closure the site has been used for livestock grazing (i.e., horses up until 2020) but is now vacant.

During recent years the Rangitata River channel has migrated towards the west resulting in terrace toe erosion and resulting in exposure and loss of some waste, particularly within the gully area, to the Rangitata Riverbed. Erosion of the gully terrace edge has also been compounded by overland flow from the wider catchment, which is naturally being directed to the gully.

The erosion of the terrace has resulted in exposure of a surficial layer of waste within the gully area and some loss of this waste onto the riverbed. Interim remedial works have pulled the exposed waste back from the gully terrace edge and stabilised the gully area, however, some waste material still remains on the riverbed within the 'fall' debris zone. This debris is currently stabilising the terrace wall so has been left in place, but does contain some waste material (intermixed with natural soils) and could be quickly eroded during a flood event. Emergency interim remediation and stabilisation works have been undertaken to reduce the immediate threat of the potential loss of additional waste material, however, these are only temporary mitigative measures and could still be overcome by future flood/rainfall events.

A summary of the key information obtained during the investigation works is as follows:

- A geophysical survey of the landfill indicated the waste was up to 9 m deep within the filled gully area. The total volume of waste was estimated at 18,000 m^3 (in situ). This excludes the waste on the riverbed within the 'fall' debris.
- The groundwater table has been measured between 24.6 and 25.9 m below ground level (bgl) at the site indicating there is at least 15 m of natural soils between the base of the landfill and groundwater table. Groundwater sampling showed no definitive evidence of obvious leachate impacts in groundwater beneath the site.
- A series of test pits were excavated within and around the landfill to aid with the delineation and enable the waste to be characterised. A summary is as follows:
  - A thin cover layer (generally <0.1 m) was observed above the majority of the landfill.
  - The landfill was not lined, although there were areas of layers of low permeability soils, however, this is likely associated with disposal of material or interim cover as opposed to any direct engineering (i.e., lining) consideration.
  - Localised perched water was noted entering a test pit at 1.7 m depth. Installation of shallow bores within four of the test pits showed no evidence of any water/leachate when inspected approximately 1 week later.
  - The materials encountered can be divided into 'Cover' (either a thin layer of topsoil or discontinuous layer of sandy gravel); 'Waste Mixture' (a high proportion of anthropogenic waste in a soil matrix); 'Soil-Waste Mixture' (soil with some fragments of waste materials); and 'Visibly Clean Soils'. The proportion of soil in the landfill waste

varied between test locations but was the predominant fraction in all cases (between 54 and 91%). Soil therefore makes up a significant proportion of the landfill material.

- The waste types observed included **Timber** (including fence posts, branches, tree trunks, woodchip, sawdust), **Plastic** (including bale/silage wrap, food and drink containers, netting), **Metal** (including wire, vehicle parts), **Textiles** (including old clothing, rags and shoes, rope, netting), **Building materials** (concrete, brick, asbestos containing fibre cement sheet), and **Animal bones** (a few observed in each screened test hole). The dominant waste type (excluding soil) was plastic in most test pits (up to 76%), with high levels of timber (up to 46%) and metals (up to 25%) also observed.
- A metal vehicle fuel tank was observed in one location; however, no other large chemical containers were encountered.
- The surface Cover material showed concentrations below the residential/recreational guideline criteria (i.e., suitable for the current land use).
- The Waste Mixture and Soil-Waste Mixture material showed the highest concentrations of contaminants (as to be expected) with heavy metals, organochlorine pesticides and total petroleum hydrocarbons being recorded above background levels and ANZG (2018) default sediment guidelines.
- Heavy metals were recorded above the Redruth Landfill screening criteria with zinc also recorded above the TCLP leachability criteria. This appears to be an isolated occurrence with the majority of the samples showing acceptable concentrations for disposal at Redruth Landfill.
- Asbestos was detected within the Waste Mixture only at concentrations up to 0.01828% w/w and above the recreational land use criteria. Sampling did not necessarily show the presence of asbestos fibres in the soil matrix at all locations tested, however, ACM fragments were visually detected in the majority of the test pits suggesting asbestos was generally present throughout. Asbestos will therefore be the driver for controls around the handling and disposal of the waste/soils. Based on the results the works would be required to be undertaken under Class B controls under BRANZ (2017).
- Trial screening successfully segregated bulk waste material using a 25 mm screen, however, the sorting of the waste materials and finding a suitable reuse/recycling point may prove difficult given the waste was ‘dirty’ and would likely need to be cleaned. The potential for asbestos to be present on the items adds further complication for

  handling and disposal. Items such as large boulders or other smooth surfaces could be cleaned and reused onsite and would need to be considered during any remedial excavation works.

  - Sampling of the underlying natural soils was limited to three locations and did not include the deepest areas of fill. Results indicate that some degree of leaching has occurred, although does not appear to be widespread or significant and limited to <1 m below the waste. If an additional 1 m of soil was removed from beneath the waste, this would add an additional 5,000 m^3 to the total volume of material to be excavated.

- LFG monitoring with the shallow test pit bores showed generally low levels of LFG and no flow rate (pressure). The monitoring bores away from the landfill showed no methane, however, carbon dioxide was recorded up to 4.0%. The low-level readings are not unexpected given the age of the landfill and support the observations of minimal organic material in the waste.

Based on the results of the soil sampling, the Waste Mixture would need to be disposed of at a landfill authorised to receive this level of contaminated soils as “special waste”. Options for off-site disposal could include Redruth Landfill and Hororata Managed fill, subject to the approval of the operator. Screening the material to separate larger waste materials from the soil matrix would provide the option to dispose of these two fractions separately, however, given the presence of asbestos this may prove to be difficult and not cost effective. Some items such as larger boulders and cobbles may however be separated, cleaned and retained on site, provided this remedial process can be validated.

A risk assessment for the landfill in its current state shows that the risks to human health and the environment is either incomplete or considered to be currently low. This is because the site is currently unused and is likely to remain so in the near to distant future, a cover (albeit thin) manages the current risk of contaminants in the waste, there is no appreciable LFG generation and leachate does not appear to be significantly affecting groundwater quality beneath the site. The risk of future landfill disturbance could be mitigated through the development of a Remedial Action Plan and improved surface cover to manage long term risks or for other land use activities to be undertaken on site. However, the current risk assessment assumes that the landfill will remain in its current state. The vulnerability of the landfill to erosion means that this is unlikely and the potential for landfill waste exposure as a result of future rainfall/flood events is high and cannot be reliably predicted. Depending on the severity of the rainfall/flood event, this could have catastrophic effects to human health and environmental receptors if the main body of the landfill is exposed and falls into the river. The vulnerability of the landfill to erosion is therefore the driver to mitigating the risks identified for this landfill.

With regard to the NESCS, resource consent under a restricted discretionary status will be required from TDC for any disturbance activities that exceed the permitted activity thresholds. Resource consents will also likely be required depending on the remedial strategy selected.

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Appendices

Acronyms

ACM	Asbestos containing material
bgl	below ground level
DDT	Dichlorodiphenyltrichloroethane (an insecticide used in agriculture)
DSI	Detailed Site Investigation
ECan	Environment Canterbury
ERT	Electrical Resistivity Tomography
GME	Groundwater monitoring event
GPR	Ground penetrating radar
HAIL	Hazardous Activities and Industries List
LEL	Lower explosive limit
LFG	Landfill gas
LLUR	Listed Land Use Register
LWRP	Land and Water Regional Plan
MfE	Ministry for the Environment
OCP	Organochlorine pesticides
PACM	Presumed asbestos containing material
PAH	Polycyclic aromatic hydrocarbons
PDP	Pattle Delamore Partners
PPE	Personal protective equipment
NESCS	*Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011*
RAP	Remedial Action Plan
SQEP	Suitably Qualified and Experienced Practitioner
SVOC	Semi-volatile organic compounds
TCLP	Toxicity Characteristic Leachate Procedure
TDC	Timaru District Council
TOC	Top of casing
TPH	Total petroleum hydrocarbons
UEL	Upper explosive limit
VOC	volatile organic compounds

1.0 Introduction

Pattle Delamore Partners Limited (PDP) has been engaged by Timaru District Council (TDC) to undertake a review of the site history (i.e. preliminary site investigation; PSI) and intrusive investigation works (detailed site investigation; DSI) for the Peel Forest closed landfill (sometimes referred to as the Dennistoun Road Landfill) located at the eastern end of Dennistoun Road, Peel Forest (i.e., 'the site' or 'the landfill'). The investigations have been undertaken over a period of four years in response to flood events in the Rangitata River causing instability and collapse of the 30 m high river terrace, resulting in landfill waste becoming exposed and released into the Rangitata Riverbed. This has been compounded by stormwater overland flow further eroding the face of the terrace exposing additional waste.

Emergency interim remediation and stabilisation works have been undertaken to reduce the immediate threat of the potential loss of additional waste material, however, these are only temporary mitigative measures and could still be overcome by future flood/rainfall events. This report has been prepared to summarise the works undertaken to date to investigate the extent and nature of the landfill and any associated environmental effects. The findings of the investigations are to be used to inform the preparation of a remedial options assessment to identify the most suitable remedial option for the landfill, and subsequently, the requirements for the management and/or off-site disposal of landfill materials (including consideration for protection of human health), as well as providing supporting documentation for any resource consenting process.

The location of the landfill, key features on-site, and the immediate surroundings are shown in Figure 1, Appendix A.

This report has focused on the landfill, its extents, nature, types of waste and contamination status, and any associated environmental effects. This report does not technically assess the geotechnical stability of the landfill or describe the remedial works undertaken in the gully area or in the Rangitata River as a means for flood protection, however, its vulnerability to erosion is discussed to provide context.

1.1 Purpose and Objectives

1.1.1 Purpose

The purpose of the investigation works was to:

- Assess readily available information about the landfill's history;
- Determine the lateral and vertical extents of the landfill and estimate the volume of waste material in the landfill;
- Determine whether the landfill is generating landfill gas (LFG);
- Determine whether leachate generation within the landfill is having an effect on groundwater beneath the site;

- Characterise and understand the nature of the landfill waste (i.e., the physical composition of waste, and contaminant concentrations in soils that make up the landfill waste matrix); and
- Undertake a human health and environmental risk assessment for the landfill.

1.1.2 Objectives

The following objectives were developed to address the purpose of the investigation:

- Undertake investigation works to delineate the landfill extents to determine the volume of landfill waste;
- Determine the contamination status of the soil forming the matrix around landfill materials (i.e., anthropogenic waste) to support waste disposal options and understand what health and safety and environmental controls will be needed during any future site remedial works that disturb landfill waste;
- Identify the types, state, and proportions (i.e., volume) of waste materials and soils present in the landfill to determine if segregation of anthropogenic material from soil is feasible;
- Evaluate the landfill for evidence of leachate, contamination sources (e.g., chemical containers, asbestos, etc.), LFG and moisture content to support the development of a suitable methodology for remediation;
- Assess the applicability of the NESCS[1] in relation to future disturbance of the landfill as part of any future remedial works at the landfill;
- Provide an assessment of the current environmental effects associated with the landfill;
- Provide a preliminary assessment for the potential risk from landfill contamination to remedial excavation and oversight workers during future remedial works (including consideration for site neighbours); and
- Provide an initial assessment of potential offsite disposal options for landfill waste and associated contaminated soils or materials generated during future remediation of the landfill.

This assessment has been carried out in accordance with Contaminated Land Management Guidelines No. 1: Reporting on Contaminated Sites in New Zealand (Revised 2021) (MfE, 2021) and Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils (Revised 2021) (MfE, 2021a). The investigation has been certified by suitably qualified and experienced practitioners (SQEP) as outlined by the NESCS. A certifying statement to this effect is attached at the end of this letter report.

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[1] *Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011*.

The purpose and objectives highlighted above were achieved through the review of historical information about the landfill and from undertaking site investigations works to understand the environmental conditions at the site as well as the nature and extent of waste and contamination status.

1.2 Background Information and Summary of Interim Landfill Remedial Works

Over the past four years, flood events in the Rangitata River have caused significant erosion of the toe of the 30 m high river terrace along the eastern boundary of the landfill. This has caused terrace instability and collapse, resulting in landfill waste at the terrace edge of a gully section becoming exposed and released into the Rangitata Riverbed. The most significant flood flow event of the past several years occurred in early December 2019 with a 1 in 20-year event generating 2,300 m^3/s (cumecs), but other events in July/August 2022 also resulted in further erosion. The combination of flood flow events has undermined and eroded the river terrace adjacent to the landfill resulting in the loss of approximately 10-15 m of toe to the river terrace. Fluvial action and the natural inclination of the river terrace to find a natural angle of repose has caused the crest line of the previously near vertical river terrace to progressively recede toward the landfill. In addition, overland water flow from the wider catchment down the gully section and over the terrace edge into the Rangitata River has also resulted in erosion of the terrace edge. The gully is a natural feature where overland flow from the wider catchment is directed.

As a result of the flooding effects and overland flow erosion, surficial waste exposed at the terrace edge was lost into the riverbed. This was primarily along the face of the gully area, however, also included other discrete areas along the terrace where historically waste was tipped over the existing river terrace at the time and had been caught up in the vegetated slopes, which slipped into the river during the July/August flood events. The responses to flood and overland flow impacts on the landfill have included emergency remediation works, river protection/engineering, and supplemental supporting field activities to investigate the landfill.

River engineering works have been coordinated through engagement of an independent river engineering consultant (Christensen Consulting Limited), and these efforts to date (October to November 2021, and October to November 2022), have focused on establishment of interim physical controls (i.e., erosion protection, channel diversion, embankments). These works have not been detailed any further in this report as it focuses on the landfill, but were completed under the existing resource consents used by ECan for river engineering works and in support of ECan.

Emergency interim remediation and terrace stabilisation works of the landfill area (e.g., December 2019 – January 2020, and December 2022 – January 2023) have been coordinated by PDP and have primarily focused on the gully and has involved pulling back exposed waste from the gully edge and stabilising the gully surface. These are discussed in more detail in Sections 1.2.2 and 1.2.4 below.

The overall intent of emergency interim remediation and stabilisation, and river engineering works, was to reduce the immediate threat of the potential loss of the main body of the landfill (i.e., during future river flood flow events) before a long-term remedial solution can be applied. The physical mitigative measures undertaken to date are however considered temporary and are likely to be overcome by natural fluvial processes in future (e.g., resulting from high rainfall/river flow events) or mass ground movement/slippage (e.g., caused by moisture laden unstable ground or earthquake).

A summary of key inspections and remedial works of the landfill is outlined in the following sections.

1.2.1 Initial Landfill Inspection (19 December 2019)

On 19 December 2019 just after the initial erosion event, a PDP engineering geologist visited the site to make observations of the failure and provide interim remedial options to limit further exposure and release of landfill materials until a longer-term solution can be implemented. It was observed that minimal landfill materials were within the Rangitata Riverbed. Some hand picking of visible waste materials was completed however this was limited due to the risk posed by the instability of the adjacent river terrace.

The failure of the terrace face was considered to be a result of erosion at the toe of the terrace by high river flow rates in the Rangitata River, which also resulted in secondary minor failures of the overlying landfill. The terrace face was damp at the base of the adjoining gully, indicating that water may be entering the landfill from overland flow further upgradient.

The recovered waste materials comprised of plastic, rusted metal, bovine bone (decomposed), food wrappers, engine parts, rubber, and glass. The waste appeared to be limited to the overlying soils and was not encountered within the eroded gravel mass.

The visible landfill mass was restricted to the upper 0.5 m of the river terrace (i.e., a veneer over the terrace) at the then point of failure (within the gully).

1.2.2 Stage 1 Gully Remediation (23 December 2019)

The first of the emergency remediation work on the landfill was undertaken on 23 December 2019 to address exposed landfill waste in the gully area of the landfill (caused by the 1 in 20-year flood) until a more permanent solution could be implemented. These works comprised the pulling back of some of the rubbish approximately 5 m within the surficial soil layer (0.5 m depth) from the edge of the gully and picking up the loose rubbish that had fallen down on to the riverbed (where possible). The pulled back landfill waste was retained on site within the gully and covered by bidim cloth.

1.2.3 Rangitata Riverbed Inspection (September 2022)

Following the July/August 2022 Flood events when more erosion and exposure of waste occurred, PDP completed an inspection of an approximately 500 m section of dry riverbed on the western side of the Rangitata River from an access point off Ferry Road, located approximately 4 km downstream of the Dennistoun Road landfill site on 20 September 2022. Figure 3 (Appendix A) shows the location of the inspection. The aim of the inspection was to identify and collect any waste materials along a section of the river to gain an understanding of whether the recent erosion/slips around the closed landfill may have caused waste material to enter the river and whether a 'waste pick' was warranted. Access directly downstream of the landfill area was not possible at the time. The area selected was easily accessible and was expected to provide a typical representation of the riverbed.

Waste materials were observed in the section of river inspected, primarily tangled with vegetative debris. It included plastic wrapping and container pieces, food packaging, plastic bottles, polystyrene fragments and the back of an old TV. Of note there was no silage wrapping which was the predominant waste material observed on the exposed face. The materials observed are typical with fly tipping and the dates on a couple of pieces suggested they were manufactured in 2011 and 2013 indicating that the material observed may have resulted from other fly tipping activities. There was no conclusive evidence to link the waste material observed during the inspection with the landfill. The volume of material collected did not warrant a dedicated 'waste pick' event.

1.2.4 Stage 2 Emergency Remediation Work (December 2022-January 2023)

During the July/August 2022 flood events, additional erosion of the river terrace occurred. This primarily occurred at the bottom of the river terrace with only minor loss of the top, however, the slope of the terrace has steepened significantly and will likely continue to erode to its natural angle of repose overtime. In addition to the river erosion, significant rainfall in the catchment resulted in high overland flows down through the gully area resulting in erosion of the ground surface and erosion of the gully river terrace edge (an estimated 6-8 m of river terrace edge in the gully was eroded). These events resulted in additional waste being exposed and an unknown volume of landfill waste being discharged into the Rangitata Riverbed. The previously constructed embankment protecting the toe of the gully river terrace retained the waste material that fell in this area, and this was not lost down the river (and still remains at the time of writing this report), however, other waste material that had been historically tipped directly over terrace edge was lost and taken away by the flood flows (as shown and described in Figure 5).

Under emergency provisions, PDP was engaged by TDC in November 2022 to prepare and implement an Emergency Works Remedial Action Plan to address exposed landfill waste in the lower gully area. The emergency remediation works was comprised of the following:

- Removal of exposed landfill waste from the edge of the gully area, pulling back waste from the edge and off-site disposal of 940 tonnes of general municipal waste intermixed with soil. This included removal of the previously stockpiled waste material beneath the bidim. Observed waste, shown in photograph 3, Appendix B, includes plastic wrapping, timber, metal, glass, vehicle parts and asbestos containing materials (ACM; i.e., fragments of fibre cement sheet and one fragment of an ACM pipe).
- Armouring of the lower gully area face and terrace edge with boulders following the removal of the waste. BioCoir coconut matting was installed across the full gully slope and seeded with a ryegrass and clover pasture mix to aid in the revegetation of the site and act as erosion protection.
- Redirection of stormwater from heavy rainfall events through sealed conveyance over the gully area (via the installation of a culvert pipe with attached Flexiflume lay flat piping) to reduce the likelihood of rapid gully erosion. See Figure 1 aerial image and in photographs 4 and 6 (Appendices A and B respectively).
- The waste material that had fallen onto the riverbed behind the constructed embankment was not removed as this was intermixed with large quantities of soil which had formed a natural angle of repose stabilising the terrace edge at this point. It was decided that disturbance/removal of this material could result in additional erosion of the terrace (refer to Figure 5 showing the area of waste left on the riverbed).

The remedial works were undertaken with controls to manage the risk associated with likely contaminants and hazardous substances that may have been encountered. This included assuming the presence of asbestos in the waste. Over the period of the gully interim remedial works, a total of nine days of asbestos fibre air monitoring was undertaken. All air monitoring results showed that airborne fibre levels were recorded at <0.01 f/mL, which is below the trace limit of 0.01 f/mL and shows the dust suppression methods applied were sufficient.

These emergency remedial earthworks are only temporary and are not intended as a permanent long-term solution. Regular inspection/monitoring (i.e., following large rainfall and/or flood events) of the site is being undertaken to identify any areas of risk or concern until a permanent solution can be implemented.

2.0 Site Details and Physical Setting

2.1 Site Details

The site details are presented in Table 1 below while a plan showing the location is presented in Figure 1, Appendix A. General photographs of the site taken during the PDP investigation are also presented in Appendix B.

Table 1: Site Details	
Address	Eastern end of Dennistoun Road, Timaru
Legal Description	Crown Land (under action) Survey Office Plan 3144
Owner	Land Information New Zealand (LINZ)
Lessee	Timaru District Council
Other Interested Parties	Arowhenua Rūnanga, Aoraki Environmental Consultancy, Environment Canterbury (ECan), Department of Conservation (DOC), Peel Forest Community, Rangitata River Restoration Group
Landfill Area	Approx. 5,025 m^2 (5 ha)
Zoning	Rural Zone
Territorial Authority	Timaru District Council
Grid Reference	BY19: 6115-3626
Land Use	Vacant, level grassed paddock previously used for grazing.
Surrounding Land Use	Rural Residential – Rural dwelling are located to the north of the site and Dennistoun Road with a livestock grazing paddock located to the west and south. The Rangitata Riverbed bounds the site to the east.

2.2 Site Description

The surface of the landfill is currently a vacant grassed paddock with a vegetated gully sloping down to the Rangitata River. The site is comprised of ‘the main landfill area’ which is 3,420 m^2 and ‘the gully area’ which is 1,605 m^2. The main landfill area has hummocky terrain and occasional pieces of anthropogenic waste are partially exposed (i.e., concrete, tyres, etc). The majority of the site is fenced, with restricted access in place. A vehicle turning circle is located adjacent to this at the eastern end of Dennistoun Road.

A rural lifestyle residential property, with an access track to the Rangitata Riverbed, is located to the north of the landfill and livestock grazing paddocks are located to the west and south. The Rangitata Riverbed is located immediately east and south of the landfill, below a 30 m high terrace (i.e., relative to the main landfill surface).

Two drains are present on site crossing the northern and western boundaries and directing overland flow over the terrace edge and down the gully respectively during stormwater events. The northern drain has recently been blocked off during remedial works to protect the north eastern terrace edge from further erosion. The western boundary drain remains in place, but is directed to a Flexiflume lay flat pipe to protect the gully from further erosion. This drain receives overland flow from the wider catchment area as the gully is a natural feature that overland flow is directed towards and is likely why the gully was originally formed.

The physical setting of the landfill is presented under Section 2.3.

2.3 Physical Setting

The geological map for the area (Cox and Barrell, 2007; 1:250,000) reports that the site is underlain by Late Pleistocene 'light brownish grey river gravel, sand and silt within abandoned outwash plains or low to mid-level terraces'.

The topography of much of the main landfill area is hummocky. The gully area slopes down from the main landfill area at an angle of approximately 22 degrees.

The site is not located within a Community Drinking Water Protection Zone.

The nearest surface water body to the site is the Rangitata River, located immediately east of the site and flowing towards the south east.

The regional groundwater flow direction is expected to be towards the Rangitata River. Groundwater level has been measured between 24.6 and 25.9 m bgl at the site (measured at bores installed in June 2022 close to the terrace edge) and has been observed seeping from the walls of the river terrace (30 m high).

According to the ECan GIS database, there are no groundwater bores within the site boundary or within a 500 m radius of the site, however there is a record of one bore, approximately 500 m west of the site that is recorded as 'Not Drilled'.

3.0 Desktop Review of Site History

A desktop assessment was undertaken to provide an overview of any potential contaminants of concern that may be present at the site as a result of any documented past and present activities. The following readily available information was sourced to establish the history of the site:

- Historical aerial photographs
- ECan information
- TDC information

3.1 Historical Aerial Photographs

Historical aerial photographs of the site from between 1938 and 2020 have been reviewed. These photographs have been sourced from Canterbury Map Partners, administered by ECan, Retrolens, Google Earth Pro and recent drone surveys. The historical aerial photographs reviewed are presented in Appendix C while a summary is provided in Table 2 below. Note that the review of the aerial photographs was carried out on the electronic versions, which provides a higher resolution compared with the printed versions appended.

Table 2: Historical Aerial Photograph Review

1938	The site comprises an undeveloped paddock with a vegetation lined gully located in the south. A faint track can be seen in the current Dennistoun Road footprint. Undeveloped paddocks continue west of the site with a small stream flowing generally north to south approximately 270 m west of the site. A vegetated terrace slope bounds the site to the east with the Rangitata River beyond it. The width between the top of terrace to the true right river bank is approximately 70 m.
1962	A vehicle track is clearly visible in the location of Dennistoun Road with the small stream crossing it. The site itself and the area to the north are more densely vegetated than the previous image. There is some evidence of soil disturbance/filling towards the north western corner of the site. The width between the top of terrace to true right river bank is approximately 60 m. No significant changes are observed in the surrounding area, except that the main Rangitata River flow path has migrated towards the east.
1984	Landfilling activities are evident in the northern portion of the site with an oval shaped pit/mound visible in the central area circled by vehicle tracks. Surficial dumping appears to be occurring over the terrace edge in the east. Within the surrounding area, a track has been formed north of the site which leads down to the base of the terrace. No other significant changes are evident.
1987	Landfilling has progressed southwards and vegetation has been cleared from much of the site, excluding the south east section of the gully. Rubbish from the tipping head of the landfill appears to be entering the northern extent of the gully. Dennistoun Road appears to have been upgraded, with the stream that crosses it now redirected beneath it.
1995	Landfilling has progressed further east and south east. The width between the top of terrace to true right river bank is approximately 30 m following the migration of the main Rangitata River flow channel back towards the west. The gully area is heavily vegetated.
2001, 2004	Ground disturbance due to landfilling activities is still evident across the site with the top of the gully now having been filled in addition to the wider site. The base of the gully and the bank/terrace to the south has been eroded out by the Rangitata River. The location of the Rangitata River flow channel is generally similar to 1995. No significant changes are visible in the surrounding area.

Table 2: Historical Aerial Photograph Review

2012, 2018, 2019	The site has been levelled and formed a grassed paddock. The gully in the south is vegetated with gorse and a couple of mature trees. A dwelling has been constructed immediately north of the site (2012). No other significant changes are evident.
2020	This image may have been taken following a flood event based on the turbidity of the river. The edge of the terrace appears to be recently eroded back into the gully and towards the main body of the landfill. The width between the top of terrace to true right river bank is approximately 10 m following further erosion by the Rangitata River. A garage/shed has been constructed north of the site and is associated with the dwelling.
2021	The central portion of the gully has been cleared of vegetation, otherwise no significant changes are evident in the site or surrounding area. The edges of the terrace top, base and the Rangitata River channel have been traced onto this image for comparison with the 2022 aerial photograph.
2022	The gully has revegetated following the 2021 image. A comparison of the terrace and channel edgelines between the 2021 and 2022 aerial photographs clearly show migration of the river channel towards the west and terrace edge regression – particularly towards the northern section of the site and at the south eastern edge of the gully.

3.2 Environment Canterbury Information

The LLUR is used to hold information about sites that have used, stored or disposed of hazardous substances, based on activities detailed on MfE's (2023) HAIL. The LLUR is not complete and new sites are regularly being added as ECan receives information and conduct their own investigations into current and historical land uses.

The site is listed on the LLUR as a HAIL site (Site ID 274) relating to 'landfill sites' (HAIL Reference G3). Information obtained from the LLUR is summarised below:

- Landfilling occurred from the 1960s to 2002;
- A note from 2005 states the fill volume is approximately 20,000 m^3 comprising domestic refuse 5 m thick. The landfill area is 0.4 hectares, located in an old gully draining into the Rangitata River;
- A note from 2006 states discharge of landfill leachate to ground is managed by ECan consent CRC950949 and a management plan exists for the site (Timaru District Council – Closed Landfill Management Plan). TDC elected to manage the risk of bank erosion through monitoring and investigation. Surface

water monitoring of the Rangitata River surface water monitoring for any adverse effects is part of the monitoring measures; and

- The LLUR categorises the site as 'Not Investigated'.

A copy of the LLUR statement is presented in Appendix D.

3.3 Timaru District Council Information

TDC has provided the following information about the Peel Forest landfill:

- The Peel Forest landfill operated from 1962 until 2004, when the Council formally closed it as a landfill.
- The topography of the area directs surface runoff over the landfill through the gully to the Rangitata River, 30 m below the top of the terrace. Interim remedial works have since redirected stormwater through sealed conveyance over the gully area.
- Council was made aware of the potential erosion risk of this landfill due to a new braiding pattern of the river in June 2000. At the time TDC chose to manage the risk through monitoring and investigation. No signs of any leachate impacts have been recorded in the Rangitata River, however, this is not unexpected give the dilution potential in the river. The greatest risk to the landfill was identified as erosion caused by flooding.
- Council has monitored the closed landfill site since 2010 through site visits, photos and monitoring the surface water in the Rangitata River for contaminants coming from any leachate of the landfill. The only reported contamination has been observations of exposed waste in the central and northern area of the landfill site which was grassed and used to graze horses up until c.2020. In addition, waste was also occasionally observed to have fallen from the gully area.
- In 2019, a monitoring report noted that changes made to roading and stormwater management by the Land Transport Unit (LTU) resulted in increased stormwater runoff over the gully area, and LTU was notified.
- On 9 December 2019, the Rangitata River experienced a one in 1 in 20-year flooding event, creating a flow of 2,300 m^3/s which resulted in erosion of the toe of the terrace and the failure of the cliff face exposing landfill waste along the gully edge river terrace. A test pitting investigation identified that the edge of the eroding terrace was still approximately 10 m from the primary landfill area (>5 m deep waste). The waste exposed was within the surficial layer only and appears to be what had rolled/blow down the gully. The main body of the landfill had not been exposed.
- Preliminary works were undertaken in December 2019 to pull back some of the rubbish within the surficial soil layer (0.5 m depth) from the edge of the gully and picking up the loose rubbish that had fallen down on to the riverbed.

In addition, an inspection of the downgradient Rangitata riverbed for evidence of waste was completed in September 2022 following July/August flood events.

A second phase of interim remedial works was completed in the gully in December/January 2022 to remove more waste material from the gully edge, stabilise the remaining soils and redirect stormwater through sealed conveyance to reduce the impact of overland stormwater flow down the gully area.

- Complaints have been made to TDC from the neighbouring site owners and the department of Conservation (DOC) in relation to the presence of loose waste debris observed to have fallen to the riverbed and concerns about the release of larger volumes of rubbish into the Rangitata River.

4.0 Summary of Site History and Potential Sources of Contamination

The reviewed information shows that the site was been used as a municipal landfill from c.1962 to 2004 and received waste from the local and surrounding settlements. The site is currently recorded on ECan's LLUR under HAIL category G3. No other HAIL activities are reported on or immediately adjacent to the site.

Historical aerial images from the 1960s suggest the areas of deep fill were originally at the head of the natural gully area (refer to Figure 2, Appendix A). Waste present within the gully area appears to have accumulated as a result of waste being habitually pushed over into it from the main landfill area above. Since the landfill closure the site has been used for livestock grazing (i.e., horses up until 2020) but is now vacant. During recent years the Rangitata River channel has migrated towards the west resulting in terrace toe erosion and resulting in exposure and loss of some waste, particularly within the gully area, to the Rangitata Riverbed. Erosion of the gully terrace edge has also been compounded by overland flow from the wider catchment, which is naturally being directed to the gully.

The erosion of the terrace has resulted in exposure of a surficial layer of waste within the gully area and some loss of this waste onto the riverbed. Interim remedial works have pulled the exposed waste back from the gully terrace edge and gully area stabilised, however, some waste material still remains on the riverbed within the 'fall' debris zone. This debris is currently stabilising the terrace wall so has been left in place, but does contain some waste material (intermixed with natural soils) and could be quickly eroded during a flood event.

Emergency river engineering works to redirect the river and the construction of an embankment have been completed to reduce the immediate threat of the potential loss of the main body of the landfill during future river flood flow events. However, these are considered temporary and are likely to be overcome by natural fluvial processes in future. The potential for future erosion of the terrace and further exposure of the landfill waste still exists, including a catastrophic event where the main body of the landfill is exposed and large volumes of waste are released into the river.

The potential contamination sources from a landfill can be divided into three categories:

- The Waste

  Landfills can accept a wide variety of waste types from varying locations. The potential for contamination depends on the physical and chemical properties of waste materials accepted, as well as the potential for the landfill to have accepted hazardous substances.

  Based on its rural location, we would typically expect the waste to comprise various municipal, demolition, agricultural, organics and miscellaneous wastes (e.g., whiteware, machinery, vehicle parts, etc.). Contaminants of concern associated with these materials include heavy metals, persistent pesticides, petroleum hydrocarbons and asbestos.

- Landfill Gas (LFG)

  Municipal landfills produce appreciable amounts of gas within 1 to 3 years of placement of waste material, with peak gas production occurring around 5 to 10 years. The majority of LFG is produced within 20 years after waste is disposed of, however, small quantities of gas may continue to be emitted from a landfill for 50 or more years. Different portions of the landfill might be in different phases of the decomposition process at the same time, depending on when the waste was originally placed in each area.

  It has been close to 20 years since the landfill was closed, meaning the landfill should be nearing the end of the LFG production cycle. LFG migration occurs as the gases fill and move through the available pore spaces and will follow the path of least resistance. The natural tendency of LFG that are lighter than air, such as methane, is to move upward. It is only when the upward movement of LFG is inhibited by densely compacted waste or landfill cover material (e.g., by daily soil cover) that the gas tends to migrate horizontally.

  Potentially harmful gases include methane (CH_4), carbon dioxide (CO_2), carbon monoxide (CO) and hydrogen sulphide (H_2S). Methane may form an explosive mixture when it is combined with air in certain proportions. At room temperature, methane is explosive between its lower explosive limit (LEL) of 5% by volume and its upper explosive limit (UEL) of 15% by volume. Within a landfill, the concentration of methane is typically higher than the UEL and oxygen (O_2) levels are insufficient to form an explosive mixture. As methane migrates away from a source zone, or mixes with air within a building, it may form an explosive gas level. If the concentration of methane is below the LEL, then there is no explosion risk.

  Other compounds such as carbon dioxide, carbon monoxide (CO) and low oxygen concentrations can present an asphyxiation hazard if these gases accumulate within a confined space, such as a building or in a pit. If present in high enough concentrations hydrogen sulphide (H_2S) and volatile organic compounds (VOCs) may also be toxic in confined spaces and pose a hazard to building occupants.

- Leachate

  Conceptually, leachate forms via decomposition of putrescible and organic fractions of landfill material which are transported by water percolating through the waste profile (e.g., rainfall, snow melt or groundwater) or will form when waste is placed in saturated conditions.

  The resulting leachate is a blend of highly contaminated and toxic liquid substances which could result in harmful effects on flora and fauna of a receiving environment. Leachate often contains a range of organic and inorganic contaminants and nutrients, including but not limited to heavy metals, hydrocarbons, nutrients, etc.

The remainder of this report describes the investigation works that have been undertaken to inform the development of a remedial options assessment to identify the most suitable remedial option for the landfill to mitigate the current risk of landfill waste entering the Rangitata River system.

5.0 Site Investigation Works

A number of site investigation activities have been undertaken at the site since the original exposure of the landfill waste in 2019 to better understand the extent and nature of the landfill and whether there are any current human health or environmental effects. The investigation works have also been undertaken to inform a remedial options assessment report and support resource consenting processes.

A timeline of the landfill investigations undertaken since 2019 is outlined below:

- Preliminary test pitting – December 2019
- Geophysical investigation – February 2021
- Groundwater monitoring bore installation (May-June 2022)
- Groundwater monitoring bore sampling (August 2022 and January 2023)
- Landfill waste characterisation (January 2023)
- LFG monitoring (August 2022 and January 2023)

The following sections provide a summary of the investigations undertaken.

5.1 Preliminary Test Pitting (December 2019)

A PDP engineer and TDC representative supervised the excavation of eight test pits (TP3 to TP10; Figure 1, Appendix A) across the landfill area on 23 December 2019. These works were undertaken soon after the original landfill exposure event at the same time as the emergency remedial works to pull back the waste from the eroding river terrace were being completed (refer Section 1.2). The aim of the test pitting was to gain an initial understanding of the types of waste present, confirm the thickness and type of any landfill cap, and how close the main landfill body of waste was to the river terrace. This was a visual investigation only and no soil sampling was completed.

Negligible cover material was encountered across the landfill with waste material encountered within 0.1 m below the surficial topsoil/grass cover. Waste material was also observed protruding from the surface in some areas. The landfill waste was bottomed at TP3 at the lower end of the gully at 1.5 m bgl; and at the east and north of the main landfill in TP5, TP9 and TP10 at depths between 0.3 m and 2.3 m bgl. Landfill waste was not encountered in TP4, excavated in the far east of the site indicating there was at least 10 m between the main body of landfill waste and the river terrace. The basement of landfill waste was not achieved in TP6, TP7 or TP8, which were excavated to between 2 m and 3.5 m bgl. Care was taken to not advance the test pits too deep in case a confining layer or liner was present.

The waste material observed comprised typical landfill waste including domestic rubbish, plastics, metal, and wood. Railway irons were encountered together with old household appliances and car parts. Within the gully area large volumes of silage wrap was encountered. The waste material was considered typical for a landfill servicing a small rural community. The soil matrix within the waste varied between sampling locations. A homogenous silty clay soil was observed within a number of the test pits beneath the landfill waste at depth of around 3 m bgl. It was unknown if this was intentionally placed as part of any landfill construction process. Perched water was observed in one location (TP7) where the silty clay material was observed.

5.2 Geophysical Investigation (February 2021)

Although there was some indication of the extent and location of the placement of the landfill waste through the review of the historical aerial photos, a geophysical survey was undertaken to provide more certainty of the extent and depth of waste. Geophysical surveys are ideal for this as they are non-intrusive reducing the need to advance large numbers of test pits in the waste potentially penetrating any confining/lining layers.

Southern Geophysical completed a series of geophysical investigations at the site on 21 January 2021 to characterise the vertical and lateral extents of landfill waste. Four complementary geophysical methods were used to define the boundary between the undisturbed natural soils and the landfill body. The geophysical methods undertaken at the landfill site were Ground Penetrating Radar (GPR), Electrical Resistivity Tomography (ERT), ground conductivity (EM31), and metal detection (EM61).

The approximate extents of the landfill deposits and location of ferrous metal objects were visible within the EM31 and EM61 (refer to attached Figures in Appendix E). GPR surveying delineated the extents of the landfill deposits with the highest resolution as it is capable of imaging the pre-existing sedimentary structures surrounding the landfill deposits (refer to Appendix E). The depth of the landfill material was best determined with ERT as it has the largest depth of investigation of the four survey methods and the electrical resistivity contrast between landfill deposits and alluvial gravel sediments is relatively high (refer to Appendix E). In summary, the EM31, EM61 and GPR results were used to determine the extents of the landfill while the ERT system best determined the depth of the landfill.

The data was provided to PDP and overlayed with the surface contours to produce a plot showing the thickness of waste. This is presented as Figure 4 in Appendix A. The maximum depth of landfill waste using this approach was found to be approximately 9 m and a total volume of waste estimated at 18,000 m^3 (in situ). These values have been calculated based on the information provided by Southern Geophysical and should be considered to be an estimate only. There is some level of uncertainty as to whether the base depth of the landfill relates to the base of the waste only or includes any leachate impacts beneath. This would need to be verified by intrusive investigations. Figure 2, Appendix A shows the landfill extent identified using the geophysical investigation techniques.

5.3 Monitoring Bore Installation (May-June 2022)

In order to gain an understanding of the presence of any leachate impacts beneath the landfill, and if present the extent of its migration to the groundwater table and Rangitata River, PDP proposed the installation of three groundwater monitoring bores to approximately 30 m depth (one upgradient (MW1) and two downgradient (MW2 and MW3). The locations of the boreholes were sited away from the landfill and within natural soils to avoid penetrating any potential lining/confining layer beneath the landfill which could create a preferential migration pathway for any leachate that may be present. This did limit the level of understanding of the presence and vertical extent of any leachate directly beneath the landfill, however, some soil sampling was undertaken during drilling to determine whether there was any lateral migration along any geological layering.

PDP supervised the installation of the 50 mm diameter PVC monitoring bores, which was undertaken by McMillan Drilling Limited using the 114mm OD Sonic core drilling method between 23 May 2022 and 7 June 2022. Drilling equipment was decontaminated between each location. Monitoring wells MW2 and MW3 were screened from 23 m and 21.4 m and the base of each bore at up to 32 m bgl. The upgradient monitoring bore (MW1) was unable to reach the target drilling depth due to refusal at 25.84 m bgl (suspected boulder). The well was dry therefore no installation at this location was undertaken and the borehole was backfilled. The locations of the three drilling locations are shown on Figure 1, Appendix A (noting only MW2 and MW3 have monitoring bores installed), and copies of the bore logs are shown in Appendix F.

PDP developed the bores following installation. No obvious odours or signs of any leachate was evident during the installation and development of the bores.

Caps with valves were placed on the two monitoring bores to allow for LFG monitoring to be undertaken in the future. This is discussed in Section 5.6.

Eight soil samples collected from depths between 6.5 m and 29.0 m bgl were analysed at an IANZ laboratory for heavy metals and total petroleum hydrocarbons (TPH). In addition, two samples collected from MW3 collected from 27.4 m and 29.0 m were analysed for semi-volatile organic compounds and organochlorine pesticides. These results are included as Table A4 in Appendix G, with the laboratory report included in Appendix H.

In order to provide a context of potential contamination levels in soils, reference has been given to applicable human health guideline values, the ECan local background levels and the applicable default sediment guideline values (refer Section 5.5.9.1).

In summary, the majority of results reported concentrations below reported local background levels with the following exceptions:

- A chromium concentration of 52 mg/kg compared to the background concentration of 25.9 mg/kg in MW2 at 22.3 m bgl. This concentration is below the default sediment guideline value.
- Low but detectable TPH concentrations in MW2 at 7.7 m depth (total TPH of 135 mg/kg), however this concentration does not exceed the selected sediment quality or land use guideline criteria.

Apart from the low-level detection of TPH at 7.7 m within MW2, there was very little evidence of any impacts in the soil profile laterally away from the landfill. As no sampling was able to be undertaken directly beneath the landfill, it could not be determined whether any vertical migration of leachate has occurred. It is expected that some level of migration would have occurred, however, this cannot be determined at this time without potentially creating preferential pathways for leachate migration to occur and potentially creating a worse environmental effect.

5.4 Groundwater Sampling (August 2022 and January 2023)

Two groundwater monitoring events (GMEs) have been undertaken to date in the two monitoring bores. The first round was undertaken on 12 August 2022 soon after installation and the second round on 19 January 2023. The primary purpose of the GMEs was to determine the depth to groundwater and also determine whether groundwater beneath the site has been impacted from any leachate migration from the landfill. The results would also support the assessment of any environmental effects to groundwater and the Rangitata River.

The following sampling methodology was carried out as part of the sampling and monitoring exercise:

- Measurement of the depth to groundwater;
- Prior to sample collection, the monitoring bores were purged (following low-flow methodology using a bladder pump with dedicated tubing) until the key stabilisation criteria of water quality field parameters (temperature, pH, electrical conductivity, and dissolved oxygen) were met;

- All groundwater samples were immediately chilled and sent to Hills Laboratories in Hamilton for analysis of a range of analytes including anions, cations, dissolved heavy metals, pH, hardness, alkalinity, bicarbonate, electrical conductivity, chloride, nitrogen, dissolved reactive phosphorus, semi-volatile organic compounds (SVOC) and volatile organic compounds (VOC), accompanied by standard PDP chain-of-custody documentation (see Appendix H); and
- All purged water was disposed directly to the ground at the site.

Copies of the results table is included in Appendix G and field monitoring forms are provided in Appendix I.

5.4.1 Field Observations

The following field observations were noted during the two GMEs:

- Groundwater levels were measured at depths of between 24.085 m bgl at MW3 (12 August 2022) and 25.581 m bgl at MW2 (19 January 2023); and
- Water appearance during purging and sampling of MW2 and MW3 was generally noted to be clear except for the first 3 L purged from MW2 during the August 2022 GME which was observed to be cloudy/silty. No odour or visual indicators of leachate were observed.

Table 3 below documents the details of the monitoring bores.

Table 3: Bore Details and Water Levels

Monitoring Bore Reference	**MW2**		**MW3**	
Total Depth of Bore (m below ground level)	32.0		30.4	
Screen Interval (m below ground level)	23 – 32 m		21.4 – 30.4	
Height of TOC^{1,2} above ground level (m)	0.36		0.56	
Diameter (mm)	50		50	
Date	12 Aug 2022	19 Jan 2023	12 Aug 2022	19 Jan 2023
Depth to Water (m below TOC)^{1,2}	25.131	25.941	24.645	25.524
Depth to Water (m below ground level)	24.771	25.581	24.085	24.964

Notes:

1 Water level measurements taken from top of PVC casing.

2 TOC - Top of Casing.

5.4.2 Selected Groundwater Guideline Criteria

Due to the proximity to the Rangitata River, the groundwater sampling results have been compared with the Australian and New Zealand guidelines for Fresh and Marine Water Quality (ANZG, 2018) for 95% level of species protection.

Since the installation of MW1 was unsuccessful and sampling of an upgradient bore was not possible, in order to be able to compare the groundwater sampling results with expected background levels, maximum and average concentrations from the closet groundwater bore (K37/0493) monitored by Environment Canterbury, located approximately 6.7 km south-east of Peel Forest Landfill, has been used. Bore K37/0493 contains data from 12 groundwater monitoring events between September 2011 and December 2021.

5.4.3 Groundwater Sample Results and Comparison to Guideline Criteria

The following is a summary of the results obtained.

- pH: During the August 2022 round the pH levels were measured below the guideline range in both wells (each at pH 6.4 compared to the guideline range of 7.23-7.8). The January round showed pH levels within the guideline range at 7.3 and 7.4, respectively, within the two bores. The average background range was pH 7.2-7.7;
- Electrical conductivity: Measured between 19.6 and 28.7 mS/m for both rounds which exceed the guideline value of 11.6 mS/m, but are similar to the maximum background concentration of 26.3 mS/m suggesting there may be naturally higher conductivity in the area;
- Nitrogen: Total nitrogen was measured above the guideline value on both occasions (6.4 to 10.1 g/m^3 compared to the guideline value of 0.913 g/m^3). There is no background total nitrogen concentration in the data obtained from ECan. There is however a background Nitrate-nitrogen concentration. The laboratory results show that the majority of the total nitrogen is in fact Nitrate-N and the maximum background concentration of Nitrate-N is 11.2 g/m^3. This is higher than the concentrations measured in the two bores and suggests Nitrate-N may be already elevated in the area. High nitrate-N concentrations in the Canterbury Plains are not uncommon;
- Dissolved Reactive Phosphorus: The January 2023 round recorded a slightly elevated concentration (0.009 g/m^3 compared to a background of 0.008 g/m^3) in MW2. The background levels show a maximum concentration of 0.0063 g/m^3;
- Total alkalinity, bicarbonate, hardness, dissolved boron, dissolved potassium, dissolved sodium, dissolved magnesium, dissolved zinc, chloride and sulphate were recorded on at least one occasion above the background levels, but below the guideline values. In general, the exceedances of the background level were only marginally elevated, with the exception being dissolved boron (up to

0.31 g/m^3 compared to a background of 0.013 g/m^3) and dissolved potassium (up to 4.3 g/m^3 compared to a background of 1.46 g/m^3); and

- Other parameters including SVOC and VOC compounds, Total Ammoniacal-Nitrogen, Nitrite-N and dissolved arsenic, chromium, iron, lead and nickel were all recorded below the laboratory limits of reporting.

In general, although there were some parameters above the ANZG Guideline Values, the concentrations of these parameters were similar to the water quality for a bore in the wider area suggesting these may not necessarily be associated with the landfill. This is particularly evident with the nitrate-N concentration where the background concentration is higher than the concentrations recorded during both sampling rounds. In addition, Total Ammoniacal-N, which is considered a key indicator of landfill leachate, was not detected in any of the samples collected. However, the detection of some parameters including dissolved boron, dissolved potassium and chloride above background levels indicate that there may be some minor leachate impacts on the groundwater beneath the site. The presence of low permeability soils within and/or beneath the landfill coupled with the approximate 16 m of natural soils between the base of the landfill and groundwater table, appears to be restricting any significant leachate migration or environmental effect.

5.5 Landfill Waste Characterisation (January 2023)

A PDP environmental geologist attended the site on 10 to 13 January 2023 and carried out the landfill waste characterisation and soil testing exercise to further assess the waste materials within the main landfill. The investigation excluded the gully area.

The waste characterisation included advancement of seven test pits, sorting and characterisation of waste (including waste screening), soil sampling and analysis, installation of shallow bores in selected test pits, and routine air monitoring for respirable asbestos fibres. The required PDP health and safety procedures were carried out prior to breaking ground including obtaining and reviewing available underground service plans and supervising a physical underground services assessment.

5.5.1 Test Pit Positions

The seven test pits (advanced to up to 4 m bgl at some locations) were located to supplement previous (December 2019) test pitting work, which involved advancement of eight test pits over the main landfill area. The test pits were positioned to:

- Increase the coverage achieved by the December 2019 test pits,
- Target various stages of landfill waste deposition over time, and
- Evaluate areas of various waste thickness identified by the geophysical survey (February 2021).

The intent was that information gathered during both test pitting events would provide a comprehensive understanding of waste characteristics and composition.

5.5.2 Waste Characterisation

Landfill waste characterisation was carried out to understand the composition of the waste across the main landfill area, particularly to understand the ratio of soil, cobbles, gravels to anthropogenic waste materials. The findings would inform possibilities and limitations in terms of waste sorting, recycling, and off-site disposal options at the landfill remediation phase. The procedure for the waste characterisation was as follows:

- Excavation of seven test pits (TP101-TP107). At selected locations (TP101, TP103, TP105 and TP107) stockpiles of excavated waste materials were placed adjacent to each hole to allow the material to be inspected and characterised before being loaded for off-site removal and disposal.
- Waste segregation/characterisation first using the excavator bucket to separate the larger waste materials (e.g., tree trunks, decaying car parts, and cobbles (>60 mm) to boulder sized (>200 mm) materials). The remaining finer materials were screened through an excavator-mounted 25 mm flip screen. A PDP environmental geologist then hand picked out waste materials from the >25 mm stockpile and sorted them into separate waste types. Finally, the approximate volumes of each stockpile of waste (i.e., scrap metals, timber, plastic etc), <25 mm screened soils, >25 mm screened soils and large unscreened waste materials were recorded.
- Collection of soil samples (refer to Section 5.5.6).
- Backfilling of test holes with clean imported material and installation of shallow temporary wells within selected test holes (TP101, TP102, TP104 and TP105) to facilitate ongoing LFG monitoring and leachate sample collection and analysis from within the waste.
- The works were undertaken using mitigation measures to manage the potential for exposure of hazardous substances to the site workers and/or causing an environmental effect. This included having emergency control procedures in place to manage any discovery of chemical drum, ensuring no contamination was tracked offsite by trucks, controlling dust (i.e., dust suppression) and decontaminating the excavator following the works. Works were undertaken assuming the presence of asbestos, so site workers wore P2 dust masks or half face respirators for the duration of the works as well as disposable Tyvek suits.
- The waste materials excavated during the characterisation investigation was taken to Redruth Landfill in Timaru for disposal.

Note - Test pits were generally terminated at a maximum depth of 4.0 m bgl (i.e., towards the maximum reach of the excavator), except where the suspected base of the landfill waste material was encountered first (refer to Section 5.5.7 and Table 5).

5.5.3 Test Hole Boreholes

Shallow boreholes were placed within test pits TP101, TP102, TP104 and TP105 during backfilling to allow for future monitoring purposes. Installation details are provided in Table 4 below.

During the subsequent groundwater monitoring round on 19 January 2023 (approx. 1 week after installation), each of the bores was inspected for the presence of water/leachate with the intention to collect water/leachate samples. All four bores were dry on this occasion.

Table 4: Test Hole Bore Details and Water Levels

Bore Reference	TP101	TP102	TP104	TP105
Date	19 Jan 2023	19 Jan 2023	19 Jan 2023	19 Jan 2023
Total Depth of Bore (m bgl)	3.83	3.47	3.78	3.81
Screen Interval (m bgl)	0.5-3.83	0.5-3.47	0.5-3.78	0.5-3.81
Height of TOC[1,2] above ground level (m)	0.60	0.55	0.53	0.60
Diameter (mm)	50	50	50	50
Depth to Water (m bgl)	Dry	Dry	Dry	Dry

Notes:

1. *Water level measurements taken from top of PVC casing.*
2. *TOC - Top of Casing.*

5.5.4 Ambient LFG Monitoring

A Gas Alert meter was used during the test pitting excavations to enable gas readings (lower explosion limit, oxygen, hydrogen sulphide and carbon monoxide) to be continuously monitored. The meter was located on the front of the excavator and did not record any alarms during the works.

5.5.5 Air Monitoring (Asbestos)

Routine air monitoring for airborne asbestos fibres was undertaken on 10th, 11th and 12th January during the test pitting exercise based on confirmation of the presence of asbestos containing materials (ACM) in some of the waste materials pulled back from the gully area. Air monitoring was set up in three locations each day at the northern, western and southern site boundaries. The northern boundary bounds the residential dwelling to the north of the site. The wind was recorded to be light for the duration of the work. All air monitoring results showed that airborne fibre levels were recorded at <0.01 f/mL, which is below the trace limit of 0.01 f/mL. The laboratory reports and chain of custody documents are included in Appendix H.

5.5.6 Soil Sampling

Samples of soil making up the matrix around landfill waste were collected with the aid of a mechanical excavator or by hand from stockpiles. Each soil sample was placed directly into a glass jar with a food grade plastic sealed lid for general contaminants, and where applicable, into a separate plastic container suitable for asbestos in soil analysis (supplied by RJ Hill Laboratories Limited). A fresh pair of nitrile gloves was worn when collecting each sample to prevent sample cross contamination and to protect the PDP site worker.

Following collection, samples were placed immediately into chilly-bins containing frozen ice packs. The chilly-bins were sent with chain of custody documentation to RJ Hill Laboratories in Hamilton for analysis (non-asbestos analysis) or Terra Scientific in Christchurch for asbestos analysis. The sample consignments were received the following day after shipment at the respective laboratories.

On the basis of field observations, a total of 27 selected soil samples (24 representing the landfill material and three of soils that appeared to be representative of the underlying natural soils) were submitted to an accredited laboratory and analysed for the following key contaminants:

- Heavy metals (arsenic, cadmium, chromium, copper, lead, nickel, and zinc),
- SVOCs (which included the OCP and PAH suite of parameters),
- TPH, and
- Asbestos.

Where screening was completed, three landfill waste samples were collected from the <25 mm screened stockpile. Otherwise, samples were collected from specific depths.

Note – The soil asbestos analysis was completed using the semi-quantitative laboratory method to enable comparison with relevant human health asbestos soil guideline values. In addition, selected fibre cement sheet fragments that were observed within the landfill matrix were also analysed for asbestos.

A plan showing the test pit locations is presented as Figure 1 in Appendix A.

5.5.7 General Field Observations

There was limited, if any, cover layer across the landfill surface. At TP101, TP102, TP105 and TP106 only a very thin layer of topsoil was encountered above the main landfill waste. Test pits TP103, TP104 and TP107 encountered a layer of sandy greywacke gravels to between 0.3 and 0.6 m bgl over the landfill waste, however this was observed to be inconsistent and was only found across half of one of these test holes.

Landfill waste was encountered in all seven test pits and was divided into two types:

- ‘Waste Mixture’ – Higher proportion of waste including metal, timber (including some pockets of sawdust), plastics, textiles, and small fragments of glass, and presumed asbestos containing material (PACM).
- ‘Soil-Waste Mixture’ – Low proportion of waste, majority of soil and gravels with minor waste fragments including timber and plastic.

Underlying ‘Visibly Clean Soil’ were observed in four locations:

- TP102 – A visibly clean, firm clay with some sand and gravel (not consistent with the expected local geology of sandy gravels observed during the May 2022 drilling investigation). It is considered this may represent an interim cover layer within the landfill, an underlying lining layer or just bulk soil disposal at the time of the landfill operation).
- TP105, TP106, and TP107 – Light brown sandy gravel and cobbles of greywacke with occasional greywacke boulders. This is expected to be representative of the underlying natural soils. Samples collected at depths of 0.3 – 0.8 m below the base of the waste to determine the depth of impacts associated with leaching.

Perched water was encountered in one location (TP104) only as a localised flow from the north western side into the test pit.

Based on the test pit observations, the landfill depth is shallowest towards the north. The depth of waste materials, where bottomed, are in broad agreement with the results of the 2021 Geophysical Investigations.

A summary of field observations at each test hole is presented in Table 5 below:

Table 5: Summary of Test Pit Observations

Test Pit	**Observed Soil Profile**	
	Depth (m bgl)	**Profile**
TP101	0 – 0.1 0.1 – 4.0	**Cover –** Light brown sandy SILT. **Waste Mixture –** Dark brown silty gravelly sand matrix with waste including car parts (license plate, wheels, tyres, body) scrap metal (wire, flat and corrugated sheets, food cans), plastic (bale wrap, food and drink containers, one empty herbicide container), glass (fragments and bottles), bagged household refuse, cement sheet fragments, ceramic fragments, rope, textiles, animal bones, timber, minor brick and concrete and greywacke cobbles. Of note:

Table 5: Summary of Test Pit Observations		
Test Pit	**Observed Soil Profile**	
	Depth (m bgl)	**Profile**
		- A tree trunk 2.8 long x 0.9 m wide was encountered at approximately 1.0 m bgl. - Occasional pockets of woodchips and sawdust were observed from 1.7 to 4.0 m bgl. - A metal vehicle fuel tank containing some water was observed but there was no strong fuel odour. **Water/Leachate** – None encountered.
TP102	0 – 2.0	**Waste Mixture (Minimal Soil Cover) –** As for TP101 0.1-4.0 m with additional waste types including concrete curbs, polystyrene fragments, a car battery and plastic netting. Of note: - Tree trunk encountered in upper 1 m of a similar size to that encountered in TP101.
	2.0 – 3.0	**Soil-Waste Mixture –** Grey and brown silty sandy gravel of greywacke with some fragments of timber and plastic wrap.
	3.0 – 4.0	**Visibly Clean Soil** – Firm orange-brown clay with some sand and greywacke gravel (possibly interim or daily cover). **Perched Water/Leachate** – Localised minor seepage at 2.0 m bgl.
TP103	0 – 0.6	**Cover**– Sandy greywacke gravel and cobbles (eastern side of test pit only).
	0.6 – 1.0	**Waste Mixture** – As for TP101 0.1-4.0 m.
	1.0 – 2.1	**Soil-Waste Mixture –** Grey sandy gravelly clay with minor waste of timber and glass fragments and occasional pockets of sawdust.
	2.1 – 4.0	**Soil-Waste Mixture** – Grey and brown sandy gravelly clay with some cobbles and boulders of greywacke and some fragments of asphalt, plant matter (branches, woodchip) and ceramic. **Perched Water/Leachate** – Localised minor seepage at 2.1 m bgl.

Table 5: Summary of Test Pit Observations

Test Pit	Observed Soil Profile	
	Depth (m bgl)	**Profile**
TP104	0 – 0.1	**Cover –** Light brown sandy silt with some greywacke gravel.
	0.1 – 0.3	**Cover –** Light brown sandy gravel with some cobbles. Gravel and cobbles of greywacke.
	0.3 – 3.5	**Waste Mixture –** As for TP101 0.1-4.0 m. Of note: ⁖ A section of tree trunk was encountered; ⁖ Some clay pockets were encountered.
	3.5 – 4.0	**Soil-Waste Mixture –** Silty clay with some greywacke gravel and waste fragments including glass and plastic wrap. **Perched Water/Leachate –** Localised perched water flow from 1.7 m depth. Water was clear (i.e., as opposed to a dark liquid typical of landfill leachate). Flow continued for >10 minutes although at a reduced rate.
TP105	0 – 0.7	**Waste Mixture –** As for TP101 0.1-4.0 m.
	0.7 – 1.2	**Soil-Waste Mixture –** Silty sandy gravel of greywacke with some cobbles and occasional waste including metal wire and timber pieces.
	1.2 – 2.7	**Waste Mixture –** As for TP101 01-4.0 m. Of note: ⁖ A car frame was encountered from 1.4 m.
	2.7-3.8	**Visibly Clean Soil** – Light brown sandy gravel and cobbles of greywacke, minor silt [NATURAL SOILS].
		Water/Leachate – None encountered.
TP106	0 – 0.6	**Cover –** Brown and orange-brown sandy gravel and cobbles of greywacke with some waste fragments (plastic wrap, metal (wire and sheet), brick, ceramic and plastic fragments.
	0.6 – 2.3	**Waste Mixture –** As for TP101 0.1-4.0 m. Of note: ⁖ Some boulder sized pieces of scrap metal leading to side instability once disturbed; ⁖ Higher proportion of scrap metals than observed in other test holes.
	2.3 – 3.0	**Visibly Clean Soil** – Light brown sandy gravel and cobbles of greywacke, minor silt [NATURAL SOILS].
		Water/Leachate – None encountered.

Table 5: Summary of Test Pit Observations

Test Pit	Observed Soil Profile	
	Depth (m bgl)	Profile
TP107	0 – 0.4	**Cover –** Light brown sandy gravel with some cobbles of greywacke.
	0.4 – 1.6	**Waste Mixture –** As for TP101 0.1-4.0 m. Of note: - A wheelbarrow was encountered.
	1.6 – 2.8	**Visibly Clean Soil** – Light brown sandy gravel and cobbles of greywacke, minor silt, occasional boulder up to 300 mm [NATURAL SOILS].
		Water/Leachate – None encountered.

Selected photographs of the soils encountered during the soil sampling investigation are presented under Appendix B.

5.5.8 Waste Composition Assessment

5.5.8.1 Limitations of Waste Composition Assessment

The following limitations should be considered when reviewing the findings and observations associated with the waste characterisation assessment of the main landfill area (i.e., in terms of waste to soil ratios, waste composition, waste volume approximations, etc.):

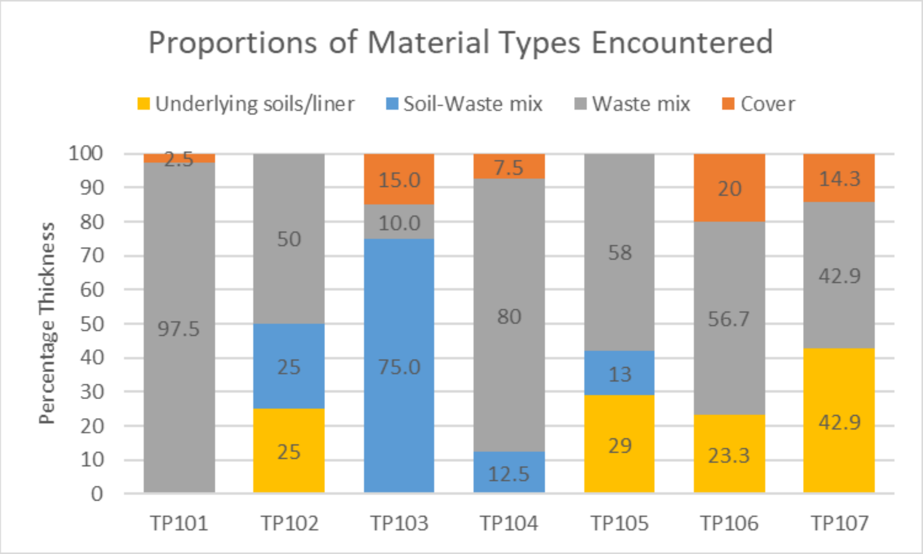
- The greatest depth of the test pits was 4 m bgl, therefore waste characteristics and composition at greater depths (i.e., down to 9 m bgl) remain unknown;
- The efficiency of waste screening and sorting of waste was hindered by the clogging effect of moisture in soils and limited personnel on site to keep pace with screening;
- Where natural soils were encountered excavations were terminated at <4 m (specifically in TP105, TP106 and TP107), therefore a smaller volume of waste was screened at these locations; and
- Natural soils encountered during test pitting may be associated with interim cover materials and the presence of underlying waste at these locations cannot be ruled out.

5.5.8.2 Material Types

From general site observations, the materials encountered can be divided into four groups:

1. **Cover Material** – comprised of surficial materials (soil, gravel, etc.) with little to no waste.
2. **Waste Mixture** – comprised of various waste materials with less natural composition.
3. **Soil-Waste Mixture** – comprised of greater ratio of soil to waste materials.
4. **Visibly Clean Soil** – non-surficial natural soils/gravels that are possibly representative of daily cover (i.e., as encountered in TP102, and natural soils encountered in TP105, TP106 and TP107).

The proportional thicknesses of each of these layers encountered in each test pit are displayed in Graph 1 below.



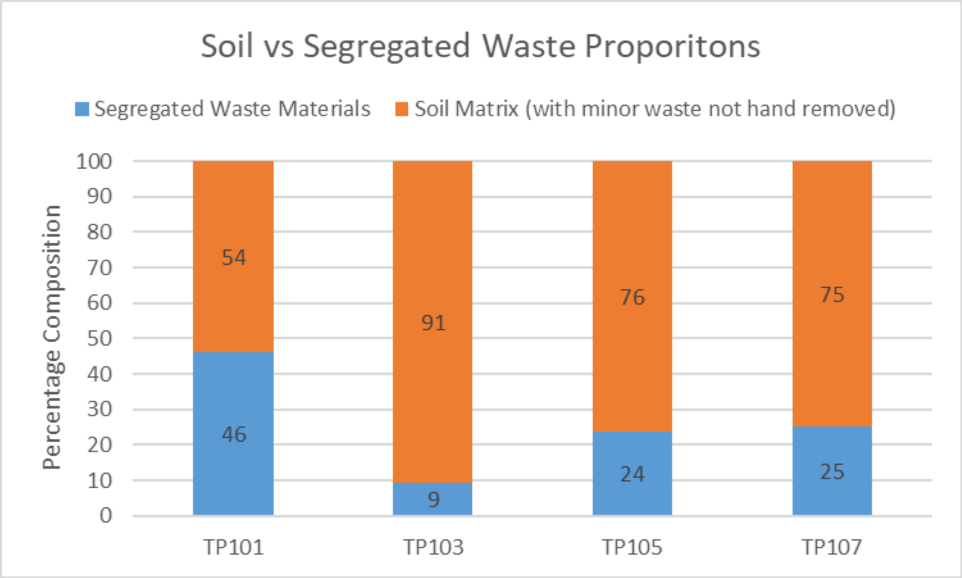
Graph 1: Proportions of Material Types Encountered

Graph 1 demonstrates the variability in material thicknesses in the seven test pits advanced across the main landfill area. These observations are summarised as below:

- **Cover Material** - encountered at the surface of five of seven test pits and made up the smallest percentage of test pit materials observed (2.5 to 20% where present). Cover material contained minimal waste.
- **Waste Mixture** - encountered in all seven test pits and accounted for the majority of the materials (except for TP103) across each test pit profile (i.e., 10 to 97.5% of materials observed), especially in TP101 (97.5%), TP104 (80%), TP106 (56.7%) and TP102 (50%). This likely reflects the varying waste streams received by the landfill during operation.
- **Soil-Waste Mixture** - encountered in four of seven test pits and represented 13 to 75% of materials where observed. The most significant percentage of Soil-Waste Mixture was observed in TP103 at 75%.

- **Visibly Clean Soil** - encountered in four of seven test pits and represented 23.3 to 42.9% of materials where observed. The most significant percentages of Visibly Clean soil were observed in TP107 (42.9%) and TP105 (29%).

A summary of the approximate ratio of soil matrix to waste materials within TP101, TP103, TP105 and TP107 (waste screening test pits) is presented in Graph 2 below. The main soil matrix including fine waste fragments that passed the 25 mm screen, as well as smaller missed fragments not removed during the manual hand picking, comprised 54-91% of test pit arisings. The highest proportion of waste material was encountered in TP101, which is where the highest proportion of 'Waste Mixture' was observed. The lowest proportion of waste material was encountered in TP103 where the lowest proportion of 'Waste Mixture' was observed and there was a higher proportion of 'Soil-Waste mix'. This indicates that the manual hand-picking exercise and screening results compare well with test pit observations.



Note: 'minor waste' includes fine waste fragments that passed the 25 mm screen as well as smaller and missed fragments not removed during the manual hand picking. Note that TP105 and TP107 encountered natural soils and so had an overall lower proportion of waste. Whilst the majority of the natural soils were separated from the waste, some would have been mixed in the waste materials and will be influencing the above proportions.

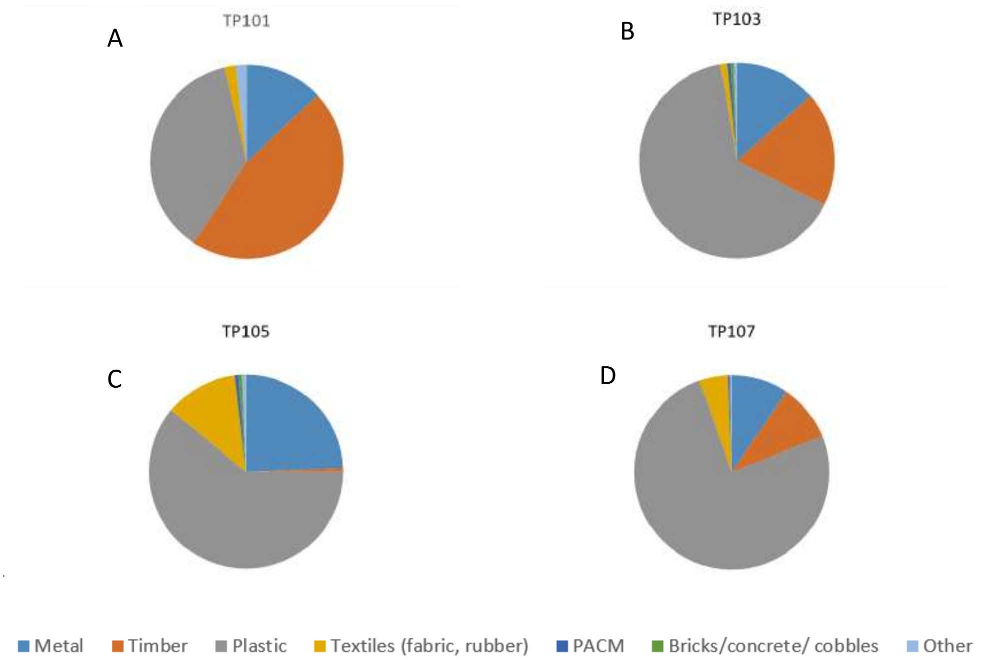
Graph 2: Soil vs Segregated Waste Proportions

Of the hand separated waste materials, the dominant waste types within the landfill soil matrix are:

- Timber (including fence posts, branches, tree trunks, woodchip, sawdust)
- Plastic (including bale/silage wrap, food and drink containers, netting)
- Metal (including wire, vehicle parts)

- Textiles (including old clothing, rags and shoes, rope, netting)
- Building materials (concrete, brick, fibre cement sheet (PACM))
- Animal bones (a few observed in each screened test hole)

The proportions of these waste types identified within the hand separated waste materials are presented in Graphs 3A to 3D below. With the exception of TP101, Plastic (in TP103, TP105 and TP107) was the dominant waste type, forming 61-76% of hand separated waste material. Within TP101, timber was the most dominant waste type at 46 % of the waste materials with plastic forming the second highest proportion at 37%. Timber was much less frequently found further north in the landfill (TP105 and TP107), forming only <1% to 10% of the waste materials in these locations. Metal and textiles made up the four most frequent waste types (between 9-25% and 1-12% of hand separated waste, respectively). Remaining waste types made up less than 1% of overall separated waste materials.



Graphs 3A-3D: Proportion of Segregated Waste Types in Each Test Pit

5.5.8.3 Waste Segregation Summary

The waste types observed included **Timber** (including fence posts, branches, tree trunks, woodchip, sawdust), **Plastic** (including bale/silage wrap, food and drink containers, netting), **Metal** (including wire, vehicle parts), **Textiles** (including old clothing, rags and shoes, rope, netting), **Building materials** (concrete, brick, fibre cement sheet (PACM)), and **Animal bones** (a few observed in each screened test hole). The dominant waste type (excluding soil) was plastic in most test pits (up to 76%), with high levels of timber (up to 46%) and metals (up to 25%) also observed.

The results of the waste composition assessment indicate it is possible to segregate waste materials from the soil matrix, and to further separate these materials based on material type. However, the observed waste was noted to be degraded (e.g., rusted metals and brittle plastic wrapping) and covered in a layer of soil (i.e., 'dirty').

The waste materials will be difficult to clean once segregated and the associated cost would likely be prohibitive. However, it may be possible to segregate and clean smooth surfaced cobbles and boulders which could then be retained on site. In addition, it may also be viable to segregate any homogenous, visually clean soil layers encountered (i.e., soils containing no waste fragments). The feasibility of screening and segregating the waste materials requires further assessment.

5.5.9 Soil Matrix Testing

5.5.9.1 Selected Guideline Criteria - Soils

The site is currently unused and is likely to remain so for the foreseeable future. Therefore, it is unlikely that there will be any site users who may be receptors to contaminants from the site in its current state. However, there is a potential for environmental, aesthetic, and physical hazards if the landfill body is eroded into the receiving environment (i.e., riverbed and downstream coastal areas).

If remediation of the landfill proceeds, the exposure pathway for human health (i.e., excavation works) through exposure to volatile contaminant and asbestos could be complete. With the exception of the residential property immediately north of the landfill, the risk to human health for neighbours is considered acceptably low.

In order to provide a context of contamination levels in soils, reference has been given to the following:

- Ministry for the Environment (2004). Module 2 – Hazardous waste guidelines: Landfill waste acceptance criteria and landfill classification
- Ministry for the Environment (2011a). Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health
- Ministry for the Environment (2011b). Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011)
- National Environmental Protection Council (NEPC, 2013). Guideline on the Investigation Levels for Soil and Groundwater
- BRANZ, 2017. New Zealand Guidelines for Assessing and Managing Asbestos in Soil
- Australian and New Zealand Guidelines for Fresh & Marine Water Quality 2018

A further discussion regarding the selected soil guidelines is provided below.

The site does not fit well into any of the available land use scenarios for protection of human health (i.e., residential – standard and rural/lifestyle, recreational, and commercial/industrial). The conservative soil contaminant standards (SCS) and/or guideline values for a rural residential/lifestyle block (assuming 25% homegrown produce consumption) land use were considered based on the site's rural location and proximity to rural residential dwellings. However, the site itself has never been residential in use and is unlikely to be in future. Similarly, no produce is known to have been grown on the site or is proposed in the near future. Of the land use criteria available, the site is considered to align best with the recreational land use scenario, although is not used for, or proposed to be used for recreational activities. It is considered this will provide an initial conservative assessment of risk to human health. For those guidelines without a recreational land use scenario (i.e., MfE), residential land use has been included as a conservative approach.

Given the vulnerability of the landfill to erosion, the default sediment guidelines in the ANZG (2018) have also been included for comparative purposes. These are considered appropriate as another flood event could result in further loss of material to the Rangitata River below. Comparison of the results against these criteria will indicate whether a risk is posed to the aquatic ecosystem.

To determine the suitability for the material to be taken to Redruth Landfill for disposal, the soil sample results have also been compared with MfE (2004) Class A Landfill criteria (screening and leachability).

Reference has also been made to ECan background soil concentrations for selected trace elements in the major Canterbury soil groups (ECan, 2007). In particular, the heavy metals analytical results have been compared with ECan Level Two background soil concentrations for the 'Regional – Intergrade' soil group in which the site is located.

Whilst OCP compounds are anthropogenic it is important to note that due to their historical ubiquitous application in agriculture, parklands, and turf management they can be considered to also be present at low but detectable 'background' concentrations (MfE, 1998). While there is no official ECan background soil concentrations, ECan has recently recognised that some OCPs are ubiquitous in the environment and has adopted an interim 'background' level (0.431 mg/kg) for ∑DDT (OCP compounds). This value was informed by the report prepared by MfE entitled 'Ambient Concentrations of Selected Organochlorines in Soils' and dated December 1998.

5.5.9.2 Soil Sampling Results and Comparison to Guideline Criteria

The following samples were submitted for laboratory analysis:

- Three samples of 'Cover Material'
- 17 samples of 'Waste Mixture' materials (note samples collected from screened stockpiles have been classified as 'Waste Mixture', although these are generally a combination of 'Waste Mixture' and 'Soil-Waste Mixture')
- Three samples of 'Soil-Waste Mixture'

- Four samples of 'Visibly Clean Soil'

The results of the soil sample analysis are presented as Table A (heavy metals and the OCPs ∑DDT, dieldrin, and pentachlorophenol), Table B (TPH), Table C (asbestos) and Table D (Toxicity Characteristic Leachate Procedure – heavy metals) under Appendix E. Note the PAH results have not been tabulated as all were reported below laboratory limits of reporting. The laboratory reports and chain of custody documentation are presented in Appendix H.

5.5.9.3 Heavy Metals

- Cover Material – one of three samples analysed (TP106_0.5) recorded two heavy metal concentrations (lead and zinc) slightly above background levels. No results exceeded recreational land use criteria, sediment default guideline values or Class A landfill screening criteria.
- Waste Mixture – All 17 samples recorded six or seven heavy metal concentrations above background levels. In addition, all but one sample recorded between one and five heavy metal concentrations above the sediment default guideline values and Class A landfill screening criteria (copper, lead and zinc).

  No sample results exceeded the soil contaminants standards for a recreational land use.
- Soil-Waste Mixture – All three samples recorded between two and six heavy metals above background levels. In addition, one sample (TP102_2.0-2.3) recorded a zinc concentration above the Class A landfill screening criteria and zinc and lead concentrations above sediment default guideline values.

  No sample results exceeded the soil contaminants standards for a recreational land use.
- Visibly Clean Soil – Three of the four samples recorded between one and four heavy metals above background concentrations. One sample (TP106_2.6) recorded a zinc concentration above Class A landfill screening criteria as well as zinc, lead and cadmium concentrations above sediment default guideline values.

  No sample results exceeded the soil contaminants standards for a recreational land use.

5.5.9.4 Toxicity Characteristic Leachate Procedure – Heavy Metals

Toxicity Characteristic Leachate Procedure (TCLP) testing was undertaken on selected Waste Mixture samples where lead, zinc and/or copper concentrations exceeded total concentration screening criteria for Class A Landfills. Heavy metals were present in laboratory induced leachate but generally at concentrations below the Class A waste acceptance limits (refer to Table D) with the exception being zinc in two samples (TP106_1.4 and TP107_3) recorded at 12.4 mg/L and 16.2 mg/L compared to the acceptance limit of 10 mg/L.

5.5.9.5 Organochlorine Pesticides

- One of the 17 samples of Waste Mixture recorded a total DDT concentration of 4.15 mg/kg, compared to the background value of 0.431 mg/kg and sediment default guideline value of 1.2 mg/kg. The concentration did not exceed Class A landfill screening criteria or the soil contaminants standards for a recreational land use (400 mg/kg).
- None of the Cover Material, Soil-Waste Mixture or Visibly Clean Soil samples analysed recorded OCP concentrations above the laboratory limits of reporting, and consequently no results exceed reported background concentrations, Class A landfill waste acceptance criteria or the soil contaminants standards for a recreational land use.

5.5.9.6 Total Petroleum Hydrocarbon (TPH)

Three samples of Waste Mixture, targeted to get a good lateral spread across the landfill within the Waste Mixture material, were analysed for TPH. In summary:

- All three samples collected contained TPH concentrations below the MfE (2011b) Tier 1 soil acceptance criteria (All Pathways) for residential land use. Two of the three samples contained TPH concentrations above the sediment default guideline values.
- Generally low but detectable heavy fraction TPH (i.e., C_{15}-C_{36} carbon band) concentrations (up to 530 mg/kg in TP102_0-1.0)) were measured in all three samples. Review of the chromatograms associated with detections of TPH C_{15}-C_{36} shows that these results are likely natural organic compounds as opposed to man-made sources (e.g., fuel oil or waste oil).

5.5.9.7 Polycyclic Aromatic Hydrocarbons (PAH)

27 samples were analysed for PAHs. In summary:

- All 27 samples analysed contained PAH compounds below the laboratory limits of reporting and below Class A landfill screening criteria.

5.5.9.8 Other SVOCs

All other analyte concentrations within the SVOC suite recorded concentrations below the laboratory limits of reporting in all 27 samples analysed.

5.5.9.9 Asbestos

A total of 25 soil samples (three Cover Material, 17 Waste Mixture, three Soil-Waste Mixture and four Visibly Clean Soil) were collected and analysed at the laboratory using the semi-quantitative analytical method.

- 20 of the 27 soil samples analysed using the semi-quantitative method did not record the presence of asbestos.

- The remaining seven samples were all samples of Waste Mixture.
- TP105_2 and TP105_3 contained asbestos fines/fibrous asbestos but no ACM. Detectable asbestos fines/fibrous asbestos was recorded above the BRANZ (2017) soil guideline value for all land uses of 0.001% w/w for asbestos as asbestos fines/fibrous asbestos, up to 0.00767 % w/w asbestos.
- Samples TP106_1.4 contained asbestos fines/fibrous asbestos and ACM. Detectable asbestos fines/fibrous asbestos was recorded above the BRANZ (2017) soil guideline value for all land uses of 0.001% w/w for asbestos as asbestos fines/fibrous asbestos, up to 0.01828 % w/w asbestos. ACM was recorded below the BRANZ (2017) soil guideline value for recreational land use of 0.02% w/w for asbestos as ACM.
- Sample TP105_1 contained asbestos fines/fibrous asbestos and ACM. ACM was recorded at 0.02243% w/w above the BRANZ (2017) soil guideline value for recreational land use of 0.02% w/w for asbestos as ACM. Detectable asbestos fines/fibrous asbestos was recorded below the BRANZ (2017) soil guideline value for all land uses of 0.001% w/w for asbestos in soil.
- The remaining two samples (TP103_1 and TP103_2) recorded low but detectable asbestos fines/fibrous asbestos, but below the BRANZ (2017) soil guideline value for all land uses of 0.001% w/w for asbestos in soil.

In addition, asbestos was detected in as fibre cement sheet fragments that were collected from the Waste Mixture material from TP101, TP103, TP105, TP106 and TP107.

The results show that whilst sampling did not necessarily show the presence of asbestos fibres in the soil matrix, ACM fragments were visually detected in the majority of the test pits suggesting asbestos was generally present throughout.

5.5.9.10 Soil Results Summary

The results of the soil matrix testing showed heavy metal concentrations above background levels in all four soil types (Cover, Waste Mixture, Soil-Water Mixture and Visibly Clean Soil) indicating impacts are present associated with the landfill operations. There was no evidence of highly toxic persistent pesticides in the samples collected.

The surface Cover material however showed concentrations below the residential/recreational guideline criteria and therefore suitable for the current land use.

The Waste Mixture and Soil-Waste Mixture material showed the highest concentrations of contaminants (as to be expected) with heavy metals, OCP and TPH being recorded above background levels and ANZG (2018) default sediment guidelines, however, only asbestos was detected above the residential/recreational guideline criteria. Some heavy metals were also recorded above the Redruth Landfill screening criteria with zinc recorded above the TCLP leachability criteria. This appears to be an isolated occurrence with the majority of the samples showing acceptable concentrations for disposal at Redruth Landfill.

The Visibly Clean Soil beneath the waste did show some low but detectable heavy metal concentrations above background levels, with one of the four samples showing an exceedance of the default sediment guidelines. This sample was collected 0.3 m below the base of the waste in what was expected to be natural underlying soils. The samples collected deeper below the waste layer (up to 0.8 m below the waste) showed lower concentrations of contaminants and at or around background levels. Sampling of the underlying natural soils was limited to three locations and did not include beneath the deepest areas of fill, but indicates that some degree of leaching has occurred, although does not appear to be widespread or significant and limited to <1 m below the waste.

Overall, sampling of the soil matrix showed that contaminants are present within the landfill above background levels, but with the exception of asbestos, were present below the residential/recreational guideline criteria and therefore suitable for the current land use. The results do however show the soil matrix in the waste material exceeds the default sediment guidelines so would pose a risk to the aquatic ecosystem in the event it entered the Rangitata River system.

It should be noted that given this is a landfill and received all range of waste materials, it is possible that there may be other contaminants/chemicals/ hazardous materials present that were not detected as part of the laboratory testing. The lab testing was also limited to the soil matrix and actual waste material was not tested.

A summary of the soil results for each of the soil types is shown in Table 6 below.

Table 6: Summary of Soil Results

Soil Type	Contaminants > Background Conc.	Contaminants > SCS for Recreational Land Use	Contaminants > Sediment Default Guideline Values	Contaminants > Class A Screening Criteria	Contaminants > Class A Leachate Criteria
Cover	Lead, Zinc	None	None	None	N/A
Waste Mixture	7 heavy metals, OCP, TPH, Asbestos	Asbestos	7 heavy metals, OCP, TPH, Asbestos	Copper, Lead, Zinc	Zinc
Soil-Waste Mixture	Arsenic, Cadmium, Chromium, Copper, Lead, Zinc	None	Lead, Zinc	Zinc	N/A
Visibly Clean Soil	Lead, Cadmium, Zinc	None	Lead, Zinc	Zinc	N/A

5.6 Landfill Gas Investigation (August 2022 and January 2023)

LFG monitoring was undertaken within the two monitoring bores (MW2 and MW3) installed outside of the landfill area and also within the four bores (TP101, TP102, TP104 and TP105) installed within the test pits advanced directly within the landfill. All bores were fitted with caps and valves to directly connect to the LFG meter. A GA5000 landfill gas analyser was used to measure the LFG readings on each occasion.

Monitoring was undertaken within the two monitoring bores on two occasions (12 August 2022 and 19 January 2023), whilst only a single monitoring round has been undertaken within the four bores installed within the test pits (19 January 2023).

A summary of LFG measurements is presented in Table 7 below.

Table 7: Landfill Gas Monitoring Results

Sample	**MW2**		**MW3**		**TP101**	**TP102**	**TP104**	**TP105**
Date	12/08/22	19/01/23	12/08/22	19/01/23	19/01/23			
Methane (%)	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0
Carbon Dioxide (%)	0.7	0.9	4.0	0.1	3.0	4.9	0.8	1.7
Oxygen (%)	19.3	16.7	16.2	20.1	17.3	14.9	19.5	18.7
Balanced Gases (%)	79.8	82.4	80.1	79.9	79.7	79.5	79.6	79.5
Hydrogen Sulphide (ppm)	0	0	4	4	0	0	0	0
Carbon Monoxide (ppm)	0	1	0	1	0	1	0	1
Flow Rate (L/min)	-	0.1	-	0.1	0.1	0.2	0.1	0.1

Notes:

1. *Samples collected using GA5000 connected to a gas cap on the monitoring bores*
2. *Concentrations shown are peak concentrations measured to date.*

The results show that methane was only detected at low levels within test pit bore TP102 at 0.4% and carbon dioxide up to 4.9% at the same location. Although these are detections of LFG, considering these were installed directly within the landfill these are considered to be very low. Flow rates were also measured and were recorded at the detection limit of the meter. LFG readings in the monitoring bores away from the landfill showed no methane, however, carbon dioxide was recorded up to 4.0%. Based on the results obtained, the landfill does not appear to be generating LFG at quantities that present a current risk to nearby land users. This is not unexpected given the age of the landfill. However, it would be expected that some pockets of LFG may still be present and could be encountered during any intrusive works and therefore would need to be managed appropriately.

6.0 Conceptual Site Model and Risk Assessment

Based on the information gathered, a conceptual site model (CSM) and risk assessment has been prepared to understand if the landfill poses a risk to human health and the environment. This is presented in Table 8 below.

The CSM is a key framework that guides the risk assessment, management and remedial approach for contaminated sites, such as a landfill site. The CSM was used to identify potentially complete exposure pathways to support the risk assessment process. A risk to human health or the environment can only exist if there is a hazard (e.g., source; contaminated soil, dust or water), a receptor (i.e., people) and an exposure pathway between the hazard and the receptor. An absence of any one of these components means no risk can exist.

It should be noted that the site is currently unused and is likely to remain so in the near to distant future. Therefore, it is unlikely that there will be any future site occupiers/users. Remedial excavation workers involved in any probable remediation work in future could potentially be exposed to contaminants.

Table 8: CSM – Peel Forest Closed Landfill

Receptors and Exposure Pathway	Linkage	Assessment
Direct human contact/ingestion/ inhalation (i.e., of asbestos fibres) with contaminated soils or landfill waste (including small quantities of potentially hazardous wastes and sharp objects)	Current: Potentially Complete	Although elevated contaminant contaminants and asbestos are present within the landfill waste, the thin cover layer has good grass cover and provides a reasonable barrier to the underlying impacts. As there are no current, or foreseeable future site users/occupiers, there is considered to be no current risk. However, there is some protruding waste, so it is recommended anybody accessing the site (i.e., for inspections/monitoring visits/maintenance) wears suitable personal protective equipment (PPE) including steel capped boots and cut resistant gloves to manage this risk. The site should not be used for any other land use/activity unless a risk assessment is undertaken to assess the level of risk associated with that land use/activity.
	Future: Potentially Complete	It is probable disturbance of the landfill materials will be required as part of any remedial work in future. As such, the exposure pathway via human contact and/or ingestion pathways is potentially complete, and a human health risk would exist. Any risk to excavation workers posed would be expected to be managed by appropriate health and safety measures under the Health and Safety at Work Act 2015, the Health and Safety at Work (Asbestos) Regulations 2016, the preparation of a site-specific Remedial Action Plan (RAP) and the implementation of robust health and safety procedures. Based on the asbestos soil results, the BRANZ (2017) asbestos guideline document requires any soil disturbance works associated with remedial activities will need to be undertaken as 'Class B' removal works. Contaminant exposure risks can be appropriately mitigated by contractors wearing the appropriate PPE and minimising direct and indirect contact with soil. On this basis, the risk to site workers from these contaminants is considered to be acceptably low.

Table 8: CSM – Peel Forest Closed Landfill

Receptors and Exposure Pathway	Linkage	Assessment
		A minimum 0.5 m landfill cap and erosion protection would be required if the site was to remain as is to manage this risk long term or for other land use activities to be undertaken on it.
Exposure and discharge of wastes into the environment from natural hazards	Current and Future: Potentially Complete (surface water and aquatic ecosystems)	Interim remedial measures have removed landfill waste from the edge of the gully and there is currently no exposed landfill waste face. Waste debris is however intermixed through the natural soils in the 'fall' debris beneath the gully terrace edge on the riverbed. This is currently protected from erosion by the river by the embankment constructed as part of the previously completed river engineering works. However, future flood events may overwhelm the river engineering works and expose the terrace to further fluvial erosion leading to further terrace collapse back into the gully and main landfill area. This presents a risk of further waste and contaminated sediment exposure and loss to the Rangitata River. Flood events may also overwhelm the constructed embankment exposing the current waste debris in the 'fall' material on the riverbed to direct erosion from the river. A potential risk therefore exists for future flood/rainfall events causing erosion of the terrace exposing landfill waste. Depending on the severity of the rainfall/flood event, this could be catastrophic if the main body of the landfill is exposed and falls into the river.

Table 8: CSM – Peel Forest Closed Landfill

Receptors and Exposure Pathway	Linkage	Assessment
Generation of leachate migrating into groundwater/surface water	Current: Potentially Complete (surface water quality and aquatic ecosystem, groundwater and human health)	The current cover thickness across the landfill is not sufficient and can be <0.1 m thick. Therefore there is a risk of leachate generation associated with rainfall infiltration through the waste. Prior to interim remedial works overland flow was directed over the terrace edge and down the gully during stormwater events leading to the potential for stormwater to infiltrate down through the landfill during high rainfall events. Both situations have the potential for leachate to be generated and contaminants to be mobilised during a rainfall event. However, any leachate generated would originate >10-15 m vertical distance from the groundwater table and the natural soils would provide some level of attenuation through sorption, volatilisation, and biodegradation. This is supported by the groundwater sampling showing no obvious leachate impacts in groundwater beneath the site. There are there are no nearby downgradient bore users who would be affected by leachate impacts. The primary receptor is the Rangitata River and given the high dilution potential, a significant level of leachate migration would be required before any observed impact to the water quality would be observed. On the basis of the absence of any notable leachate impacts in groundwater beneath the site, the risk of leachate impacts on groundwater users and the Rangitata River are currently considered to be low.
	Future: Potentially Complete (surface water quality and aquatic	During any future remedial works, it is likely the cover material will be removed and the waste be exposed directly to rainfall and/or areas of the landfill that have not been investigated to date may contain leachate (i.e., waste between test pits and >4 m depth). Risks of leachate generation can be reduced by redirecting stormwater flow away from the landfill during the earthworks; and by staging

Table 8: CSM – Peel Forest Closed Landfill

Receptors and Exposure Pathway	Linkage	Assessment
	ecosystem, groundwater)	any excavations in a way to reduce the area of exposed waste as remedial works progress. Controls and measures to manage any leachate encountered would be included in the site-specific remedial action plan (RAP).
Generation of LFG/volatile contaminants leading to inhalation or accumulation in enclosed spaces/ excavations	Current: Incomplete	There is no permanent human occupancy or enclosed building at the site. The closest dwelling is located 20 m to the north on a neighbouring property. Ambient gas monitoring completed during test pitting did not record any alarms during the works. The results of gas monitoring from bores installed in and beside the landfill indicate the landfill does not appear to be generating sufficient LFG to be considered a source for LFG migration so the risk to nearby land users is considered incomplete. This is not unexpected given the age of the landfill.
	Future: Potentially Complete (site workers)	It would be expected that some pockets of LFG may still be present and could be encountered during any intrusive works and therefore would need to be managed appropriately. Management controls would be outlined in a site-specific RAP and would likely include provisions for monitoring of atmospheric conditions via personal gas monitor.
Ingestion by terrestrial ecosystem	Current and future: Potentially Complete	Exposed pieces of landfill waste have been observed across the surface of the site and are also present in the toe of the terrace beneath the gully where waste debris became mixed through natural soils during the terrace collapse. There is a risk of further exposure and loss of landfill waste to the environment due to ongoing fluvial erosion. As such, a potential risk to terrestrial species within the Rangitata River system exists.

In summary, based on the above, the current risks from the landfill in its current state associated with solid waste, leachate or LFG to identified human or environmental (i.e., groundwater and surface water, the Rangitata River in this case) receptors is either incomplete or considered to be currently low. The site is currently unused and is likely to remain so in the near to distant future. With a thin cover layer above the landfill and vegetation established across the site, there is an acceptably low risk of asbestos fibres and volatiles being blown onto neighbouring sites as long as the landfill waste remains undisturbed. Testing has also shown that the risk from leachate impacts, and LFG is currently low.

There are a number of potentially complete pathways associated with any future remedial works that involve disturbing the landfill waste which include direct contact with waste, leachate generation and LFG for site workers. These risks would need to be managed by the development of a suitable RAP for any landfill disturbance activities.

The current risk assessment assumes that the landfill remains in its current state. The vulnerability of the landfill to erosion means that this is unlikely and the potential for landfill waste exposure as a result of rainfall/flood events is high and cannot be reliably predicted. Depending on the severity of the rainfall/flood event, this could have catastrophic effects if the main body of the landfill is exposed and falls into the river. The vulnerability of the landfill to erosion is therefore the driver to mitigating the risks identified for this landfill.

A landfill remedial options assessment process is currently being carried out and will be informed in part by this DSI report. Any potential exposure pathways for earthworks contractors, future occupants/users of the site and site neighbours will be reassessed following the selection of the preferred remedial option.

7.0 Other Considerations

7.1 Suitability of Soils and Waste Materials to Remain Onsite

The waste observed to date is predominantly inert, however landfill waste is heterogeneous by nature so the possibility exists for contaminant concentrations to vary over other areas and depths at the site as well as the potential for pockets of hazardous materials, including ACM and chemical containers. However, as there are no identified human receptors and no leachate impacts have been identified through groundwater monitoring, the risk is currently considered to be acceptably low for the landfill waste to remain in situ if the landfill was to remain in its current state. The risk of future landfill disturbance could be mitigated through the development of a RAP and improved surface cover to manage long term risks or for other land use activities to be undertaken on site.

However, as mentioned previously, the vulnerability of the landfill to erosion means that the landfill remaining in its current state is unlikely and the potential for landfill waste exposure and therefore increased risks to human health and the environment is high. The risks associated with erosion of the landfill through flood effects in the Rangitata River and/or overland flow of stormwater down the gully would need to be mitigated with a high level of assurance if leaving the landfill material insitu was to be considered.

7.2 Offsite Disposal Requirements and Approvals

The following disposal options could be considered if remedial excavation of the landfill is the preferred remedial option.

7.2.1 Cover Material

The Cover Material (when encountered) was found to be thin. Based on this observation, it may not be practical to attempt separating this material from the main waste body of the landfill if removed as part of any remedial works. If an attempt is made to separate the 'Cover Material' from the remaining underlying waste materials, this should be done under supervision of the SQEP for contaminated land. Based on the results of the soil sampling, this material could be suitable for disposal as cleanfill or reused on site. However, since one sample recorded heavy metal concentrations slightly above background levels, acceptance of the material would need to be discussed with the cleanfill facility and would likely require additional testing during the works. Alternatively, the cover material could be disposed of at Hororata Managed Fill, which has a less conservative waste acceptance criteria (i.e., subject to the approval of the operator). Care would need to be taken to ensure no cross contamination occurs with the underlying contaminated 'Waste Mixture'. The material could also be used as bulk fill/cover material at Redruth Landfill or other similar controlled facility.

7.2.2 Waste Mixture

Based on the results of the soil sampling, the Waste Mixture (with asbestos concentrations up to 0.01828 % w/w asbestos) would need to be disposed of at a landfill authorised to receive this level of contaminated soils as "special waste". Options for off-site disposal could include Redruth Landfill and Hororata Managed fill, subject to the approval of the operator and screening of the soil matrix. Screening the material to separate larger waste materials from the soil matrix would provide the option to dispose of these two fractions separately. This may also allow for larger boulders and cobbles to be separated, cleaned and retained on site, provided this remedial process can be validated.

Leachate testing at the analytical laboratory has shown this material mostly complies with Class A landfill acceptance criteria. Although a couple of samples recorded zinc concentrations above criteria, this should be adequately addressed during the mixing that will occur during excavation, screening and loading of soils, favouring acceptance at a Class A landfill. However, acceptance of this material will be at the discretion of the landfill operator. Results should be compared to the acceptance criteria for the preferred landfill.

7.2.3 Soil-Waste Mixture

Based on the results of the soil sampling, the Soil-Waste Mixture material could be disposed of at Redruth Landfill or Hororata Managed Fill, subject to the approval of the operator.

Although no asbestos was detected within the analysed samples (soil matrix), due to the heterogeneous nature of the landfill it is possible asbestos may be present in pockets of this material, which has been observed to contain anthropogenic fragments. In addition, separating this material from the Waste Mixture is subjective. Based on this, it could be more practical to treat the Waste Mixture and Soil Waste Mixture the same (i.e., as special waste) for disposal purposes.

7.2.4 Visibly Clean Soil

Visibly clean soil includes both pockets of bulk soil placed into the landfill either as cover or disposal at the time of operation, or the natural soils beneath the landfill waste (i.e., no evidence of any anthropogenic materials).

Soil sampling of a thick clay layer encountered during test pitting showed that it is possible that large pockets of homogenous soil may be encountered during large remedial excavation works. Testing of the clay layer did show the presence of some slightly elevated contaminant concentrations above background levels, but given it was absent of any visible ‘waste’ materials, could be segregated during removal and taken to a suitable disposal facility. This would only be beneficial if large volumes of homogeneous pockets of soil are encountered.

There will be an interface between the waste and underlying natural soil and based on preliminary testing as part of this investigation, some leaching has occurred, but appears to be limited to <1.0 m (note the deepest areas of landfill have not been assessed). The extent of removal of the underlying natural soils would be dependent on the overall remedial goal of the site (i.e., remediate to reported background levels, sediment guideline values or to meet contaminant standards for a specific land use criteria). This material could easily be segregated from the waste material during removal for separate handling and disposal.

Both scenarios would require segregation during removal and an area to quarantine until further testing can be undertaken to confirm where the soils could be taken for disposal. This includes cleanfill, managed fills or used as bulk fill/cover material at Redruth Landfill or other similar controlled facility.

Confirmation of the soil disposal options and further details on the handling and disposal of the material would form part of the RAP.

7.3 Consideration of the NESCS

The NESCS seeks to control activities on contaminated land to protect human health. The regulations apply to land, which is described as having, has had or is more likely than not to have had an activity or industry described in the HAIL undertaken on it. As discussed in Section 4.0, the site's past use classifies it as a HAIL site. Therefore, under regulation 5(7), the NESCS regulations must be taken into consideration for any relevant future activities on the piece of land as described in sub-clauses (2) – (6) of regulation 5:

> *(2) An activity is removing a fuel storage system from the piece of land or replacing a fuel storage system in or on the piece of land.*
>
> *(3) An activity is sampling the soil of the piece of land, which means sampling it to determine whether or not it is contaminated and, if it is, the amount and kind of contamination.*
>
> *(4) An activity is disturbing the soil of the piece of land.*
>
> *(5) An activity is subdividing land.*
>
> *(6) An activity is changing the use of a piece of land which, means changing it to a use that, because the land is as described in sub clause (7), is reasonably likely to harm human health.*

It is likely that the landfill will be remediated in future to mitigate against further loss of landfill waste into the receiving environment. As such, it is expected that significant soil disturbance associated with remedial earthworks would occur as per NESCS regulation 5(4). Based on the results of the soil sampling investigation and presence of contaminants (e.g., soil asbestos concentrations) above the relevant criteria in the context of a recreational land use (conservatively adopted for the site); any soil disturbance exceeding the NESCS limits on the volume of soil disturbance (no more than 25 m^3 per 500 m^2 is disturbed), soil removal (no more than 5 m^3 per 500 m^2 is removed from the site per year) and duration of works (no longer than two months) would require resource consent under a **restricted discretionary** status. In the context of a restricted discretionary activity under the NESCS, the controls will predominantly relate to the management of the remedial excavation works and the offsite disposal of waste and waste-soil mixes, which would need to be outlined in a site-specific RAP for the landfill remediation.

7.4 ECan Resource Consenting Matters

Given the site is a confirmed HAIL site, resource consents will be required from ECan under the Land and Water Regional Plan (LWRP) for any remedial works undertaken. The type of consent required would be dependent on the remedial works being undertaken, however, it is expected that the following consents would be required to be obtained for most activities:

- Land use for earthworks and vegetation clearance within 5 m of a river (Rule 5.169);
- Land use for earthworks over an aquifer (Rule 5.176); and
- Discharge consent for construction phase stormwater (Rule 5.94B)

The consenting requirements should be assessed by a suitably qualified RMA planner.

8.0 Conclusions

PDP has undertaken a number of investigations at the site between 2019 and 2023 to investigate the extent and nature of Peel Forest Closed Landfill and any associated environmental effects. The works have been undertaken in response to rainfall/flood events, which have caused erosion of the river terrace and exposure of landfill waste, to support the development of a remedial options assessment to identify the most suitable remedial strategy for the landfill.

The site has been used as a municipal landfill from c.1962 to 2004 and received waste from the local and surrounding settlements. Since the landfill closure the site has been used for livestock grazing (i.e., horses up until 2020) but is now vacant. During recent years the Rangitata River channel has migrated towards the west resulting in terrace toe erosion and resulting in exposure and loss of some waste, particularly within the gully area, to the Rangitata Riverbed. Erosion of the gully terrace edge has also been compounded by overland flow from the wider catchment, which is naturally being directed to the gully.

The erosion of the terrace has resulted in exposure of a surficial layer of waste within the gully area and some loss of this waste onto the riverbed. Interim remedial works have pulled the exposed waste back from the gully terrace edge and stabilised the gully area, however, some waste material still remains on the riverbed within the ‘fall’ debris zone. River engineering works have also been undertaken to reduce the immediate threat of the potential loss of the main body of the landfill during future river flood flow events to allow a long-term remedial solution to be applied. However, these mitigative measures are considered temporary and are likely to be overcome by natural fluvial processes in future.

A summary of the key information obtained during the investigation works is as follows:

- A geophysical survey of the landfill indicated the waste was up to 9 m deep within the filled gully area. The total volume of waste was estimated at 18,000 m^3 (in situ). This excludes the waste on the riverbed within the ‘fall’ debris.

- Two monitoring bores installed between the landfill and 30 m high river terrace. The groundwater table has been measured between 24.6 and 25.9 m bgl at the site indicating there is at least 10-15 m of natural soils between the base of the landfill and groundwater table. Groundwater sampling showed no definitive evidence of obvious leachate impacts in groundwater beneath the site.
- A series of test pits were excavated within and around the landfill to aid with the delineation and enable the waste to be characterised. A summary is as follows:
  - A thin cover layer (generally <0.1 m) was observed above the majority of the landfill.
  - The landfill was not lined, although there were areas of layers of low permeability soils, however, this is likely associated with disposal of material or interim cover as opposed to any direct engineering (i.e., lining) consideration.
  - Localised perched water was noted entering a test pit at 1.7 m depth. Installation of shallow bores within four of the test pits showed no evidence of any water/leachate when inspected approximately 1 week later.
  - The materials encountered can be divided into 'Cover' (either a thin layer of topsoil or discontinuous layer of sandy gravel); 'Waste Mixture' (a high proportion of anthropogenic waste in a soil matrix); 'Soil-Waste Mixture' (soil with some fragments of waste materials); and 'Visibly Clean Soils'. The proportion of soil in the landfill waste varied between test locations but was the predominant fraction in all cases (between 54 and 91%). Soil therefore makes up a significant proportion of the landfill material.
  - The waste types observed included **Timber** (including fence posts, branches, tree trunks, woodchip, sawdust), **Plastic** (including bale/silage wrap, food and drink containers, netting), **Metal** (including wire, vehicle parts), **Textiles** (including old clothing, rags and shoes, rope, netting), **Building materials** (concrete, brick, fibre cement sheet (PACM)), and **Animal bones** (a few observed in each screened test hole). The dominant waste type (excluding soil) was plastic in most test pits (up to 76%), with high levels of timber (up to 46%) and metals (up to 25%) also observed.
  - A metal vehicle fuel tank was observed in one location; however, no other large chemical containers were encountered.
  - The surface Cover material showed contaminant concentrations below the residential/recreational guideline criteria (i.e., suitable for the current land use).

  - The Waste Mixture and Soil-Waste Mixture material showed the highest concentrations of contaminants (as to be expected) with heavy metals, OCP and TPH being recorded above background levels and ANZG (2018) default sediment guidelines. The majority of the samples showed it was acceptable for disposal at Redruth Landfill or similar licenced facility.
  - ACM fragments were visually detected in the majority of the test pits suggesting asbestos was generally present throughout with soil sampling showing asbestos fines up to 0.01828% w/w and above the recreational land use criteria. Asbestos will therefore be the driver for controls around the handling and disposal of the waste. Based on the results the works would be required to be undertaken under Class B controls under BRANZ (2017).
  - Trials successfully segregated bulk waste material using a 25 mm screen, however, the sorting of the waste materials and finding a suitable reuse/recycling point may prove difficult given the waste was 'dirty' and would likely need to be cleaned. The potential for asbestos to be present on the items adds further complication for handling and disposal. Items such as large boulders or other smooth surfaces could be cleaned and reused onsite and would need to be considered during any remedial excavation works.
  - Sampling of the underlying natural soils was limited to three locations and did not include beneath the deepest areas of fill, but indicates that some degree of leaching has occurred, although does not appear to be widespread or significant and limited to <1 m below the waste. If an additional 1 m of soil was removed from beneath the waste, this would add an additional 5,000 m^3 to the total volume of material to be excavated.
- LFG monitoring with the shallow test pit bores showed generally low levels of LFG and no flow rate (pressure). The monitoring bores away from the landfill showed no methane, however, carbon dioxide was recorded up to 4.0%. The low-level readings are not unexpected given the age of the landfill and support the observations of minimal organic material in the waste.

A risk assessment for the landfill in its current state shows that the risks to human health and the environment are either incomplete or considered to be currently low. This is because the site is currently unused and is likely to remain so in the near to distant future, a cover (albeit thin) manages the current risk of contaminants in the waste, there is no appreciable LFG generation and leachate does not appear to be significantly affecting groundwater quality beneath the site. Risks associated with future landfill disturbance could be mitigated through the development of a RAP and improved surface cover to manage long term risks or for other land use activities to be undertaken on site. However, the current risk assessment assumes that the landfill will remain in its current state. The vulnerability of the landfill to erosion means that this is unlikely and the potential for landfill waste exposure as a result of rainfall/flood events is high and cannot be reliably predicted. Depending on the severity of the rainfall/flood event, this could have catastrophic effects to human health and environmental receptors if the main body of the landfill is exposed and falls into the river. The vulnerability of the landfill to erosion is therefore the driver to mitigating the risks identified for this landfill.

With regard to the NESCS, resource consent under a **restricted discretionary status** will be required from TDC for any disturbance activities that exceed the permitted activity thresholds. Additional resource consents will also likely be required (e.g., from ECan) depending on the remedial strategy selected.

9.0 References

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Southern Geophysical, February 2021. Geophysical Investigations 105 Dennistoun Road, Peel Forest, Canterbury.

10.0 Certifying Statement

I, Scott Wilson of Pattle Delamore Partners certify that:

1. This Detailed Site Investigation meets the requirements of the *Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011* (the NESCS) because it has been:
   a. done by a SQEP, and
   b. done in accordance with the current edition of *Contaminated Land Management Guidelines No 5 – Site Investigation and Analysis of Soils*, and
   c. reported on in accordance with the current edition of *Contaminated Land Management Guidelines No 1 – Reporting on Contaminated Sites in New Zealand*, and
   d. the report is certified by a suitably qualified and experienced practitioner.
2. This detailed site investigation concludes that HAIL activities have been identified over parts of the site (i.e., piece of land) and therefore, the requirements of the NESCS applicable for this portion of the site. A restricted discretionary consent for any soil disturbance above the permitted activity thresholds will be required from Timaru District Council.

Evidence of the qualifications and experience of the suitably qualified and experienced practitioner(s) who have done certified this report is provided below.

This certification applies to the date of this report.

Signed

Scott Wilson

Technical Director – Contaminated Land

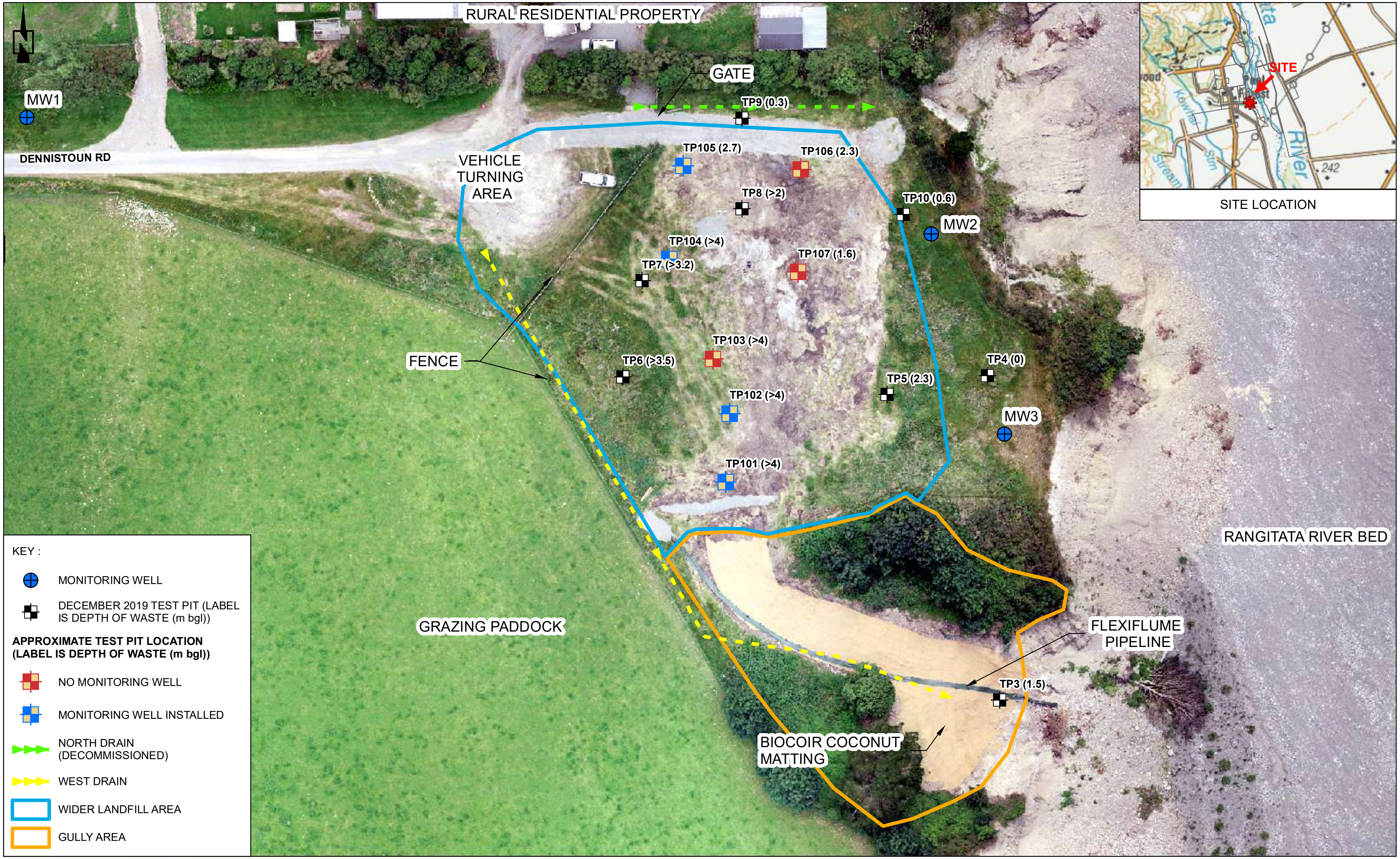
Scott Wilson – Project Director (Report Approver/SQEP)

Scott is an environmental engineer with over 23 years of consulting experience in environmental, contaminated land, air, soil-air and groundwater site investigations in New Zealand. He has a B.E (Hons)(Nat.Res)(1st Class), University of Canterbury (2000). Scott has worked on a wide variety of contaminated sites over the years, including commercial/industrial redevelopments, closed and operating landfills, former market gardens, sheep dip sites, petroleum sites, chlorinated solvent sites, timber treatment sites, asbestos sites and proposed residential and commercial subdivisions. Scott also specialises in remedial design, conducting pilot trials and implementation of remedial work for the petroleum industry and is a key technical specialist for PDP nationwide. Scott has experience in the assessment of data (including statistical analysis) to undertake risk assessments, including Tier 2 risk assessments.

Scott has familiarity with and understanding of the current contaminated land regulation and practice in New Zealand including assessments against the NESCS; and in the consenting of contaminated sites.

Appendix A: Figures

PEEL FOREST LANDFILL, DENNISTOUN ROAD, PEEL FOREST



SOURCE:
1. UAV IMAGERY FLOWN BY PATTLE DELAMORE PARTNERS LIMITED DECEMBER 2022 (<2 M ACCURACY).
2. CADASTRAL INFORMATION AND INSET SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/
AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

FIGURE 1 : PEEL FOREST LANDFILL FEATURES (SEPTEMBER 2022)

SCALE : 1:750 (A4)

0 2.5 5 10 15 20 25

METRES

PATTLE DELAMORE PARTNERS LTD

C02450Z006_TP101-107.mxd 26/09/2023 ISSUE 1

PEEL FOREST LANDFILL, DENNISTOUN ROAD, PEEL FOREST

SOURCE:
1. UAV IMAGERY FLOWN BY PATTLE DELAMORE PARTNERS LIMITED DECEMBER 2022 (<2 M ACCURACY).
2. CADASTRAL INFORMATION AND INSET SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 LICENCE.
3. DEPTH OF WASTE CONTOURS 9m bgl) INTERPRETED FROM AERIAL IMAGERY, LiDAR SURVEY, FIELD INVESTIGATIONS, TEST PITTING AND GEOPHYSICAL SURVEY

FIGURE 2 : PEEL FOREST LANDFILL INTERPOLATED WASTE THICKNESS

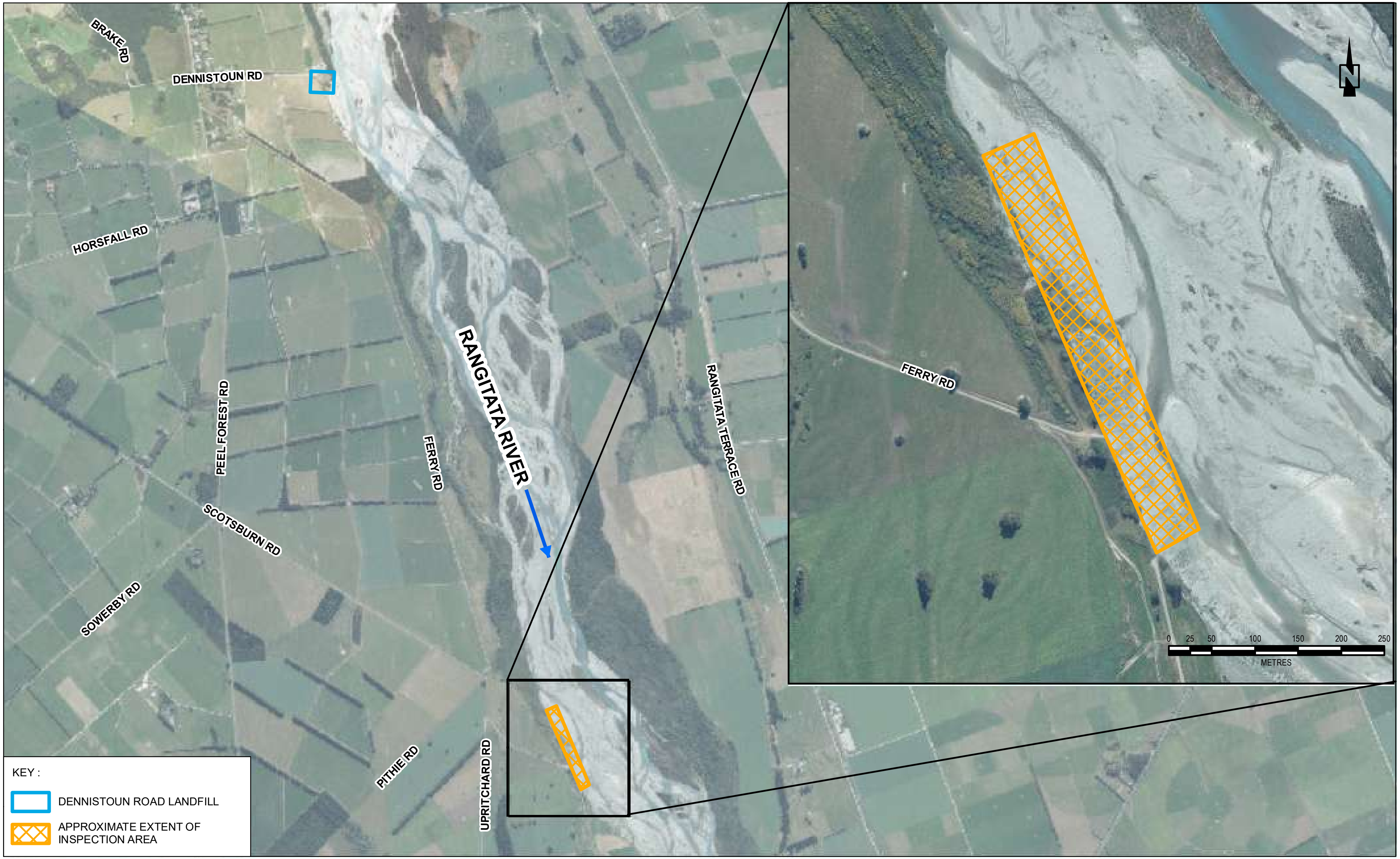
SCALE : 1:750 (A4)

0 2.5 5 10 15 20 25
METRES

PATTLE DELAMORE PARTNERS LTD

C02450Z007_Figure2.mxd 24/02/2023 ISSUE 1

PEEL FOREST LANDFILL, DENNISTOUN ROAD, PEEL FOREST



SOURCE:
1. AERIAL IMAGERY (FLOWN JANUARY 2020) SOURCED FROM CANTERBURY MAP PARTNERS ADMINISTERED BY ENVIRONMENT CANTERBURY (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION AND INSET SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

FIGURE 3 : LOCATION AND APPROXIMATE EXTENT OF RANGITATA RIVER INSPECTION (COMPLETED 20 SEPTEMBER 2022)

SCALE : 1:30,000 (A4)

0 100 200 400 600 800 1,000
METRES

PATTLE DELAMORE PARTNERS LTD

C02450Z002_River_Inspectiont.mxd 21/09/2022 ISSUE 1

DENNISTOUN ROAD LANDFILL, PEEL FOREST

KEY :

- ▬ Approximate Base of Waste Elevation Contours (m NZVD)

Interpolated Waste Depth (Estimated Total Waste Volume: 18,000 m³)

m bgl

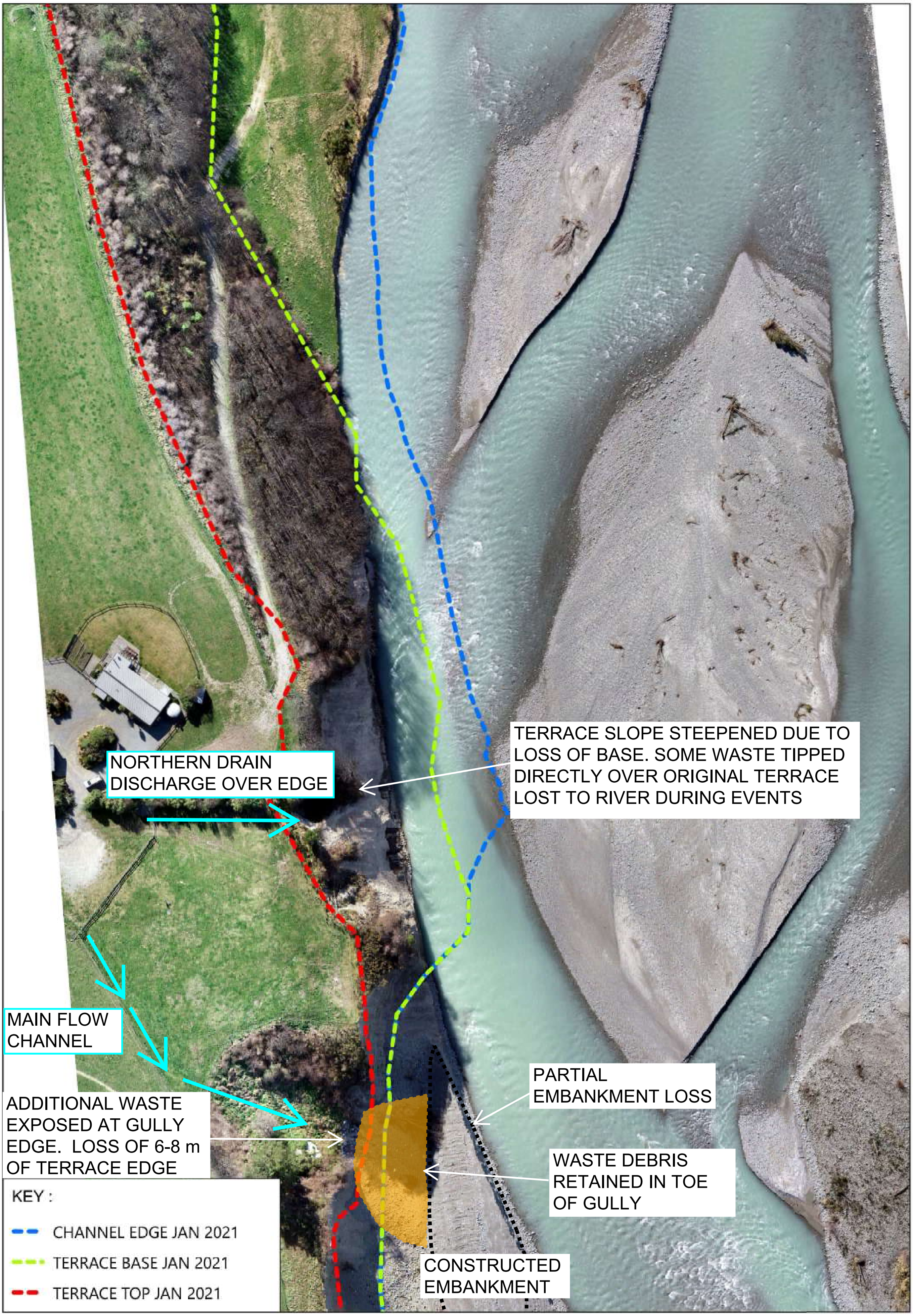
- 🟩 0 - 1
- 🟩 1 - 2
- 🟩 2 - 3
- 🟨 3 - 4
- 🟨 4 - 5
- 🟨 5 - 6
- 🟧 6 - 7
- 🟧 7 - 8
- 🟥 8 - 9
- ─ Ground Surface Elevation Contours From Ditigal Terrain Model (0.5 m Interval)

SOURCE:
1. AERIAL IMAGERY: JAN 2021 DRONE SURVEY

FIGURE 4 : ESTIMATED WASTE DEPTH

SCALE : 1:600 (A4)

0 5 10 20 30
METRES



SOURCE:
1. UAV IMAGERY FLOWN BY PATTLE DELAMORE PARTNERS LTD.

FIGURE 5 : SITE FEATURES FOLLOWING JULY/AUGUST 2022 FLOOD EVENTS

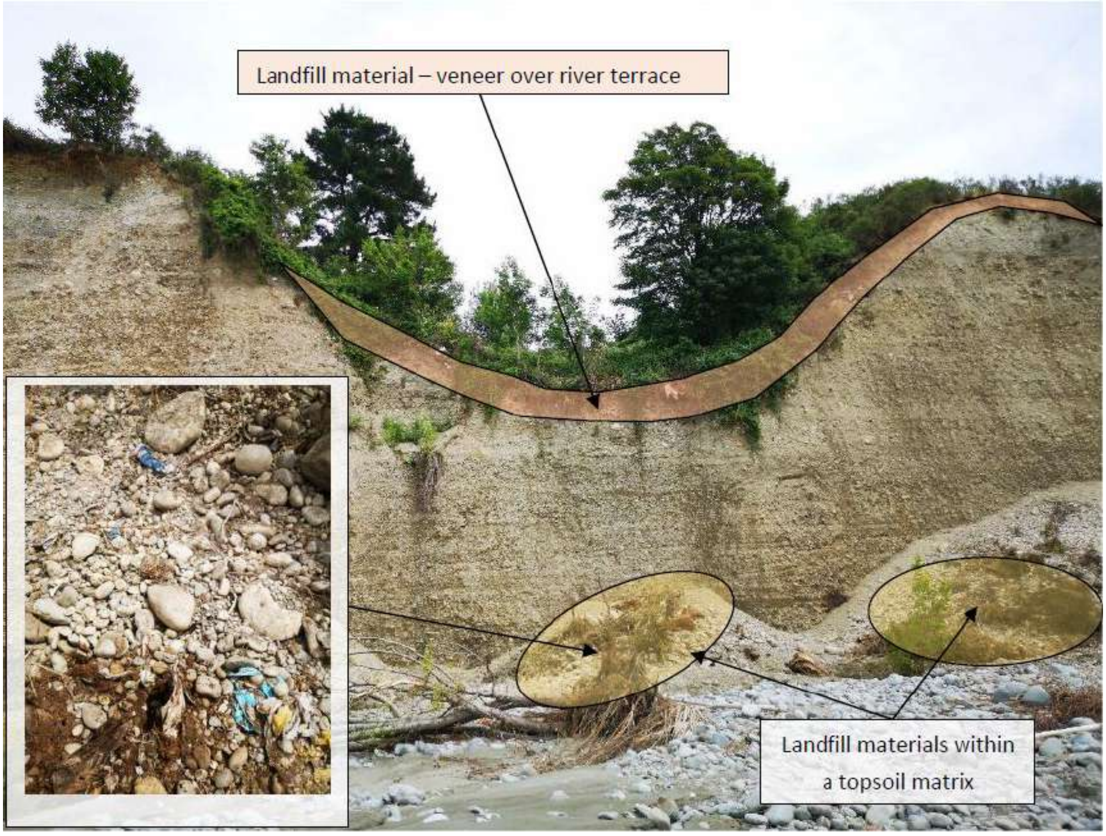
SCALE : 1:1,400 (A4)

0 12.5 25 50

METRES

C02450100.mxd 21/09/2023 ISSUE 1

Appendix B: Site Photographs



Photograph 1: View looking west towards gully from Rangitata River Bed following flood event (December 2019)

Photograph 2: View looking north west during Rangitata River Bed inspection downstream of the landfill following flood event. Inset shows waste collected from survey area. (September 2022)

Photograph 3: View looking north west from Rangitata River Bed inspection towards gully during interim remedial works. Waste materials can be seen to have fallen into the toe of the terrace. Inset shows waste materials encountered. (December 2022)

Photograph 4: View looking west from Rangitata River Bed towards gully following interim remedial works. BioCoir coconut matting and Flexiflume piping visible. (December 2022)

Photograph 5: View looking north across the site.

Photograph 6: View looking south east down the recently partially remediated gully area towards the Rangitata River.

Photograph 7: TP101 excavation

Photograph 8: TP101 arisings (before screening)

Photograph 9: Vehicle parts and large section of tree trunk encountered in TP101.

Photograph 10: TP101 <25 mm screened stockpile

Photograph 11: TP101 Stockpile of material which did not pass through the 25 mm screen.

Photograph 12: Timber separated from TP101 arisings

Photograph 13: Scrap metal separated from TP101 arisings.

Photograph 14: Selected greywacke cobbles separated from TP101 arisings.

Photograph 15: Textiles separated from TP101 arisings.

Photograph 16: TP102 Excavation.

Photograph 17: TP103 excavation.

Photograph 18: TP103 <25 mm screened stockpile in foreground. >25 mm screened stockpile can be seen behind.

Photograph 19: ACM fragments separated from TP103 arisings.

Photograph 20: Plastics and timber separated from TP103 arisings.

Photograph 21: Scrap metal separated from TP103 arisings. Inset shows some of the coarse fraction of scrap metal.

Photograph 22: ‘Cover’ material observed in TP104.

Photograph 23: TP104 arisings.

Photograph 24: TP104 excavation. Perched groundwater can be seen at the base.

Photograph 25: TP105 excavation.

Photograph 26: TP105 unscreened stockpile.

Photograph 27: ACM fragments separated from TP105 arisings.

Photograph 28: Timber separated from TP105 arisings.

Photograph 29: Brick fragments separated from TP105 arisings.

Photograph 30: Textiles separated from TP105 arisings.

Photograph 31: Ceramic fragments separated from TP105 arisings.

Photograph 32: Scrap metal separated from TP105 arisings.

Photograph 33: Plastic separated from TP105 arisings.

Photograph 34: TP105 >25 mm screened stockpile.

Photograph 35: TP105 <25 mm screened stockpile.

Photograph 36: TP106 excavation.

Photograph 37: TP106 arisings.

Photograph 38: TP107 'Cover' material and underlying 'Waste Mix'.

Photograph 39: TP107 excavation.

Photograph 40: TP107 coarse arisings that were separated out by the excavator bucket.

Photograph 41: TP107 <25 mm screened stockpile.

Photograph 42: TP107 >25 mm screened stockpile.

Photograph 43: Scrap metal separated from TP107 arisings.

Photograph 44: Timber separated from TP107 arisings.

Photograph 45: Plastic separated from TP107 arisings.

Photograph 46: View looking south east across the main landfill area following the test pitting.

Photograph 47: View looking north west across the main landfill area. Raised monitoring wells TP102 and TP104 are visible.

Appendix C: Historical Aerial Photographs

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST

SOURCE:
1. AERIAL IMAGERY SOURCED FROM RETROLENS.CO.NZ AND LICENSED FOR REUSE UNDER A CREATIVE COMMONS ATTRIBUTION 3.0 NEW ZEALAND LICENSE (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

1938 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

0 10 20 40 60 80 100

METRES

PATTLE DELAMORE PARTNERS LTD

C02450Z001_1938.mxd 31/03/2023 ISSUE 1

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST

SOURCE:
1. AERIAL IMAGERY SOURCED FROM RETROLENS.CO.NZ AND IS LICENSED UNDER A CREATIVE COMMONS ATTRIBUTION 3.0 NEW ZEALAND LICENSE (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

1962 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

0 10 20 40 60 80 100

METRES

PATTLE DELAMORE PARTNERS LTD

C02450Z001_1962.mxd 31/03/2023 ISSUE 1

SOURCE:
1. AERIAL IMAGERY SOURCED FROM CANTERBURY MAPPARTNERS ADMINISTERED BY ENVIRONMENT CANTERBURY (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

1984 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

0 10 20 40 60 80 100

METRES

PATTLE DELAMORE PARTNERS LTD

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST

SOURCE:
1. AERIAL IMAGERY SOURCED FROM RETROLENS.CO.NZ AND IS LICENSED UNDER A CREATIVE COMMONS ATTRIBUTION 3.0 NEW ZEALAND LICENSE (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

1987 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

0 10 20 40 60 80 100

METRES

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST

SOURCE:
1. AERIAL IMAGERY SOURCED FROM CANTERBURY MAPPARTNERS ADMINISTERED BY ENVIRONMENT CANTERBURY (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

1995 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

0 10 20 40 60 80 100

METRES

PATTLE DELAMORE PARTNERS LTD

C02450Z001_1995.mxd 31/03/2023 ISSUE 1

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST

SOURCE:
1. AERIAL IMAGERY SOURCED FROM CANTERBURY MAPPARTNERS ADMINISTERED BY ENVIRONMENT CANTERBURY (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

2001 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

0 10 20 40 60 80 100

METRES

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST

SOURCE:
1. AERIAL IMAGERY SOURCED FROM CANTERBURY MAPPARTNERS ADMINISTERED BY ENVIRONMENT CANTERBURY (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

2004 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

0 10 20 40 60 80 100

METRES

C02450Z001_2004.mxd 21/09/2023 ISSUE 1

SOURCE:
1. AERIAL IMAGERY SOURCED FROM CANTERBURY MAPPARTNERS ADMINISTERED BY ENVIRONMENT CANTERBURY (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

2012 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

0 10 20 40 60 80 100

METRES

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST

SOURCE:
1. AERIAL IMAGERY SOURCED FROM CANTERBURY MAPPARTNERS ADMINISTERED BY ENVIRONMENT CANTERBURY (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

2018 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

PATTLE DELAMORE PARTNERS LTD

C02450Z001_2018.mxd 31/03/2023 ISSUE 1

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST

SOURCE:
1. AERIAL IMAGERY SOURCED FROM GOOGLE EARTH PRO (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

JULY 2019 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

0 10 20 40 60 80 100

METRES

C02450Z001_2019.mxd 21/09/2023 ISSUE 1

PATTLE DELAMORE PARTNERS LTD

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST

SOURCE:
1. AERIAL IMAGERY SOURCED FROM GOOGLE EARTH PRO (MAY NOT BE SPATIALLY ACCURATE).
2. CADASTRAL/TOPOGRAPHICAL INFORMATION SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

SEPTEMBER 2020 AERIAL PHOTOGRAPH

SCALE : 1:3,000 (A4)

0 10 20 40 60 80 100

METRES

PATTLE DELAMORE PARTNERS LTD

C02450Z001_2020.mxd 31/03/2023 ISSUE 1

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST

SOURCE:
1. UAV IMAGERY FLOWN BY FOX AND ASSOCIATES (JANUARY 2021)

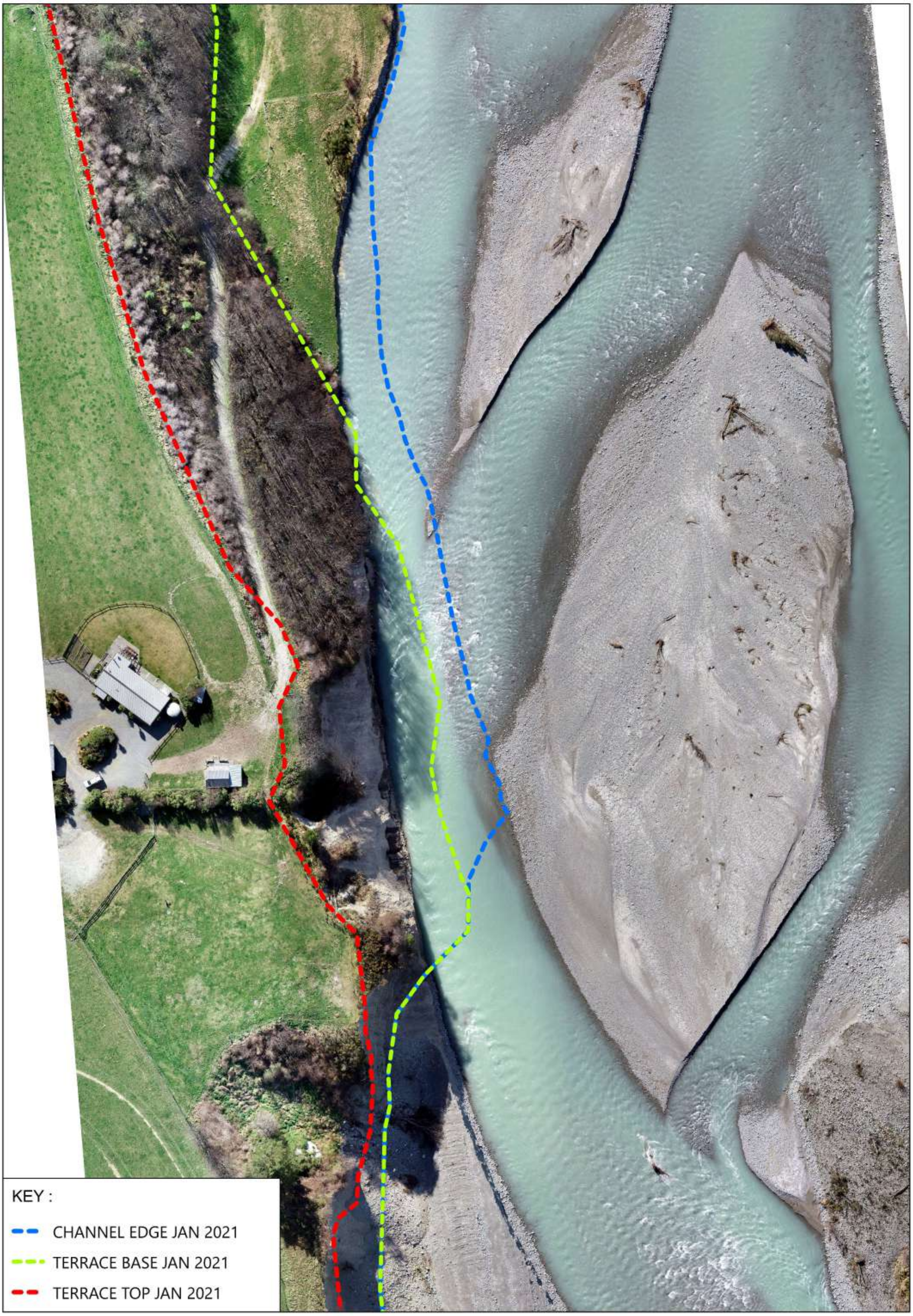
JANUARY 2021 AERIAL PHOTOGRAPH

SCALE : 1:1,400 (A4)

PATTLE DELAMORE PARTNERS LTD

C02450100.mxd 21/09/2023 ISSUE 1

DENNISTOUN ROAD CLOSED LANDFILL, PEEL FOREST



SOURCE:
1. UAV IMAGERY FLOWN BY PATTLE DELAMORE PARTNERS LTD.

SEPTEMBER 2022 AERIAL PHOTOGRAPH

SCALE : 1:1,400 (A4)

0 12.5 25 50

METRES

PATTLE DELAMORE PARTNERS LTD

C02450100.mxd 21/09/2023 ISSUE 1

Appendix D: Environment Canterbury Information

Environment
Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Dear Sir/Madam

Thank you for submitting your property enquiry from our Listed Land Use Register (LLUR). The LLUR holds information about sites that have been used or are currently used for activities which have the potential to cause contamination.

The LLUR statement shows the land parcel(s) you enquired about and provides information regarding any potential LLUR sites within a specified radius.

Please note that if a property is not currently registered on the LLUR, it does not mean that an activity with the potential to cause contamination has never occurred, or is not currently occurring there. The LLUR database is not complete, and new sites are regularly being added as we receive information and conduct our own investigations into current and historic land uses.

The LLUR only contains information held by Environment Canterbury in relation to contaminated or potentially contaminated land; additional relevant information may be held in other files (for example consent and enforcement files).

Please contact Environment Canterbury if you wish to discuss the contents of this property statement.

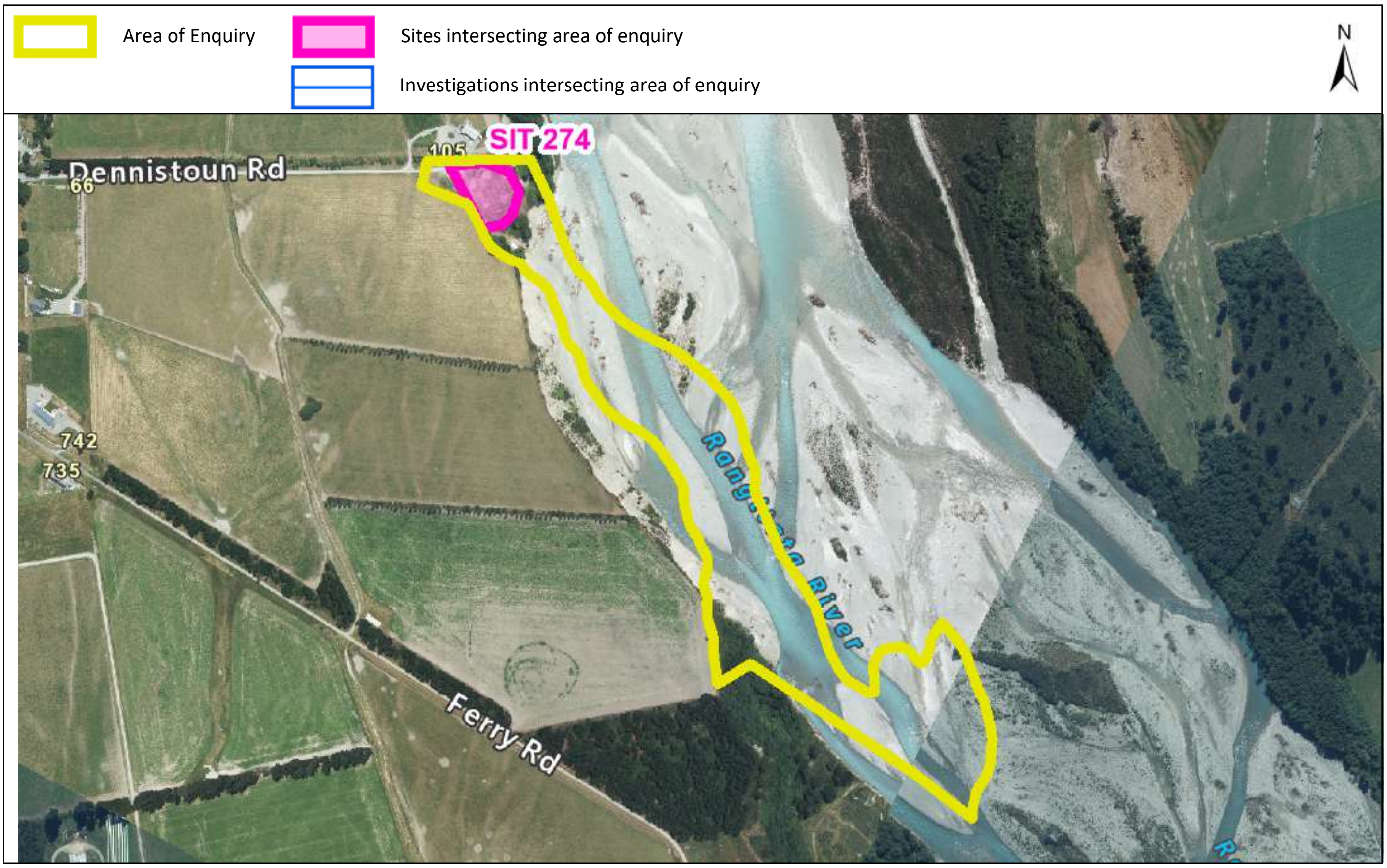
Yours sincerely

Contaminated Sites Team

Property Statement
from the Listed Land Use Register

Visit ecan.govt.nz/HAIL for more information or
contact Customer Services at ecan.govt.nz/contact/ and quote ENQ354757

Date generated: 20 September 2023
Land parcels: Crown Land (under action) Survey Office Plan 3144



The information presented in this map is specific to the property you have selected. Information on nearby properties may not be shown on this map, even if the property is visible.

Sites at a glance

▭ **Sites within enquiry area**

Site number	Name	Location	HAIL activity(s)	Category
274	Peel Forest Landfill	End of Dennistoun Road, Adjacent to Rangitata River	G3 - Landfill sites;	Not Investigated

More detail about the sites

Site 274: Peel Forest Landfill (Intersects enquiry area.)

Category: Not Investigated
Definition: Verified HAIL has not been investigated.

Location: End of Dennistoun Road, Adjacent to Rangitata River
Legal description(s): Crown Land (under action) Survey Office Plan 3144

HAIL activity(s):

Period from	Period to	HAIL activity
1960s	2002	Landfill sites

Notes:

4 Jul 2005

The fill volume is approximately 20,000 cubic metres, comprising domestic refuse 5 m thick. Landfill area is 0.4 ha, located in an old gully draining into Rangitata River.

8 Feb 2006

Discharge of landfill leachate to ground is managed by the Envrionemtn Canterbury consent CRC950949. The provisions for the closure of the landfill, ongoing monitoring and mitigation, are described in the management plan for the site ("Timaru District Council - Closed landfills Management Plan"). The main concern at Peel Forest is the potential for bank erosion, particularly as a new braid pattern developed next to the filled gully some time prior 2000. Timaru District Council has chosen to manage the risk through monitoring and investigation. Surface water from Rangitata River, both upstream and downstream of the Peel Forest Landfil, is to be monitoried for any adeverse effect, bl.

Investigations:

There are no investigations associated with this site.

Disclaimer

The enclosed information is derived from Environment Canterbury’s Listed Land Use Register and is made available to you under the Local Government Official Information and Meetings Act 1987.

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate assessment of the site. It is provided on the basis that Environment Canterbury makes no warranty or representation regarding the reliability, accuracy or completeness of the information provided or the level of contamination (if any) at the relevant site or that the site is suitable or otherwise for any particular purpose. Environment Canterbury accepts no responsibility for any loss, cost, damage or expense any person may incur as a result of the use, reference to or reliance on the information contained in this report.

Any person receiving and using this information is bound by the provisions of the Privacy Act 1993.

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Listed Land Use Register

What you need to know

Everything is connected

What is the Listed Land Use Register (LLUR)?

The LLUR is a database that Environment Canterbury uses to manage information about land that is, or has been, associated with the use, storage or disposal of hazardous substances.

Why do we need the LLUR?

Some activities and industries are hazardous and can potentially contaminate land or water. We need the LLUR to help us manage information about land which could pose a risk to your health and the environment because of its current or former land use.

Section 30 of the Resource Management Act (RMA, 1991) requires Environment Canterbury to investigate, identify and monitor contaminated land. To do this we follow national guidelines and use the LLUR to help us manage the information.

The information we collect also helps your local district or city council to fulfil its functions under the RMA. One of these is implementing the National Environmental Standard (NES) for Assessing and Managing Contaminants in Soil, which came into effect on 1 January 2012.

For information on the NES, contact your city or district council.

How does Environment Canterbury identify sites to be included on the LLUR?

We identify sites to be included on the LLUR based on a list of land uses produced by the Ministry for the Environment (MfE). This is called the Hazardous Activities and Industries List (HAIL)[1]. The HAIL has 53 different activities, and includes land uses such as fuel storage sites, orchards, timber treatment yards, landfills, sheep dips and any other activities where hazardous substances could cause land and water contamination.

We have two main ways of identifying HAIL sites:

- We are actively identifying sites in each district using historic records and aerial photographs. This project started in 2008 and is ongoing.
- We also receive information from other sources, such as environmental site investigation reports submitted to us as a requirement of the Regional Plan, and in resource consent applications.

---

[1] The Hazardous Activities and Industries List (HAIL) can be downloaded from MfE's website www.mfe.govt.nz, keyword search HAIL

How does Environment Canterbury classify sites on the LLUR?

Where we have identified a HAIL land use, we review all the available information, which may include investigation reports if we have them. We then assign the site a category on the LLUR. The category is intended to best describe what we know about the land use and potential contamination at the site and is signed off by a senior staff member.

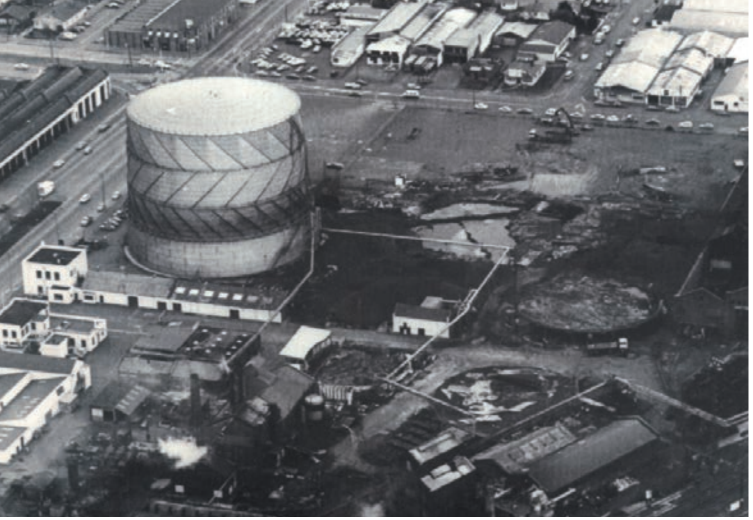
Please refer to the Site Categories and Definitions factsheet for further information.

What does Environment Canterbury do with the information on the LLUR?

The LLUR is available online at www.llur.ecan.govt.nz. We mainly receive enquiries from potential property buyers and environmental consultants or engineers working on sites. An inquirer would typically receive a summary of any information we hold, including the category assigned to the site and a list of any investigation reports.

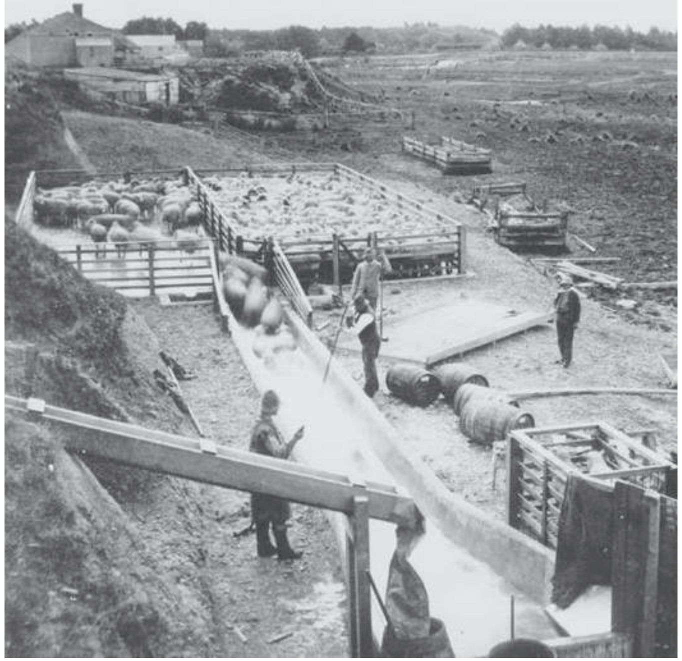
We may also use the information to prioritise sites for further investigation, remediation and management, to aid with planning, and to help assess resource consent applications. These are some of our other responsibilities under the RMA.

If you are conducting an environmental investigation or removing an underground storage tank at your property, you will need to comply with the rules in the Regional Plan and send us a copy of the report. This means we can keep our records accurate and up-to-date, and we can assign your property an appropriate category on the LLUR. To find out more, visit www.ecan.govt.nz/HAIL.



IMPORTANT!

The LLUR is an online database which we are continually updating. A property may not currently be registered on the LLUR, but this does not necessarily mean that it hasn't had a HAIL use in the past.



Sheep dipping (ABOVE) and gas works (TOP) are among the former land uses that have been identified as potentially hazardous. (Photo above by Wheeler & Son in 1987, courtesy of Canterbury Museum.)

My land is on the LLUR – what should I do now?

IMPORTANT! Just because your property has a land use that is deemed hazardous or is on the LLUR, it doesn't necessarily mean it's contaminated. The only way to know if land is contaminated is by carrying out a detailed site investigation, which involves collecting and testing soil samples.

You do not need to do anything if your land is on the LLUR and you have no plans to alter it in any way. It is important that you let a tenant or buyer know your land is on the Listed Land Use Register if you intend to rent or sell your property. If you are not sure what you need to tell the other party, you should seek legal advice.

You may choose to have your property further investigated for your own peace of mind, or because you want to do one of the activities covered by the National Environmental Standard for Assessing and Managing Contaminants in Soil. Your district or city council will provide further information.

If you wish to engage a suitably qualified experienced practitioner to undertake a detailed site investigation, there are criteria for choosing a practitioner on www.ecan.govt.nz/HAIL.

I think my site category is incorrect – how can I change it?

If you have an environmental investigation undertaken at your site, you must send us the report and we will review the LLUR category based on the information you provide. Similarly, if you have information that clearly shows your site has not been associated with HAIL activities (eg. a preliminary site investigation), or if other HAIL activities have occurred which we have not listed, we need to know about it so that our records are accurate.

If we have incorrectly identified that a HAIL activity has occurred at a site, it will be not be removed from the LLUR but categorised as Verified Non-HAIL. This helps us to ensure that the same site is not re-identified in the future.

Contact us

Property owners have the right to look at all the information Environment Canterbury holds about their properties.

It is free to check the information on the LLUR, online at www.llur.ecan.govt.nz.

If you don't have access to the internet, you can enquire about a specific site by phoning us on (03) 353 9007 or toll free on 0800 EC INFO (32 4636) during business hours.

Contact Environment Canterbury:

Email: ecinfo@ecan.govt.nz

Phone:
Calling from Christchurch: (03) 353 9007
Calling from any other area: 0800 EC INFO (32 4636)

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Everything is connected

Promoting quality of life through balanced resource management.

www.ecan.govt.nz

E13/101

Listed Land Use Register

Site categories and definitions

When Environment Canterbury identifies a Hazardous Activities and Industries List (HAIL) land use, we review the available information and assign the site a category on the Listed Land Use Register. The category is intended to best describe what we know about the land use.

If a site is categorised as **Unverified** it means it has been reported or identified as one that appears on the HAIL, but the land use has not been confirmed with the property owner.

If the land use has been confirmed but analytical information from the collection of samples is not available, and the presence or absence of contamination has therefore not been determined, the site is registered as:

Not investigated:

- A site whose past or present use has been reported and verified as one that appears on the HAIL.
- The site has not been investigated, which might typically include sampling and analysis of site soil, water and/or ambient air, and assessment of the associated analytical data.
- There is insufficient information to characterise any risks to human health or the environment from those activities undertaken on the site. Contamination may have occurred, but should not be assumed to have occurred.

If analytical information from the collection of samples is available, the site can be registered in one of six ways:

At or below background concentrations:

The site has been investigated or remediated. The investigation or post remediation validation results confirm there are no hazardous substances above local background concentrations other than those that occur naturally in the area. The investigation or validation sampling has been sufficiently detailed to characterise the site.

Below guideline values for:

The site has been investigated. Results show that there are hazardous substances present at the site but indicate that any adverse effects or risks to people and/or the environment are considered to be so low as to be acceptable. The site may have been remediated to reduce contamination to this level, and samples taken after remediation confirm this.

Managed for:

The site has been investigated. Results show that there are hazardous substances present at the site in concentrations that have the potential to cause adverse effects or risks to people and/or the environment. However, those risks are considered managed because:

- the nature of the use of the site prevents human and/or ecological exposure to the risks; and/or
- the land has been altered in some way and/or restrictions have been placed on the way it is used which prevent human and/or ecological exposure to the risks.

Partially investigated:

The site has been partially investigated. Results:

- demonstrate there are hazardous substances present at the site; however, there is insufficient information to quantify any adverse effects or risks to people or the environment; or
- do not adequately verify the presence or absence of contamination associated with all HAIL activities that are and/or have been undertaken on the site.

Significant adverse environmental effects:

The site has been investigated. Results show that sediment, groundwater or surface water contains hazardous substances that:

- have significant adverse effects on the environment; or
- are reasonably likely to have significant adverse effects on the environment.

Contaminated:

The site has been investigated. Results show that the land has a hazardous substance in or on it that:

- has significant adverse effects on human health and/or the environment; and/or
- is reasonably likely to have significant adverse effects on human health and/or the environment.

If a site has been included incorrectly on the Listed Land Use Register as having a HAIL, it will not be removed but will be registered as:

Verified non-HAIL:

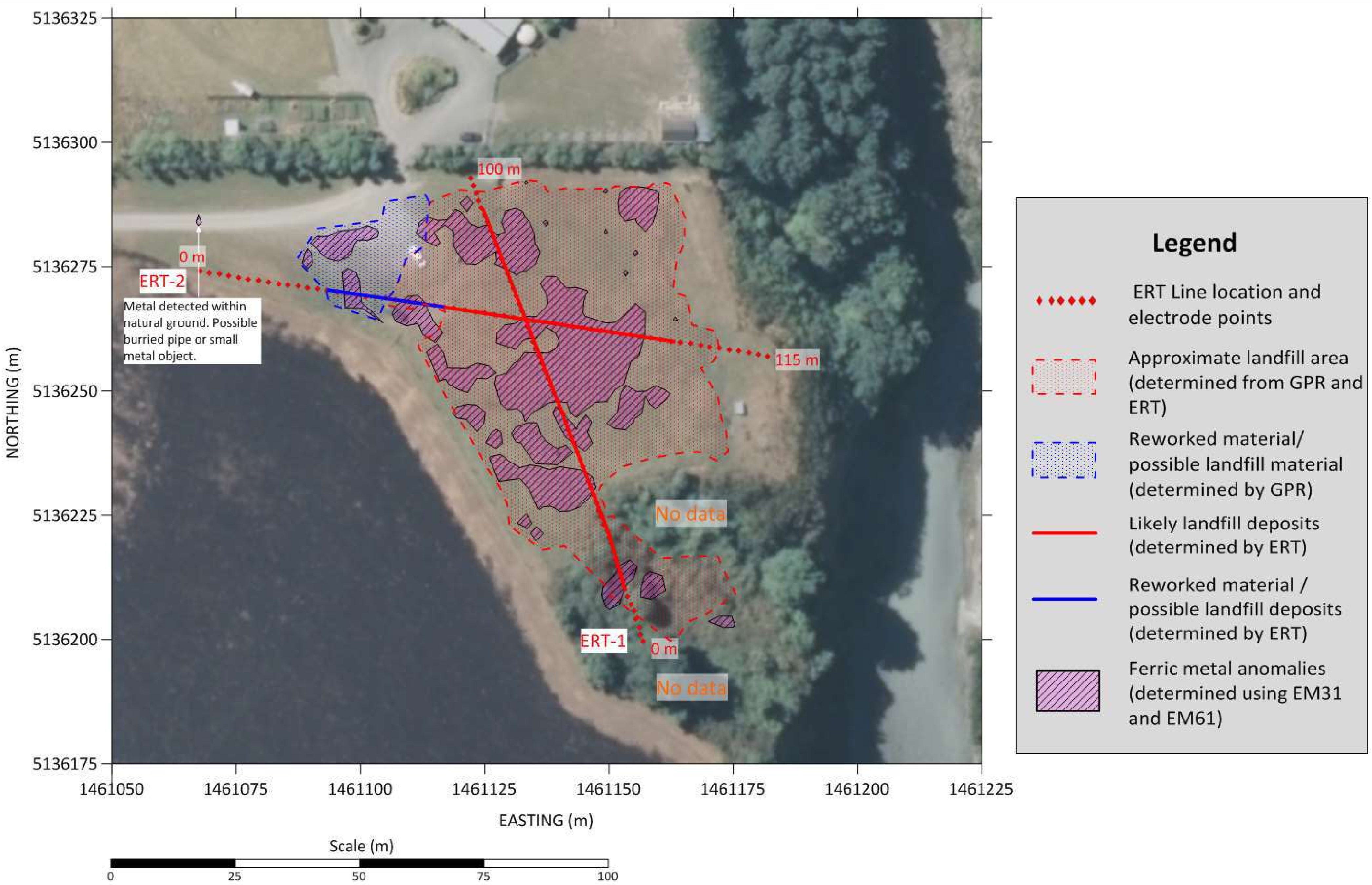
Information shows that this site has never been associated with any of the specific activities or industries on the HAIL.

Please contact Environment Canterbury for further information:

(03) 353 9007 or toll free
on 0800 EC INFO (32 4636)
email ecinfo@ecan.govt.nz

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Appendix E: Southern Geophysical Survey Figures



DRAWING- **Figure 1: Geophysical Site Investigation**

LOCATION- **105 Dennistoun Road, Peel Forest**

NOTES- Coordinates NZ2000 TM Grid.
2017-2018 Aerial photograph sourced from LINZ, Crown Copyright ©

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A3

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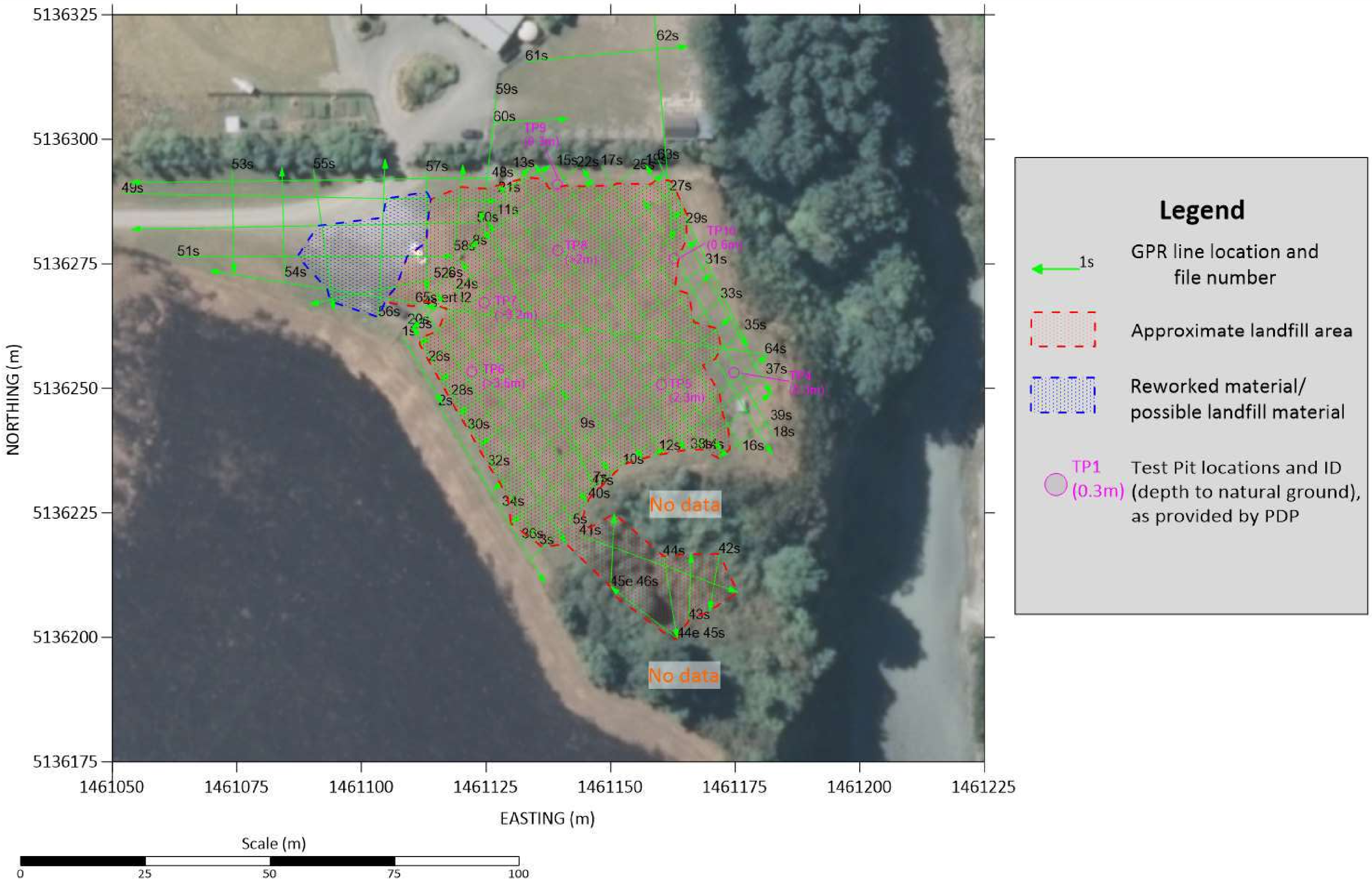
www.southerngeophysical.com



DRAWING: **Figure 2: 200 MHz GPR Site Investigation**

LOCATION: **105 Dennistoun Road, Peel Forest**

NOTES:
Coordinates NZ2000 TM Grid.
2017-2018 Aerial photograph sourced from LINZ, Crown Copyright ©
GPR
GPR lines marked by green arrows, and are labelled at the start.

N

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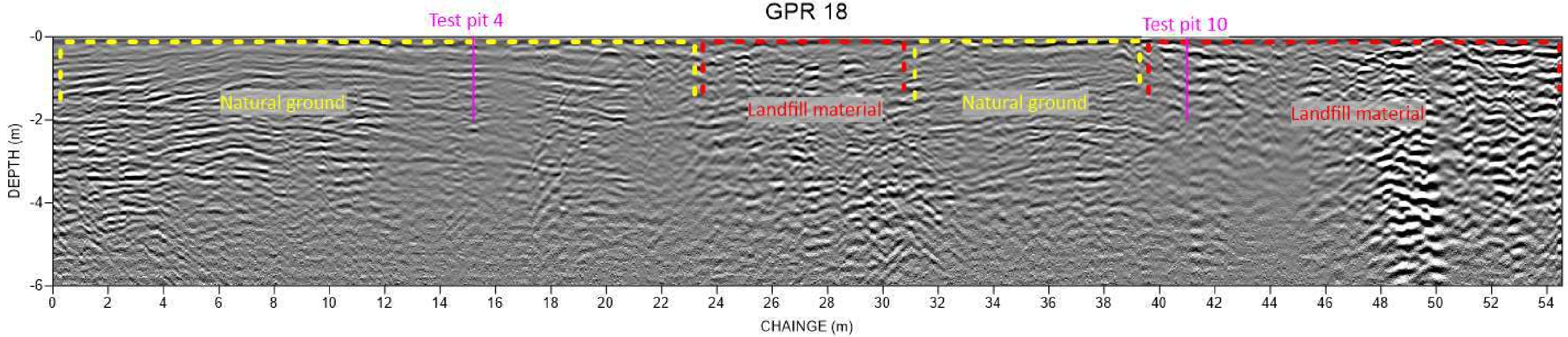
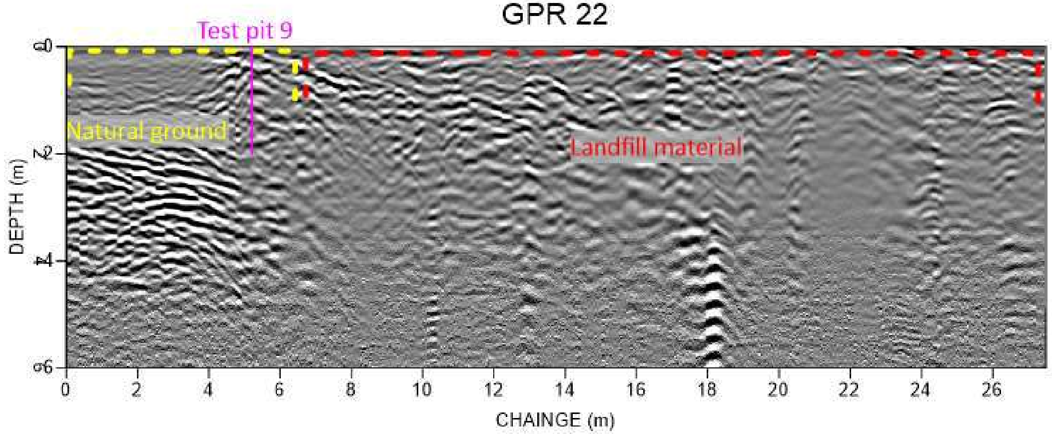
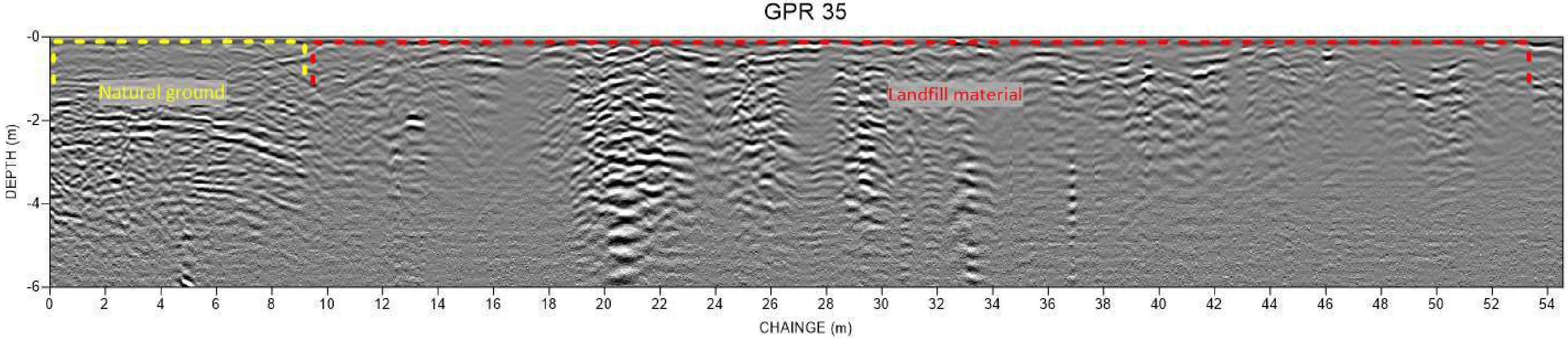
www.southerngeophysical.com



GPR 18



GPR 22



GPR 35

DRAWING: **Figure 3: Example GPR Radargrams**

LOCATION: **105 Dennistoun Road, Peel Forest**

NOTES

See site map for location of lines.

A3

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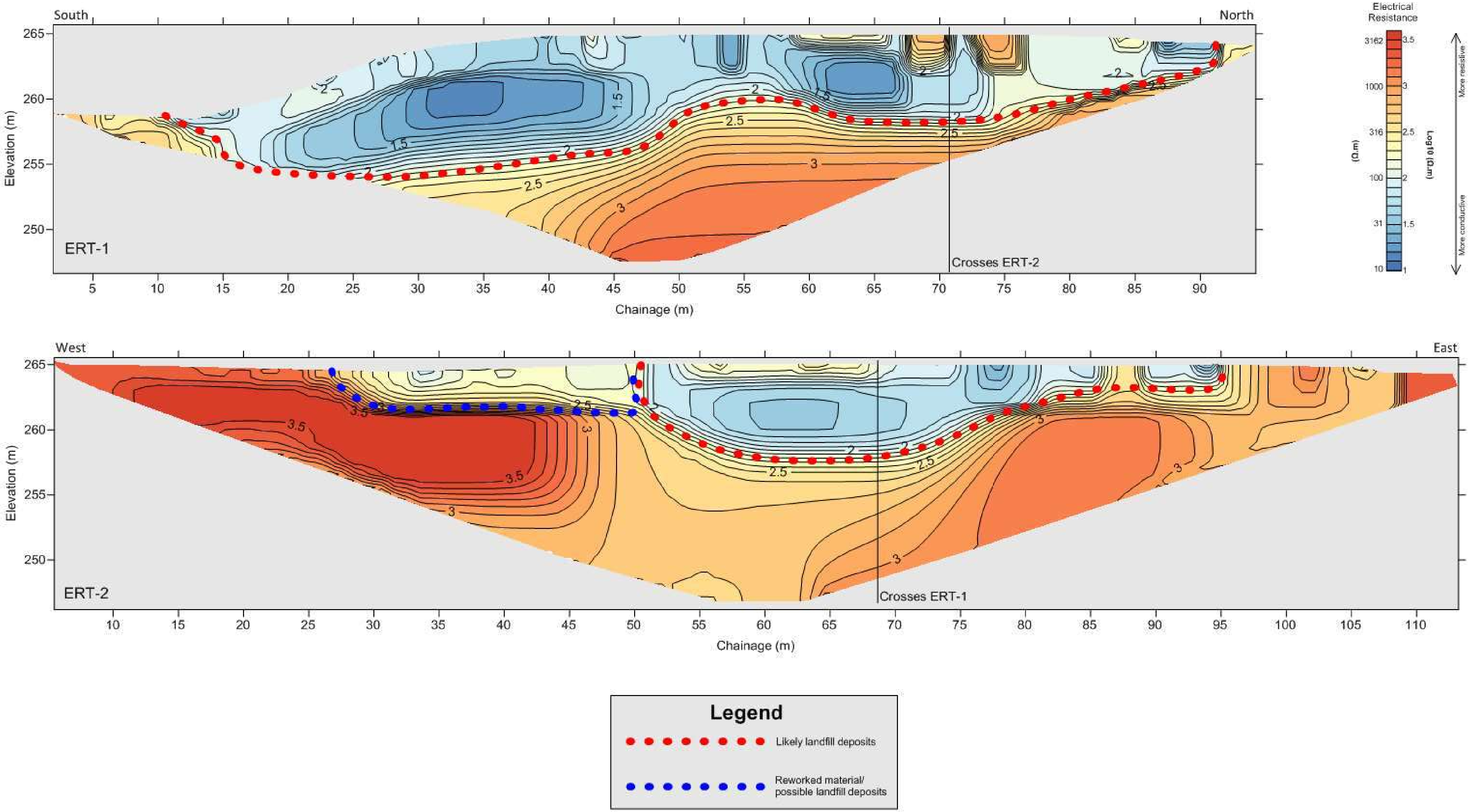
www.southerngeophysical.com



DRAWING- **Figure 4: ERT Survey Profiles**

LOCATION- **105 Dennistoun Road, Peel Forest**

NOTES- Elevation in NZGD2000 mean sea level

N

A3

Southern Geophysical Ltd
www.southerngeophysical.com

Metal detected within natural ground. Possible burried pipe or small metal object.

DRAWING- **Figure 5: EM31 and EM61 investigation map**

LOCATION- **105 Dennistoun Road, Peel Forest**

NOTES- Coordinates NZ2000 TM Grid.
2017-2018 Aerial photograph sourced from LINZ, Crown Copyright ©

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www.southerngeophysical.com

DRAWING- **Figure 6: Historic landfill locations**

LOCATION- **105 Dennistoun Road, Peel Forest**

NOTES- Coordinates NZ2000 TM Grid.
2017-2018 Aerial photograph sourced from LINZ, Crown Copyright ©

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Appendix F: Bore Logs

McMILLAN Drilling

Client: Pattle Delamore Partners

Bore No.: MW001

Project: 105 Dennistoun Road, Peel Forest

Job No.: 20884

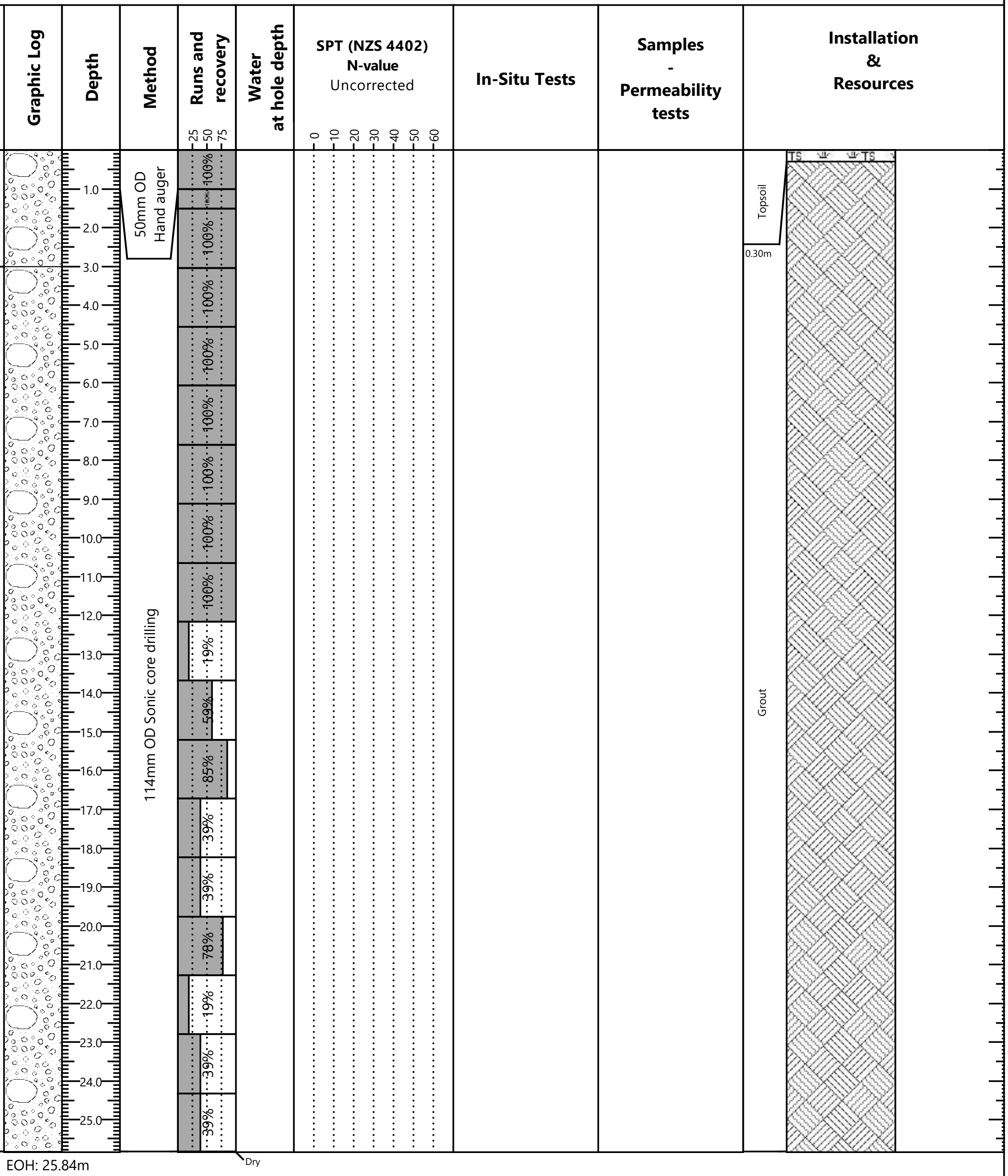
Site Location: 105 Dennistoun Road, Peel Forest
Date: 1/6/2022 - 7/6/2022
Grid Reference: 1461036.06m E, 5136293.94m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz Farias
Elevation: 0.00m
Datum: Ground
Equipment: Geoprobe 8140LC - track

Description

Sandy fine to coarse GRAVEL with some boulders and trace of silt; grey.

3.00m

Sandy fine to coarse GRAVEL with some boulders; light brown.



EOH: 25.84m

Remarks

Additional Resources:
Core boxes: -
Water added: 8000 liters
Cement: 6 bags

Generated by GEROC Core-GS

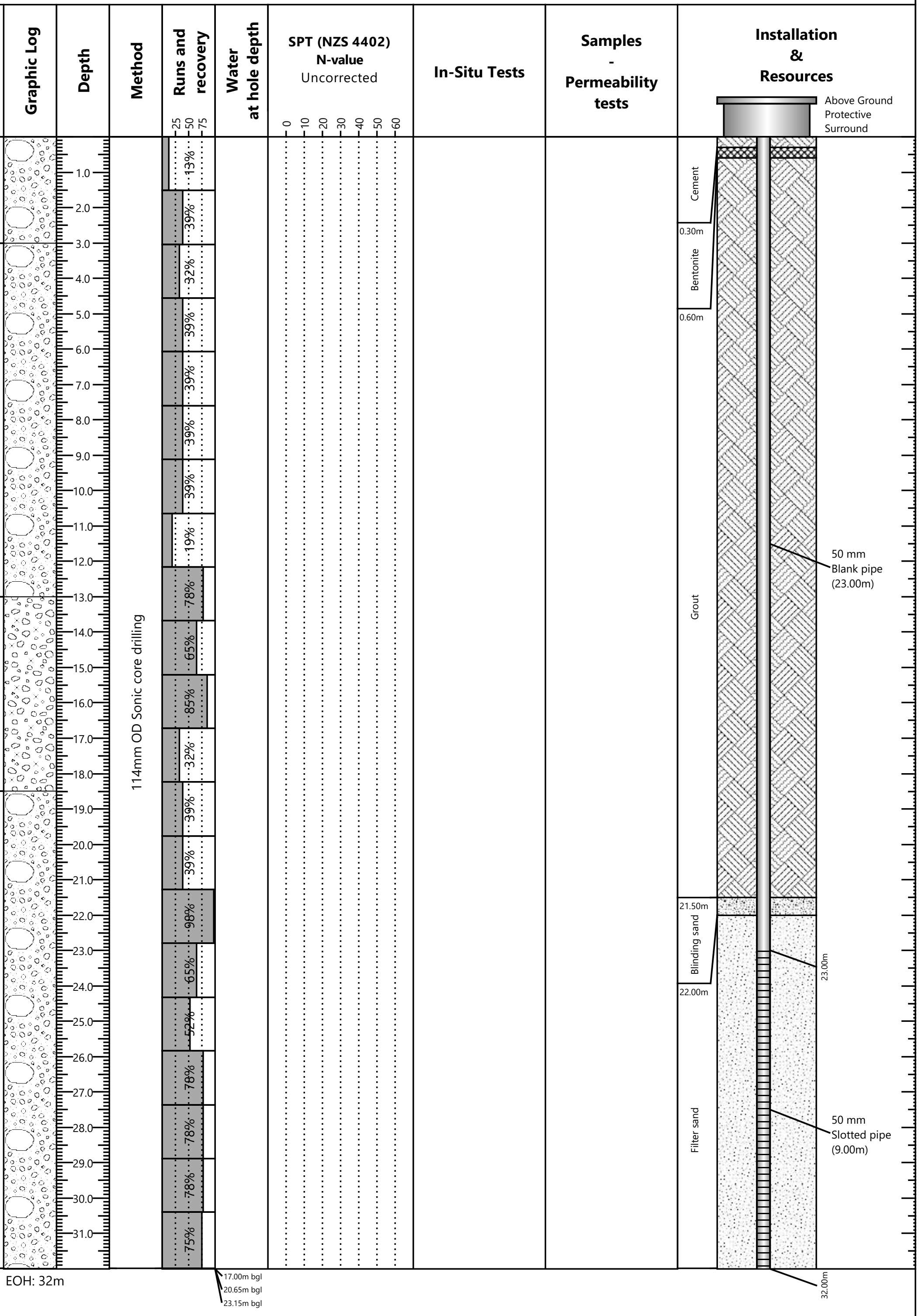
Hole Depth: 25.84m

Created: 9/06/2022 09:14:28

Client:	Pattle Delamore Partners	**Bore No.:**	**MW002**
Project:	105 Dennistoun Road, Peel Forest	**Job No.:**	**20884**

Site Location: 105 Dennistoun Road, Peel Forest
Date: 25/5/2022 - 2/6/2022
Grid Reference: 1461163.51m E, 5136281.18m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz Farias
Elevation: 0.00m
Datum: Ground
Equipment: Geoprobe 8140LC - track

Description	Depth
Sandy fine to coarse GRAVEL with some boulders and trace of silt; grey.	
Sandy fine to coarse GRAVEL with some boulders; light brown.	3.00m
Silty GRAVEL with trace of sand; grey.	13.00m
Sandy fine to coarse GRAVEL with some boulders; light brown.	18.50m



EOH: 32m

Remarks

Additional Resources:
Core boxes: -
Water added: 8000 liters
Concrete: 2 bags
Bentonite: 0.5 bag
Cement: 6 bags
Blinding sand: 0.5 bag
Filter sand: 5 bags

McMILLAN Drilling

Client: Pattle Delamore Partners

Project: 105 Dennistoun Road, Peel Forest

Bore No.: MW003

Job No.: 20884

Site Location: 105 Dennistoun Road, Peel Forest

Date: 23/5/2022 - 25/5/2022

Grid Reference: 1461177.6m E, 5136247.52m N (NZTM) - Map or aerial photograph

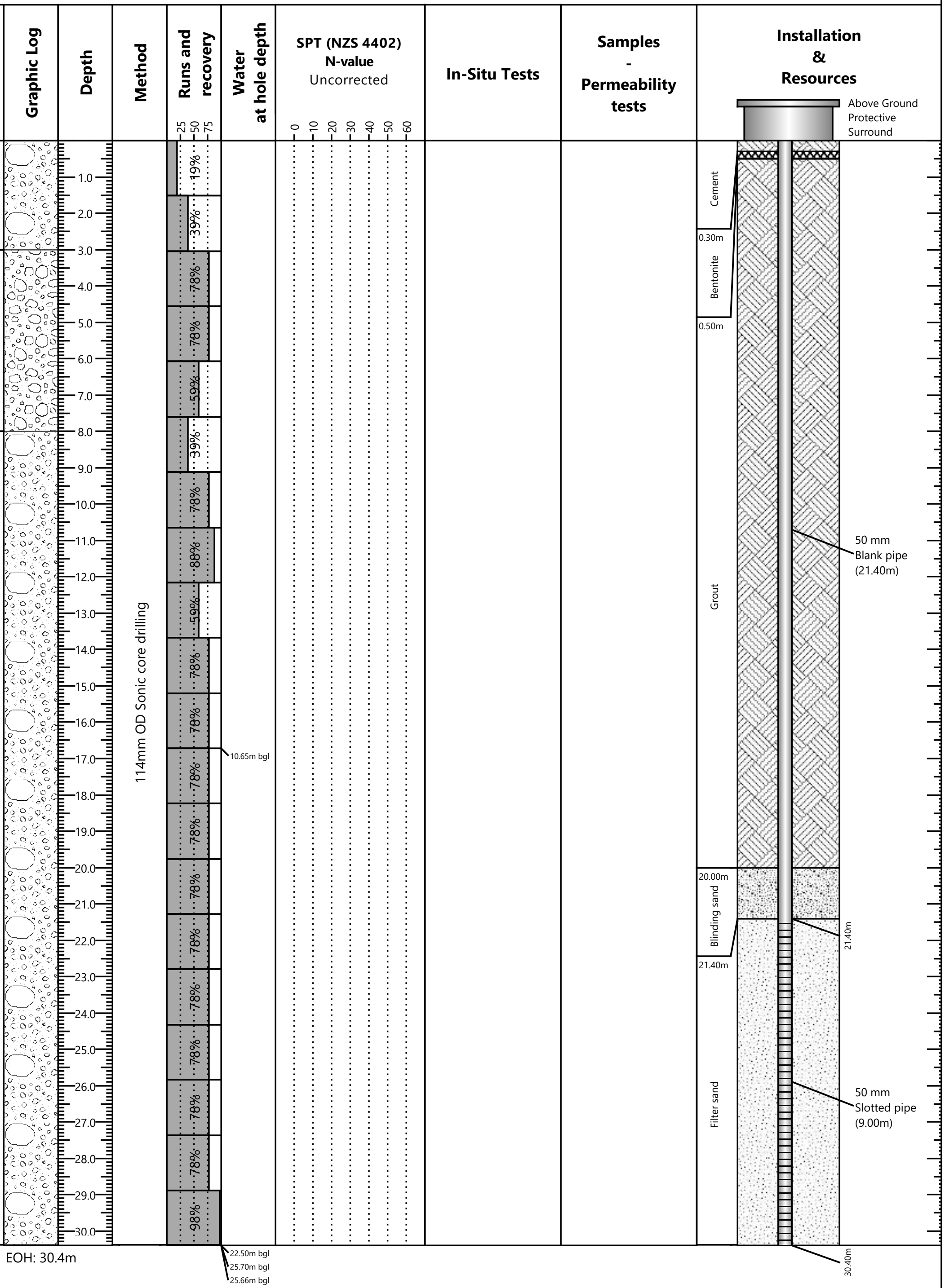
Rig Operator: E. Diaz Farias

Elevation: 0.00m

Datum: Ground

Equipment: Geoprobe 8140LC - track

Description	Depth
Sandy fine to coarse GRAVEL with some boulders and trace of silt; grey.	
Sandy fine to coarse GRAVEL with some cobbles; light brown.	3.00m
Sandy fine to coarse GRAVEL with some boulders; light brown.	8.00m



EOH: 30.4m

Remarks

Additional Resources:

Core boxes: 8
Water added: 8000 liters
Concrete: 3 bags
Bentonite: 0.5 bag
Cement: 3 bags
Blinding sand: 0.5 bag
Filter sand: 5 bags

Hole Depth: 30.4m

Created: 9/06/2022 09:14:30

Generated by GEROC Core-GS

Appendix G: Results Tables

Table A1: Soil Sample Results - Heavy Metals/Organochlorine Pesticides - Peel Forest Closed Landfill

Sample Name	**TP101_1**	**TP101_2**	**TP101_3**	**TP102_0-1.0**	**TP102_2.0-2.3**	**TP102_2.9**	**TP102_3.5**	**TP103_1**	**TP103_2**	Human Health Based Soil Contaminant Standard	Environment Canterbury Background Concentrations[3]	Default Guideline Value for Sediment Quality[12]	Class A Landfill Waste Acceptance Criteria [10]
Sample Depth (m)	NA (from <25 mm screened stockpile)			0-1.0	2.0-2.3	2.9	3.5	NA (from <25 mm screened stockpile)					
Material Type	Waste Mixture			Waste Mixture	Soil-Waste Mixture	Soil-Waste Mixture	Underlying Soil/Liner	Waste Mixture					
Laboratory Reference	3151614.2	3151614.3	3151614.4	3151614.5	3151614.6	3151614.7	3151614.8	3151614.10	3151614.11	Recreation	Regional - Intergrade		
Date	10-Jan-2023	10-Jan-2023	10-Jan-2023	11-Jan-2023	11-Jan-2023	11-Jan-2023	11-Jan-2023	11-Jan-2023	11-Jan-2023				
Heavy Metals													
Arsenic	**48**	**46**	**54**	**73**	**11**	4	7	**23**	**22**	80 [1]	7.0	20	100
Cadmium	**2.0**	**0.76**	**0.74**	**1.05**	**0.16**	0.12	< 0.10	**0.49**	**0.41**	400 [1,4]	0.14	1.5	20
Chromium	**68**	**70**	**71**	**94**	22	12	11	**41**	**40**	2,700 [1,5]	25.9	80	100 [5]
Copper	**58**	**49**	**58**	**141**	**21**	**21**	14	**44**	**39**	>10,000 [1]	16.3	65	100
Lead	**120**	**121**	**92**	**194**	**88**	27	**31**	**270**	**280**	880 [1]	30.3 (135.8)	50	100
Nickel	15	15	**41**	**17**	10	9	9	13	12	1,200 [2]	16.4	21	200
Zinc	**3,500**	**930**	**970**	**1,290**	**210**	**100**	75	**440**	**330**	30,000 [2]	83.5 (147.75)	200	200
Organochlorine Pesticides (OCP) in Semivolatile Organic Compounds (SVOC)													
ΣDDT [6,8]	<2.4	<2.3	<2.0	**4.15**	<2.0	<2.0	<2.0	<2.0	<2.0	400 [1,6]	0.431 [9]	1.2	500 [11]
Dieldrin [7,8]	<1.2	<1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	70 [1,7]	-	2.8	8
PCP	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	150 [1]	-	-	-

Cover
Waste Mixture
Soil-Waste Mixture
Underlying Soils

Notes:

1. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health (MfE, 2011) - Recreation Land Use
2. Guideline on Investigation Levels for Soil and Groundwater (Assessment of Site Contamination Amendment Measure 2013) (NEPC, 2013) - Recreational C land use.
3. Background concentrations of selected trace elements in Canterbury soils - Addendum 1. (ECan 2007, Report no. R07/1/2). Based on 'Regional - Intergrade' soil type - background concentration value based on maximum plus half inter-quartile range (excluding outliers, which are indicated in brackets).
4. Based on a default pH of 5.
5. Soil contaminant standard for Cr VI used as a conservative approach.
6. Results for DDT, DDD and DDE summed.
7. Results for Aldrin and Dieldrin summed and compared to Class A Waste Acceptance Criteria for Dieldrin.
8. Where one or more of the compounds was below the detection limit, a value of half the detection limit was used in the sum. Where all compounds in the sum are non-detects, the overall detection limit is the sum of the detection limits.
9. Background soils concentration for DDT - Ministry for the Environment, December 1998. Ambient Concentrations of Selected Organochlorines in Soils. Ministry for the Environment, Wellington.
10. Module 2: Hazardous Waste Guidelines: Landfill waste acceptance criteria and landfill classification (MfE, 2004)
11. Derived from the concentration at which free product will be present in leachate.
12. Australian and New Zealand Guidelines for Fresh & Marine Water Quality 2018

All results in mg/kg.

48	Concentration above reported ECan Background soil concentration.
48	Concentration above Default Guideline Value for Sediment Quality.
120	Concentration above MfE Class A Landfill Waste Acceptance Criteria

Table A2: Soil Sample Results - Heavy Metals/Organochlorine Pesticides - Peel Forest Closed Landfill

Sample Name	**TP103_3**	**TP104_0.3**	**TP104_0.9**	**TP104_1.7**	**TP104_2.8**	**TP104_3.8**	**TP105_3.5**	**TP105_1**	**TP105_2**	Human Health Based Soil Contaminant Standard	Environment Canterbury Background Concentrations[3]	Default Guideline Value for Sediment Quality[12]	Class A Landfill Waste Acceptance Criteria [10]
Sample Depth (m)	NA (from <25 mm screened stockpile)	0.3	0.9	1.7	2.8	3.8	3.5	NA (from <25 mm screened stockpile)					
Material Type	Waste Mixture	Cover	Waste Mixture	Waste Mixture	Waste Mixture	Soil-Waste Mixture	Underlying Soil	Waste Mixture					
Laboratory Reference	3151614.12	3151614.14	3151614.15	3151614.16	3151614.17	3151614.18	3151614.20	3151614.21	3151614.22	Recreation	Regional - Intergrade		
Date	11-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023				
Heavy Metals													
Arsenic	**21**	2	**21**	**10**	4	3	3	**19**	**17**	80 [1]	7.0	20	100
Cadmium	**0.39**	< 0.10	**16.4**	**0.32**	**0.16**	0.11	**0.28**	**1.60**	**1.85**	400 [1,4]	0.14	1.5	20
Chromium	**43**	11	**44**	22	16	13	14	**37**	**30**	2,700 [1,5]	25.9	80	100 [5]
Copper	**33**	10	**49**	**21**	14	11	16	**89**	**80**	>10,000 [1]	16.3	65	100
Lead	**197**	13.6	**117**	**78**	**46**	**31**	15.8	**260**	**250**	880 [1]	30.3 (135.8)	50	100
Nickel	13	10	**81**	11	11	9	12	**30**	**23**	1,200 [2]	16.4	21	200
Zinc	**330**	51	**1,760**	**420**	**148**	**97**	59	**1,080**	**1,240**	30,000 [2]	83.5 (147.75)	200	200
Organochlorine Pesticides (OCP) in Semivolatile Organic Compounds (SVOC)													
ΣDDT [6,8]	<2.0	<2.0	<2.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	400 [1,6]	0.431 [9]	1.2	500 [11]
Dieldrin [7,8]	<1.0	<1.0	<1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	70 [1,7]	-	2.8	8
PCP	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	150 [1]	-	-	-

Cover
Waste Mixture
Soil-Waste Mixture
Underlying Soils

Notes:

1. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health (MfE, 2011) - Recreation Land Use
2. Guideline on Investigation Levels for Soil and Groundwater (Assessment of Site Contamination Amendment Measure 2013) (NEPC, 2013) - Recreational C land use.
3. Background concentrations of selected trace elements in Canterbury soils - Addendum 1. (ECan 2007, Report no. R07/1/2). Based on 'Regional - Intergrade' soil type - background concentration value based on maximum plus half inter-quartile range (excluding outliers, which are indicated in brackets).
4. Based on a default pH of 5.
5. Soil contaminant standard for Cr VI used as a conservative approach.
6. Results for DDT, DDD and DDE summed.
7. Results for Aldrin and Dieldrin summed and compared to Class A Waste Acceptance Criteria for Dieldrin.
8. Where one or more of the compounds was below the detection limit, a value of half the detection limit was used in the sum. Where all compounds in the sum are non-detects, the overall detection limit is the sum of the detection limits.
9. Background soils concentration for DDT - Ministry for the Environment, December 1998. Ambient Concentrations of Selected Organochlorines in Soils. Ministry for the Environment, Wellington.
10. Module 2: Hazardous Waste Guidelines: Landfill waste acceptance criteria and landfill classification (MfE, 2004)
11. Derived from the concentration at which free product will be present in leachate.
12. Australian and New Zealand Guidelines for Fresh & Marine Water Quality 2018

All results in mg/kg.

21	Concentration above reported ECan Background soil concentration.
21	Concentration above Default Guideline Value for Sediment Quality.
197	Concentration above MfE Class A Landfill Waste Acceptance Criteria

Table A3: Soil Sample Results - Heavy Metals/Organochlorine Pesticides - Peel Forest Closed Landfill

Sample Name	**TP105_3**	**TP106_0.5**	**TP106_1.4**	**TP106_2.6**	**TP107_0.2**	**TP107_2.0**	**TP107_1**	**TP107_2**	**TP107_3**	Human Health Based Soil Contaminant Standard	Environment Canterbury Background Concentrations[3]	Default Guideline Value for Sediment Quality[12]	Class A Landfill Waste Acceptance Criteria [10]
Sample Depth (m)	NA (from <25 mm screened stockpile)	0.5	1.4	2.6	0.2	2.0	NA (from <25 mm screened stockpile)						
Material Type	Waste Mixture	Cover	Waste Mixture	Underlying Soil	Cover	Underlying Soil	Waste Mixture						
Laboratory Reference	3151614.23	3151614.24	3151614.25	3151614.26	3151614.28	3151614.29	3151614.3	3151614.31	3151614.32	Recreation	Regional - Intergrade		
Date	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	13-Jan-2023	13-Jan-2023	13-Jan-2023	13-Jan-2023	13-Jan-2023				
Heavy Metals													
Arsenic	**17**	6	**16**	5	6	2	**22**	**25**	**24**	80 [1]	7.0	20	100
Cadmium	**1.45**	< 0.10	**3.2**	**0.51**	< 0.10	< 0.10	**0.74**	**0.59**	**0.60**	400 [1,4]	0.14	1.5	20
Chromium	**33**	18	**35**	15	12	15	**31**	**38**	**38**	2,700 [1,5]	25.9	80	100 [5]
Copper	**76**	13	**57**	**22**	11	11	**36**	**34**	**35**	>10,000 [1]	16.3	65	100
Lead	**280**	**48**	**2,300**	**75**	12.8	12.3	**62**	**49**	**71**	880 [1]	30.3 (135.8)	50	100
Nickel	**26**	9	**26**	13	10	11	**17**	14	15	1,200 [2]	16.4	21	200
Zinc	**1,060**	**134**	**2,600**	**330**	49	61	**890**	**850**	**930**	30,000 [2]	83.5 (147.75)	200	200
Organochlorine Pesticides (OCP) in Semivolatile Organic Compounds (SVOC)													
ΣDDT [6,8]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	400 [1,6]	0.431 [9]	1.2	500 [11]
Dieldrin [7,8]	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	70 [1,7]	-	2.8	8
PCP	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	150 [1]	-	-	-

Cover
Waste Mixture
Soil-Waste Mixture
Underlying Soils

Notes:

1. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health (MfE, 2011) - Recreation Land Use
2. Guideline on Investigation Levels for Soil and Groundwater (Assessment of Site Contamination Amendment Measure 2013) (NEPC, 2013) - Recreational C land use.
3. Background concentrations of selected trace elements in Canterbury soils - Addendum 1. (ECan 2007, Report no. R07/1/2). Based on 'Regional - Intergrade' soil type - background concentration value based on maximum plus half inter-quartile range (excluding outliers, which are indicated in brackets).
4. Based on a default pH of 5.
5. Soil contaminant standard for Cr VI used as a conservative approach.
6. Results for DDT, DDD and DDE summed.
7. Results for Aldrin and Dieldrin summed and compared to Class A Waste Acceptance Criteria for Dieldrin.
8. Where one or more of the compounds was below the detection limit, a value of half the detection limit was used in the sum. Where all compounds in the sum are non-detects, the overall detection limit is the sum of the detection limits.
9. Background soils concentration for DDT - Ministry for the Environment, December 1998. Ambient Concentrations of Selected Organochlorines in Soils. Ministry for the Environment, Wellington.
10. Module 2: Hazardous Waste Guidelines: Landfill waste acceptance criteria and landfill classification (MfE, 2004)
11. Derived from the concentration at which free product will be present in leachate.
12. Australian and New Zealand Guidelines for Fresh & Marine Water Quality 2018

All results in mg/kg.

17	Concentration above reported ECan Background soil concentration.
22	Concentration above Default Guideline Value for Sediment Quality.
280	Concentration above MfE Class A Landfill Waste Acceptance Criteria

Table A4: Soil Sample Results - Heavy Metals/Organochlorine Pesticides - Peel Forest Closed Landfill, Drilling Investigation (May-June 2022)

Sample Name	**MW3_9.2**	**MW3_20.1**	**MW3_27.4**	**MW3_29.0**	**MW2_7.7**	**MW2_17.1**	**MW2_22.3**	**MW1_6.5**	Human Health Based Soil Contaminant Standard Recreation	Environment Canterbury Background Concentrations[3] Regional - Intergrade	Default Guideline Value for Sediment Quality[12]	Class A Landfill Waste Acceptance Criteria [10]
Sample Depth (m)	9.2	20.1	27.4	29.0	7.7	17.1	22.3	6.5				
Laboratory Reference	3002366.3	3002366.6	3002366.10	3002366.11	3002366.12	3002366.16	3008295.3	3008295.6				
Date	23-May-2022	24-May-2022	24-May-2022	24-May-2022	25-May-2022	26-May-2022	30-May-2022	01-Jun-2022				
Heavy Metals												
Arsenic	3	< 2	2	< 2	2	2	< 2	2	80 [1]	7.0	20	100
Cadmium	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	400 [1,4]	0.14	1.5	20
Chromium	18	20	16	13	17	18	**52**	19	2,700 [1,5]	25.9	80	100 [5]
Copper	15	11	11	9	14	11	15	15	>10,000 [1]	16.3	65	100
Lead	12.8	10.7	10.5	9.9	11.2	11	9.8	12.9	880 [1]	30.3 (135.8)	50	100
Nickel	12	13	11	9	12	12	15	13	1,200 [2]	16.4	21	200
Zinc	55	47	46	40	49	46	44	52	30,000 [2]	83.5 (147.75)	200	200
Organochlorine Pesticides (OCP) in Semivolatile Organic Compounds (SVOC)												
ΣDDT [6,8]	-	-	<0.066	<0.066	-	-	-	-	400 [1,6]	0.431 [9]	1.2	500 [11]
Dieldrin [7,8]	-	-	<0.022	<0.022	-	-	-	-	70 [1,7]	-	2.8	8
PCP	-	-	<30	<30	-	-	-	-	150 [1]	-	-	-

Notes:

1. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health (MfE, 2011) - Recreation Land Use
2. Guideline on Investigation Levels for Soil and Groundwater (Assessment of Site Contamination Amendment Measure 2013) (NEPC, 2013) - Recreational C land use.
3. Background concentrations of selected trace elements in Canterbury soils - Addendum 1. (ECan 2007, Report no. R07/1/2). Based on 'Regional - Intergrade' soil type - background concentration value based on maximum plus half inter-quartile range (excluding outliers, which are indicated in brackets).
4. Based on a default pH of 5.
5. Soil contaminant standard for Cr VI used as a conservative approach.
6. Results for DDT, DDD and DDE summed.
7. Results for Aldrin and Dieldrin summed and compared to Class A Waste Acceptance Criteria for Dieldrin.
8. Where one or more of the compounds was below the detection limit, a value of half the detection limit was used in the sum. Where all compounds in the sum are non-detects, the overall detection limit is the sum of the detection limits.
9. Background soils concentration for DDT - Ministry for the Environment, December 1998. Ambient Concentrations of Selected Organochlorines in Soils. Ministry for the Environment, Wellington.
10. Module 2: Hazardous Waste Guidelines: Landfill waste acceptance criteria and landfill classification (MfE, 2004)
11. Derived from the concentration at which free product will be present in leachate.
12. Australian and New Zealand Guidelines for Fresh & Marine Water Quality 2018

All results in mg/kg.

52	Concentration above reported ECan Background soil concentration.

Table B: Soil Sample Results - Petroleum Hydrocarbons - ALL PATHWAYS - Peel Forest Closed Landfill

Soil Samples Collected at a Depth of <1 m Below Ground Level [1]

Sample Name	TP102_0-1.0	TP104_0.9	Tier 1 Soil Acceptance Criteria[2,3] Residential Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3]	Default Guideline Value for Sediment Quality[7]
Laboratory Reference	3151614.5	3151614.15		Protection of Groundwater Quality (b,c)	
Sample Location	TP102	TP104			
Soil Fate	Removed	Removed	Sand	Sand	
Soil Type - Field	Waste Mixture	Waste Mixture			
Soil Type - MfE (2011)	Sand	Sand			
Sample Depth (m bgl)	0-1.0	0.9	<1 m	Depth of Contamination < 1 m Depth to Groundwater - 8 m	
C_7-C_9 hydrocarbons	< 30	< 30	120 [5m]	NA [4]	-
C_{10}-C_{14} hydrocarbons	< 20	< 30	(470) [6,5x]	NA [4]	-
C_{15}-C_{36} hydrocarbons	530	490	NA [4]	NA [4]	-
TPH	540	490	-	-	280

Soil Samples Collected at a Depth of 1 - 4 m Below Ground Level [1]

Sample Name	TP106_1.4		Tier 1 Soil Acceptance Criteria[2,3] Residential Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3]	Default Guideline Value for Sediment Quality[7]
Laboratory Reference	3151614.25			Protection of Groundwater Quality (b,c)	
Sample Location	TP106				
Soil Fate	Removed		Sand	Sand	
Soil Type - Field	Waste Mixture				
Soil Type - MfE (2011)	Sand				
Sample Depth (m bgl)	1.4		1 - 4 m	Depth of Contamination 1 - 4 m Depth to Groundwater - 8 m	
C_7-C_9 hydrocarbons	< 20		120 [5m]	NA [4]	-
C_{10}-C_{14} hydrocarbons	< 20		(560) [6,5x]	NA [4]	-
C_{15}-C_{36} hydrocarbons	62		NA [4]	NA [4]	-
TPH	< 80		-	-	280

Note:
1. All results in mg/kg.
2. Criteria from Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Revised 2011 (MfE 2011).
3. Criteria assume residential land use, 'sand' soil type, and contamination depths of <1 m and 1 - 4 m below ground level.
4. NA indicates contaminant is not limiting as health based criterion is significantly higher than may be encountered on site (i.e. 20,000 mg/kg for TPH, 10,000 mg/kg for other contaminants).
5. The following notes indicate the limiting pathway for each criterion: m - maintenance/excavation, x - PAH surrogate.
6. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons.
7. Australian and New Zealand Guidelines for Fresh & Marine Water Quality 2018
b. Based on Tier 1 groundwater acceptance criteria for potable use.
c. Criteria based on the assumption of adsorbed phase hydrocarbons only and 1st order biodegradation. Migration of separate phase hydrocarbons through soil profile may result in greater impact than indicated by above criteria.

21	Concentration above Default Guideline Value for Sediment Quality.

Table B2: Soil Sample Results - Petroleum Hydrocarbons - ALL PATHWAYS - Peel Forest Closed Landfill, Drilling Investigation (May-June 2022)

Soil Samples Collected at a Depth of >4 m Below Ground Level [1]											
Sample Name	MW3_9.2	MW3_20.1	MW3_27.4	MW3_29.0	MW2_7.7	MW2_17.1	MW2_22.3	MW1_6.5	Tier 1 Soil Acceptance Criteria[2,3] Residential Land Use ALL PATHWAYS	Tier 1 Soil Acceptance Criteria[2,3]	Default Guideline Value for Sediment Quality[7]
Laboratory Reference	3002366.3	3002366.6	3002366.10	3002366.11	3002366.12	3002366.16	3008295.3	3008295.6		Protection of Groundwater Quality (a,b,c)	
Sample Location	MW3				MW2			MW1			
Soil Fate	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Remaining	Sand	Sand	
Soil Type - Field	Sandy GRAVEL	Sandy GRAVEL	Gravelly SAND	Gravelly SAND	Sandy GRAVEL	Sandy GRAVEL	Sandy GRAVEL	Sandy GRAVEL			
Soil Type - MfE (2011)	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand			
Sample Depth (m bgl)	9.2	20.1	27.4	29.0	7.7	17.1	22.3	6.5	>4 m	Depth of Contamination > 4 m Depth to Groundwater - 8 m	
C_7-C_9 hydrocarbons	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	(3,800) [6,8,5v]	NA [4]	-
C_{10}-C_{14} hydrocarbons	< 20	< 20	< 20	< 20	59	< 20	< 20	< 20	(650) [6,5x]	NA [4]	-
C_{15}-C_{36} hydrocarbons	< 40	< 40	< 40	< 40	75	< 40	50	< 40	NA [4]	NA [4]	-
TPH	< 80	< 80	< 80	< 80	135	< 80	< 80	< 80	-	-	280

Note:

1. All results in mg/kg.
2. Criteria from Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Revised 2011 (MfE 2011).
3. Criteria assume residential land use, 'sand' soil type, and contamination depths of >4 m below ground level.
4. NA indicates contaminant is not limiting as health based criterion is significantly higher than may be encountered on site (i.e. 20,000 mg/kg for TPH, 10,000 mg/kg for other contaminants).
5. The following notes indicate the limiting pathway for each criterion: v - volitisation, x - PAH surrogate.
6. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons.
7. Australian and New Zealand Guidelines for Fresh & Marine Water Quality 2018
8. Due to the boundary conditions in volatilisation model, calculated criteria for sandy soils are higher than that for the sandy silt soil type. Therefore, the criteria for sand are set equal to the criteria for sandy silt.

a. Contaminated soil layer is in direct contact with groundwater and hence no attenuation associated with vertical migration through the soil column occurs.
b. Based on Tier 1 groundwater acceptance criteria for potable use.
c. Criteria based on the assumption of adsorbed phase hydrocarbons only and 1st order biodegradation. Migration of separate phase hydrocarbons through soil profile may result in greater impact than indicated by above criteria.

Table C: Test Pit Soil Sample Results - Asbestos Semi-Quantitative Analysis - Peel Forest Closed Landfill

Sample Name	**TP101_1**	**TP101_2**	**TP101_3**	**TP102_0-1.0**	**TP102_2.0-2.3**	**TP102_2.9**	**TP102_3.5**	**TP103_1**	**TP103_2**	**TP103_3**
Soil Type	Waste Mixture			Waste Mixture	Soil-Waste Mixture	Soil-Waste Mixture	Underlying Soil/Liner	Waste Mixture		
Laboratory Reference	T009132.2.1	T009132.2.2	T009132.2.3	T009132.2.4	T009132.2.5	T009132.2.6	T009132.2.7	T009132.2.8	T009132.2.9	T009132.2.10
Date	10-Jan-2023	10-Jan-2023	10-Jan-2023	11-Jan-2023	11-Jan-2023	11-Jan-2023	11-Jan-2023	11-Jan-2023	11-Jan-2023	11-Jan-2023
Asbestos										
Asbestos Type	NAD	**Chrysotile (White Asbestos); Amosite (Brown Asbestos)**	NAD	NAD	NAD	NAD	NAD	**Chrysotile (White Asbestos)**	**Chrysotile (White Asbestos); Crocidolite (Blue Asbestos)**	NAD
Asbestos as ACM[1]	NAD	<0.001	NAD	NAD	NAD	NAD	NAD	<0.001	<0.001	NAD
Asbestos as FA & AF[2]	NAD	0.00664	NAD	NAD	NAD	NAD	NAD	0.00035	0.00039	NAD

Sample Name	**TP104_0.3**	**TP104_0.9**	**TP104_1.7**	**TP104_2.8**	**TP104_3.8**	**TP105_3.5**	**TP105_1**	**TP105_2**	**TP105_3**	**TP106_0.5**
Soil Type	Cover	Waste Mixture	Waste Mixture	Waste Mixture	Soil-Waste Mixture	Underlying Soil	Waste Mixture			Cover
Laboratory Reference	T009132.2.11	T009132.2.12	T009132.2.13	T009132.2.14	T009132.2.15	T009132.2.16	T009132.2.17	T009132.2.18	T009132.2.19	T009132.2.20
Date	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023
Asbestos										
Asbestos Type	NAD	NAD	NAD	NAD	NAD	NAD	**Chrysotile (White Asbestos)**	**Chrysotile (White Asbestos); Amosite (Brown Asbestos)**	**Chrysotile (White Asbestos); Amosite (Brown Asbestos); Crocidolite (Blue Asbestos)**	NAD
Asbestos as ACM[2]	NAD	NAD	NAD	NAD	NAD	NAD	**0.02243**	NAD	NAD	NAD
Asbestos as FA & AF[3]	NAD	NAD	NAD	NAD	NAD	NAD	0.00001	0.00676	0.00767	NAD

Sample Name	**TP106_1.4**	**TP106_2.6**	**TP107_0.2**	**TP107_2.0**	**TP107_1**	**TP107_2**	**TP107_3**			
Soil Type	Waste Mixture	Underlying Soil	Cover	Underlying Soil	Waste Mixture					
Laboratory Reference	T009132.2.21	T009132.2.22	T009132.2.23	T009132.2.24	T009132.2.25	T009132.2.26	T009132.2.27			
Date	12-Jan-2023	12-Jan-2023	13-Jan-2023	13-Jan-2023	13-Jan-2023	13-Jan-2023	13-Jan-2023			
Asbestos										
Asbestos Type	**Chrysotile (White Asbestos)**	NAD	NAD	NAD	NAD	NAD	NAD			
Asbestos as ACM[2]	0.01334	NAD	NAD	NAD	NAD	NAD	NAD			
Asbestos as FA & AF[3]	0.01828	NAD	NAD	NAD	NAD	NAD	NAD			

Soil Type

Cover

Waste Mixture

Soil-Waste Mixture

Underlying Soils

NOTES:

1. Weight of asbestos in ACM as a percent of the total sample (weight for weight percent (w/w%)).
2. Combined fibrous asbestos and asbestos fines as weight for weight percentage (w/w %) of the total sample.

Results as % weight for weight asbestos for Semi-Quantitative Analysis.

BRANZ NZ Guidelines for Assessing and Managing Asbestos in Soil (2017) soil guideline vlaue screening criteria for asbestos fines and/or friable asbestos of 0.001% w/w and for ACM of 0.02% w/w for recreational land use.

NAD - No Asbestos Detected

0.02243	- asbestos concentration above BRANZ (2017) soil guideline value for ACM (bonded) of 0.02% w/w for recreational land use.
0.00664	- asbestos concentration above BRANZ (2017) soil guideline value for asbestos fines and/or friable asbestos of 0.001% w/w for all site uses

Table D: Soil Sample Results - Heavy Metals TCLP - Peel Forest Closed Landfill

Sample Name	**TP101_1**	**TP102_0-1.0**	**TP103_2**	**TP104_0.9**	**TP105_1**	**TP106_1.4**	**TP107_3**	Kate Valley Waste Acceptance Limits (mg/L)[1]
Sample Depth (m)	NA (from <25 mm screened stockpile)	0-1.0	NA (from <25 mm screened stockpile)	0.9	NA (from <25 mm screened stockpile)	1.4	NA (from <25 mm screened stockpile)	
Marterial Type	Waste Mixture	Waste Mixture	Waste Mixture	Waste Mixture	Waste Mixture	Waste Mixture	Waste Mixture	
Laboratory Reference	3151614.2	3151614.5	3151614.11	3151614.15	3151614.21	3151614.25	3151614.32	
Date	10-Jan-2023	11-Jan-2023	11-Jan-2023	12-Jan-2023	12-Jan-2023	12-Jan-2023	13-Jan-2023	
Heavy Metals								
Copper	-	0.036	-	-	-	-	-	5
Lead	0.0159	0.035	0.103	0.029	0.079	5.5	-	5
Zinc	3.0	7.6	1.58	5.9	6.7	**12.4**	**16.2**	10

Notes:

1. Class A Landfill Waste Acceptance - TCLP Limits (*Hazardous waste guidelines: Landfill waste acceptance criteria and landfill classification* (MfE, 2004)).

All results in mg/L

12.4	Concentration above MfE (2004) Class A Landfill Waste Acceptance Criteria

Table E - Groundwater Monitoring Results (MW2 and MW3) - Peel Forest Closed Landfill

	Location	MW2		MW3		ANZG(2018)^{1} (95% Level of Species Protection)	Average concentration from K37/0493^{6,7}	Maximum concentration from K37/0493^{6}
	Sample Name:	MW2	MW2	MW3	MW3			
	Date	12/08/2022	19/01/2023	12/08/2022	19/01/2023			
	Lab Number:	3055181.1	3156040.1	3055181.2	3156040.2			
Water Level	m below TOC	25.131	25.945	24.645	25.524	-	-	-
Sum of Anions	meq/L	2.4	1.71	**2.7**	1.99	-	1.85	2.5
Sum of Cations	meq/L	2.4	1.78	**2.6**	2.1	-	1.86	2.5
pH Lab	pH Units	6.4	7.3	6.4	7.4	7.23 - 7.8^{2}	7.2 - 7.7^{8}	7.7
Total Alkalinity	g/m^{3} as CaCO3	56	43	**70**	56	-	52.7	62
Bicarbonate	g/m^{3} at 25°C	68	53	**85**	68	-	65.1	75
Hardness	g/m^{3} as CaCO3	90	66	**100**	77	-	73.2	99
Electrical Conductivity	mS/m	**26.5**	19.6	**28.7**	22.3	11.6^{2}	19.0	26.3
Dissolved Arsenic	g/m^{3}	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.013	-	-
Dissolved Boron	g/m^{3}	**0.170**	**0.062**	**0.31**	**0.183**	0.94^{5,9}	0.013	0.013
Dissolved Calcium	g/m^{3}	23	16.7	25	19.7	-	18.8	26
Dissolved Chromium	g/m^{3}	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.001^{5}	-	-
Dissolved Iron	g/m^{3}	< 0.02	< 0.02	< 0.02	< 0.02	-	<0.020	<0.020
Dissolved Lead	g/m^{3}	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.0034	-	-
Dissolved Magnesium	g/m^{3}	7.9	5.9	**8.8**	6.7	-	6.43	8.6
Dissolved Nickel	g/m^{3}	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.011	-	-
Dissolved Potassium	g/m^{3}	**2.5**	**1.80**	**4.3**	**3.0**	-	1.26	1.46
Dissolved Sodium	g/m^{3}	**11.2**	9.5	**12.0**	**10.7**	-	8.25	10
Dissolved Zinc	g/m^{3}	0.0016	**0.0029**	0.0013	0.0015	0.008^{5}	0.002	0.002
Chloride	g/m^{3}	**12.2**	**8.5**	**11.6**	**8.3**	-	5.36	8.2
Total Nitrogen	g/m^{3}	10.1	6.6	9.3	6.4	0.913^{2}	-	-
Total Ammoniacal-N	g/m^{3}	< 0.010	< 0.010	< 0.010	< 0.010	0.01^{2}	0.0076	0.02
Nitrite-N	g/m^{3}	< 0.002	< 0.002	< 0.002	< 0.002	-	<0.002	<0.002
Nitrate-N	g/m^{3}	10.0	6.6	9.2	6.3	0.265^{2}	6.73	11.2
Nitrate-N + Nitrite-N	g/m^{3}	**10.0**	6.6	9.2	6.3	-	8.4	9.6
Total Kjeldahl Nitrogen (TKN)	g/m^{3}	0.13	< 0.10	0.16	< 0.10	-	-	-
Dissolved Reactive Phosphorus	g/m^{3}	**0.007**	**0.009**	**0.008**	**0.008**	0.008^{2}	0.0045	0.0063
Sulphate	g/m^{3}	10.1	6.6	**13.1**	9.0	-	9.11	11.8
Semivolatile Organic Compounds	g/m^{3}	ND^{3}	ND^{3}	ND^{3}	ND^{3}	-	-	-
Volatile Organic Compounds	g/m^{3}	ND^{4}	ND^{4}	ND^{4}	ND^{4}	-	-	-

Notes:

1. Values dervived from Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)
2. Default guideline values for the 'Cool-Dry Low-Elevation' River Environment Classification.
3. ND - All of the individual SVOC analytes are below the laboratory limit of detection (e.g. Haloethers, Nitrogen containing compounds, Organochlorine Pesticides, Polycyclic Aromatic Hydrocarbons, Phenols, Plasticisers and Other Halogenated compounds).
4. ND - All of the individual VOC analytes are below the laboratory limit of detection (e.g. BTEX, Halogenated Aliphatics, Haloaromatics, Monoaromatic Hydrocarbons, Ketones and Trihalomethanes).
5. Figure may not protect key test species from chronic toxicity (this refers to experimental chronic figures or geometric mean for species).
6. Average concentrations of water quality results from K37/0493 (closet water quality monitoring well, located approximately 6.7 km south-east of the site).
7. Where one of the analytes were below the detection limit, a value of half the detection limit was used in the sum. Where all compounds in the sum are non-detects, the overall detection limit is the sum of the detection limits.
8. pH range from previous datasets from K36/0493
9. Toxicant default guideline values for aquatic ecosystem protection: Boron in freshwater (ANZG, 2021)

GREY	Value above ANZG (2018) default guideline values
UNDERLINE	Value above K37/0493 average concentration
BOLD	Value above K37/0493 maximum concentration

Appendix H: Laboratory Reports and Chain of Custody Documentation

Hill Laboratories
TRIED, TESTED AND TRUSTED

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Hamilton 3240 New Zealand

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Certificate of Analysis

Client:	Pattle Delamore Partners Limited	**Lab No:**	3002366 SPv1
Contact:	S Wilson C/- Pattle Delamore Partners Limited PO Box 389 Christchurch 8140	**Date Received:**	31-May-2022
		Date Reported:	02-Jun-2022
		Quote No:	81087
		Order No:	
		Client Reference:	C02450100
		Submitted By:	Lucy Duffus

Sample Type: Soil

Sample Name:		MW3_9.2 23-May-2022	MW3_20.1 24-May-2022	MW3_27.4 24-May-2022	MW3_29.0 24-May-2022	MW2_7.7 25-May-2022
Lab Number:		3002366.3	3002366.6	3002366.10	3002366.11	3002366.12
Individual Tests						
Dry Matter	g/100g as rcvd	91	94	92	91	91
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	3	< 2	2	< 2	2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	18	20	16	13	17
Total Recoverable Copper	mg/kg dry wt	15	11	11	9	14
Total Recoverable Lead	mg/kg dry wt	12.8	10.7	10.5	9.9	11.2
Total Recoverable Nickel	mg/kg dry wt	12	13	11	9	12
Total Recoverable Zinc	mg/kg dry wt	55	47	46	40	49
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	-	< 0.011	< 0.011	-
alpha-BHC	mg/kg dry wt	-	-	< 0.011	< 0.011	-
beta-BHC	mg/kg dry wt	-	-	< 0.011	< 0.011	-
delta-BHC	mg/kg dry wt	-	-	< 0.011	< 0.011	-
gamma-BHC (Lindane)	mg/kg dry wt	-	-	< 0.011	< 0.011	-
cis-Chlordane	mg/kg dry wt	-	-	< 0.011	< 0.011	-
trans-Chlordane	mg/kg dry wt	-	-	< 0.011	< 0.011	-
2,4'-DDD	mg/kg dry wt	-	-	< 0.011	< 0.011	-
4,4'-DDD	mg/kg dry wt	-	-	< 0.011	< 0.011	-
2,4'-DDE	mg/kg dry wt	-	-	< 0.011	< 0.011	-
4,4'-DDE	mg/kg dry wt	-	-	< 0.011	< 0.011	-
2,4'-DDT	mg/kg dry wt	-	-	< 0.011	< 0.011	-
4,4'-DDT	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Total DDT Isomers	mg/kg dry wt	-	-	< 0.07	< 0.07	-
Dieldrin	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Endosulfan I	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Endosulfan II	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Endosulfan sulphate	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Endrin	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Endrin aldehyde	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Endrin ketone	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Heptachlor	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Heptachlor epoxide	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Hexachlorobenzene	mg/kg dry wt	-	-	< 0.011	< 0.011	-
Methoxychlor	mg/kg dry wt	-	-	< 0.011	< 0.011	-

Sample Type: Soil						
Sample Name:		MW3_9.2 23-May-2022	MW3_20.1 24-May-2022	MW3_27.4 24-May-2022	MW3_29.0 24-May-2022	MW2_7.7 25-May-2022
Lab Number:		3002366.3	3002366.6	3002366.10	3002366.11	3002366.12
Haloethers in SVOC Soil Samples by GC-MS						
Bis(2-chloroethoxy) methane	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Bis(2-chloroethyl)ether	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Bis(2-chloroisopropyl)ether	mg/kg dry wt	-	-	< 0.5	< 0.5	-
4-Bromophenyl phenyl ether	mg/kg dry wt	-	-	< 0.4	< 0.4	-
4-Chlorophenyl phenyl ether	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Nitrogen containing compounds in SVOC Soil Samples by GC-MS						
2,4-Dinitrotoluene	mg/kg dry wt	-	-	< 1.0	< 1.0	-
2,6-Dinitrotoluene	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Nitrobenzene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
N-Nitrosodi-n-propylamine	mg/kg dry wt	-	-	< 0.7	< 0.7	-
N-Nitrosodiphenylamine + Diphenylamine	mg/kg dry wt	-	-	< 0.7	< 0.7	-
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Aldrin	mg/kg dry wt	-	-	< 0.5	< 0.5	-
alpha-BHC	mg/kg dry wt	-	-	< 0.5	< 0.5	-
beta-BHC	mg/kg dry wt	-	-	< 0.5	< 0.5	-
delta-BHC	mg/kg dry wt	-	-	< 0.5	< 0.5	-
gamma-BHC (Lindane)	mg/kg dry wt	-	-	< 0.5	< 0.5	-
4,4'-DDD	mg/kg dry wt	-	-	< 0.5	< 0.5	-
4,4'-DDE	mg/kg dry wt	-	-	< 0.5	< 0.5	-
4,4'-DDT	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Dieldrin	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Endosulfan I	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Endosulfan II	mg/kg dry wt	-	-	< 2	< 2	-
Endosulfan sulphate	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Endrin	mg/kg dry wt	-	-	< 0.7	< 0.7	-
Endrin ketone	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Heptachlor	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Heptachlor epoxide	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Hexachlorobenzene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS*						
Acenaphthene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Acenaphthylene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Anthracene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Benzo[a]anthracene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Benzo[k]fluoranthene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
1&2-Chloronaphthalene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Chrysene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Fluoranthene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Fluorene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
2-Methylnaphthalene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Naphthalene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Phenanthrene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Pyrene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	-	-	< 1.3	< 1.3	-
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	-	-	< 1.3	< 1.3	-

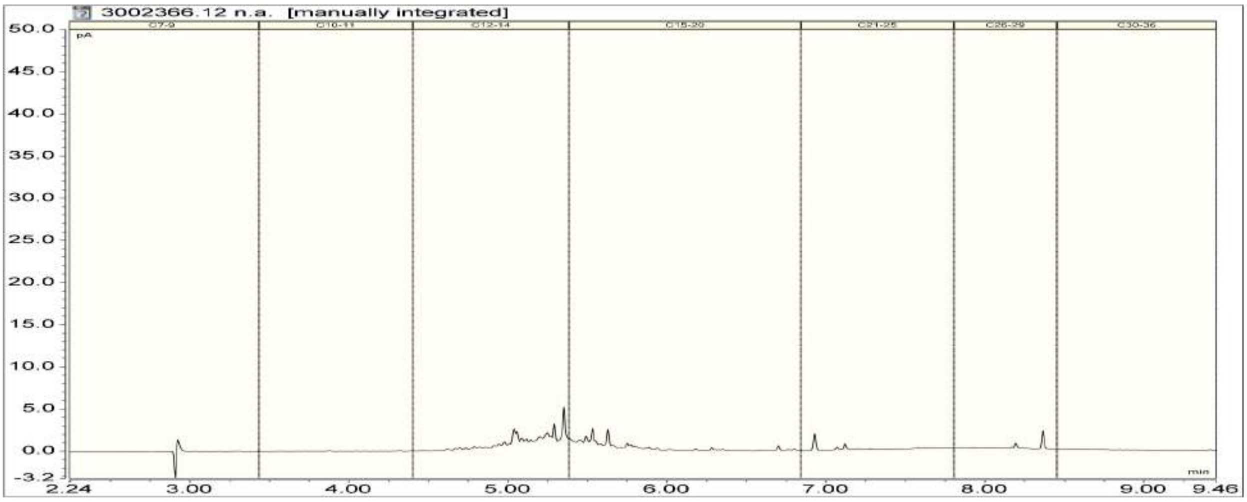
Sample Type: Soil

Sample Name:		MW3_9.2 23-May-2022	MW3_20.1 24-May-2022	MW3_27.4 24-May-2022	MW3_29.0 24-May-2022	MW2_7.7 25-May-2022
Lab Number:		3002366.3	3002366.6	3002366.10	3002366.11	3002366.12
Phenols in SVOC Soil Samples by GC-MS						
4-Chloro-3-methylphenol	mg/kg dry wt	-	-	< 5	< 5	-
2-Chlorophenol	mg/kg dry wt	-	-	< 1.0	< 1.0	-
2,4-Dichlorophenol	mg/kg dry wt	-	-	< 1.0	< 1.0	-
2,4-Dimethylphenol	mg/kg dry wt	-	-	< 3	< 3	-
3 & 4-Methylphenol (m- + p-cresol)	mg/kg dry wt	-	-	< 3	< 3	-
2-Methylphenol (o-cresol)	mg/kg dry wt	-	-	< 1.0	< 1.0	-
2-Nitrophenol	mg/kg dry wt	-	-	< 5	< 5	-
Pentachlorophenol (PCP)	mg/kg dry wt	-	-	< 30	< 30	-
Phenol	mg/kg dry wt	-	-	< 1.0	< 1.0	-
2,4,5-Trichlorophenol	mg/kg dry wt	-	-	< 1.0	< 1.0	-
2,4,6-Trichlorophenol	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Plasticisers in SVOC Soil Samples by GC-MS						
Bis(2-ethylhexyl)phthalate	mg/kg dry wt	-	-	< 5	< 5	-
Butylbenzylphthalate	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Di(2-ethylhexyl)adipate	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Diethylphthalate	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Dimethylphthalate	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Di-n-butylphthalate	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Di-n-octylphthalate	mg/kg dry wt	-	-	< 1.0	< 1.0	-
Other Halogenated compounds in SVOC Soil Samples by GC-MS						
1,2-Dichlorobenzene	mg/kg dry wt	-	-	< 0.7	< 0.7	-
1,3-Dichlorobenzene	mg/kg dry wt	-	-	< 0.7	< 0.7	-
1,4-Dichlorobenzene	mg/kg dry wt	-	-	< 0.7	< 0.7	-
Hexachlorobutadiene	mg/kg dry wt	-	-	< 0.7	< 0.7	-
Hexachloroethane	mg/kg dry wt	-	-	< 0.7	< 0.7	-
1,2,4-Trichlorobenzene	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Other compounds in SVOC Soil Samples by GC-MS						
Benzyl alcohol	mg/kg dry wt	-	-	< 10	< 10	-
Carbazole	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Dibenzofuran	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Isophorone	mg/kg dry wt	-	-	< 0.5	< 0.5	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	59
C15 - C36	mg/kg dry wt	< 40	< 40	< 40	< 40	75
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 80	< 80	< 80	135

Sample Name:		MW2_17.1 26-May-2022				
Lab Number:		3002366.16				
Individual Tests						
Dry Matter	g/100g as rcvd	93	-	-	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	2	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	18	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	11	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	11.0	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	12	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	46	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 20	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-
C15 - C36	mg/kg dry wt	< 40	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	-	-	-	-

Sample Type: Soil					
Sample Name:	MW2_17.1 26-May-2022				
Lab Number:	3002366.16				

3002366.12
MW2_7.7 25-May-2022
Client Chromatogram for TPH by FID



Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil

Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	3, 6, 10-12, 16
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	3, 6, 10-12, 16
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	3, 6, 10-12, 16
Organochlorine Pesticides Screening in Soil	Sonication extraction, GC-ECD analysis. Tested on as received sample. In-house based on US EPA 8081.	0.010 - 0.06 mg/kg dry wt	10-11
Semivolatile Organic Compounds Screening in Soil by GC-MS	Sonication extraction, GC-MS analysis. Tested on as received sample. In-house based on US EPA 8270.	0.002 - 30 mg/kg dry wt	10-11
Total Petroleum Hydrocarbons in Soil			
Client Chromatogram for TPH by FID	Small peaks associated with QC compounds may be visible in chromatograms with low TPH concentrations. QC peaks are as follows: one peak in the C12 - 14 band, the C21 - 25 band and the C30 - 36 band. All QC peaks are corrected for in the reported TPH concentrations.	-	12
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	20 mg/kg dry wt	3, 6, 10-12, 16
C10 - C14	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	20 mg/kg dry wt	3, 6, 10-12, 16
C15 - C36	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	40 mg/kg dry wt	3, 6, 10-12, 16
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	70 mg/kg dry wt	3, 6, 10-12, 16

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

Testing was completed between 01-Jun-2022 and 02-Jun-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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

Ara Heron BSc (Tech)
Client Services Manager - Environmental

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Certificate of Analysis

Client: Pattle Delamore Partners Limited
Contact: Rowan Freeman
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Lab No: 3151614 SPv2
Date Received: 13-Jan-2023
Date Reported: 28-Feb-2023 **(Amended)**
Quote No: 81087
Order No:
Client Reference: C02450100
Submitted By: Lucy Duffus

Sample Type: Soil

Sample Name:		TP101_1 10-Jan-2023	TP101_2 10-Jan-2023	TP101_3 10-Jan-2023	TP102_0-1.0 11-Jan-2023	TP102_2.0-2.3 11-Jan-2023
Lab Number:		3151614.2	3151614.3	3151614.4	3151614.5	3151614.6
Individual Tests						
Dry Matter	g/100g as rcvd	51	56	65	62	79
TCLP Weight of Sample Taken	g	50	-	-	50	-
TCLP Initial Sample pH	pH Units	6.8	-	-	6.6	-
TCLP Acid Adjusted Sample pH	pH Units	1.8	-	-	1.6	-
TCLP Extractant Type*		NaOH/Acetic acid at pH 4.93 +/- 0.05	-	-	NaOH/Acetic acid at pH 4.93 +/- 0.05	-
TCLP Extraction Fluid pH	pH Units	4.9	-	-	4.9	-
TCLP Post Extraction Sample pH	pH Units	4.9	-	-	5.0	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	48	46	54	73	11
Total Recoverable Cadmium	mg/kg dry wt	2.0	0.76	0.74	1.05	0.16
Total Recoverable Chromium	mg/kg dry wt	68	70	71	94	22
Total Recoverable Copper	mg/kg dry wt	58	49	58	141	21
Total Recoverable Lead	mg/kg dry wt	120	121	92	194	88
Total Recoverable Nickel	mg/kg dry wt	15	15	41	17	10
Total Recoverable Zinc	mg/kg dry wt	3,500	930	970	1,290	210
Haloethers in SVOC Soil Samples by GC-MS						
Bis(2-chloroethoxy) methane	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Bis(2-chloroethyl)ether	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Bis(2-chloroisopropyl)ether	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
4-Bromophenyl phenyl ether	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.4
4-Chlorophenyl phenyl ether	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Nitrogen containing compounds in SVOC Soil Samples by GC-MS						
2,4-Dinitrotoluene	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
2,6-Dinitrotoluene	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
Nitrobenzene	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
N-Nitrosodi-n-propylamine	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 0.8
N-Nitrosodiphenylamine + Diphenylamine	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 0.8
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Aldrin	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
alpha-BHC	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
beta-BHC	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
delta-BHC	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
gamma-BHC (Lindane)	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
4,4'-DDD	mg/kg dry wt	< 0.6	< 0.6	< 0.5	1.6	< 0.5
4,4'-DDE	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
4,4'-DDT	mg/kg dry wt	< 1.2	< 1.1	< 1.0	2.3	< 1.0

Sample Type: Soil

	Sample Name:	TP101_1 10-Jan-2023	TP101_2 10-Jan-2023	TP101_3 10-Jan-2023	TP102_0-1.0 11-Jan-2023	TP102_2.0-2.3 11-Jan-2023
	Lab Number:	3151614.2	3151614.3	3151614.4	3151614.5	3151614.6
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Dieldrin	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Endosulfan I	mg/kg dry wt	< 1.2	< 1.1	< 5	< 5	< 1.0
Endosulfan II	mg/kg dry wt	< 2	< 2	< 5	< 5	< 2
Endosulfan sulphate	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
Endrin	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 0.8
Endrin ketone	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
Heptachlor	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Heptachlor epoxide	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Hexachlorobenzene	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS*						
Acenaphthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Benzo[k]fluoranthene	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
1&2-Chloronaphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
2-Methylnaphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 1.4	< 1.3	< 1.3	< 1.3	< 1.3
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 1.4	< 1.3	< 1.3	< 1.3	< 1.3
Phenols in SVOC Soil Samples by GC-MS						
4-Chloro-3-methylphenol	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
2-Chlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dimethylphenol	mg/kg dry wt	< 3	< 3	< 3	< 3	< 3
3 & 4-Methylphenol (m- + p-cresol)	mg/kg dry wt	< 3	< 3	< 3	< 3	< 3
2-Methylphenol (o-cresol)	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Nitrophenol	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
Pentachlorophenol (PCP)	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Phenol	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
2,4,5-Trichlorophenol	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
2,4,6-Trichlorophenol	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
Plasticisers in SVOC Soil Samples by GC-MS						
Bis(2-ethylhexyl)phthalate	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
Butylbenzylphthalate	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
Di(2-ethylhexyl)adipate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Diethylphthalate	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
Dimethylphthalate	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
Di-n-butylphthalate	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0
Di-n-octylphthalate	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 1.0

Sample Type: Soil

Sample Name:		TP101_1 10-Jan-2023	TP101_2 10-Jan-2023	TP101_3 10-Jan-2023	TP102_0-1.0 11-Jan-2023	TP102_2.0-2.3 11-Jan-2023
Lab Number:		3151614.2	3151614.3	3151614.4	3151614.5	3151614.6
Other Halogenated compounds in SVOC Soil Samples by GC-MS						
1,2-Dichlorobenzene	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 0.8
1,3-Dichlorobenzene	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 0.8
1,4-Dichlorobenzene	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 0.8
Hexachlorobutadiene	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 0.8
Hexachloroethane	mg/kg dry wt	< 1.2	< 1.1	< 1.0	< 1.0	< 0.8
1,2,4-Trichlorobenzene	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Other compounds in SVOC Soil Samples by GC-MS						
Benzyl alcohol	mg/kg dry wt	< 10	< 10	< 10	< 10	< 10
Carbazole	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Dibenzofuran	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Isophorone	mg/kg dry wt	< 0.6	< 0.6	< 0.5	< 0.5	< 0.5
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	-	< 30	-
C10 - C14	mg/kg dry wt	-	-	-	< 20	-
C15 - C36	mg/kg dry wt	-	-	-	530	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	-	540	-

Sample Name:		TP102_2.9 11-Jan-2023	TP102_3.5 11-Jan-2023	TP103_1 11-Jan-2023	TP103_2 11-Jan-2023	TP103_3 11-Jan-2023
Lab Number:		3151614.7	3151614.8	3151614.10	3151614.11	3151614.12
Individual Tests						
Dry Matter	g/100g as rcvd	81	67	78	72	85
TCLP Weight of Sample Taken	g	-	-	-	50	-
TCLP Initial Sample pH	pH Units	-	-	-	6.0	-
TCLP Acid Adjusted Sample pH	pH Units	-	-	-	1.6	-
TCLP Extractant Type*		-	-	-	NaOH/Acetic acid at pH 4.93 +/- 0.05	-
TCLP Extraction Fluid pH	pH Units	-	-	-	4.9	-
TCLP Post Extraction Sample pH	pH Units	-	-	-	4.9	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	4	7	23	22	21
Total Recoverable Cadmium	mg/kg dry wt	0.12	< 0.10	0.49	0.41	0.39
Total Recoverable Chromium	mg/kg dry wt	12	11	41	40	43
Total Recoverable Copper	mg/kg dry wt	21	14	44	39	33
Total Recoverable Lead	mg/kg dry wt	27	31	270	280	197
Total Recoverable Nickel	mg/kg dry wt	9	9	13	12	13
Total Recoverable Zinc	mg/kg dry wt	100	75	440	330	330
Haloethers in SVOC Soil Samples by GC-MS						
Bis(2-chloroethoxy) methane	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bis(2-chloroethyl)ether	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bis(2-chloroisopropyl)ether	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4-Bromophenyl phenyl ether	mg/kg dry wt	< 0.4	< 0.5	< 0.4	< 0.4	< 0.4
4-Chlorophenyl phenyl ether	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Nitrogen containing compounds in SVOC Soil Samples by GC-MS						
2,4-Dinitrotoluene	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,6-Dinitrotoluene	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nitrobenzene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
N-Nitrosodi-n-propylamine	mg/kg dry wt	< 0.8	< 0.9	< 0.8	< 0.8	< 0.8
N-Nitrosodiphenylamine + Diphenylamine	mg/kg dry wt	< 0.8	< 0.9	< 0.8	< 0.8	< 0.8
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Aldrin	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
alpha-BHC	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
beta-BHC	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
delta-BHC	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
gamma-BHC (Lindane)	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Sample Type: Soil						
Sample Name:		TP102_2.9 11-Jan-2023	TP102_3.5 11-Jan-2023	TP103_1 11-Jan-2023	TP103_2 11-Jan-2023	TP103_3 11-Jan-2023
Lab Number:		3151614.7	3151614.8	3151614.10	3151614.11	3151614.12
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
4,4'-DDD	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4,4'-DDE	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4,4'-DDT	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dieldrin	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Endosulfan I	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Endosulfan II	mg/kg dry wt	< 2	< 2	< 2	< 2	< 2
Endosulfan sulphate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Endrin	mg/kg dry wt	< 0.8	< 0.9	< 0.8	< 0.8	< 0.8
Endrin ketone	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Heptachlor	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Heptachlor epoxide	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Hexachlorobenzene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS*						
Acenaphthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[k]fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1&2-Chloronaphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2-Methylnaphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
Phenols in SVOC Soil Samples by GC-MS						
4-Chloro-3-methylphenol	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
2-Chlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dimethylphenol	mg/kg dry wt	< 3	< 3	< 3	< 3	< 3
3 & 4-Methylphenol (m- + p-cresol)	mg/kg dry wt	< 3	< 3	< 3	< 3	< 3
2-Methylphenol (o-cresol)	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Nitrophenol	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
Pentachlorophenol (PCP)	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Phenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4,5-Trichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4,6-Trichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Plasticisers in SVOC Soil Samples by GC-MS						
Bis(2-ethylhexyl)phthalate	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
Butylbenzylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Di(2-ethylhexyl)adipate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Diethylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dimethylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Di-n-butylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Sample Type: Soil

Sample Name:		TP102_2.9 11-Jan-2023	TP102_3.5 11-Jan-2023	TP103_1 11-Jan-2023	TP103_2 11-Jan-2023	TP103_3 11-Jan-2023
Lab Number:		3151614.7	3151614.8	3151614.10	3151614.11	3151614.12
Plasticisers in SVOC Soil Samples by GC-MS						
Di-n-octylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Other Halogenated compounds in SVOC Soil Samples by GC-MS						
1,2-Dichlorobenzene	mg/kg dry wt	< 0.8	< 0.9	< 0.8	< 0.8	< 0.8
1,3-Dichlorobenzene	mg/kg dry wt	< 0.8	< 0.9	< 0.8	< 0.8	< 0.8
1,4-Dichlorobenzene	mg/kg dry wt	< 0.8	< 0.9	< 0.8	< 0.8	< 0.8
Hexachlorobutadiene	mg/kg dry wt	< 0.8	< 0.9	< 0.8	< 0.8	< 0.8
Hexachloroethane	mg/kg dry wt	< 0.8	< 0.9	< 0.8	< 0.8	< 0.8
1,2,4-Trichlorobenzene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Other compounds in SVOC Soil Samples by GC-MS						
Benzyl alcohol	mg/kg dry wt	< 10	< 10	< 10	< 10	< 10
Carbazole	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibenzofuran	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Isophorone	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Sample Name:		TP104_0.3 12-Jan-2023	TP104_0.9 12-Jan-2023	TP104_1.7 12-Jan-2023	TP104_2.8 12-Jan-2023	TP104_3.8 12-Jan-2023
Lab Number:		3151614.14	3151614.15	3151614.16	3151614.17	3151614.18
Individual Tests						
Dry Matter	g/100g as rcvd	97	57	64	66	78
TCLP Weight of Sample Taken	g	-	50	-	-	-
TCLP Initial Sample pH	pH Units	-	6.0	-	-	-
TCLP Acid Adjusted Sample pH	pH Units	-	1.6	-	-	-
TCLP Extractant Type*		-	NaOH/Acetic acid at pH 4.93 +/- 0.05	-	-	-
TCLP Extraction Fluid pH	pH Units	-	4.9	-	-	-
TCLP Post Extraction Sample pH	pH Units	-	4.9	-	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	2	21	10	4	3
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	16.4	0.32	0.16	0.11
Total Recoverable Chromium	mg/kg dry wt	11	44	22	16	13
Total Recoverable Copper	mg/kg dry wt	10	49	21	14	11
Total Recoverable Lead	mg/kg dry wt	13.6	117	78	46	31
Total Recoverable Nickel	mg/kg dry wt	10	81	11	11	9
Total Recoverable Zinc	mg/kg dry wt	51	1,760	420	148	97
Haloethers in SVOC Soil Samples by GC-MS						
Bis(2-chloroethoxy) methane	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Bis(2-chloroethyl)ether	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Bis(2-chloroisopropyl)ether	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
4-Bromophenyl phenyl ether	mg/kg dry wt	< 0.3	< 0.6	< 0.5	< 0.5	< 0.4
4-Chlorophenyl phenyl ether	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Nitrogen containing compounds in SVOC Soil Samples by GC-MS						
2,4-Dinitrotoluene	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
2,6-Dinitrotoluene	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
Nitrobenzene	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
N-Nitrosodi-n-propylamine	mg/kg dry wt	< 0.6	< 1.1	< 1.0	< 0.9	< 0.8
N-Nitrosodiphenylamine + Diphenylamine	mg/kg dry wt	< 0.6	< 1.1	< 1.0	< 0.9	< 0.8
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Aldrin	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
alpha-BHC	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
beta-BHC	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
delta-BHC	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
gamma-BHC (Lindane)	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
4,4'-DDD	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
4,4'-DDE	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
4,4'-DDT	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0

Sample Type: Soil

Sample Name:		TP104_0.3 12-Jan-2023	TP104_0.9 12-Jan-2023	TP104_1.7 12-Jan-2023	TP104_2.8 12-Jan-2023	TP104_3.8 12-Jan-2023
Lab Number:		3151614.14	3151614.15	3151614.16	3151614.17	3151614.18
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Dieldrin	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Endosulfan I	mg/kg dry wt	< 1.0	< 6	< 1.0	< 1.0	< 1.0
Endosulfan II	mg/kg dry wt	< 2	< 6	< 2	< 2	< 2
Endosulfan sulphate	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
Endrin	mg/kg dry wt	< 0.6	< 1.1	< 1.0	< 0.9	< 0.8
Endrin ketone	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
Heptachlor	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Heptachlor epoxide	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Hexachlorobenzene	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS*						
Acenaphthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Benzo[k]fluoranthene	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
1&2-Chloronaphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
2-Methylnaphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
Phenols in SVOC Soil Samples by GC-MS						
4-Chloro-3-methylphenol	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
2-Chlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dimethylphenol	mg/kg dry wt	< 3	< 3	< 3	< 3	< 3
3 & 4-Methylphenol (m- + p-cresol)	mg/kg dry wt	< 3	< 3	< 3	< 3	< 3
2-Methylphenol (o-cresol)	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Nitrophenol	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
Pentachlorophenol (PCP)	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Phenol	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
2,4,5-Trichlorophenol	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
2,4,6-Trichlorophenol	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
Plasticisers in SVOC Soil Samples by GC-MS						
Bis(2-ethylhexyl)phthalate	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
Butylbenzylphthalate	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
Di(2-ethylhexyl)adipate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Diethylphthalate	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
Dimethylphthalate	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
Di-n-butylphthalate	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0
Di-n-octylphthalate	mg/kg dry wt	< 1.0	< 1.1	< 1.0	< 1.0	< 1.0

Sample Type: Soil

Sample Name:		TP104_0.3 12-Jan-2023	TP104_0.9 12-Jan-2023	TP104_1.7 12-Jan-2023	TP104_2.8 12-Jan-2023	TP104_3.8 12-Jan-2023
Lab Number:		3151614.14	3151614.15	3151614.16	3151614.17	3151614.18
Other Halogenated compounds in SVOC Soil Samples by GC-MS						
1,2-Dichlorobenzene	mg/kg dry wt	< 0.6	< 1.1	< 1.0	< 0.9	< 0.8
1,3-Dichlorobenzene	mg/kg dry wt	< 0.6	< 1.1	< 1.0	< 0.9	< 0.8
1,4-Dichlorobenzene	mg/kg dry wt	< 0.6	< 1.1	< 1.0	< 0.9	< 0.8
Hexachlorobutadiene	mg/kg dry wt	< 0.6	< 1.1	< 1.0	< 0.9	< 0.8
Hexachloroethane	mg/kg dry wt	< 0.6	< 1.1	< 1.0	< 0.9	< 0.8
1,2,4-Trichlorobenzene	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Other compounds in SVOC Soil Samples by GC-MS						
Benzyl alcohol	mg/kg dry wt	< 10	< 10	< 10	< 10	< 10
Carbazole	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Dibenzofuran	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Isophorone	mg/kg dry wt	< 0.5	< 0.6	< 0.5	< 0.5	< 0.5
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	< 30	-	-	-
C10 - C14	mg/kg dry wt	-	< 30	-	-	-
C15 - C36	mg/kg dry wt	-	490	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	490	-	-	-

Sample Name:		TP105_3.5 12-Jan-2023	TP105_1 12-Jan-2023	TP105_2 12-Jan-2023	TP105_3 12-Jan-2023	TP106_0.5 12-Jan-2023
Lab Number:		3151614.20	3151614.21	3151614.22	3151614.23	3151614.24
Individual Tests						
Dry Matter	g/100g as rcvd	96	74	75	78	76
TCLP Weight of Sample Taken	g	-	50	-	-	-
TCLP Initial Sample pH	pH Units	-	7.3	-	-	-
TCLP Acid Adjusted Sample pH	pH Units	-	1.6	-	-	-
TCLP Extractant Type*		-	NaOH/Acetic acid at pH 4.93 +/- 0.05	-	-	-
TCLP Extraction Fluid pH	pH Units	-	4.9	-	-	-
TCLP Post Extraction Sample pH	pH Units	-	5.0	-	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	3	19	17	17	6
Total Recoverable Cadmium	mg/kg dry wt	0.28	1.60	1.85	1.45	< 0.10
Total Recoverable Chromium	mg/kg dry wt	14	37	30	33	18
Total Recoverable Copper	mg/kg dry wt	16	89	80	76	13
Total Recoverable Lead	mg/kg dry wt	15.8	260	250	280	48
Total Recoverable Nickel	mg/kg dry wt	12	30	23	26	9
Total Recoverable Zinc	mg/kg dry wt	59	1,080	1,240	1,060	134
Haloethers in SVOC Soil Samples by GC-MS						
Bis(2-chloroethoxy) methane	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bis(2-chloroethyl)ether	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bis(2-chloroisopropyl)ether	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4-Bromophenyl phenyl ether	mg/kg dry wt	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
4-Chlorophenyl phenyl ether	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Nitrogen containing compounds in SVOC Soil Samples by GC-MS						
2,4-Dinitrotoluene	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,6-Dinitrotoluene	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nitrobenzene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
N-Nitrosodi-n-propylamine	mg/kg dry wt	< 0.7	< 0.8	< 0.8	< 0.8	< 0.8
N-Nitrosodiphenylamine + Diphenylamine	mg/kg dry wt	< 0.7	< 0.8	< 0.8	< 0.8	< 0.8
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Aldrin	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
alpha-BHC	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
beta-BHC	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
delta-BHC	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
gamma-BHC (Lindane)	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Sample Type: Soil

Sample Name:		TP105_3.5 12-Jan-2023	TP105_1 12-Jan-2023	TP105_2 12-Jan-2023	TP105_3 12-Jan-2023	TP106_0.5 12-Jan-2023
Lab Number:		3151614.20	3151614.21	3151614.22	3151614.23	3151614.24
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
4,4'-DDD	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4,4'-DDE	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4,4'-DDT	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dieldrin	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Endosulfan I	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Endosulfan II	mg/kg dry wt	< 2	< 2	< 2	< 2	< 2
Endosulfan sulphate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Endrin	mg/kg dry wt	< 0.7	< 0.8	< 0.8	< 0.8	< 0.8
Endrin ketone	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Heptachlor	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Heptachlor epoxide	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Hexachlorobenzene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS*						
Acenaphthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[k]fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1&2-Chloronaphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2-Methylnaphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
Phenols in SVOC Soil Samples by GC-MS						
4-Chloro-3-methylphenol	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
2-Chlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dimethylphenol	mg/kg dry wt	< 3	< 3	< 3	< 3	< 3
3 & 4-Methylphenol (m- + p-cresol)	mg/kg dry wt	< 3	< 3	< 3	< 3	< 3
2-Methylphenol (o-cresol)	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Nitrophenol	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
Pentachlorophenol (PCP)	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Phenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4,5-Trichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4,6-Trichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Plasticisers in SVOC Soil Samples by GC-MS						
Bis(2-ethylhexyl)phthalate	mg/kg dry wt	< 5	< 5	< 5	6	< 5
Butylbenzylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Di(2-ethylhexyl)adipate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Diethylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dimethylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Di-n-butylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Sample Type: Soil

Sample Name:		TP105_3.5 12-Jan-2023	TP105_1 12-Jan-2023	TP105_2 12-Jan-2023	TP105_3 12-Jan-2023	TP106_0.5 12-Jan-2023
Lab Number:		3151614.20	3151614.21	3151614.22	3151614.23	3151614.24
Plasticisers in SVOC Soil Samples by GC-MS						
Di-n-octylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Other Halogenated compounds in SVOC Soil Samples by GC-MS						
1,2-Dichlorobenzene	mg/kg dry wt	< 0.7	< 0.8	< 0.8	< 0.8	< 0.8
1,3-Dichlorobenzene	mg/kg dry wt	< 0.7	< 0.8	< 0.8	< 0.8	< 0.8
1,4-Dichlorobenzene	mg/kg dry wt	< 0.7	< 0.8	< 0.8	< 0.8	< 0.8
Hexachlorobutadiene	mg/kg dry wt	< 0.7	< 0.8	< 0.8	< 0.8	< 0.8
Hexachloroethane	mg/kg dry wt	< 0.7	< 0.8	< 0.8	< 0.8	< 0.8
1,2,4-Trichlorobenzene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Other compounds in SVOC Soil Samples by GC-MS						
Benzyl alcohol	mg/kg dry wt	< 10	< 10	< 10	< 10	< 10
Carbazole	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibenzofuran	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Isophorone	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Sample Name:		TP106_1.4 12-Jan-2023	TP106_2.6 12-Jan-2023	TP107_0.2 13-Jan-2023	TP107_2.0 13-Jan-2023	TP107_1 13-Jan-2023
Lab Number:		3151614.25	3151614.26	3151614.28	3151614.29	3151614.30
Individual Tests						
Dry Matter	g/100g as rcvd	79	92	95	96	79
TCLP Weight of Sample Taken	g	50	-	-	-	-
TCLP Initial Sample pH	pH Units	7.3	-	-	-	-
TCLP Acid Adjusted Sample pH	pH Units	1.6	-	-	-	-
TCLP Extractant Type*		NaOH/Acetic acid at pH 4.93 +/- 0.05	-	-	-	-
TCLP Extraction Fluid pH	pH Units	4.9	-	-	-	-
TCLP Post Extraction Sample pH	pH Units	5.0	-	-	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	16	5	6	2	22
Total Recoverable Cadmium	mg/kg dry wt	3.2	0.51	< 0.10	< 0.10	0.74
Total Recoverable Chromium	mg/kg dry wt	35	15	12	15	31
Total Recoverable Copper	mg/kg dry wt	57	22	11	11	36
Total Recoverable Lead	mg/kg dry wt	2,300	75	12.8	12.3	62
Total Recoverable Nickel	mg/kg dry wt	26	13	10	11	17
Total Recoverable Zinc	mg/kg dry wt	2,600	330	49	61	890
Haloethers in SVOC Soil Samples by GC-MS						
Bis(2-chloroethoxy) methane	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bis(2-chloroethyl)ether	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bis(2-chloroisopropyl)ether	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4-Bromophenyl phenyl ether	mg/kg dry wt	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
4-Chlorophenyl phenyl ether	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Nitrogen containing compounds in SVOC Soil Samples by GC-MS						
2,4-Dinitrotoluene	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,6-Dinitrotoluene	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nitrobenzene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
N-Nitrosodi-n-propylamine	mg/kg dry wt	< 0.8	< 0.7	< 0.7	< 0.7	< 0.8
N-Nitrosodiphenylamine + Diphenylamine	mg/kg dry wt	< 0.8	< 0.7	< 0.7	< 0.7	< 0.8
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Aldrin	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
alpha-BHC	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
beta-BHC	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
delta-BHC	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
gamma-BHC (Lindane)	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4,4'-DDD	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4,4'-DDE	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4,4'-DDT	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Sample Type: Soil

	Sample Name:	TP106_1.4 12-Jan-2023	TP106_2.6 12-Jan-2023	TP107_0.2 13-Jan-2023	TP107_2.0 13-Jan-2023	TP107_1 13-Jan-2023
	Lab Number:	3151614.25	3151614.26	3151614.28	3151614.29	3151614.30
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Dieldrin	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Endosulfan I	mg/kg dry wt	< 4	< 1.0	< 1.0	< 1.0	< 4
Endosulfan II	mg/kg dry wt	< 4	< 2	< 2	< 2	< 4
Endosulfan sulphate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Endrin	mg/kg dry wt	< 0.8	< 0.7	< 0.7	< 0.7	< 0.8
Endrin ketone	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Heptachlor	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Heptachlor epoxide	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Hexachlorobenzene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS*						
Acenaphthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[k]fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1&2-Chloronaphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2-Methylnaphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
Phenols in SVOC Soil Samples by GC-MS						
4-Chloro-3-methylphenol	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
2-Chlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dimethylphenol	mg/kg dry wt	< 3	< 3	< 3	< 3	< 3
3 & 4-Methylphenol (m- + p-cresol)	mg/kg dry wt	< 3	< 3	< 3	< 3	< 3
2-Methylphenol (o-cresol)	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Nitrophenol	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
Pentachlorophenol (PCP)	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Phenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4,5-Trichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4,6-Trichlorophenol	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Plasticisers in SVOC Soil Samples by GC-MS						
Bis(2-ethylhexyl)phthalate	mg/kg dry wt	< 5	< 5	< 5	< 5	< 5
Butylbenzylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Di(2-ethylhexyl)adipate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Diethylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dimethylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Di-n-butylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Di-n-octylphthalate	mg/kg dry wt	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Sample Type: Soil

Sample Name:		TP106_1.4 12-Jan-2023	TP106_2.6 12-Jan-2023	TP107_0.2 13-Jan-2023	TP107_2.0 13-Jan-2023	TP107_1 13-Jan-2023
Lab Number:		3151614.25	3151614.26	3151614.28	3151614.29	3151614.30
Other Halogenated compounds in SVOC Soil Samples by GC-MS						
1,2-Dichlorobenzene	mg/kg dry wt	< 0.8	< 0.7	< 0.7	< 0.7	< 0.8
1,3-Dichlorobenzene	mg/kg dry wt	< 0.8	< 0.7	< 0.7	< 0.7	< 0.8
1,4-Dichlorobenzene	mg/kg dry wt	< 0.8	< 0.7	< 0.7	< 0.7	< 0.8
Hexachlorobutadiene	mg/kg dry wt	< 0.8	< 0.7	< 0.7	< 0.7	< 0.8
Hexachloroethane	mg/kg dry wt	< 0.8	< 0.7	< 0.7	< 0.7	< 0.8
1,2,4-Trichlorobenzene	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Other compounds in SVOC Soil Samples by GC-MS						
Benzyl alcohol	mg/kg dry wt	< 10	< 10	< 10	< 10	< 10
Carbazole	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibenzofuran	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Isophorone	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 20	-	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-	-
C15 - C36	mg/kg dry wt	62	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	-	-	-	-

Sample Name:		TP107_2 13-Jan-2023	TP107_3 13-Jan-2023
Lab Number:		3151614.31	3151614.32
Individual Tests			
Dry Matter	g/100g as rcvd	74	74
TCLP Weight of Sample Taken	g	-	50
TCLP Initial Sample pH	pH Units	-	7.0
TCLP Acid Adjusted Sample pH	pH Units	-	1.6
TCLP Extractant Type*		-	NaOH/Acetic acid at pH 4.93 +/- 0.05
TCLP Extraction Fluid pH	pH Units	-	4.9
TCLP Post Extraction Sample pH	pH Units	-	5.0
Heavy Metals, Screen Level			
Total Recoverable Arsenic	mg/kg dry wt	25	24
Total Recoverable Cadmium	mg/kg dry wt	0.59	0.60
Total Recoverable Chromium	mg/kg dry wt	38	38
Total Recoverable Copper	mg/kg dry wt	34	35
Total Recoverable Lead	mg/kg dry wt	49	71
Total Recoverable Nickel	mg/kg dry wt	14	15
Total Recoverable Zinc	mg/kg dry wt	850	930
Haloethers in SVOC Soil Samples by GC-MS			
Bis(2-chloroethoxy) methane	mg/kg dry wt	< 0.5	< 0.5
Bis(2-chloroethyl)ether	mg/kg dry wt	< 0.5	< 0.5
Bis(2-chloroisopropyl)ether	mg/kg dry wt	< 0.5	< 0.5
4-Bromophenyl phenyl ether	mg/kg dry wt	< 0.4	< 0.4
4-Chlorophenyl phenyl ether	mg/kg dry wt	< 0.5	< 0.5
Nitrogen containing compounds in SVOC Soil Samples by GC-MS			
2,4-Dinitrotoluene	mg/kg dry wt	< 1.0	< 1.0
2,6-Dinitrotoluene	mg/kg dry wt	< 1.0	< 1.0
Nitrobenzene	mg/kg dry wt	< 0.5	< 0.5
N-Nitrosodi-n-propylamine	mg/kg dry wt	< 0.8	< 0.8
N-Nitrosodiphenylamine + Diphenylamine	mg/kg dry wt	< 0.8	< 0.8
Organochlorine Pesticides in SVOC Soil Samples by GC-MS			
Aldrin	mg/kg dry wt	< 0.5	< 0.5
alpha-BHC	mg/kg dry wt	< 0.5	< 0.5
beta-BHC	mg/kg dry wt	< 0.5	< 0.5
delta-BHC	mg/kg dry wt	< 0.5	< 0.5
gamma-BHC (Lindane)	mg/kg dry wt	< 0.5	< 0.5
4,4'-DDD	mg/kg dry wt	< 0.5	< 0.5

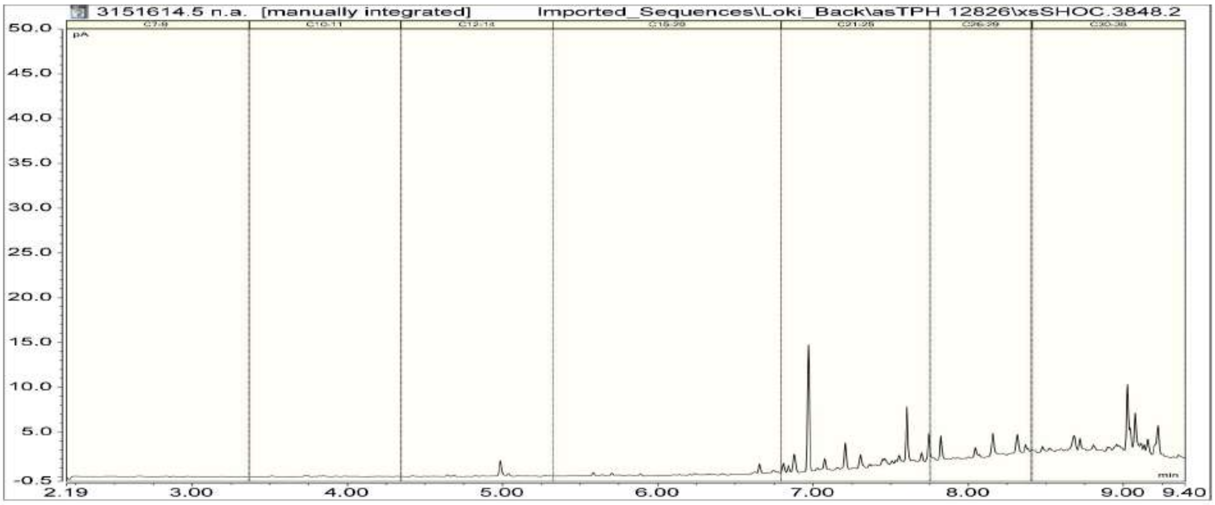
Sample Type: Soil			
	Sample Name:	TP107_2 13-Jan-2023	TP107_3 13-Jan-2023
	Lab Number:	3151614.31	3151614.32
Organochlorine Pesticides in SVOC Soil Samples by GC-MS			
4,4'-DDE	mg/kg dry wt	< 0.5	< 0.5
4,4'-DDT	mg/kg dry wt	< 1.0	< 1.0
Dieldrin	mg/kg dry wt	< 0.5	< 0.5
Endosulfan I	mg/kg dry wt	< 4	< 1.0
Endosulfan II	mg/kg dry wt	< 4	< 2
Endosulfan sulphate	mg/kg dry wt	< 1.0	< 1.0
Endrin	mg/kg dry wt	< 0.8	< 0.8
Endrin ketone	mg/kg dry wt	< 1.0	< 1.0
Heptachlor	mg/kg dry wt	< 0.5	< 0.5
Heptachlor epoxide	mg/kg dry wt	< 0.5	< 0.5
Hexachlorobenzene	mg/kg dry wt	< 0.5	< 0.5
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS*			
Acenaphthene	mg/kg dry wt	< 0.5	< 0.5
Acenaphthylene	mg/kg dry wt	< 0.5	< 0.5
Anthracene	mg/kg dry wt	< 0.5	< 0.5
Benzo[a]anthracene	mg/kg dry wt	< 0.5	< 0.5
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.5	< 0.5
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.5	< 0.5
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.5	< 0.5
Benzo[k]fluoranthene	mg/kg dry wt	< 0.5	< 0.5
1&2-Chloronaphthalene	mg/kg dry wt	< 0.5	< 0.5
Chrysene	mg/kg dry wt	< 0.5	< 0.5
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.5	< 0.5
Fluoranthene	mg/kg dry wt	< 0.5	< 0.5
Fluorene	mg/kg dry wt	< 0.5	< 0.5
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.5	< 0.5
2-Methylnaphthalene	mg/kg dry wt	< 0.5	< 0.5
Naphthalene	mg/kg dry wt	< 0.5	< 0.5
Phenanthrene	mg/kg dry wt	< 0.5	< 0.5
Pyrene	mg/kg dry wt	< 0.5	< 0.5
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES*	mg/kg dry wt	< 1.3	< 1.3
Benzo[a]pyrene Toxic Equivalence (TEF)*	mg/kg dry wt	< 1.3	< 1.3
Phenols in SVOC Soil Samples by GC-MS			
4-Chloro-3-methylphenol	mg/kg dry wt	< 5	< 5
2-Chlorophenol	mg/kg dry wt	< 1.0	< 1.0
2,4-Dichlorophenol	mg/kg dry wt	< 1.0	< 1.0
2,4-Dimethylphenol	mg/kg dry wt	< 3	< 3
3 & 4-Methylphenol (m- + p-cresol)	mg/kg dry wt	< 3	< 3
2-Methylphenol (o-cresol)	mg/kg dry wt	< 1.0	< 1.0
2-Nitrophenol	mg/kg dry wt	< 5	< 5
Pentachlorophenol (PCP)	mg/kg dry wt	< 30	< 30
Phenol	mg/kg dry wt	< 1.0	< 1.0
2,4,5-Trichlorophenol	mg/kg dry wt	< 1.0	< 1.0
2,4,6-Trichlorophenol	mg/kg dry wt	< 1.0	< 1.0
Plasticisers in SVOC Soil Samples by GC-MS			
Bis(2-ethylhexyl)phthalate	mg/kg dry wt	< 5	< 5
Butylbenzylphthalate	mg/kg dry wt	< 1.0	< 1.0
Di(2-ethylhexyl)adipate	mg/kg dry wt	< 1.0	< 1.0
Diethylphthalate	mg/kg dry wt	< 1.0	< 1.0
Dimethylphthalate	mg/kg dry wt	< 1.0	< 1.0
Di-n-butylphthalate	mg/kg dry wt	< 1.0	< 1.0
Di-n-octylphthalate	mg/kg dry wt	< 1.0	< 1.0

Sample Type: Soil		
Sample Name:	TP107_2 13-Jan-2023	TP107_3 13-Jan-2023
Lab Number:	3151614.31	3151614.32
Other Halogenated compounds in SVOC Soil Samples by GC-MS		
1,2-Dichlorobenzene mg/kg dry wt	< 0.8	< 0.8
1,3-Dichlorobenzene mg/kg dry wt	< 0.8	< 0.8
1,4-Dichlorobenzene mg/kg dry wt	< 0.8	< 0.8
Hexachlorobutadiene mg/kg dry wt	< 0.8	< 0.8
Hexachloroethane mg/kg dry wt	< 0.8	< 0.8
1,2,4-Trichlorobenzene mg/kg dry wt	< 0.5	< 0.5
Other compounds in SVOC Soil Samples by GC-MS		
Benzyl alcohol mg/kg dry wt	< 10	< 10
Carbazole mg/kg dry wt	< 0.5	< 0.5
Dibenzofuran mg/kg dry wt	< 0.5	< 0.5
Isophorone mg/kg dry wt	< 0.5	< 0.5

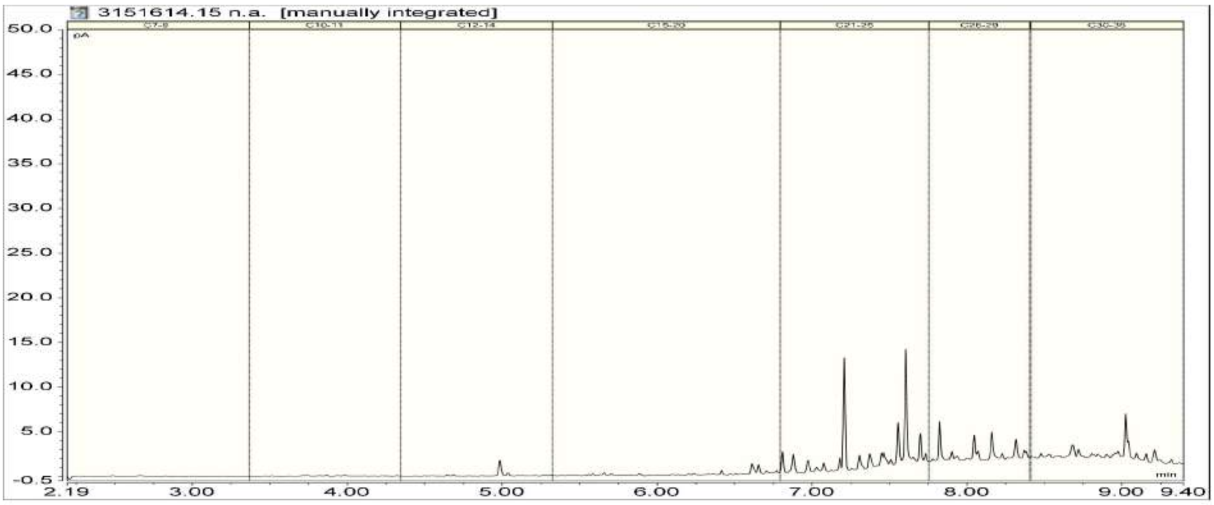
Sample Type: Aqueous					
Sample Name:	TP101_1 [TCLP Extract]	TP102_0-1.0 [TCLP Extract]	TP103_2 [TCLP Extract]	TP104_0.9 [TCLP Extract]	TP105_1 [TCLP Extract]
Lab Number:	3151614.33	3151614.34	3151614.35	3151614.36	3151614.37
Individual Tests					
Total Copper g/m³	-	0.036	-	-	-
Total Lead g/m³	0.0159	0.035	0.103	0.029	0.079
Total Zinc g/m³	3.0	7.6	1.58	5.9	6.7

Sample Name:	TP106_1.4 [TCLP Extract]	TP107_3 [TCLP Extract]
Lab Number:	3151614.38	3151614.39
Individual Tests		
Total Lead g/m³	5.5	-
Total Zinc g/m³	12.4	16.2

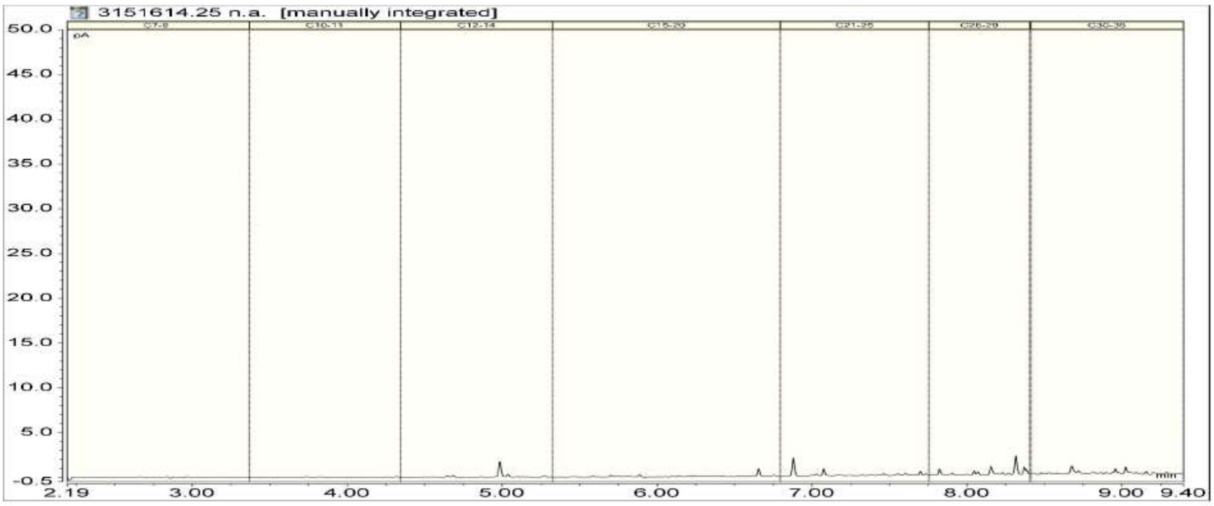
3151614.5
TP102_0-1.0 11-Jan-2023
Client Chromatogram for TPH by FID



3151614.15
TP104_0.9 12-Jan-2023
Client Chromatogram for TPH by FID



3151614.25
TP106_1.4 12-Jan-2023
Client Chromatogram for TPH by FID



Analyst's Comments

Amended Report: This certificate of analysis replaces report '3151614-SPv1' issued on 18-Jan-2023 at 4:44 pm.
Reason for amendment: TCLP metals added to 7 samples.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	2-8, 10-12, 14-18, 20-26, 28-32
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	2-8, 10-12, 14-18, 20-26, 28-32
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	2-8, 10-12, 14-18, 20-26, 28-32

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Semivolatile Organic Compounds Screening in Soil by GC-MS	Sonication extraction, GC-MS analysis. Tested on as received sample. In-house based on US EPA 8270.	0.024 - 30 mg/kg dry wt	2-8, 10-12, 14-18, 20-26, 28-32
TCLP Profile*	Extraction at 30 +/- 2 rpm for 18 +/- 2 hours, (Ratio 1g sample : 20g extraction fluid). US EPA 1311.	-	2, 5, 11, 15, 21, 25, 32
Total Petroleum Hydrocarbons in Soil			
Client Chromatogram for TPH by FID	Small peaks associated with QC compounds may be visible in chromatograms with low TPH concentrations. QC peaks are as follows: one peak in the C12 - 14 band, the C21 - 25 band and the C30 - 36 band. All QC peaks are corrected for in the reported TPH concentrations.	-	5, 15, 25
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	20 mg/kg dry wt	5, 15, 25
C10 - C14	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	20 mg/kg dry wt	5, 15, 25
C15 - C36	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	40 mg/kg dry wt	5, 15, 25
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	70 mg/kg dry wt	5, 15, 25
TCLP Profile			
TCLP Weight of Sample Taken	Gravimetric. US EPA 1311.	0.1 g	2, 5, 11, 15, 21, 25, 32
TCLP Initial Sample pH	pH meter. US EPA 1311.	0.1 pH Units	2, 5, 11, 15, 21, 25, 32
TCLP Acid Adjusted Sample pH	pH meter. US EPA 1311.	0.1 pH Units	2, 5, 11, 15, 21, 25, 32
TCLP Extractant Type*	US EPA 1311.	-	2, 5, 11, 15, 21, 25, 32
TCLP Extraction Fluid pH	pH meter. US EPA 1311.	0.1 pH Units	2, 5, 11, 15, 21, 25, 32
TCLP Post Extraction Sample pH	pH meter. US EPA 1311.	0.1 pH Units	2, 5, 11, 15, 21, 25, 32

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Total Digestion of Extracted Samples*	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	33-39
Total Copper	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23rd ed. 2017.	0.011 g/m³	34
Total Lead	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23rd ed. 2017.	0.0021 g/m³	33-38
Total Zinc	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23rd ed. 2017.	0.021 g/m³	33-39

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

Testing was completed between 16-Jan-2023 and 28-Feb-2023. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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

Ara Heron BSc (Tech)
Client Services Manager - Environmental

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ACCREDITED IANZ TESTING LABORATORY Nº 1334

Version Number: 12	Date Issued: Oct 2021	Authorised By: LB	Controlled Document

Client Name:	Pattle Delamore Partners	**Job Number:**	T009132.2	**Total Samples Received:**	27
Client Address:	Level 2/134 Oxford Terrace, Christchurch Central City, Christchurch 8011	**Site Reference / Address:**	C02450100	**Date Received:**	16/01/2023
Client Reference:	C02450100			**Date Analysed:**	23/01/2023
Client Contact:	Lucy Duffus			**Date Reported:**	30/03/2023

ASBESTOS IN SOIL ANALYSIS REPORT

Laboratory Sample Number	Client Sample Number	General Description	Received Weight (g)	Dry Weight (g)	Results	ACM Weight (g)	FA Weight (g)	AF Weight (g)	ACM w/w %	FA w/w %	AF w/w %	Combined AF/FA %	Comments
T009132.2.1	1	TP101_1, Soil											
		Layer 1: >10 mm	602.60	29.66	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		72.88		N/A	0.00000	0.00000					
		Layer 3: <2 mm		158.65		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		54.70									
		Total sample weight:		261.19	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.2	2	TP101_2, Soil											
		Layer 1: >10 mm	613.75	25.05	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00664%	0.00000%	0.00664%	
		Layer 2: 10 - 2 mm		78.46	**Chrysotile (White Asbestos)** **Amosite (Brown Asbestos)** Organic Fibres	N/A	0.01885	0.00000					
		Layer 3: <2 mm		180.36	Organic Fibres	N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		50.90									
		Total sample weight:		283.87	Total Combined:	0.00000	0.01885	0.00000					
T009132.2.3	3	TP101_3, Soil											
		Layer 1: >10 mm	619.42	37.64	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		81.05		N/A	0.00000	0.00000					
		Layer 3: <2 mm		147.19		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		55.58									
		Total sample weight:		265.88	Total Combined:	0.00000	0.00000	0.00000					

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T009132.2.4	7	TP102_0-1.0, Soil											
		Layer 1: >10 mm	671.13	125.10	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		133.13		N/A	0.00000	0.00000					
		Layer 3: <2 mm		151.18		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		53.83									
		Total sample weight:		409.41	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.5	8	TP102_2.0-2.3, Soil											
		Layer 1: >10 mm	916.96	157.52	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		351.33		N/A	0.00000	0.00000					
		Layer 3: <2 mm		213.27		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		56.43									
		Total sample weight:		722.12	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.6	9	TP102_2.9, Soil											
		Layer 1: >10 mm	961.77	188.73	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		189.64		N/A	0.00000	0.00000					
		Layer 3: <2 mm		383.01		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		51.48									
		Total sample weight:		761.38	Total Combined:	0.00000	0.00000	0.00000					

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Client Reference:	C02450100			**Date Analysed:**	23/01/2023
Client Contact:	Lucy Duffus			**Date Reported:**	30/03/2023

ASBESTOS IN SOIL ANALYSIS REPORT

Laboratory Sample Number	Client Sample Number	General Description	Received Weight (g)	Dry Weight (g)	Results	ACM Weight (g)	FA Weight (g)	AF Weight (g)	ACM w/w %	FA w/w %	AF w/w %	Combined AF/FA %	Comments
T009132.2.7	10	TP102_3.5, Soil											
		Layer 1: >10 mm	915.81	82.39	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		195.46		N/A	0.00000	0.00000					
		Layer 3: <2 mm		335.73		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		53.99									
		Total sample weight:		613.58	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.8	12	TP103_1, Soil											
		Layer 1: >10 mm	731.15	89.99	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00035%	0.00035%	
		Layer 2: 10 - 2 mm		241.34	Organic Fibres	N/A	0.00000	0.00000					
		Layer 3: <2 mm		195.39	**Chrysotile (White Asbestos)** Organic Fibres Synthetic Mineral Fibres	N/A	0.00000	0.00186					
		Layer 3 sub sampled weight:		52.48									
		Total sample weight:		526.72	Total Combined:	0.00000	0.00000	0.00186					
T009132.2.9	13	TP103_2, Soil											
		Layer 1: >10 mm	953.77	191.49	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00032%	0.00007%	0.00039%	
		Layer 2: 10 - 2 mm		250.36	**Chrysotile (White Asbestos)** **Crocidolite (Blue Asbestos)** Organic Fibres	N/A	0.00222	0.00050					
		Layer 3: <2 mm		262.12	Organic Fibres	N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		57.92									
		Total sample weight:		703.97	Total Combined:	0.00000	0.00222	0.00050					

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Client Reference:	C02450100			**Date Analysed:**	23/01/2023
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Laboratory Sample Number	Client Sample Number	General Description	Received Weight (g)	Dry Weight (g)	Results	ACM Weight (g)	FA Weight (g)	AF Weight (g)	ACM w/w %	FA w/w %	AF w/w %	Combined AF/FA %	Comments
T009132.2.10	14	TP103_3, Soil											
		Layer 1: >10 mm	937.45	108.75	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		286.72		N/A	0.00000	0.00000					
		Layer 3: <2 mm		276.90		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		55.86									
		Total sample weight:		672.37	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.11	18	TP104_0.3, Soil											
		Layer 1: >10 mm	1101.95	219.14	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		461.88		N/A	0.00000	0.00000					
		Layer 3: <2 mm		338.83		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		55.55									
		Total sample weight:		1019.85	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.12	19	TP104_0.9, Soil											
		Layer 1: >10 mm	741.75	68.81	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		124.10		N/A	0.00000	0.00000					
		Layer 3: <2 mm		182.43		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		51.52									
		Total sample weight:		375.34	Total Combined:	0.00000	0.00000	0.00000					

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T009132.2.13	20	TP104_1.7, Soil											
		Layer 1: >10 mm	756.56	109.01	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		130.86		N/A	0.00000	0.00000					
		Layer 3: <2 mm		213.33		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		56.09									
		Total sample weight:		453.20	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.14	21	TP104_2.8, Soil											
		Layer 1: >10 mm	1230.83	104.69	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		193.41		N/A	0.00000	0.00000					
		Layer 3: <2 mm		590.49		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		52.51									
		Total sample weight:		888.59	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.15	22	TP104_3.8, Soil											
		Layer 1: >10 mm	861.70	55.02	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		99.31		N/A	0.00000	0.00000					
		Layer 3: <2 mm		506.63		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		52.05									
		Total sample weight:		660.96	Total Combined:	0.00000	0.00000	0.00000					

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Laboratory Sample Number	Client Sample Number	General Description	Received Weight (g)	Dry Weight (g)	Results	ACM Weight (g)	FA Weight (g)	AF Weight (g)	ACM w/w %	FA w/w %	AF w/w %	Combined AF/FA %	Comments
T009132.2.16	24	TP105_3.5, Soil											
		Layer 1: >10 mm	1134.03	323.52	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		598.70		N/A	0.00000	0.00000					
		Layer 3: <2 mm		109.65		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		52.24									
		Total sample weight:		1031.87	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.17	25	TP105_1, Soil											
		Layer 1: >10 mm	1021.46	125.82	**Chrysotile (White Asbestos)** Organic Fibres	1.13929	0.00000	0.00000	0.02243%	0.00000%	0.00001%	0.00001%	ACM Cement Content Calculated at 15%
		Layer 2: 10 - 2 mm		275.27	Organic Fibres	N/A	0.00000	0.00000					
		Layer 3: <2 mm		360.69	**Chrysotile (White Asbestos)** Organic Fibres	N/A	0.00000	0.00007					
		Layer 3 sub sampled weight:		53.50									
		Total sample weight:		761.78	Total Combined:	1.13929	0.00000	0.00007					
T009132.2.18	26	TP105_2, Soil											
		Layer 1: >10 mm	933.05	92.09	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00546%	0.00129%	0.00676%	
		Layer 2: 10 - 2 mm		243.64	**Chrysotile (White Asbestos)** **Amosite (Brown Asbestos)** Organic Fibres	N/A	0.03787	0.00896					
		Layer 3: <2 mm		357.27	Organic Fibres	N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		50.04									
		Total sample weight:		693.00	Total Combined:	0.00000	0.03787	0.00896					

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Laboratory Sample Number	Client Sample Number	General Description	Received Weight (g)	Dry Weight (g)	Results	ACM Weight (g)	FA Weight (g)	AF Weight (g)	ACM w/w %	FA w/w %	AF w/w %	Combined AF/FA %	Comments
T009132.2.19	27	TP105_3, Soil											
		Layer 1: >10 mm	935.91	183.70	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00689%	0.00079%	0.00767%	
		Layer 2: 10 - 2 mm		214.10	**Chrysotile (White Asbestos)** **Amosite (Brown Asbestos)** **Crocidolite (Blue Asbestos)** Organic Fibres	N/A	0.04997	0.00571					
		Layer 3: <2 mm		327.92	Organic Fibres	N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		52.75									
		Total sample weight:		725.72	Total Combined:	0.00000	0.04997	0.00571					
T009132.2.20	31	TP106_0.5, Soil											
		Layer 1: >10 mm	828.01	146.06	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		126.44		N/A	0.00000	0.00000					
		Layer 3: <2 mm		356.98		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		52.42									
		Total sample weight:		629.48	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.21	32	TP106_1.4, Soil											
		Layer 1: >10 mm	823.59	149.70	**Chrysotile (White Asbestos)** Organic Fibres	0.16432	0.00000	0.00000	0.01334%	0.01598%	0.00230%	0.01828%	ACM Fibrous Material Content Calculated at 50%
		Layer 2: 10 - 2 mm		165.15	**Chrysotile (White Asbestos)** Organic Fibres	N/A	0.09842	0.00080					
		Layer 3: <2 mm		301.09	**Chrysotile (White Asbestos)** Organic Fibres	N/A	0.00000	0.01336					
		Layer 3 sub sampled weight:		56.11									
		Total sample weight:		615.94	Total Combined:	0.16432	0.09842	0.01416					

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Client Reference:	C02450100			**Date Analysed:**	23/01/2023
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Laboratory Sample Number	Client Sample Number	General Description	Received Weight (g)	Dry Weight (g)	Results	ACM Weight (g)	FA Weight (g)	AF Weight (g)	ACM w/w %	FA w/w %	AF w/w %	Combined AF/FA %	Comments
T009132.2.22	33	TP106_2.6, Soil											
		Layer 1: >10 mm	1033.78	234.87	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		444.89		N/A	0.00000	0.00000					
		Layer 3: <2 mm		229.27		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		55.14									
		Total sample weight:		909.03	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.23	37	TP107_0.2, Soil											
		Layer 1: >10 mm	1029.44	216.12	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		353.95		N/A	0.00000	0.00000					
		Layer 3: <2 mm		353.37		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		54.33									
		Total sample weight:		923.44	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.24	38	TP107_2.0, Soil											
		Layer 1: >10 mm	1027.68	176.72	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		456.44		N/A	0.00000	0.00000					
		Layer 3: <2 mm		287.88		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		55.14									
		Total sample weight:		921.04	Total Combined:	0.00000	0.00000	0.00000					

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T009132.2.25	39	TP107_1, Soil											
		Layer 1: >10 mm	830.55	104.80	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		212.18		N/A	0.00000	0.00000					
		Layer 3: <2 mm		269.83		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		50.68									
		Total sample weight:		586.81	Total Combined:	0.00000	0.00000	0.00000					
T009132.2.26	40	TP107_2, Soil											
		Layer 1: >10 mm	899.01	93.01	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		256.19		N/A	0.00000	0.00000					
		Layer 3: <2 mm		323.16		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		54.05									
		Total sample weight:		672.36	Total Combined:	0.00000	0.00000	0.00000					

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T009132.2.27	41	TP107_3, Soil											
		Layer 1: >10 mm	994.67	27.66	Organic Fibres	0.00000	0.00000	0.00000	0.00000%	0.00000%	0.00000%	0.00000%	No Asbestos Detected
		Layer 2: 10 - 2 mm		296.64		N/A	0.00000	0.00000					
		Layer 3: <2 mm		425.17		N/A	0.00000	0.00000					
		Layer 3 sub sampled weight:		53.07									
		Total sample weight:		749.47	Total Combined:	0.00000	0.00000	0.00000					

Note: This report has been amended to include ACM classification for samples 17 & 21. This report now supersedes report T009312.2a issued on 24/01/2023

Method References and Disclaimers

Samples were analysed in accordance with:	AS4964-2004 Australian Standard - Method for Qualitative Identification of Asbestos in Bulk Samples BRANZ - New Zealand Guidelines for Assessing and Managing Asbestos in Soil 2017
Disclaimers:	Samples are reported 'As Received'. Terra Scientific takes no responsibility for sampling processes, client sample descriptions and sample locations as these were provided by the client. The results presented in this report relate specifically to the samples submitted for this job. The detection limit is 0.1g/1kg (0.01% w/w) as stated in the AS4964-2004. Samples that contain asbestos less than this limit are outside the scope of accreditation. Asbestos calculations are outside the scope of accreditation. All opinions and interpretations are outside the scope of accreditation. This report shall not be reproduced, except in full, without the written consent of the Key Technical Person assigned to this report.

For any queries regarding this report, please do not hesitate to contact the laboratory and speak with the Key Technical Person.

Jessica Griffin
Managing Director
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ACCREDITED TESTING LABORATORY Nº 1334

Version Number: 9 | Date Issued: Oct 2021 | Authorised By: LB | Controlled Document

Client Name:	Pattle Delamore Partners	**Job Number:**	T009132.1	**Total Samples Received:**	7
Client Address:	Level 2/134 Oxford Terrace, Christchurch Central City, Christchurch 8011	**Site Reference / Address:**	C02450100	**Date Received:**	16/01/2023
Client Reference:	C02450100			**Date Analysed:**	20/01/2023
Client Contact:	Lucy Duffus			**Date Reported:**	20/01/2023

ASBESTOS ANALYSIS REPORT

Laboratory Sample Number	Client Sample Number	General Description	Results	Comments
T009132.1.1	5	TP101_ASB002 Dirt-covered white painted cement **Sample Weight (g):** 10.98	**Chrysotile (White Asbestos)** Organic Fibres	QA/QC Reviewed
T009132.1.2	6	TP101_ASB003 Dirt-covered white painted cement **Sample Weight (g):** 67.57	**Chrysotile (White Asbestos)** **Amosite (Brown Asbestos)** Organic Fibres	QA/QC Reviewed
T009132.1.3	15	TP103_ASB001 Dirt-covered cement **Sample Weight (g):** 114.68	**Chrysotile (White Asbestos)** **Amosite (Brown Asbestos)** **Crocidolite (Blue Asbestos)** Organic Fibres	QA/QC Reviewed
T009132.1.4	16	TP103_ASB002 Dirt-covered unpainted cement **Sample Weight (g):** 58.48	**Chrysotile (White Asbestos)** **Crocidolite (Blue Asbestos)** Organic Fibres	QA/QC Reviewed
T009132.1.5	28	TP105_ASB001 Dirt-covered cement **Sample Weight (g):** 22.22	**Chrysotile (White Asbestos)** **Amosite (Brown Asbestos)** **Crocidolite (Blue Asbestos)** Organic Fibres	
T009132.1.6	35	TP106_ASB001 Dirt-covered cement **Sample Weight (g):** 19.90	**Chrysotile (White Asbestos)** Organic Fibres	

Client Name:	Pattle Delamore Partners	**Job Number:**	T009132.1	**Total Samples Received:**	7
Client Address:	Level 2/134 Oxford Terrace, Christchurch Central City, Christchurch 8011	**Site Reference / Address:**	C02450100	**Date Received:**	16/01/2023
Client Reference:	C02450100			**Date Analysed:**	20/01/2023
Client Contact:	Lucy Duffus			**Date Reported:**	20/01/2023

T009132.1.7	42	TP107_ASB001 Dirt-covered cement **Sample Weight (g):**	 13.45	**Chrysotile (White Asbestos)** **Amosite (Brown Asbestos)** Organic Fibres	

Method References and Disclaimers

Samples were analysed in accordance with:	AS4964-2004 Australian Standard - Method for Qualitative Identification of Asbestos in Bulk Samples Samples are reported 'As Received'. Terra Scientific takes no responsibility for sampling processes, client sample descriptions and sample locations as these were provided by the client.
Disclaimers:	The results presented in this report relate specifically to the samples submitted for this job. The detection limit is 0.1g/1kg as stated in the AS4964-2004. This report shall not be reproduced, except in full, without the written consent of the Key Technical Person assigned to this report.

For any queries regarding this report, please do not hesitate to contact the laboratory and speak with the Key Technical Person.

Jessica Griffin
Managing Director
Key Technical Person

Hill Laboratories
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Certificate of Analysis

SPv1

Client:	Pattle Delamore Partners Limited	**Lab No:**	3055181
Contact:	S Wilson C/- Pattle Delamore Partners Limited PO Box 389 Christchurch 8140	**Date Received:**	16-Aug-2022
		Date Reported:	02-Sep-2022
		Quote No:	119397
		Order No:	
		Client Reference:	C02450100
		Submitted By:	Chanelle Seabrook

Sample Type: Aqueous

Sample Name:		MW2 12-Aug-2022	MW3 12-Aug-2022
Lab Number:		3055181.1	3055181.2
Individual Tests			
Sum of Anions	meq/L	2.4	2.7
Sum of Cations	meq/L	2.4	2.6
pH	pH Units	6.4	6.4
Total Alkalinity	g/m³ as $CaCO_3$	56	70
Bicarbonate	g/m³ at 25°C	68	85
Total Hardness	g/m³ as $CaCO_3$	90	100
Electrical Conductivity (EC)	mS/m	26.5	28.7
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010
Dissolved Boron	g/m³	0.170	0.31
Dissolved Calcium	g/m³	23	25
Dissolved Chromium	g/m³	< 0.0005	< 0.0005
Dissolved Iron	g/m³	< 0.02	< 0.02
Dissolved Lead	g/m³	< 0.00010	< 0.00010
Dissolved Magnesium	g/m³	7.9	8.8
Dissolved Nickel	g/m³	< 0.0005	< 0.0005
Dissolved Potassium	g/m³	2.5	4.3
Dissolved Sodium	g/m³	11.2	12.0
Dissolved Zinc	g/m³	0.0016	0.0013
Chloride	g/m³	12.2	11.6
Total Nitrogen	g/m³	10.1	9.3
Total Ammoniacal-N	g/m³	< 0.010	< 0.010
Nitrite-N	g/m³	< 0.002	< 0.002
Nitrate-N	g/m³	10.0	9.2
Nitrate-N + Nitrite-N	g/m³	10.0	9.2
Total Kjeldahl Nitrogen (TKN)	g/m³	0.13	0.16
Dissolved Reactive Phosphorus	g/m³	0.007	0.008
Sulphate	g/m³	10.1	13.1
Haloethers in SVOC Water Samples by GC-MS			
Bis(2-chloroethoxy) methane	g/m³	< 0.005	< 0.005
Bis(2-chloroethyl)ether	g/m³	< 0.005	< 0.005
Bis(2-chloroisopropyl)ether	g/m³	< 0.005	< 0.005
4-Bromophenyl phenyl ether	g/m³	< 0.005	< 0.005
4-Chlorophenyl phenyl ether	g/m³	< 0.005	< 0.005
Nitrogen containing compounds in SVOC Water Samples by GC-MS*			
2,4-Dinitrotoluene	g/m³	< 0.010	< 0.010
2,6-Dinitrotoluene	g/m³	< 0.010	< 0.010
Nitrobenzene	g/m³	< 0.005	< 0.005
N-Nitrosodi-n-propylamine	g/m³	< 0.010	< 0.010

Sample Type: Aqueous

Sample Name:		MW2 12-Aug-2022	MW3 12-Aug-2022
Lab Number:		3055181.1	3055181.2
Nitrogen containing compounds in SVOC Water Samples by GC-MS*			
N-Nitrosodiphenylamine + Diphenylamine*	g/m³	< 0.010	< 0.010
Organochlorine Pesticides in SVOC Water Samples by GC-MS			
Aldrin	g/m³	< 0.005	< 0.005
alpha-BHC	g/m³	< 0.005	< 0.005
beta-BHC	g/m³	< 0.005	< 0.005
delta-BHC	g/m³	< 0.005	< 0.005
gamma-BHC (Lindane)	g/m³	< 0.005	< 0.005
4,4'-DDD	g/m³	< 0.005	< 0.005
4,4'-DDE	g/m³	< 0.005	< 0.005
4,4'-DDT	g/m³	< 0.010	< 0.010
Dieldrin	g/m³	< 0.005	< 0.005
Endosulfan I	g/m³	< 0.010	< 0.010
Endosulfan II	g/m³	< 0.010	< 0.010
Endosulfan sulphate	g/m³	< 0.010	< 0.010
Endrin	g/m³	< 0.010	< 0.010
Endrin ketone	g/m³	< 0.010	< 0.010
Heptachlor	g/m³	< 0.005	< 0.005
Heptachlor epoxide	g/m³	< 0.005	< 0.005
Hexachlorobenzene	g/m³	< 0.005	< 0.005
Polycyclic Aromatic Hydrocarbons in SVOC Water Samples by GC-MS*			
Acenaphthene	g/m³	< 0.003	< 0.003
Acenaphthylene	g/m³	< 0.003	< 0.003
Anthracene	g/m³	< 0.003	< 0.003
Benzo[a]anthracene	g/m³	< 0.003	< 0.003
Benzo[a]pyrene (BAP)	g/m³	< 0.003	< 0.003
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.003	< 0.003
Benzo[g,h,i]perylene	g/m³	< 0.003	< 0.003
Benzo[k]fluoranthene	g/m³	< 0.003	< 0.003
1&2-Chloronaphthalene	g/m³	< 0.003	< 0.003
Chrysene	g/m³	< 0.003	< 0.003
Dibenzo[a,h]anthracene	g/m³	< 0.003	< 0.003
Fluoranthene	g/m³	< 0.003	< 0.003
Fluorene	g/m³	< 0.003	< 0.003
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.003	< 0.003
2-Methylnaphthalene	g/m³	< 0.003	< 0.003
Naphthalene	g/m³	< 0.003	< 0.003
Phenanthrene	g/m³	< 0.003	< 0.003
Pyrene	g/m³	< 0.003	< 0.003
Benzo[a]pyrene Toxic Equivalence (TEF)*	g/m³	< 0.008	< 0.008
Phenols in SVOC Water Samples by GC-MS			
4-Chloro-3-methylphenol	g/m³	< 0.010	< 0.010
2-Chlorophenol	g/m³	< 0.005	< 0.005
2,4-Dichlorophenol	g/m³	< 0.005	< 0.005
2,4-Dimethylphenol	g/m³	< 0.005	< 0.005
3 & 4-Methylphenol (m- + p-cresol)	g/m³	< 0.010	< 0.010
2-Methylphenol (o-Cresol)	g/m³	< 0.005	< 0.005
2-Nitrophenol	g/m³	< 0.010	< 0.010
Pentachlorophenol (PCP)	g/m³	< 0.10	< 0.10
Phenol	g/m³	< 0.010	< 0.010
2,4,5-Trichlorophenol	g/m³	< 0.010	< 0.010
2,4,6-Trichlorophenol	g/m³	< 0.010	< 0.010
Plasticisers in SVOC Water Samples by GC-MS			
Bis(2-ethylhexyl)phthalate	g/m³	< 0.03	< 0.03
Butylbenzylphthalate	g/m³	< 0.010	< 0.010

Sample Type: Aqueous			
Sample Name:		MW2 12-Aug-2022	MW3 12-Aug-2022
Lab Number:		3055181.1	3055181.2
Plasticisers in SVOC Water Samples by GC-MS			
Di(2-ethylhexyl)adipate	g/m³	< 0.005	< 0.005
Diethylphthalate	g/m³	< 0.010	< 0.010
Dimethylphthalate	g/m³	< 0.010	< 0.010
Di-n-butylphthalate	g/m³	< 0.010	< 0.010
Di-n-octylphthalate	g/m³	< 0.010	< 0.010
Other Halogenated compounds in SVOC Water Samples by GC-MS			
1,2-Dichlorobenzene	g/m³	< 0.010	< 0.010
1,3-Dichlorobenzene	g/m³	< 0.010	< 0.010
1,4-Dichlorobenzene	g/m³	< 0.010	< 0.010
Hexachlorobutadiene	g/m³	< 0.010	< 0.010
Hexachloroethane	g/m³	< 0.010	< 0.010
1,2,4-Trichlorobenzene	g/m³	< 0.005	< 0.005
Other compounds in SVOC Water Samples by GC-MS			
Benzyl alcohol	g/m³	< 0.05	< 0.05
Carbazole	g/m³	< 0.005	< 0.005
Dibenzofuran	g/m³	< 0.005	< 0.005
Isophorone	g/m³	< 0.005	< 0.005
BTEX in VOC Water by Headspace GC-MS			
Benzene	g/m³	< 0.003	< 0.003
Ethylbenzene	g/m³	< 0.005	< 0.005
Toluene	g/m³	< 0.003	< 0.003
m&p-Xylene	g/m³	< 0.005	< 0.005
o-Xylene	g/m³	< 0.003	< 0.003
Halogenated Aliphatics in VOC Water by Headspace GC-MS			
Bromomethane (Methyl Bromide)	g/m³	< 0.003	< 0.003
Carbon tetrachloride	g/m³	< 0.003	< 0.003
Chloroethane	g/m³	< 0.003	< 0.003
Chloromethane	g/m³	< 0.003	< 0.003
1,2-Dibromo-3-chloropropane	g/m³	< 0.003	< 0.003
1,2-Dibromoethane (ethylene dibromide, EDB)	g/m³	< 0.003	< 0.003
Dibromomethane	g/m³	< 0.003	< 0.003
Dichlorodifluoromethane	g/m³	< 0.003	< 0.003
1,1-Dichloroethane	g/m³	< 0.003	< 0.003
1,2-Dichloroethane	g/m³	< 0.003	< 0.003
1,1-Dichloroethene	g/m³	< 0.003	< 0.003
cis-1,2-Dichloroethene	g/m³	< 0.003	< 0.003
trans-1,2-Dichloroethene	g/m³	< 0.003	< 0.003
Dichloromethane (methylene chloride)	g/m³	< 0.10	< 0.10
1,2-Dichloropropane	g/m³	< 0.003	< 0.003
1,3-Dichloropropane	g/m³	< 0.003	< 0.003
1,1-Dichloropropene	g/m³	< 0.003	< 0.003
cis-1,3-Dichloropropene	g/m³	< 0.005	< 0.005
trans-1,3-Dichloropropene	g/m³	< 0.005	< 0.005
Hexachlorobutadiene	g/m³	< 0.003	< 0.003
1,1,1,2-Tetrachloroethane	g/m³	< 0.003	< 0.003
1,1,2,2-Tetrachloroethane	g/m³	< 0.003	< 0.003
Tetrachloroethene (tetrachloroethylene)	g/m³	< 0.003	< 0.003
1,1,1-Trichloroethane	g/m³	< 0.003	< 0.003
1,1,2-Trichloroethane	g/m³	< 0.003	< 0.003
Trichloroethene (trichloroethylene)	g/m³	< 0.003	< 0.003
Trichlorofluoromethane	g/m³	< 0.003	< 0.003
1,2,3-Trichloropropane	g/m³	< 0.003	< 0.003
1,1,2-Trichlorotrifluoroethane (Freon 113)	g/m³	< 0.003	< 0.003
Vinyl chloride	g/m³	< 0.003	< 0.003

Sample Type: Aqueous			
	Sample Name:	MW2 12-Aug-2022	MW3 12-Aug-2022
	Lab Number:	3055181.1	3055181.2
Haloaromatics in VOC Water by Headspace GC-MS			
Bromobenzene	g/m³	< 0.003	< 0.003
Chlorobenzene (monochlorobenzene)	g/m³	< 0.003	< 0.003
2-Chlorotoluene	g/m³	< 0.003	< 0.003
1,2-Dichlorobenzene	g/m³	< 0.003	< 0.003
1,3-Dichlorobenzene	g/m³	< 0.003	< 0.003
1,4-Dichlorobenzene	g/m³	< 0.003	< 0.003
4-Chlorotoluene	g/m³	< 0.003	< 0.003
1,2,3-Trichlorobenzene	g/m³	< 0.003	< 0.003
1,2,4-Trichlorobenzene	g/m³	< 0.003	< 0.003
1,3,5-Trichlorobenzene	g/m³	< 0.003	< 0.003
Monoaromatic Hydrocarbons in VOC Water by Headspace GC-MS			
n-Butylbenzene	g/m³	< 0.005	< 0.005
tert-Butylbenzene	g/m³	< 0.003	< 0.003
4-Isopropyltoluene (p-Cymene)	g/m³	< 0.005	< 0.005
Isopropylbenzene (Cumene)	g/m³	< 0.003	< 0.003
n-Propylbenzene	g/m³	< 0.005	< 0.005
sec-Butylbenzene	g/m³	< 0.003	< 0.003
Styrene	g/m³	< 0.005	< 0.005
1,2,4-Trimethylbenzene	g/m³	< 0.003	< 0.003
1,3,5-Trimethylbenzene	g/m³	< 0.003	< 0.003
Ketones in VOC Water by Headspace GC-MS			
Acetone	g/m³	< 0.5	< 0.5
2-Butanone (MEK)	g/m³	< 0.5	< 0.5
Methyl tert-butylether (MTBE)	g/m³	< 0.003	< 0.003
4-Methylpentan-2-one (MIBK)	g/m³	< 0.10	< 0.10
Trihalomethanes in VOC Water by Headspace GC-MS			
Bromodichloromethane	g/m³	< 0.003	< 0.003
Bromoform (tribromomethane)	g/m³	< 0.003	< 0.003
Chloroform (Trichloromethane)	g/m³	< 0.003	< 0.003
Dibromochloromethane	g/m³	< 0.003	< 0.003
Other VOC in Water by Headspace GC-MS			
Carbon disulphide	g/m³	< 0.005	< 0.005
Naphthalene	g/m³	< 0.005	< 0.005

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Semivolatile Organic Compounds Screening in Water by GC-MS	Liquid / liquid extraction, GC-MS analysis. In-house based on US EPA 8270.	0.00005 - 0.10 g/m³	1-2
Volatile Organic Compounds Screening in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.003 - 0.5 g/m³	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-2
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23rd ed. 2017.	0.07 meq/L	1-2
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 23rd ed. 2017.	0.05 meq/L	1-2

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
pH	pH meter. APHA 4500-H^+ B 23rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-2
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	1-2
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 23rd ed. 2017.	1.0 g/m^3 at 25°C	1-2
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	1-2
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23rd ed. 2017.	0.1 mS/m	1-2
Dissolved Arsenic	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-2
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.005 g/m^3	1-2
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.05 g/m^3	1-2
Dissolved Chromium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.00010 g/m^3	1-2
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.05 g/m^3	1-2
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-2
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3. In-house calculation.	0.05 g/m^3	1-2
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-2
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-2
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-2
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-2
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D (modified) 4500 NH_3 F (modified) 23rd ed. 2017.	0.10 g/m^3	1-2
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) 23rd ed. 2017.	0.004 g/m^3	1-2
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2

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

Testing was completed between 17-Aug-2022 and 02-Sep-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Hill Laboratories
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Certificate of Analysis

Client:	Pattle Delamore Partners Limited	**Lab No:**	3156040 SPv1
Contact:	S Wilson C/- Pattle Delamore Partners Limited PO Box 389 Christchurch 8140	**Date Received:**	19-Jan-2023
		Date Reported:	25-Jan-2023
		Quote No:	119397
		Order No:	
		Client Reference:	C02450100
		Submitted By:	Lucy Duffus

Sample Type: Aqueous

Sample Name:		MW2 19-Jan-2023	MW3 19-Jan-2023
Lab Number:		3156040.1	3156040.2
Individual Tests			
Sum of Anions	meq/L	1.71	1.99
Sum of Cations	meq/L	1.78	2.1
pH	pH Units	7.3	7.4
Total Alkalinity	g/m^3 as $CaCO_3$	43	56
Bicarbonate	g/m^3 at 25°C	53	68
Total Hardness	g/m^3 as $CaCO_3$	66	77
Electrical Conductivity (EC)	mS/m	19.6	22.3
Dissolved Arsenic	g/m^3	< 0.0010	< 0.0010
Dissolved Boron	g/m^3	0.062	0.183
Dissolved Calcium	g/m^3	16.7	19.7
Dissolved Chromium	g/m^3	< 0.0005	< 0.0005
Dissolved Iron	g/m^3	< 0.02	< 0.02
Dissolved Lead	g/m^3	< 0.00010	< 0.00010
Dissolved Magnesium	g/m^3	5.9	6.7
Dissolved Nickel	g/m^3	< 0.0005	< 0.0005
Dissolved Potassium	g/m^3	1.80	3.0
Dissolved Sodium	g/m^3	9.5	10.7
Dissolved Zinc	g/m^3	0.0029	0.0015
Chloride	g/m^3	8.5	8.3
Total Nitrogen	g/m^3	6.6	6.4
Total Ammoniacal-N	g/m^3	< 0.010	< 0.010
Nitrite-N	g/m^3	< 0.002	< 0.002
Nitrate-N	g/m^3	6.6	6.3
Nitrate-N + Nitrite-N	g/m^3	6.6	6.3
Total Kjeldahl Nitrogen (TKN)	g/m^3	< 0.10	< 0.10
Dissolved Reactive Phosphorus	g/m^3	0.009	0.008
Sulphate	g/m^3	6.6	9.0
Haloethers in SVOC Water Samples by GC-MS			
Bis(2-chloroethoxy) methane	g/m^3	< 0.005	< 0.005
Bis(2-chloroethyl)ether	g/m^3	< 0.005	< 0.005
Bis(2-chloroisopropyl)ether	g/m^3	< 0.005	< 0.005
4-Bromophenyl phenyl ether	g/m^3	< 0.005	< 0.005
4-Chlorophenyl phenyl ether	g/m^3	< 0.005	< 0.005
Nitrogen containing compounds in SVOC Water Samples by GC-MS*			
2,4-Dinitrotoluene	g/m^3	< 0.010	< 0.010
2,6-Dinitrotoluene	g/m^3	< 0.010	< 0.010
Nitrobenzene	g/m^3	< 0.005	< 0.005
N-Nitrosodi-n-propylamine	g/m^3	< 0.010	< 0.010

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

Sample Type: Aqueous

Sample Name:		MW2 19-Jan-2023	MW3 19-Jan-2023
Lab Number:		3156040.1	3156040.2
Nitrogen containing compounds in SVOC Water Samples by GC-MS*			
N-Nitrosodiphenylamine + Diphenylamine*	g/m^3	< 0.010	< 0.010
Organochlorine Pesticides in SVOC Water Samples by GC-MS			
Aldrin	g/m^3	< 0.005	< 0.005
alpha-BHC	g/m^3	< 0.005	< 0.005
beta-BHC	g/m^3	< 0.005	< 0.005
delta-BHC	g/m^3	< 0.005	< 0.005
gamma-BHC (Lindane)	g/m^3	< 0.005	< 0.005
4,4'-DDD	g/m^3	< 0.005	< 0.005
4,4'-DDE	g/m^3	< 0.005	< 0.005
4,4'-DDT	g/m^3	< 0.010	< 0.010
Dieldrin	g/m^3	< 0.005	< 0.005
Endosulfan I	g/m^3	< 0.010	< 0.010
Endosulfan II	g/m^3	< 0.010	< 0.010
Endosulfan sulphate	g/m^3	< 0.010	< 0.010
Endrin	g/m^3	< 0.010	< 0.010
Endrin ketone	g/m^3	< 0.010	< 0.010
Heptachlor	g/m^3	< 0.005	< 0.005
Heptachlor epoxide	g/m^3	< 0.005	< 0.005
Hexachlorobenzene	g/m^3	< 0.005	< 0.005
Polycyclic Aromatic Hydrocarbons in SVOC Water Samples by GC-MS*			
Acenaphthene	g/m^3	< 0.003	< 0.003
Acenaphthylene	g/m^3	< 0.003	< 0.003
Anthracene	g/m^3	< 0.003	< 0.003
Benzo[a]anthracene	g/m^3	< 0.003	< 0.003
Benzo[a]pyrene (BAP)	g/m^3	< 0.003	< 0.003
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m^3	< 0.003	< 0.003
Benzo[g,h,i]perylene	g/m^3	< 0.003	< 0.003
Benzo[k]fluoranthene	g/m^3	< 0.003	< 0.003
1&2-Chloronaphthalene	g/m^3	< 0.003	< 0.003
Chrysene	g/m^3	< 0.003	< 0.003
Dibenzo[a,h]anthracene	g/m^3	< 0.003	< 0.003
Fluoranthene	g/m^3	< 0.003	< 0.003
Fluorene	g/m^3	< 0.003	< 0.003
Indeno(1,2,3-c,d)pyrene	g/m^3	< 0.003	< 0.003
2-Methylnaphthalene	g/m^3	< 0.003	< 0.003
Naphthalene	g/m^3	< 0.003	< 0.003
Phenanthrene	g/m^3	< 0.003	< 0.003
Pyrene	g/m^3	< 0.003	< 0.003
Benzo[a]pyrene Toxic Equivalence (TEF)*	g/m^3	< 0.008	< 0.008
Phenols in SVOC Water Samples by GC-MS			
4-Chloro-3-methylphenol	g/m^3	< 0.010	< 0.010
2-Chlorophenol	g/m^3	< 0.005	< 0.005
2,4-Dichlorophenol	g/m^3	< 0.005	< 0.005
2,4-Dimethylphenol	g/m^3	< 0.005	< 0.005
3 & 4-Methylphenol (m- + p-cresol)	g/m^3	< 0.010	< 0.010
2-Methylphenol (o-Cresol)	g/m^3	< 0.005	< 0.005
2-Nitrophenol	g/m^3	< 0.010	< 0.010
Pentachlorophenol (PCP)	g/m^3	< 0.10	< 0.10
Phenol	g/m^3	< 0.010	< 0.010
2,4,5-Trichlorophenol	g/m^3	< 0.010	< 0.010
2,4,6-Trichlorophenol	g/m^3	< 0.010	< 0.010
Plasticisers in SVOC Water Samples by GC-MS			
Bis(2-ethylhexyl)phthalate	g/m^3	< 0.03	< 0.03
Butylbenzylphthalate	g/m^3	< 0.010	< 0.010

Sample Type: Aqueous			
Sample Name:		MW2 19-Jan-2023	MW3 19-Jan-2023
Lab Number:		3156040.1	3156040.2
Plasticisers in SVOC Water Samples by GC-MS			
Di(2-ethylhexyl)adipate	g/m³	< 0.005	< 0.005
Diethylphthalate	g/m³	< 0.010	< 0.010
Dimethylphthalate	g/m³	< 0.010	< 0.010
Di-n-butylphthalate	g/m³	< 0.010	< 0.010
Di-n-octylphthalate	g/m³	< 0.010	< 0.010
Other Halogenated compounds in SVOC Water Samples by GC-MS			
1,2-Dichlorobenzene	g/m³	< 0.010	< 0.010
1,3-Dichlorobenzene	g/m³	< 0.010	< 0.010
1,4-Dichlorobenzene	g/m³	< 0.010	< 0.010
Hexachlorobutadiene	g/m³	< 0.010	< 0.010
Hexachloroethane	g/m³	< 0.010	< 0.010
1,2,4-Trichlorobenzene	g/m³	< 0.005	< 0.005
Other compounds in SVOC Water Samples by GC-MS			
Benzyl alcohol	g/m³	< 0.05	< 0.05
Carbazole	g/m³	< 0.005	< 0.005
Dibenzofuran	g/m³	< 0.005	< 0.005
Isophorone	g/m³	< 0.005	< 0.005
BTEX in VOC Water by Headspace GC-MS			
Benzene	g/m³	< 0.003	< 0.003
Ethylbenzene	g/m³	< 0.005	< 0.005
Toluene	g/m³	< 0.003	< 0.003
m&p-Xylene	g/m³	< 0.005	< 0.005
o-Xylene	g/m³	< 0.003	< 0.003
Halogenated Aliphatics in VOC Water by Headspace GC-MS			
Bromomethane (Methyl Bromide)	g/m³	< 0.003	< 0.003
Carbon tetrachloride	g/m³	< 0.003	< 0.003
Chloroethane	g/m³	< 0.003	< 0.003
Chloromethane	g/m³	< 0.003	< 0.003
1,2-Dibromo-3-chloropropane	g/m³	< 0.003	< 0.003
1,2-Dibromoethane (ethylene dibromide, EDB)	g/m³	< 0.003	< 0.003
Dibromomethane	g/m³	< 0.003	< 0.003
Dichlorodifluoromethane	g/m³	< 0.003	< 0.003
1,1-Dichloroethane	g/m³	< 0.003	< 0.003
1,2-Dichloroethane	g/m³	< 0.003	< 0.003
1,1-Dichloroethene	g/m³	< 0.003	< 0.003
cis-1,2-Dichloroethene	g/m³	< 0.003	< 0.003
trans-1,2-Dichloroethene	g/m³	< 0.003	< 0.003
Dichloromethane (methylene chloride)	g/m³	< 0.10	< 0.10
1,2-Dichloropropane	g/m³	< 0.003	< 0.003
1,3-Dichloropropane	g/m³	< 0.003	< 0.003
1,1-Dichloropropene	g/m³	< 0.003	< 0.003
cis-1,3-Dichloropropene	g/m³	< 0.005	< 0.005
trans-1,3-Dichloropropene	g/m³	< 0.005	< 0.005
Hexachlorobutadiene	g/m³	< 0.005	< 0.005
1,1,1,2-Tetrachloroethane	g/m³	< 0.003	< 0.003
1,1,2,2-Tetrachloroethane	g/m³	< 0.003	< 0.003
Tetrachloroethene (tetrachloroethylene)	g/m³	< 0.003	< 0.003
1,1,1-Trichloroethane	g/m³	< 0.003	< 0.003
1,1,2-Trichloroethane	g/m³	< 0.003	< 0.003
Trichloroethene (trichloroethylene)	g/m³	< 0.003	< 0.003
Trichlorofluoromethane	g/m³	< 0.003	< 0.003
1,2,3-Trichloropropane	g/m³	< 0.003	< 0.003
1,1,2-Trichlorotrifluoroethane (Freon 113)	g/m³	< 0.003	< 0.003
Vinyl chloride	g/m³	< 0.003	< 0.003

Sample Type: Aqueous			
Sample Name:		MW2 19-Jan-2023	MW3 19-Jan-2023
Lab Number:		3156040.1	3156040.2
Haloaromatics in VOC Water by Headspace GC-MS			
Bromobenzene	g/m³	< 0.003	< 0.003
Chlorobenzene (monochlorobenzene)	g/m³	< 0.003	< 0.003
2-Chlorotoluene	g/m³	< 0.003	< 0.003
1,2-Dichlorobenzene	g/m³	< 0.003	< 0.003
1,3-Dichlorobenzene	g/m³	< 0.003	< 0.003
1,4-Dichlorobenzene	g/m³	< 0.003	< 0.003
4-Chlorotoluene	g/m³	< 0.003	< 0.003
1,2,3-Trichlorobenzene	g/m³	< 0.003	< 0.003
1,2,4-Trichlorobenzene	g/m³	< 0.003	< 0.003
1,3,5-Trichlorobenzene	g/m³	< 0.003	< 0.003
Monoaromatic Hydrocarbons in VOC Water by Headspace GC-MS			
n-Butylbenzene	g/m³	< 0.005	< 0.005
tert-Butylbenzene	g/m³	< 0.003	< 0.003
4-Isopropyltoluene (p-Cymene)	g/m³	< 0.005	< 0.005
Isopropylbenzene (Cumene)	g/m³	< 0.003	< 0.003
n-Propylbenzene	g/m³	< 0.005	< 0.005
sec-Butylbenzene	g/m³	< 0.003	< 0.003
Styrene	g/m³	< 0.005	< 0.005
1,2,4-Trimethylbenzene	g/m³	< 0.003	< 0.003
1,3,5-Trimethylbenzene	g/m³	< 0.003	< 0.003
Ketones in VOC Water by Headspace GC-MS			
Acetone	g/m³	< 0.5	< 0.5
2-Butanone (MEK)	g/m³	< 0.5	< 0.5
Methyl tert-butylether (MTBE)	g/m³	< 0.003	< 0.003
4-Methylpentan-2-one (MIBK)	g/m³	< 0.10	< 0.10
Trihalomethanes in VOC Water by Headspace GC-MS			
Bromodichloromethane	g/m³	< 0.003	< 0.003
Bromoform (tribromomethane)	g/m³	< 0.003	< 0.003
Chloroform (Trichloromethane)	g/m³	< 0.003	< 0.003
Dibromochloromethane	g/m³	< 0.003	< 0.003
Other VOC in Water by Headspace GC-MS			
Carbon disulphide	g/m³	< 0.005	< 0.005
Naphthalene	g/m³	< 0.005	< 0.005

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	**Method Description**	**Default Detection Limit**	**Sample No**
Semivolatile Organic Compounds Screening in Water by GC-MS	Liquid / liquid extraction, GC-MS analysis. In-house based on US EPA 8270.	0.00005 - 0.10 g/m³	1-2
Volatile Organic Compounds Screening in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.003 - 0.5 g/m³	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter. Performed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch.	-	1-2
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23rd ed. 2017.	0.07 meq/L	1-2
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 23rd ed. 2017.	0.05 meq/L	1-2

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
pH	pH meter. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 4500-H^+ B 23rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-2
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 2320 B (modified for Alkalinity <20) 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	1-2
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 23rd ed. 2017.	1.0 g/m^3 at 25°C	1-2
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	1-2
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 2510 B 23rd ed. 2017.	0.1 mS/m	1-2
Dissolved Arsenic	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-2
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.005 g/m^3	1-2
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.05 g/m^3	1-2
Dissolved Chromium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.00010 g/m^3	1-2
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.05 g/m^3	1-2
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-2
Chloride	Filtered sample from Christchurch. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3. In-house calculation.	0.05 g/m^3	1-2
Total Ammoniacal-N	Filtered Sample from Christchurch. Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-2
Nitrite-N	Filtered sample from Christchurch. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-2
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-2
Nitrate-N + Nitrite-N	Filtered sample from Christchurch. Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-2
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D (modified) 4500 NH_3 F (modified) 23rd ed. 2017.	0.10 g/m^3	1-2
Dissolved Reactive Phosphorus	Filtered sample from Christchurch. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) 23rd ed. 2017.	0.004 g/m^3	1-2
Sulphate	Filtered sample from Christchurch. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2

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

Testing was completed between 23-Jan-2023 and 25-Jan-2023. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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

Ara Heron BSc (Tech)
Client Services Manager - Environmental

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ACCREDITED TESTING LABORATORY
IANZ
Nº 1334

Version: 12	Issue Date: October 2021	Authorised By: LB	Controlled Document

Client Name:	Pattle Delamore Partners	**Job Number:**	T009112	**Total Samples Received:**	3
Client Address:	Level 2/134 Oxford Terrace, Christchurch Central City, Christchurch 8011	**Site Reference / Address:**	C02450100	**Date Received:**	12/01/2023
Client Reference:	C02450100			**Date Analysed:**	12/01/2023
Client Contact:	Lucy Duffus			**Date Reported:**	12/01/2023

FIBRE COUNTING ANALYSIS REPORT

Air Monitoring Type:	Background
Work in Progress:	N/A
Date Conducted:	10/01/2023

Laboratory Sample Number	Client Sample Number	Location	Time		Flow Rate	Fibres	Fields	Fibre Concentration (f/mL)	Comments
			On	Off					
T009112.1	114858	PF_AA001_100123	10:14	16:05	1.5	2.0	100	<0.01	
T009112.2	114856	PF_AA002_100123	10:13	16:07	1.5	0.0	100	<0.01	Fell over during sampling
T009112.3	114857	PF_AA003_100123	10:21	16:08	1.5	0.0	100	<0.01	
	4788	Laboratory Blank	N/A	N/A	N/A	2.0	100	2 fibres / 100 fields	

Method References and Disclaimers:

Samples were analysed in accordance with:	NOHSC: 3003 (2005) Guidance Note on the Membrane Filter Method for estimating Airborne Asbestos Fibres 2nd Edition.
Disclaimers:	Samples are reported 'As Received'. Terra Scientific takes no responsibility for sampling processes, client sample descriptions, sample locations, flow rates and sample times as these were provided by the client. Final fibre concentrations are calculated from the data submitted by the client. The results presented in this report relate specifically to the samples submitted for this job. Unless specified in the above report, airborne filter results do not exceed the trace level of <0.01 f/ml. This report shall not be reproduced, except in full, without the written consent of the Key Technical Person assigned to this report.

For any queries regarding this report, please do not hesitate to contact the laboratory and speak with the Key Technical Person.

Jessica Griffin
Managing Director
Key Technical Person

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ACCREDITED IANZ TESTING LABORATORY Nº 1334

Client Name:	Pattle Delamore Partners	**Job Number:**	T009122	**Total Samples Received:**	3
Client Address:	Level 2/134 Oxford Terrace, Christchurch Central City, Christchurch 8011	**Site Reference / Address:**	C02450100	**Date Received:**	13/01/2023
Client Reference:	C02450100			**Date Analysed:**	13/01/2023
Client Contact:	Lucy Duffus			**Date Reported:**	13/01/2023

FIBRE COUNTING ANALYSIS REPORT

Air Monitoring Type:	Background
Work in Progress:	N/A
Date Conducted:	11/01/2023

Laboratory Sample Number	Client Sample Number	Location	Time		Flow Rate	Fibres	Fields	Fibre Concentration (f/mL)	Comments
			On	Off					
T009122.1	114855	PF_AA004_110123	07:49	15:16	1.5	1.0	100	<0.01	
T009122.2	114859	PF_AA005_110123	08:04	15:22	1.5	1.5	100	<0.01	
T009122.3	114860	PF_AA006_110123	07:59	15:19	1.5	0.0	100	<0.01	
	4775	Laboratory Blank	N/A	N/A	N/A	0.5	100	0.5 fibres / 100 fields	

Method References and Disclaimers:

Samples were analysed in accordance with: NOHSC: 3003 (2005) Guidance Note on the Membrane Filter Method for estimating Airborne Asbestos Fibres 2nd Edition.

Disclaimers:

Samples are reported 'As Received'. Terra Scientific takes no responsibility for sampling processes, client sample descriptions, sample locations, flow rates and sample times as these were provided by the client. Final fibre concentrations are calculated from the data submitted by the client.
The results presented in this report relate specifically to the samples submitted for this job.
Unless specified in the above report, airborne filter results do not exceed the trace level of <0.01 f/ml.
This report shall not be reproduced, except in full, without the written consent of the Key Technical Person assigned to this report.

For any queries regarding this report, please do not hesitate to contact the laboratory and speak with the Key Technical Person.

Jessica Griffin
Managing Director
Key Technical Person

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ACCREDITED TESTING LABORATORY Nº 1334

Version: 12	Issue Date: October 2021	Authorised By: LB	Controlled Document

Client Name:	Pattle Delamore Partners	**Job Number:**	T009122.2	**Total Samples Received:**	3
Client Address:	Level 2/134 Oxford Terrace, Christchurch Central City, Christchurch 8011	**Site Reference / Address:**	C02450100	**Date Received:**	16/01/2023
Client Reference:	C02450100			**Date Analysed:**	16/01/2023
Client Contact:	Lucy Duffus			**Date Reported:**	16/012023

FIBRE COUNTING ANALYSIS REPORT

Air Monitoring Type:	Background
Work in Progress:	N/A
Date Conducted:	12/01/2023

Laboratory Sample Number	Client Sample Number	Location	Time		Flow Rate	Fibres	Fields	Fibre Concentration (f/mL)	Comments
			On	Off					
T009122.2.1	114853	PF_AA007_120123	07:46	15:35	1.5	1.0	100	<0.01	
T009122.2.2	114854	PF_AA008_120123	07:50	15:37	1.5	1.5	100	<0.01	
T009122.2.3	114852	PF_AA009_120123	07:53	15:40	1.5	3.0	100	<0.01	
	4804	Laboratory Blank	N/A	N/A	N/A	0.0	100	0 fibres / 100 fields	

Method References and Disclaimers:

Samples were analysed in accordance with:	NOHSC: 3003 (2005) Guidance Note on the Membrane Filter Method for estimating Airborne Asbestos Fibres 2nd Edition.
Disclaimers:	Samples are reported 'As Received'. Terra Scientific takes no responsibility for sampling processes, client sample descriptions, sample locations, flow rates and sample times as these were provided by the client. Final fibre concentrations are calculated from the data submitted by the client. The results presented in this report relate specifically to the samples submitted for this job. Unless specified in the above report, airborne filter results do not exceed the trace level of <0.01 f/ml. This report shall not be reproduced, except in full, without the written consent of the Key Technical Person assigned to this report.

For any queries regarding this report, please do not hesitate to contact the laboratory and speak with the Key Technical Person.

Jessica Griffin
Managing Director
Key Technical Person

PATTLE DELAMORE PARTNERS L

Job No: 315 1614 Date Recv: 13-Jan-23 16:40

Received by: Jamie Staton

3131516148

17.7

t for Analyses

NOTE: Please acknowledge receipt of these samples by signing this form and emailing to submitter.

From: Pattle Delamore Partn

Office: ☐ Auckland ☐ Har Christchurch ☐ Invercargill

Submitted by: Lucy Duffus

Ph No.: 021524189

To: HILL LABORATORIES

Quote No.:

PDP Job No.: C02450100

Chain of Custody Record

Sent:

Name: Lucy Duffus

Signature: LDuffus

Date and time: 13.1.23

Received: ☐ Room temp. ☐ Chilled Temp.: ___°C
☐ Frozen

Name:

Signature:

Date and time:

Additional Information

Will email through test schedule

Results to: ☑ lab.samples@pdp.co.nz
☑ Email submitter: Lucy Duffus @pdp.co.nz
☑ Email other: Rowan. Freeman @pdp.co.nz
and Scott.Wilson@pdp.co.nz

Priority: ☑ Normal ☐ High ☐ Urgent

Results required by: ___ / ___ / ___

Invoice to: ☑ PDP ☐ Other:

Sample ID	Date	Time	Sample type	Analyses Requested	Notes
TP101-2.3	10/1/23		S	HOLD COLD	
TP101_1					
TP101_2					
TP101_3	↓				
TP102_0-1.0	11/1/23				
TP102_2.0-2.3					
TP102_2.9					
TP102_3.5					
TP103_1.5					
TP103_1					
TP103_2					
TP103_3	↓				
TP104_0.05	12/1/23				
TP104_0.3					
TP104_0.9					
TP104_1.7					
TP104_2.8					
TP104_3.8					
TP105_0.9					
TP105_3.5					
TP105_1					
TP105_2	↓		↓	↓	

Sample type: **S Soil** **GW Groundwater** **SAL Saline** **FW Freshwater** **GEO Geothermal** **SW Stormwater**
SED Sediment **BIO Biota** **WW Wastewater** **P Potable** **O Other:**

For physical address see www.pdp.co.nz

Note: Samples may contain dangerous or hazardous substances

Page 1 of 2

PDP Auckland Tel: +64 9 523 6900
PDP Hamilton Tel: +64 7 949 7880
PDP Tauranga Tel: +64 7 985 6440
PDP Wellington Tel: +64 4 471 4130
PDP Christchurch Tel: +64 3 345 7100
PDP Invercargill Tel: +64 3 422 169

PATTLE DELAMORE PARTNERS LTD

Request for Analyses

NOTE: Please acknowledge receipt of these samples by signing this form and emailing to submitter.

From: Pattle Delamore Partners Ltd

To: HILL LABORATORIES

Office: ☐ Auckland ☐ Hamilton ☐ Tauranga ☐ Wellington ☑ Christchurch ☐ Invercargill

Quote No.:

Submitted by: Lucy Duffus

Ph No.: 021524189

PDP Job No.: C02450100

Chain of Custody Record

Sent:

Name: LUCY DUFFUS

Signature:

Date and time: 13.1.23

Received: ☐ Room temp. ☐ Chilled Temp.: ____°C ☐ Frozen

Name:

Signature:

Date and time:

Additional Information

Results to: ☑ lab.samples@pdp.co.nz

☑ Email submitter: Lucy.Duffus @pdp.co.nz

☑ Email other: Rowan.Freeman @pdp.co.nz

↳ and Scott.Wilson@pdp.co.nz

Priority: ☑ Normal ☐ High ☐ Urgent

Results required by: ___ / ___ / ___

Invoice to: ☐ PDP ☐ Other:

Sample ID	Date	Time	Sample type	Analyses Requested	Notes
TP105_3	12/1/23		S	HOLD COLD	
TP106_0.5					
TP106_1.4					
TP106_2.6					
TP106_1	↓				
TP107_0.2					
TP107_2.0					
TP107_1					
TP107_2					
TP107_3	↓		↓	↓	

Sample type: **S Soil** **GW Groundwater** **SAL Saline** **FW Freshwater** **GEO Geothermal** **SW Stormwater**

SED Sediment **BIO Biota** **WW Wastewater** **P Potable** **O Other:**

For physical address see www.pdp.co.nz

Note: Samples may contain dangerous or hazardous substances

Page 2 of

PDP Auckland
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PDP Tauranga
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PDP Wellington
Tel: +64 4 471 4130

PDP Christchurch
Tel: +64 3 345 7100

PDP Invercargill
Tel: +64 3 422 16

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T **0508 HILL LAB** (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Job Information Summary

Page 1 of 2

Client: Pattle Delamore Partners Limited
Contact: Rowan Freeman
C/- Pattle Delamore Partners Limited
PO Box 389
Christchurch 8140

Lab No: 3151614
Date Registered: 16-Jan-2023 11:33 am
Priority: High
Quote No: 81087
Order No:
Client Reference: C02450100
Add. Client Ref:
Submitted By: Lucy Duffus
Charge To: Pattle Delamore Partners Limited
Target Date: 18-Jan-2023 4:30 pm

Samples

No	Sample Name	Sample Type	Containers	Tests Requested
1	TP101_2.3 10-Jan-2023	Soil	GSoil300	Hold Cold
2	TP101_1 10-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
3	TP101_2 10-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
4	TP101_3 10-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
5	TP102_0-1.0 11-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS; Total Petroleum Hydrocarbons in Soil
6	TP102_2.0-2.3 11-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
7	TP102_2.9 11-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
8	TP102_3.5 11-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
9	TP103_1.5 11-Jan-2023	Soil	GSoil300, GSoil300	Hold Cold
10	TP103_1 11-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
11	TP103_2 11-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
12	TP103_3 11-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
13	TP104_0.05 12-Jan-2023	Soil	GSoil300	Hold Cold
14	TP104_0.3 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
15	TP104_0.9 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS; Total Petroleum Hydrocarbons in Soil
16	TP104_1.7 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
17	TP104_2.8 12-Jan-2023	Soil	GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
18	TP104_3.8 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
19	TP105_0.9 12-Jan-2023	Soil	GSoil300, GSoil300	Hold Cold
20	TP105_3.5 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
21	TP105_1 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
22	TP105_2 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
23	TP105_3 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS

Samples

No	Sample Name	Sample Type	Containers	Tests Requested
24	TP106_0.5 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
25	TP106_1.4 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS; Total Petroleum Hydrocarbons in Soil
26	TP106_2.6 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
27	TP106_1 12-Jan-2023	Soil	GSoil300, GSoil300	Hold Cold
28	TP107_0.2 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
29	TP107_2.0 12-Jan-2023	Soil	GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
30	TP107_1 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
31	TP107_2 12-Jan-2023	Soil	GSoil300, GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS
32	TP107_3 12-Jan-2023	Soil	GSoil300	Heavy Metals, Screen Level; Semivolatile Organic Compounds Screening in Soil by GC-MS

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Environmental Solids Sample Drying	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	2-8, 10-12, 14-18, 20-26, 28-32
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	2-8, 10-12, 14-18, 20-26, 28-32
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	2-8, 10-12, 14-18, 20-26, 28-32
Semivolatile Organic Compounds Screening in Soil by GC-MS	Sonication extraction, GC-MS analysis. Tested on as received sample. In-house based on US EPA 8270.	0.024 - 30 mg/kg dry wt	2-8, 10-12, 14-18, 20-26, 28-32
Total Petroleum Hydrocarbons in Soil			
Client Chromatogram for TPH by FID	Small peaks associated with QC compounds may be visible in chromatograms with low TPH concentrations. QC peaks are as follows: one peak in the C12 - 14 band, the C21 - 25 band and the C30 - 36 band. All QC peaks are corrected for in the reported TPH concentrations.	-	5, 15, 25
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	20 mg/kg dry wt	5, 15, 25
C10 - C14	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	20 mg/kg dry wt	5, 15, 25
C15 - C36	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	40 mg/kg dry wt	5, 15, 25
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	70 mg/kg dry wt	5, 15, 25

T009132 Due: 20/1/23

PATTLE DELAMORE PARTNERS LTD

Request for Analyses

NOTE: Please acknowledge receipt of these samples by signing this form and emailing to submitter.

From: Pattle Delamore Partners Ltd

Office: ☐ Auckland ☐ Hamilton ☐ Tauranga ☐ Wellington ☑ Christchurch ☐ Invercargill

Submitted by: Lucy Duffus

Ph No.: 021524189

To: Terra Scientific

Quote No.:

PDP Job No.: C02450100

Chain of Custody Record

Sent:

Name: Lucy Duffus

Signature: LDuffus

Date and time: 13.1.23

Received: ☐ Room temp. ☐ Chilled Temp.: ___ °C ☐ Frozen

Name: J. Griffin

Signature:

Date and time: 16/1/23 3pm

Additional Information

5x ID, 4x Soil = Hold
T009132.1 = 7x ID
T009132.2 = 27x Soil

Results to: ☑ lab.samples@pdp.co.nz

☑ Email submitter: Lucy Duffus @pdp.co.nz

☑ Email other: Rowan. Freeman @pdp.co.nz

and Scott.Wilson@pdp.co.nz

Priority: ☑ Normal ☐ High ☐ Urgent

Results required by: 20 / 1 / 23

Invoice to: ☑ PDP ☐ Other:

Sample ID	Date	Time	Sample type	Analyses Requested	Notes
TP105_0.9	12/1/23		S	~~HOLD~~ — HOLD	
TP105_3.5	↓		↓	✓ Asbestos semi-quant	
TP105_1	↓		↓	✓ ↓	
TP105_2	↓		↓	✓ ↓	
TP105_3	↓		↓	✓ ↓	
TP105_ASB001	↓		O	✓ Asbestos Presence/Absence	
TP105_ASB002	↓		↓	— HOLD	
TP105_ASB003	↓		↓	— ↓	
TP106_0.5	↓		S	✓ Asbestos semi-quant.	
TP106_1.4	↓		↓	✓ ↓	
TP106_2.6	↓		↓	✓ ↓	
TP106_1	↓		↓	— HOLD	
TP106_ASB001	↓		O	✓ Asbestos presence/absence	
TP106_ASB002	↓		↓	— HOLD	
TP107_0.2	13/1/23		S	✓ Asbestos semi-quant	
TP107_2.0	↓		↓	✓ ↓	
TP107_1	↓		↓	✓ ↓	
TP107_2	↓		↓	✓ ↓	
TP107_3	↓		↓	✓ ↓	
TP107_ASB001	↓		O	✓ Asbestos presence/absence	
TP107_ASB002	↓		↓	— HOLD	

Sample type: S Soil; GW Groundwater; SAL Saline; FW Freshwater; GEO Geothermal; SW Stormwater; SED Sediment; BIO Biota; WW Wastewater; P Potable; O Other: Bulk.

For physical address see www.pdp.co.nz

Note: Samples may contain dangerous or hazardous substances

PARTNERS LTD

quest for Analyses

NOTE: Please acknowledge receipt of these samples by signing this form and emailing to submitter.

rom: Pattle Delamore Partners Ltd

To: Terra Scientific

Office: ☐ Auckland ☐ Hamilton ☐ Tauranga ☐ Wellington ☒ Christchurch ☐ Invercargill

Quote No.:

Submitted by: Lucy Duffus

Ph No.: 021524189

PDP Job No.: C02450100

Chain of Custody Record

Sent:

Name: Lucy Duffus

Signature: LDuffus

Date and time: 13.1.23

Received: ☐ Room temp. ☐ Chilled Temp.: ____°C ☐ Frozen

Name:

Signature:

Date and time:

Additional Information

Will email through test schedule.

Results to: ☑ lab.samples@pdp.co.nz

☑ Email submitter: Lucy.Duffus @pdp.co.nz

☑ Email other: Rowan.Freeman @pdp.co.nz

↓ and Scott.Wilson@pdp.co.nz

Priority: ☒ Normal ☐ High ☐ Urgent

Results required by: ___ / ___ / ___

Invoice to: ☑ PDP ☐ Other:

Sample ID	Date	Time	Sample type	Analyses Requested	Notes
TP101_1	10/1/23		S	HOLD ✓ Asbestos Semi- Quant	
TP101_2			S	✓	
TP101_3			S	✓ ↓	
TP101_ASB001			O	— HOLD	
TP101_ASB002			O	✓ Asbestos ~~Semi Quant~~ P/A	
TP101_ASB003	↓		O	✓ ↓	
TP102_0-~~0~~1.0	11/1/23		S	✓ Asbestos Semi Quant	
TP102_2.0-2.3				✓	
TP102_2.9				✓	
TP102_3.5				✓ ↓	
TP103_1.5				— HOLD	
TP103_1				✓ Asbestos Semi Quant	
TP103.2				✓	
TP103.3			↓	✓ ↓	
TP103_ASB001			O	✓ Asbestos Presence/Absence	
TP103_ASB002	↓		O	✓ ↓	
TP104.0.05	12/1/23		S	— HOLD	
TP104_0.3				✓ Asbestos Semi-Quant	
TP104_0.9				✓	
TP104_1.7				✓	
TP104_2.8				✓	
TP104_3.8	↓		↓	↓ ✓ ↓	

Sample type: **S** **Soil** **GW** **Groundwater** **SAL** **Saline** **FW** **Freshwater** **GEO** **Geothermal** **SW** **Stormwater**

SED **Sediment** **BIO** **Biota** **WW** **Wastewater** **P** **Potable** **O** **Other:** Bulk

pdp
PATTLE DELAMORE PARTNERS LTD

Request for Analyses

NOTE: Please acknowledge receipt of these samples by signing this form and emailing to submitter.

From: Pattle Delamore Partners Ltd

To: Hills

Office: ☐ Auckland ☐ Hamilton ☐ Tauranga ☐ Wellington ☑ Christchurch ☐ Invercargill

Quote No.:

Submitted by: Chanelle Seabrook Ph No.: 0212213979

PDP Job No.: C02450100

Chain of Custody Record

Additiona

Job No: 305 5181 Date Recv: 16-Aug-22 07:04

Received by: Nathaniel Sue

3130551811

Sent:

Name: Chanelle Seabrook

Signature: CSeabrook

Date and time: 15/08/2022

Received: ☐ Room temp. ☐ Chilled Temp.: 2.7°C
☐ Frozen

Name:

Signature:

Date and time:

Results to: ☐ lab.samples@pdp.co.nz
☑ Email submitter: Chanelle.Seabrook@pdp.co.nz
☑ Email other: Scott.Wilson@pdp.co.nz

Priority: ☐ Normal ☐ High ☐ Urgent

Results required by: / /

Invoice to: ☐ PDP ☐ Other:

Sample ID	Date	Time	Sample type	Analyses Requested	Notes
MW2	12/8	-	GW	as per quote 119397	
MW3	12/8	-	GW	↓	

Sample type: **S** Soil [✓ **GW** Groundwater] **SAL** Saline **FW** Freshwater **GEO** Geothermal **SW** Stormwater
SED Sediment **BIO** Biota **WW** Wastewater **P** Potable **O** Other:

For physical address see www.pdp.co.nz

Note: Samples may contain dangerous or hazardous substances

Page 1 of 1

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PDP Hamilton
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PDP Wellington
Tel: +64 4 471 4130

[✓ PDP Christchurch
Tel: +64 3 345 7100]

PDP Invercargill
Tel: +64 3 422 1690

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R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T **0508 HILL LAB** (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Job Information Summary

Page 1 of 2

Client:	Pattle Delamore Partners Limited	**Lab No:**	3055181
Contact:	S Wilson	**Date Registered:**	16-Aug-2022 12:33 pm
	C/- Pattle Delamore Partners Limited	**Priority:**	High
	PO Box 389	**Quote No:**	119397
	Christchurch 8140	**Order No:**	
		Client Reference:	C02450100
		Add. Client Ref:	
		Submitted By:	Chanelle Seabrook
		Charge To:	Pattle Delamore Partners Limited
		Target Date:	23-Aug-2022 4:30 pm

Samples

No	Sample Name	Sample Type	Containers	Tests Requested
1	MW2 12-Aug-2022	Ground Water	Org500, UP500, FN100, S100, N100, UPte100, VOC40, cVOC40	Dissolved Arsenic; Dissolved Boron; Dissolved Chromium; Dissolved Iron; Dissolved Lead; Dissolved Nickel; Dissolved Zinc; Total Nitrogen; Anion / Cation profile, dissolved metals trace level; Volatile Organic Compounds Screening in Water by Headspace GC-MS; Total Ammoniacal-N; Dissolved Reactive Phosphorus; Total Kjeldahl Nitrogen (TKN); Semivolatile Organic Compounds Screening in Water by GC-MS
2	MW3 12-Aug-2022	Ground Water	Org500, UP500, FN100, S100, N100, UPte100, VOC40, VOC40	Dissolved Arsenic; Dissolved Boron; Dissolved Chromium; Dissolved Iron; Dissolved Lead; Dissolved Nickel; Dissolved Zinc; Total Nitrogen; Anion / Cation profile, dissolved metals trace level; Volatile Organic Compounds Screening in Water by Headspace GC-MS; Total Ammoniacal-N; Dissolved Reactive Phosphorus; Total Kjeldahl Nitrogen (TKN); Semivolatile Organic Compounds Screening in Water by GC-MS

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Semivolatile Organic Compounds Screening in Water by GC-MS	Liquid / liquid extraction, GC-MS analysis. In-house based on US EPA 8270.	0.00005 - 0.10 g/m^3	1-2
Volatile Organic Compounds Screening in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.003 - 0.5 g/m^3	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter. Performed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch.	-	1-2
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23rd ed. 2017.	0.07 meq/L	1-2
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 23rd ed. 2017.	0.05 meq/L	1-2

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
pH	pH meter. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 4500-H^+ B 23rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-2
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 2320 B (modified for Alkalinity <20) 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	1-2
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 23rd ed. 2017.	1.0 g/m^3 at 25°C	1-2
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	1-2
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 2510 B 23rd ed. 2017.	0.1 mS/m	1-2
Dissolved Arsenic	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-2
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.005 g/m^3	1-2
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.05 g/m^3	1-2
Dissolved Chromium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.00010 g/m^3	1-2
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.05 g/m^3	1-2
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-2
Chloride	Filtered sample from Christchurch. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3. In-house calculation.	0.05 g/m^3	1-2
Total Ammoniacal-N	Filtered Sample from Christchurch. Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-2
Nitrite-N	Filtered sample from Christchurch. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-2
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-2
Nitrate-N + Nitrite-N	Filtered sample from Christchurch. Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-2
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D (modified) 4500 NH_3 F (modified) 23rd ed. 2017.	0.10 g/m^3	1-2
Dissolved Reactive Phosphorus	Filtered sample from Christchurch. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) 23rd ed. 2017.	0.004 g/m^3	1-2
Sulphate	Filtered sample from Christchurch. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2

Hill Laboratories
TRIED, TESTED **AND TRUSTED**

ANALYSIS REQUEST

R J Hill Laboratories Limited
28 Duke Street Hamilton 3204
Private Bag 3205
Hamilton 3240, New Zealand

T **0508 HILL LAB** (44 555 2
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Job No: Date Recv: **19-Jan-23 16:58**

315 6040

Received by: Tim Sirett

3131560405

Quote No	119397	**Lab Order No**	
Primary Contact	Scott Wilson		32300
Submitted By	~~Scott Wilson~~ LUCY DUFFUS		32300
Client Name	Pattle Delamore Partners Limited		6155
Address	PO Box 389 Christchurch 8140, New Zealand		
Phone	03 345 7100	*Mobile*	021524189
Email	hills@pdp.co.nz ; Lucy.Duffus@pdp.co.nz		
Charge To	Pattle Delamore Partners Limited		6155
Client Reference	C02450100		
Additional Client Ref			
Order No			

Results To *Reports will be emailed to Primary Contact by default. Additional Reports will be sent as specified below.*

☑ *Email Primary Contact* ☑ *Email Submitter* ☐ *Email Client*

☑ *Email Other* Lucy.Duffus@pdp.co.nz

☐ *Other* Rowan.Freeman@pdp.co.nz

Dates of testing are not routinely included in the Certificates of Analysis. Please inform the laboratory if you would like this information reported.

CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories
Date & Time: 19.1.23
Name:
☑ *Tick if you require COC to be emailed back*
Signature:

Received at Hill Laboratories
Date & Time:
Name:
Signature:

Condition
☐ *Room Temp* ☑ *Chilled* ☐ *Frozen*
Temp: 10.6

☐ Sample & Analysis details checked
Signature:

ADDITIONAL INFORMATION / KNOWN HAZARDS

Priority ☐ **Low** ☐ **Normal** ☑ **High**

☐ **Urgent** (ASAP, ~~extra charge applies, please contact lab first~~)

Requested Reporting Date:

Quoted Sample Types

No.	*Sample Name*	*Sample Date/Time*	*Sample Type*	*Tests Required*
1	MW2	19/1/23	GW	As per quote 119397
2	MW3	↓	↓	↓
3				
4				
5				
6				
7				
8				

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T **0508 HILL LAB** (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Job Information Summary

Client:	Pattle Delamore Partners Limited	**Lab No:**	3156040
Contact:	S Wilson	**Date Registered:**	19-Jan-2023 5:19 pm
	C/- Pattle Delamore Partners Limited	**Priority:**	High
	PO Box 389	**Quote No:**	119397
	Christchurch 8140	**Order No:**	
		Client Reference:	C02450100
		Add. Client Ref:	
		Submitted By:	Lucy Duffus
		Charge To:	Pattle Delamore Partners Limited
		Target Date:	27-Jan-2023 4:30 pm

Samples

No	Sample Name	Sample Type	Containers	Tests Requested
1	MW2 19-Jan-2023	Ground Water	cUP1L, Org500, FN100, S100, VOC40, VOC40	Anion / Cation profile, dissolved metals trace level; Dissolved Arsenic; Dissolved Boron; Dissolved Chromium; Dissolved Iron; Dissolved Lead; Dissolved Nickel; Dissolved Zinc; Total Nitrogen; Volatile Organic Compounds Screening in Water by Headspace GC-MS; Total Ammoniacal-N; Dissolved Reactive Phosphorus; Total Kjeldahl Nitrogen (TKN); Semivolatile Organic Compounds Screening in Water by GC-MS
2	MW3 19-Jan-2023	Ground Water	UP1L, Org500, FN100, S100, VOC40, VOC40	Anion / Cation profile, dissolved metals trace level; Total Nitrogen; Dissolved Arsenic; Dissolved Boron; Dissolved Chromium; Dissolved Iron; Dissolved Lead; Dissolved Nickel; Dissolved Zinc; Volatile Organic Compounds Screening in Water by Headspace GC-MS; Total Ammoniacal-N; Dissolved Reactive Phosphorus; Total Kjeldahl Nitrogen (TKN); Semivolatile Organic Compounds Screening in Water by GC-MS

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Semivolatile Organic Compounds Screening in Water by GC-MS	Liquid / liquid extraction, GC-MS analysis. In-house based on US EPA 8270.	0.00005 - 0.10 g/m^3	1-2
Volatile Organic Compounds Screening in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.003 - 0.5 g/m^3	1-2
Filtration, Unpreserved	Sample filtration through 0.45μm membrane filter. Performed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch.	-	1-2
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23rd ed. 2017.	0.07 meq/L	1-2
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 23rd ed. 2017.	0.05 meq/L	1-2

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
pH	pH meter. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 4500-H^+ B 23rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-2
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 2320 B (modified for Alkalinity <20) 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	1-2
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 23rd ed. 2017.	1.0 g/m^3 at 25°C	1-2
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	1-2
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; 101c Waterloo Road, Christchurch. APHA 2510 B 23rd ed. 2017.	0.1 mS/m	1-2
Dissolved Arsenic	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-2
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.005 g/m^3	1-2
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.05 g/m^3	1-2
Dissolved Chromium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.00010 g/m^3	1-2
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-2
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.05 g/m^3	1-2
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-2
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-2
Chloride	Filtered sample from Christchurch. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3. In-house calculation.	0.05 g/m^3	1-2
Total Ammoniacal-N	Filtered Sample from Christchurch. Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-2
Nitrite-N	Filtered sample from Christchurch. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-2
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-2
Nitrate-N + Nitrite-N	Filtered sample from Christchurch. Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-2
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D (modified) 4500 NH_3 F (modified) 23rd ed. 2017.	0.10 g/m^3	1-2
Dissolved Reactive Phosphorus	Filtered sample from Christchurch. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) 23rd ed. 2017.	0.004 g/m^3	1-2
Sulphate	Filtered sample from Christchurch. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-2

PDP Air Monitoring

PDP Job No: C02450100

Sampling Date: 10/01/2023

Spare:

Monitored by: LD (PDP)

Rotameter No. 101

email results to: lucy.duffus@pdp.co.nz & rowan.freeman@pdp.co.nz

Pump No.	Cowl No.	Sample Name	Start Time	Start Flow	End Time	End Flow	Total Time (min)	Avg Flow (L/min)	Comments
LFP8	114858	PF_AA001_100123	10:14	1.5	16:05	1.5	351	1.5	Background
LFP9	114 856	PF_AA002_100123	10:13	1.5	16:07	1.5	354	1.5	↓ fell over during sampling
LFP6	114 857	PF_AA003_100123	10:21	1.5	16:08	1.5	347	1.5	↓

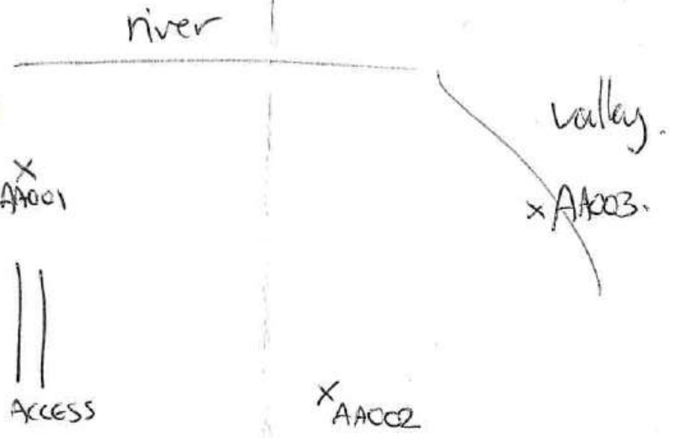
Weather: cloudy, light rain showers

Wind speed: Light

Wind direction:

Received by Hayley Jensen
at 8:00am 12/1/23
Due: EOB
3 samples
Terra Reference: T009112

Site Plan and Monitor positions:



Sent by: Lucy Duffus

Transported by: Lucy Duffus

NB: Please return copy of CoC on receipt of samples at lab to sender

PDP Air Monitoring

PDP Job No: C02450100

Sampling Date: 11.01.23

Spare:

Monitored by: LD (PDP) Rotameter No. 101

email results to: lucy.duffus@pdp.co.nz & rowan.freeman@pdp.co.nz

Pump No.	Cowl No.	Sample Name	Start Time	Start Flow	End Time	End Flow	Total Time (min)	Avg Flow (L/min)	Comments
LFP9	114855	PF_AA004_110123	7:49	1.5	15:16	1.5	447	1.5	background.
LFP8	114859	PF_AA005_110123	8:04	1.5	15:22	1.5	438	1.5	↓
LFP6	114860.	PF_AA006_110123	7:59	1.5	15:19	1.5	440	1.5	

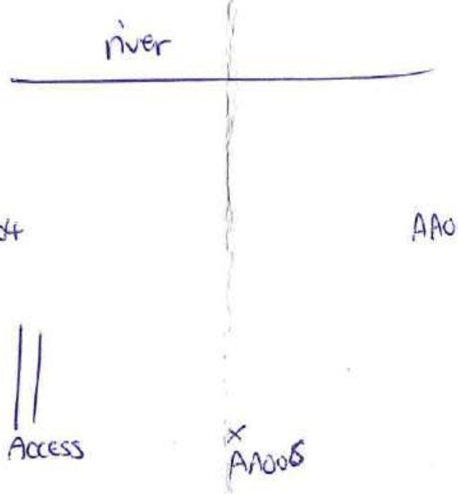
Weather: Cloudy (light rain in arvo)

Wind speed: Light

Wind direction:

Received by: Hayley Jensen HJensen
Date & time received: 13/1/23 8:00am
Due: EOB 3 samples
Terra Refference: T009122

Site Plan and Monitor positions:



Sent by: Lucy Duffus

Transported by: Lucy Duffus

NB: Please return copy of CoC on receipt of samples at lab to sender

PDP Air Monitoring

PDP Job No: C02450100

Sampling Date: 12.1.23

Spare:

Monitored by: LD (PDP)

Rotameter No.

email results to: lucy.duffus@pdp.co.nz & rowan.freeman@pdp.co.nz

Pump No.	Cowl No.	Sample Name	Start Time	Start Flow	End Time	End Flow	Total Time (min)	Avg Flow (L/min)	Comments
LFP9	114853	PF_AA007_120123	7:46	1.5	15:35	1.5	469	1.5	
LFP6	114854	PF_AA008_120123	7:50	1.5	15:37	1.5	467	1.5	
LFP8.	114852	PF.AA009_120123	7:53	1.5	15:46	1.5	467	1.5	

Weather: Cloudy/Light rain in arvo.

Wind speed: Light

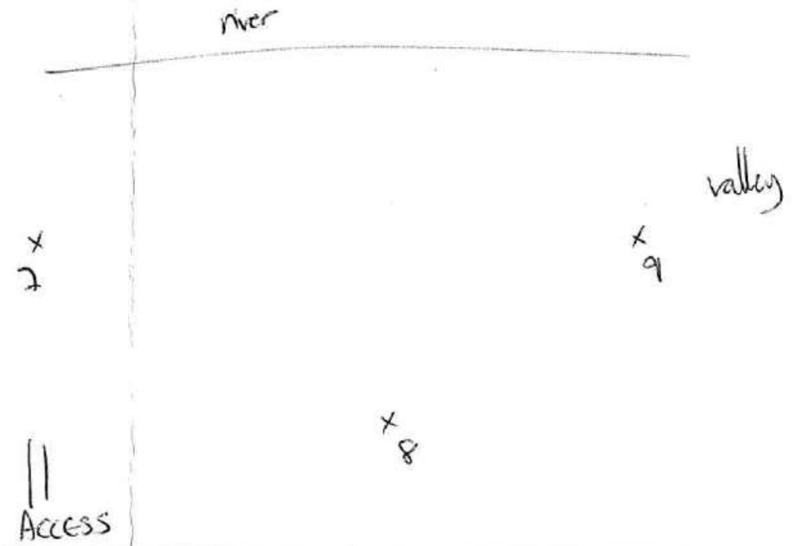
Wind direction:

received: 8:40am by Hayley Jensen

3 samples Due: EOB

Terra refference: T009122.2

Site Plan and Monitor positions:



Sent by: Lucy Duffus

Transported by: Lucy Duffus

NB: Please return copy of CoC on receipt of samples at lab to sender

Hill Laboratories
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28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

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E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

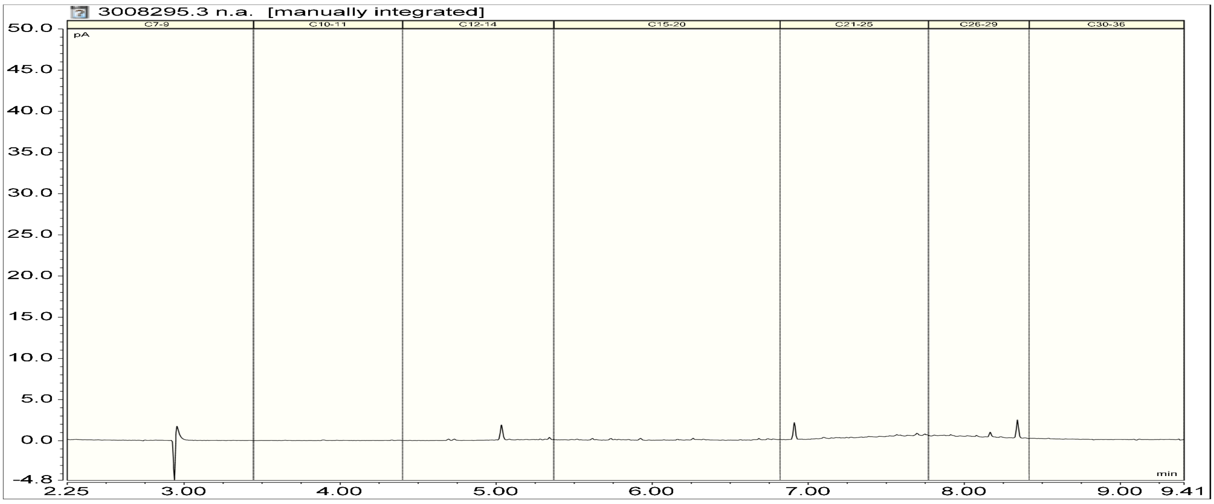
Client: Pattle Delamore Partners Limited
Contact: S Wilson
C/- Pattle Delamore Partners Limited
PO Box 389
Christchurch 8140

Lab No: 3008295 SPv1
Date Received: 08-Jun-2022
Date Reported: 10-Jun-2022
Quote No: 81087
Order No:
Client Reference: C02450100
Submitted By: Lucy Duffus

Sample Type: Soil

	Sample Name:	MW2_22.3 30-May-2022	MW1_6.5 01-Jun-2022			
	Lab Number:	3008295.3	3008295.6			
Individual Tests						
Dry Matter	g/100g as rcvd	93	91	-	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	< 2	2	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	-	-	-
Total Recoverable Chromium	mg/kg dry wt	52	19	-	-	-
Total Recoverable Copper	mg/kg dry wt	15	15	-	-	-
Total Recoverable Lead	mg/kg dry wt	9.8	12.9	-	-	-
Total Recoverable Nickel	mg/kg dry wt	15	13	-	-	-
Total Recoverable Zinc	mg/kg dry wt	44	52	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 20	< 20	-	-	-
C10 - C14	mg/kg dry wt	< 20	< 20	-	-	-
C15 - C36	mg/kg dry wt	50	< 40	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	< 80	-	-	-

3008295.3
MW2_22.3 30-May-2022
Client Chromatogram for TPH by FID



Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	3, 6
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	3, 6
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	3, 6
Total Petroleum Hydrocarbons in Soil			
Client Chromatogram for TPH by FID	Small peaks associated with QC compounds may be visible in chromatograms with low TPH concentrations. QC peaks are as follows: one peak in the C12 - 14 band, the C21 - 25 band and the C30 - 36 band. All QC peaks are corrected for in the reported TPH concentrations.	-	3
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	20 mg/kg dry wt	3, 6
C10 - C14	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	20 mg/kg dry wt	3, 6
C15 - C36	Solvent extraction, GC-FID analysis. Tested on as received sample. In-house based on US EPA 8015.	40 mg/kg dry wt	3, 6
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	70 mg/kg dry wt	3, 6

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

Testing was completed between 09-Jun-2022 and 10-Jun-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Appendix I: Groundwater Sampling Field Sheets

PATTLE DELAMORE PARTNERS LTD

PDP WELL PURGING AND SAMPLING FORM – LOW FLOW

Site: Peel Forest
Job number: C02450100
Weather: Sunny
Purging method: low flow
Sampling equipment: low flow

WELL DETAILS:

PID reading in neck of well: — (ppm)
Well casing diameter: 50 (mm)
Total depth of well: 32.075 (m)
Distance of PVC casing above/below ground level 0.36 (m)

DEPTH TO WATER (DTW)*:

Before purging ("static"): 25.131 (m)
Depth to product: — (m)
Product thickness: — (m)
Product measured by: interface probe/bailer/product-only bailer
Volume of product removed: — (L)

NOTE: purge until well has stabilised using field parameters below (3 consecutive readings) whilst maintaining a stable drawdown (see below)

Well ID: MW2
Date(s): Dip 12/08/2022
Purge //
Sampler name(s): CS

*** Water Level Measurement**

Reference Point: [✓ Top of PVC Casing] / Top of Well
(circle as appropriate)
Toby Key Type: ~~triangular? / allen key? / padlock?~~
Well Cap Type: H-cap? / screw cap? [✓ / push-fit?]

PUMP SETTINGS:

DTW before pump introduced: 25.131 (m)
Pump Intake Depth 26.5 (m)
Cycle Time ~~CPM / Period~~
Refill/Discharge Time ~~Period~~

Minimum volume between readings: 1 sample train volume (see formula below)
Key Stabilisation Criteria:
pH ± 0.1, EC ± 3%, T ± 0.2 degree, DO ± 0.3 mg/L, turbidity ± 10% of prior reading or ± 1.0 NTU (whichever is greater)

Target Stable Drawdown is 0.1 m (if drawdown is exceeded, contact your PM immediately)

	Time Elapse	Time	Volume Removed (L)	Water Temp. (°C)	pH	EC ((µS/cm)	ORP (mV)	Dissolved Oxygen (mg/L)	Water Level (m)*	Turbidity (NTU) / Water Appearance†
Before		1254	1	11.9	6.20	358.7	100.7	9.44	25.145	CO / SI
During		1257	2	11.8	6.12	356.9	106.1	7.56	25.138	CO / CL
During		1300	3	11.8	7.07	355.0	109.8	7.07	25.134	CL
During		1303	4	11.8	6.10	354.8	112.7	6.86	25.144	CL
During		1307	5	11.8	6.79	353.8	115.2	6.75	25.126	CL
During		1310	6	11.8	6.09	354.1	117.6	6.65	25.124	CL
During		1314	7	11.7	6.08	353.4	123.1	6.63	25.134	CL
During		1317	8	11.7	6.08	353.3	126.6	6.61	25.133	CL
During										
During										
During										
During										
During										
During										

† CL=clear, CO=cloudy, TU=turbid, SI=silty, SA=sandy

Comments

Sample Train Volume Calculation (L)
(length of sample tube x 3.141 x d² / 4000) + flow through cell volume.
Where d = internal diameter of sample tube in mm
In bonded tubing – water sample internal ø = 6mm ≈ 30mL per meter

Field Filtered (metals only)?: [✓ Y] / N
Analyses Required: dissolved metals (field + lab), total metals, VOC/BTEX,
Sample Bottles Collected: TKN/COD, organics
~~Lab Quote No.~~ → 5x plastic bottles, 2x small glass, 1x 500 glass

* = needs to be recorded each time you take a set of parameters

pdp
PATTLE DELAMORE PARTNERS LTD

PDP WELL PURGING AND SAMPLING FORM – LOW FLOW

Site: Peel Forest
Job number: C02450100
Weather: sunny
Purging method: low flow
Sampling equipment: low flow

Well ID: MW3
Date(s): Dip 12/8/2022
Purge 〃
Sampler name(s): CS

WELL DETAILS:

PID reading in neck of well: / (ppm)
Well casing diameter: 50 (mm)
Total depth of well: 31.075 (m)
Distance of PVC casing above/below ground level 0.56 (m)

*** Water Level Measurement**

Reference Point: [✓ Top of PVC Casing] / Top of Well
(circle as appropriate)
Toby Key Type: ~~triangular? / allen key? / padlock?~~
Well Cap Type: H-cap? / screw cap? [✓ / push-fit?]

DEPTH TO WATER (DTW)*:

Before purging ("static"): 24.645 (m)
Depth to product: / (m)
Product thickness: / (m)
Product measured by: interface probe/bailer/product-only bailer
Volume of product removed: / (L)

PUMP SETTINGS:

DTW before pump introduced: 24.645 (m)
Pump Intake Depth 26.0 (m)
Cycle Time / CPM / Period
Refill/Discharge Time / Period

NOTE: purge until well has stabilised using field parameters below (3 consecutive readings) whilst maintaining a stable drawdown (see below)

Minimum volume between readings: 1 sample train volume (see formula below)
Key Stabilisation Criteria:
pH ± 0.1, EC ± 3%, T ± 0.2 degree, DO ± 0.3 mg/L, turbidity ± 10% of prior reading or ± 1.0 NTU (whichever is greater)

<u>Target Stable Drawdown is 0.1 m</u> (if drawdown is exceeded, contact your PM immediately)

	Time Elapse	Time	Volume Removed (L)	Water Temp. (°C)	pH	EC ((µS/cm)	ORP (mV)	Dissolved Oxygen (mg/L)	Water Level (m)*	Turbidity (NTU) / Water Appearance†
Before		1459	1	12.1	6.16	396.2	127.0	7.63	–	CL
During		1504	2	12.0	6.14	391.3	132.8	7.09	–	CL
During		1508	3	11.9	6.13	392.4	136.9	6.69	–	CL
During		1514	4	11.8	6.13	391.9	140.4	6.64	–	CL
During		1518	5	11.9	6.12	392.8	142.2	6.63	–	CL
During										
During										
During										
During										
During										
During										
During										
During										
During										

† CL=clear, CO=cloudy, TU=turbid, SI=silty, SA=sandy

Comments

Sample Train Volume Calculation (L)
(length of sample tube x 3.141 x d^2 / 4000) + flow through cell volume.
Where d = internal diameter of sample tube in mm
In bonded tubing – water sample internal ø = 6mm ≈ 30mL per meter

Field Filtered (metals only)?: [✓ Y] / N
Analyses Required: total metals, dissolved metals (field + lab),
Sample Bottles Collected: VOC + BTEX, TKN/COD, organics
Lab Quote No. → 5x plastic, 2x small glass, 1x 500 glass jar

* = needs to be recorded each time you take a set of parameters

PATTLE DELAMORE PARTNERS LTD

PDP WELL PURGING AND SAMPLING FORM – LOW FLOW

Site: Peel Forest

Job number: C02450100

Weather: Fine

Purging method: low flow

Sampling equipment: low flow bladder pump

WELL DETAILS:

PID reading in neck of well: 0.0 (ppm)

Well casing diameter: 50 (mm)

Total depth of well: (m)

Distance of PVC casing above/~~below~~ ground level 0.45 (m)

DEPTH TO WATER (DTW)*:

Before purging ("static"): 25.945 (m)

Depth to product: (m)

Product thickness: (m)

Product measured by: interface probe/bailer/product-only bailer

Volume of product removed: (L)

NOTE: purge until well has stabilised using field parameters below (3 consecutive readings) whilst maintaining a stable drawdown (see below)

Well ID: MW2

Date(s): Dip 19.1.23

Purge 19.1.23

Sampler name(s): LD

*** Water Level Measurement**

Reference Point: [✓ Top of PVC Casing] / Top of Well

(circle as appropriate)

Toby Key Type: ~~triangular? / allen key? / padlock?~~ N/A

Well Cap Type: H-cap? / screw cap? / [✓ push-fit?]

PUMP SETTINGS:

DTW before pump introduced: 25.941 (m)

Pump Intake Depth 27 (m)

Cycle Time 35 CPM / Period

Refill/Discharge Time 15/20 Period

Minimum volume between readings: 1 sample train volume (see formula below)

Key Stabilisation Criteria:

pH ± 0.1, EC ± 3%, T ± 0.2 degree, DO ± 0.3 mg/L, turbidity ± 10% of prior reading or ± 1.0 NTU (whichever is greater)

Target Stable Drawdown is 0.1 m (if drawdown is exceeded, contact your PM immediately)

	Time Elapse	Time	Volume Removed (L)	Water Temp. (°C)	pH	EC ((µS/cm)	ORP (mV)	Dissolved Oxygen (mg/L)	Water Level (m)*	Turbidity (NTU) / Water Appearance†
Before		12:12	1.0	14.8	6.14	196.0		6.70	25.966	CL
During		12:18	2.0	13.9	6.18	194.5		5.83	25.970	CL
During		12:23	3.0	13.9	6.16	193.7		5.73	25.961	CL
During		12:28	4.0	14.1	6.16	194.1		5.93		CL
During										
During			- sampled after 4L purged -							
During										
During										
During										
During										
During										
During										
During										
During										

† CL=clear, CO=cloudy, TU=turbid, SI=silty, SA=sandy

Sample Train Volume Calculation (L)

(length of sample tube x 3.141 x d^2 / 4000) + flow through cell volume.
Where d = internal diameter of sample tube in **mm**

In bonded tubing – water sample internal ø = 6mm ≈ 30mL per meter

Comments

- fiddly sampling, flow stopped a few times.

Field Filtered (metals only)?: [✓ Y] / N

Analyses Required: As per quote

Sample Bottles Collected: As per quote

Lab Quote No. 119397

* = needs to be recorded each time you take a set of parameters

pdp PATTLE DELAMORE PARTNERS LTD

PDP WELL PURGING AND SAMPLING FORM – LOW FLOW

Site: Peel Forest
Job number: C02450100
Weather: Fine
Purging method: low flow
Sampling equipment: low flow bladder pump

Well ID: MW3
Date(s): Dip 19.1.23
Purge 19.1.23
Sampler name(s): LD

WELL DETAILS:

PID reading in neck of well: 0.0 (ppm)
Well casing diameter: 50 (mm)
Total depth of well: (m)
Distance of PVC casing above/~~below~~ ground level 0.45 (m)

DEPTH TO WATER (DTW)*:

Before purging ("static"): 25.524 (m)
Depth to product: (m)
Product thickness: (m)
Product measured by: interface probe/bailer/product-only bailer
Volume of product removed: (L)

NOTE: purge until well has stabilised using field parameters below (3 consecutive readings) whilst maintaining a stable drawdown (see below)

*** Water Level Measurement**

Reference Point: [✓ Top of PVC Casing] / ~~Top of Well~~
(circle as appropriate)
Toby Key Type: ~~triangular? / allen key? / padlock?~~ N/A
Well Cap Type: ~~H-cap? / screw cap?~~ / [✓ push-fit?]

PUMP SETTINGS:

DTW before pump introduced: 25.524 (m)
Pump Intake Depth 26 (m)
Cycle Time 41 CPM / Period
Refill/Discharge Time 15/~~20~~20/21 Period

Minimum volume between readings: 1 sample train volume (see formula below)
Key Stabilisation Criteria:
pH ± 0.1, EC ± 3%, T ± 0.2 degree, DO ± 0.3 mg/L, turbidity ± 10% of prior reading or ± 1.0 NTU (whichever is greater)

Target Stable Drawdown is 0.1 m (if drawdown is exceeded, contact your PM immediately)

	Time Elapse	Time	Volume Removed (L)	Water Temp. (°C)	pH	EC ((µS/cm)	ORP (mV)	Dissolved Oxygen (mg/L)	Water Level (m)*	Turbidity (NTU) / Water Appearance†
Before		13:59	1.0	17.4	6.11	225.4		5.94	25.550	CL
During		14:07	2.0	16.1	6.12	222.3		5.65	25.540	CL
During		14:14	3.0	15.7	6.14	221.6		5.35	25.561	CL
During		14:20	4.0	15.6	6.14	221.7		5.47	25.545	CL
During										
During			– sampled	after 4L	purged.					
During										
During										
During										
During										
During										
During										
During										
During										

† CL=clear, CO=cloudy, TU=turbid, SI=silty, SA=sandy

Sample Train Volume Calculation (L)
(length of sample tube x 3.141 x d^2 / 4000) + flow through cell volume.
Where d = internal diameter of sample tube in **mm**
In bonded tubing – water sample internal ø = 6mm ≈ 30mL per meter

Comments

Field Filtered (metals only)?: [✓ Y] / N
Analyses Required: As per quote
Sample Bottles Collected: As per quote
Lab Quote No. 119 397

* = needs to be recorded each time you take a set of parameters

N:\Field Templates\water%20sampling%20form%20lowflow_17092012.rtf

Appendix D: Dust Management Plan

Dust Management and Monitoring Plan – Peel Forest Landfill

Prepared for

Timaru District Council

February 2024

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Quality Control Sheet

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DOCUMENT CONTRIBUTORS

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Approved by

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Jeff Bluett

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by the Timaru District Council. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of the Timaru District Council for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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1.0 Introduction

This Dust Management and Monitoring Plan (DMMP) has been prepared by Pattle Delamore Partners Ltd (PDP) on behalf of the Timaru District Council (TDC) to assist their removal and remediation of a closed landfill at Dennistoun Road, Peel Forest.

1.1 Purpose

The purpose of the DMMP is to provide a framework to manage the impacts of dust discharged from actions relating to the removal and remediation of the Peel Forest Landfill. The DMMP will:

- Meet the requirements defined in Schedule 2 of the Canterbury Air Regional Plan[1].
- Facilitate the avoidance, remediation, and mitigation of any adverse effects of discharges of dust generated from excavation and heavy machinery movements at the Peel Forest landfill site.
- Promote proactive solutions to the control of dust discharges from the site; and
- Present an industry best practice option for dust controls to align with the recommendations and requirements contained in Ministry for the Environment's (MfE) Good Practice Guide for Assessing and Managing Dust[2].

1.2 Landfill removal and remediation

The stages of the work will be:

1. Site establishment
2. Remedial excavation
3. Removal of rubbish to stockpiles.
4. Waste segregation.
5. Haulage from Peel Forest to Redruth Landfill
6. Adding clean soil to pullback area

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[1] Schedule 2, Canterbury Air Regional Plan, Canterbury Regional Council, 2017. https://www.ecan.govt.nz/your-region/plans-strategies-and-bylaws/canterbury-air-regional-plan/

[2] Good Practice for Assessing and Managing Dust. Ministry for the Environment, 2016. MfE publication number ME1277.

A more detailed project description is provided in the technical memorandum prepared by PDP following the flood-induced exposure of the landfill[3], and the Remedial Action Plan prepared by PDP[4].

Shown in Figure 1, the site is in the Peel Forest region of Timaru District, located approximately 500 m east from the Peel Forest residential community via a partially unsealed road (Dennistoun Road). The proposed site is also immediately west of the Rangitata River, atop an approximately 30-metre-high terrace.

The timeframe for the remediation process is expected to be in the order of six to nine months.

Figure 1: Location of the Peel Forest Landfill.

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[3] Technical Memorandum (C02450100M001), Pattle Delamore Partners Limited, 2023

[4] Remedial Action Plan – Peel Forest Closed Landfill, Dennistoun Road, Peel Forest (C02450100R002), Pattle Delamore Partners Limited, 2023

1.3 Objective

The objectives of this DMMP are:

1) to support the contractors by defining the dust sources, risks, and mitigation measures, so they can minimise the potential adverse impacts of dust discharges on the receiving environment.
2) To ensure that the Landfill removal and remediation activities meet the Canterbury Regional Air Plan permitted activity requirements defined in rule numbers 7.32 and 7.35.

The DMMP methods are designed to be practical and effective for the contractors involved in the remediation of the Peel Forest Landfill. The DMMP includes a review and update procedure to ensure it is continuously improved and it adapts/improves dust control measures if needed to meet the required environmental objective.

2.0 Key Performance Indicator

The key performance indicator for this DMMP is that the dust discharged from the landfill removal and remediation activities shall not cause any offensive or objectionable effects beyond the boundary of the site.

3.0 Canterbury Air Regional Plan Requirements

The DMMP will ensure that the discharge of dust to air from the operations required for the remediation of the Peel Forest Landfill is managed to an acceptable level. This will be in accordance with and comply with the permitted activity requirements of Rule 7.32 of the Canterbury Air Regional Plan (CARP)[5], concerning the discharge of contaminants to air from the construction of buildings, land development activities, unsealed surfaces or unconsolidated land, and Rule 7.35 of the CARP, concerning the discharge of contaminants into air from the handling of bulk solid materials.

4.0 Sources of Dust

It is anticipated that approximately 18,000 m^3 of waste will be excavated and remove from the landfill.

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[5] Canterbury Air Regional Plan. Environment Canterbury, October 2017. https://www.ecan.govt.nz/your-region/plans-strategies-and-bylaws/canterbury-air-regional-plan/

Over the course of the remediation process, there are multiple activities that have the potential to discharge dust. In approximate order of dust emissions (high to low), these activities include:

- Excavation of the landfill site;
- Removal and stockpiling of topsoil;
- Construction of contractor base area;
- Backfilling and recontouring of site;
- Vehicle movements on unsealed surfaces, both onsite and on unsealed portion of Dennistoun Road. It is estimated that there will be approximately 46 daily vehicle movements on Dennistoun Road throughout the remediation process;
- Wind interacting with stockpiles and unconsolidated surfaces; and
- Waste triaging.

Furthermore, the riverbed of the Rangitata River immediately to the east of the site is a large dust source. This DMP focuses on the dust produced as a result of the remediation of the Peel Forest Landfill, and as such the character of the dust produced from the riverbed should be noted in order to differentiate from the dust produced by the remediation activities.

5.0 Sensitivity of the Receiving Environment

Figure 2 shows potentially sensitive receptors that are located within 250 m of dust sources (i.e. the landfill site, the contractor base area and the unsealed portion of Dennistoun Road). Table 1 identifies the type and location of potentially sensitive receptors, which source of dust is likely to cause the largest impact and the distance between source and receptor.

Figure 2: Map of sensitive receptors within 250 of dust sources

Table 1: Potentially sensitive receptors within 250 m of dust sources

#	Type of sensitive receptor	Closest dust source	Sensitivity	Distance from closest boundary (m)	Downwind wind directions
1	Rangitata River	Peel Forest Landfill	Moderate	10	Northerly to south-westerly
2	Residence, 105 Dennistoun Road	Peel Forest Landfill	High	25	Southerly to westerly
3-8	45 - 57 Dennistoun Road	Dennistoun Road (unsealed)	High	30 - 80	Southerly to easterly
9-14	1174 – 1190 Peel Forest Road	Dennistoun Road (unsealed)	High	125 – 250	South-easterly to easterly
15	66 Dennistoun Road	Dennistoun Road (unsealed)	High	145	Northerly to north-easterly

Notes:

1. *Dwellings and buildings have been identified through desktop study using Canterbury Maps.*

The dust mitigation and dust monitoring detailed in this DMMP will minimise the adverse dust effects on the receptors identified in Table 1.

Given the proximity of the residential property 105 Dennistoun Road to the boundary of the site this is presents a high risk of adverse dust impacts occurring. The mitigation of effects at 105 Dennistoun Road is detailed in Section 6.

Figure 3 shows the relative frequency of wind directions and speeds in Orari, approximately 23 km south of the Peel Forest Landfill site (the nearest available meteorological dataset), from 2016 - 2020. It can be seen in Figure 3 that the prevailing wind direction in the region is north-westerly, occurring approximately 12% of the time. In this direction, wind speeds rarely exceed 3 m/s.

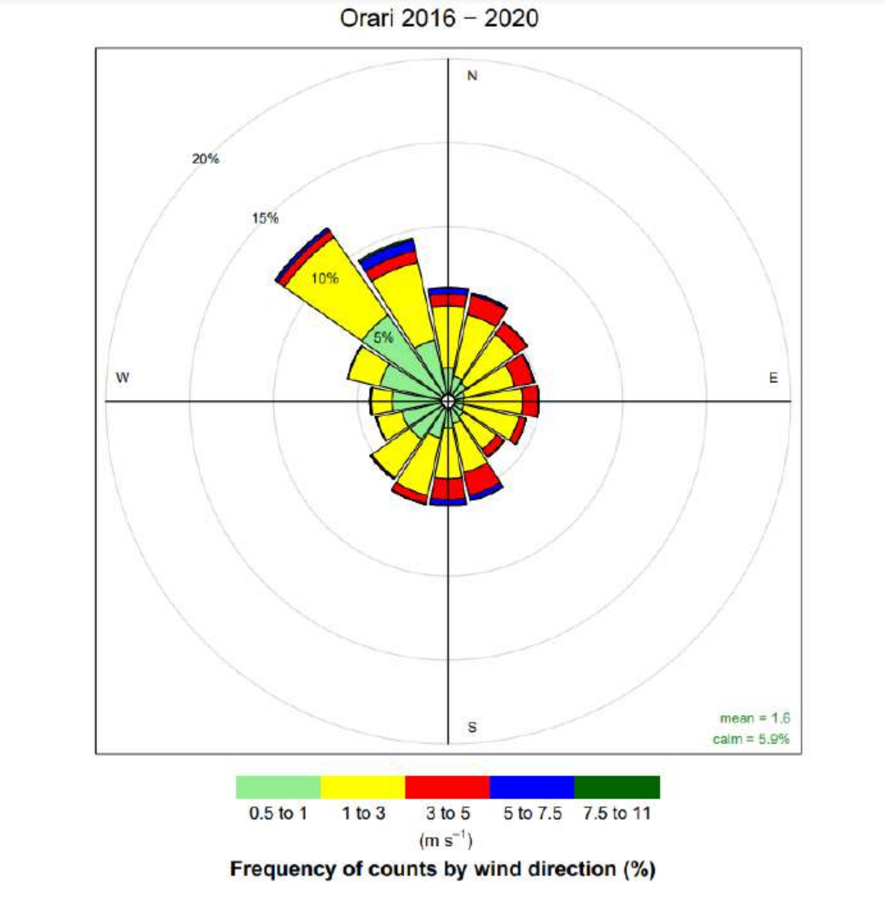


Figure 3: Wind distribution at Orari, 2016 – 2020

Table 4 shows a summary of the meteorological conditions contributing to different dust risk levels and required responses.

Table 2: Wind Speed Frequency Distribution for Orari wind station 2016 – 2020

Direction	**Wind Speed (m/s)**		**Total (%)**
	0.5-5	**>5**	
North	5.99	0.40	6.39
North Northeast	6.05	0.14	6.19
Northeast	5.32	0.02	5.34
East Northeast	4.80	0.04	4.84
East	4.98	0.02	5.00
East Southeast	4.36	0	4.36
Southeast	3.64	0.03	3.67
South Southeast	5.35	0.31	5.66
South	5.45	0.36	5.81
South Southwest	5.83	0.05	5.88
Southwest	5.25	0.01	5.26
West Southwest	4.00	0	4.00
West	4.25	0.01	4.26
West Northwest	5.74	0	5.74
Northwest	12.0	0.2	12.2
North Northwest	8.78	0.75	9.53
Calms (<0.5 m/s)			5.9

As seen in Table 2, wind speeds greater than 5 m/s are relatively rare in each direction, with the greatest frequency (0.77% of the period surveyed) occurring in the northwest sector of the windrose.

Due to the combination of separation distance and wind speed, 105 Dennistoun Road is considered to be the most at-risk sensitive receptor, with strong southerly winds occurring 0.36% of the time.

6.0 Dust Mitigation Measures

6.1 Tiered Control of Dust Sources

Dust prevention on site uses a two-tiered approach. Tier 1 controls are employed routinely, and Tier 2 controls are implemented additionally in the unlikely situation that the Tier 1 controls do not prove to be fully effective. Dust management and control measures for each dust source are detailed in Table 3. Due to the proximity of the sensitive receptors to the dust sources, dust suppression will be implemented on all areas of the remediation site.

Table 3: Sources of Dust and Tiered Controls to be Employed

Source of Dust	Controls	Responsibilities
Excavation of the landfill site; Removal and stockpiling of topsoil; Construction of contractor base area; Backfilling and recontouring of site; Waste triaging.	**Tier 1 Controls (Routine, must be employed)**	
	Take account of daily forecast wind speed, wind direction, and soil conditions before commencing an operation that has a high dust potential.	Site manager – refer to Section 9.2 Meteorological Monitoring.
	Implement good practice machine operation including minimizing drop heights.	Machine operator
	Tidy up excavation works daily.	All excavation workers
	Cover truck loads.	Truck drivers
	Tier 2 Controls (Additional, as needed)	
	Adequate water suppression systems will be available at the site to dampen areas that are to be worked prior to any earthworks or material disturbance commencing and shall be used until further earthworks or material disturbance in that area are not required. Water suppression systems could include k-line mobile sprinklers, fixed sprinklers or a water truck.	Site manager – plan for water application before any earthworks.

Table 3: Sources of Dust and Tiered Controls to be Employed

Source of Dust	**Controls**	**Responsibilities**
	Apply water to exposed areas and soils being loaded into trucks during high dust risk conditions, while also avoiding surface ponding, soil erosion, or run off.	⁛ Site manager – refer to weather forecast and current meteorological data. Define high risk conditions as winds ≥ 7.5 m/s with sensitive receptors less than 250 metres downwind of the site (refer to Section 9.2 Environmental Monitoring).
	Suspend dust generating activities if dust control measures become ineffective.	⁛ Site manager – refer to weather forecast and current meteorological data and cease work at wind speeds above 10 m/s.
Vehicle movements on unsealed surfaces (onsite and on Dennistoun Road)	**Tier 1 Controls (Routine, must be employed)**	
	Compact all unconsolidated surfaces where practicable.	⁛ Site manager ⁛ Excavation workers
	Enforce a speed limit onsite of 5 km/hr.	⁛ Site manager ⁛ Individual vehicle operators
	Encourage site vehicles to comply with the speed limit on Dennistoun Road	⁛ Individual vehicle operators
	Maintain surface of Dennistoun Road to minimise dust emissions	⁛ Coordinate with TDC

Table 3: Sources of Dust and Tiered Controls to be Employed

Source of Dust	**Controls**	**Responsibilities**
	Seal or landscape completed areas as soon as practical.	- Site manager
	Tier 2 Controls (Additional, as needed)	
	Use water application to ensure that unsealed surfaces are kept damp when haulage is occurring.	- Site manager and water tank operators – ensure that water is applied at the recommended rate (1 litre per m² per hour) to unsealed surfaces. - Heavy vehicle operators - check unsealed surfaces are sufficiently damp before haulage commences.
	Cover heavy trafficked areas with pea gravel or similar	- Site manager
	Apply a dust suppression polymer to exposed surfaces if dusty conditions persist.	- If TDC continues to receive complaints following all other Tier 2 controls, the site manager can choose to apply a polymer at their discretion.
Stockpiles and unconsolidated surfaces	**Tier 1 Controls (Routine, must be employed)**	
	Minimise height of stockpiles – maximum height 2 m.	- Excavation workers - maintain awareness of the height of in-use stockpiles.

Table 3: Sources of Dust and Tiered Controls to be Employed

Source of Dust	Controls	Responsibilities
	Place stockpiles in locations less exposed to wind.	Site manager – determine areas vulnerable to wind prior to stockpile laydown.
	Tier 2 Controls (Additional, as needed)	
	Water stockpiles	Water tanker operator - apply water to stockpiles when site manager has determined that sufficiently high-risk dust conditions have occurred.
	Cover stockpiles	Excavation workers - maintain awareness of the height of in-use stockpiles.
	Install wind shelters	If TDC continues to receive complaints following all other Tier 2 Controls, the site manager can choose to install wind shelters around stockpiles at their discretion.

Table 4: Dust Risk Levels, Meteorological Conditions and Responses

Dust Risk Level	Forecast Wind Speed	Response
Low	< 5 m/s	-
Medium	5 – 7.5 m/s	Prepare for mitigation actions, visually inspect dust discharges and implement water application for dust suppression if required.
High	≥ 7.5 m/s	Operators to visually identify potentially sensitive receptors within 100 m in downwind direction and to use Tier 1 & Tier 2 dust mitigation measures as appropriate.

6.2 Targeted dust control measures for 105 Dennistoun Road

As the closest sensitive receptor to the remediation site (immediately to the north of the remediation site), 105 Dennistoun Road requires specific dust control measures, shown in Table 5.

Table 5: Dust control measures for 105 Dennistoun Road

Controls	Responsibilities
Establishing a communication system with the householder	Site manager, householder
Erecting dust barriers on the northern edge of the remediation site.	Site manager, excavation workers
Locating stockpiles to at the southern edge of the remediation site to maximise buffer distances	Excavation workers
Avoiding dust generating activities when whenever the conditions are dry, and winds are above 5 m/s from the south.	Site manager, excavation workers
Watering dusty surfaces whenever the conditions are dry, and winds are above 5 m/s from the south.	Site manager and water tank operators – ensure that water is applied at the recommended rate (1 litre per m² per hour) to unsealed surfaces. Heavy vehicle operators - check unsealed surfaces are sufficiently damp before haulage commences.
Realtime dust monitoring if dust effects occur.	Site manager
Cleaning exterior of house if needed.	Site manager

As the receptor is also located adjacent to the Rangitata River (another large dust source), it should be noted that dust impacts at 105 Dennistoun Road during north-easterly to south-easterly winds are more likely to be due to the proximity of the riverbed, rather than the remediation activities. This should be communicated to the householder prior to remediation activities by the site manager.

7.0 Environmental Monitoring Programme

7.1 Dust Monitoring

7.1.1 Visual Monitoring

All staff will be required to continuously visually monitor activities to identify dust events during the removal and remediation activities. For the purpose of visual dust monitoring, the Site Manager or delegate will undertake a site walkover. The walkover will be undertaken at least once per day, in the early afternoon, to assess the overall effectiveness of the DMMP and assess compliance with the requirements of the CARP rules 7.32 and 7.35.

The daily visual monitoring will:

- Identity source(s) of dust (e.g. from heavy machinery, earthworks or material disturbance, etc.);
- Identify any areas of deposited dust from the site on surrounding roads and properties;
- Assess the extent and direction of any dust plumes (e.g. within boundary, cross-boundary, or covering a large extent);
- Identify receptors potentially impacted by the plume (e.g. properties downwind to the southwest);
- Assess offensiveness as:
  - High: e.g. opaque, highly visible dust plume and dark coloured plume;
  - Medium: e.g. translucent, visible, grey- or brown-coloured dust plume; or
  - Low: e.g. mainly transparent, but visible light-coloured dust plume.
- Assess overall impact as
  - High: e.g. plume passes over the landfill boundary, impacts a sensitive receptor and/or deposited dust is detectible;
  - Medium: e.g. plume passes over the landfill boundary and/or deposited dust is detectible; or
  - Low: e.g. dust plume is contained within the landfill boundary.

As part of the daily site walk over the Site Manager will also make visual dust observations on Dennistoun Road close to 45 – 57 Dennistoun Road.

With the householder’s permission, the exterior of the house at
105 Dennistoun Road will be inspected and photographed.

Visual monitoring should also be undertaken of the riverbed each day to identify how much that dust source may be contributing to the overall dust impact.

Site observations will be recorded in a daily log form, an example of which is provided as Appendix A. The daily log forms will be kept by the contractors during the remediation of the Peel Forest Landfill.

7.1.2 Instrumental Monitoring

Should the contractors receive two or more validated dust complaints from surrounding neighbours or Environment Canterbury (validated meaning that activities related to the Peel Forest Landfill remediation are the confirmed source of dust) within any 6-month period, this DMMP must be revised to incorporate real time dust monitoring. Specific issues to be considered in the updated DMMP include:

- Type of monitor;
- Location of monitor;
- Dust mitigation trigger alerts;
- Responses to dust trigger mitigation alerts; and
- Reporting of dust monitoring data.

7.2 Meteorological Monitoring

Monitoring of weather forecasts will be undertaken daily and used to inform the potential need for additional mitigation measures (e.g. in the event that strong winds are forecast). As the nearest MetService weather station is in Orari (approximately 23 kilometres away), it is recommended that a windspeed gauge is kept onsite.

Before the daily briefing meeting, the Site Manager must obtain the weather forecast for the day and identify whether high dust risk conditions (see Table 4) may occur. If high dust risk conditions are forecast, the Site Manager will highlight this to other on-site staff and instruct whether any additional dust mitigation is to be implemented for that day.

The forecast occurrence of high dust risk conditions shall be noted in the daily log along with any outcomes from the daily briefing meeting.

Should the contractors receive one validated dust complaint from surrounding neighbours or council (validated meaning that activities relating to the Peel Forest Landfill remediation are the confirmed source of dust) within any 6-month period, this DMMP must be revised to incorporate real time wind monitoring.

7.3 Frequency of Monitoring

Table 6 outlines the frequency of the activities undertaken as part of the monitoring programme.

Table 6: Earthworks Phase Monitoring Programme Activities and Frequency

Monitoring Activities	Frequency
Check **weather forecasts** for strong winds and rainfall to plan appropriate activities and dust management response (7-day forecasts also available on www.metvuw.com and www.metservice.com).	Daily and as conditions change
For the purpose of **visual dust monitoring**, the Site Manager or delegate will undertake a walkover of the site. The walkover will be undertaken at least once per day, in the early afternoon, to assess the overall effectiveness of the DMMP and assess compliance with the requirements of the CARP.	Daily
Inspect specified highly sensitive receptors: ∴ Site access and egress points; ∴ 49-75 Dennistoun Road; and ∴ 105 Dennistoun Road. to ensure dust is being contained to within the site.	Daily
Daily log form for visual monitoring of dust.	Daily
Inspect watering systems (sprinklers and any other watering system) to ensure equipment is maintained and functioning to effectively dampen exposed areas.	Weekly
Inspect dust generating activities (as listed in Section 4.0) to ensure dust emissions are effectively controlled.	Ongoing
Continuously monitor dust generating activities and water application rate.	In winds over 5 m/s from the south
Continuously monitor dust generating activities and water application rate.	In winds over 5 m/s from any direction

7.4 Reporting of Monitoring Programme

The following information must be recorded in a daily log or equivalent system (an example of the type of detail that may comprise the daily log is provided in Appendix A of this DMMP):

- Results of the daily site inspections of visible dust emissions;
- Likely source(s) of any observed dust;
- General weather conditions during the day (i.e., windy, calm, warm, rain etc.);
- Dust mitigation measures employed
- The frequency of use of the sprinkler system (if needed);
- Dust control equipment malfunctions and any remedial action(s) taken;
- Any unusual on-site activities; and
- Records of any complaints or other community feedback regarding the site activities.

The log forms will be collated and stored on site and will be made available to CRC staff upon request.

Recording relevant inspection results, as well as the conditions of external and internal factors relevant to dust emissions on the daily log forms, must be used to help assess if control measures are effective and to define appropriate corrective or preventative actions in the event that adverse effects occur.

8.0 Roles and Responsibilities

8.1 Site Manager and Staff

The Site Manager has the day-to-day responsibility for implementing the DMMP. The Site Manager has the responsibility to ensure that:

- The conditions of the CARP permitted activity rules are complied with at all times;
- The dust control and mitigation measures and procedures outlined in the DMMP are implemented effectively;
- There are adequate personnel and equipment on site at all times to implement the dust control measures;
- The meteorological and dust monitoring programmes are carried out if and as required, including recording of daily observations;
- Any complaints received are investigated and resolved as far as practicable; and

- All records are kept and are available to the relevant regulatory authorities.

All personnel working on the site have responsibility for following the requirements of the DMMP and reporting to the Site Manager on these issues.

8.2 Staff Training

Successful dust management depends on appropriate actions by site personnel in day-to-day operations of the site. Environmental training for all staff will be undertaken as part of the site induction programme. The environmental induction will include the following information specific to this DMMP:

- Information about the activities that may cause dust discharges within the site with the potential to impact neighbouring areas;
- Permitted activity requirements;
- Dust mitigation procedures;
- Description of dust and meteorological monitoring for the site; and
- Complaints management procedures.

Staff training records will be maintained on site. The records will include:

- Who was trained;
- When the person was trained; and
- General description of training content and whether follow up/refresher courses are required at a later date.

9.0 Implementation and Operation of DMMP

The Site Manager is responsible for implementing the DMMP including to:

- Identify key staff responsible for dust management and assign roles;
- Undertake staff training focusing on the objectives, responsibilities and actions defined by the DMMP;
- Establish daily processes and scheduling activities;
- Implement a daily briefing meeting; and
- Undertake regular debriefs and reviews of the DMMP.

10.0 DMMP Review

The DMMP will be reviewed each month and when needed updated throughout the course of the
Peel Forest Landfill remediation to reflect changes in dust management techniques, or changes to the receiving environment. Approval from CRC will be

required for any relevant revisions of a material nature for the DMMP. The review will take into consideration:

- Any significant changes to dust management activities or methods;
- Key changes to roles and responsibilities;
- Changes in industry best practice option for dust controls;
- Results of inspection and maintenance programmes, logs of incidents, corrective actions, internal or external assessments; and
- The outcome of investigations into any adverse effects caused by the discharges of dust from the site.

The Site Manager is responsible for reviewing the effectiveness of the DMMP and if necessary, revising it to improve management and mitigation measures to reduce any dust impacts.

Reasons for making changes to the DMMP will be documented and version tracking will be recorded in the 'Document Control' register at the start of this report. A copy of the original DMMP document and subsequent versions will be kept for the project records and marked as obsolete. Each new/updated version of the DMMP documentation will be issued with a version number and date.

11.0 Dust Complaints

Dust complaints will be recorded on the Complaint Form (Appendix B) and promptly investigated to identify and resolve the cause of the complaint. Requirements and procedures for complaints are detailed below.

11.1 Receipt Procedure

The Site Manager is responsible for responding to and following up all complaints regarding dust or any other air quality matters, and to ensure that suitably trained personnel are available to respond to complaints at all times.

Following the receipt of a complaint the Site Manager must, as soon as possible, respond as follows:

- Undertake a site inspection. Note all dust-producing activities taking place and the mitigation methods being used, take photographs for reference as appropriate. If the complaint was related to an event in the recent past, where possible, note any dust-producing activities taking place at that time and review weather records and daily log;
- Initiate any remedial action necessary, which may include a stop work period;

- Note the time and date of the complaint/s and (unless the complainant refuses to provide them) the identity and contact details of the complainant. Ask the complainant to describe the discharge:
  - Is it constant or intermittent?
  - How long has it been going on for?
  - Is it worse at any time of day?
  - Does it come from an identifiable source?
- Review meteorological data from onsite weather station (if available);
- Note if the complaint has been referred to CRC;
- As soon as possible (within 1 hour, where practicable), visit the area from where the complaint originated to ascertain if dust is still a problem;
- If it becomes apparent that there may be a source of dust other than the contractors (for example, the riverbed), remediation activities causing the complaint, it is important to verify this, for example, photograph the source and emissions and/or make notes;
- As soon as possible after initial investigations have been completed, contact the complainant to explain any problems found and remedial actions taken; and
- If necessary, update any relevant procedures to prevent any recurrence of problems and record any remedial action taken.

11.2 Response Procedures

Following the receipt of the complaint, the following actions will be undertaken:

- Advise the CRC within 48 hours that a complaint has been received, what the findings of the investigation were, and any remedial action taken;
- Call or visit the complainant to update them on the actions taken and to check that the issue has been resolved.

11.3 Record Keeping and Debrief Procedure

- Fill out the appropriate complaint form, attached as Appendix B to this DMP; and
- Advise site personnel as soon as is practicable that a complaint has been received, what the findings of the investigation were, and any remedial action taken.

12.0 Emergency Contacts

Internal and external contacts for the site in the event of an environmental emergency are provided in Table 7 and Table 8 below.

Table 7: Internal Environmental Emergency Contact Details

Role	Name	Organisation	Phone
Project Manager	TBC		
Environmental Coordinator	TBC		
Contracts Manager	TBC		
RCP Project Manager	TBC		

Table 8: External Environmental Emergency Contact Details

Role	Name	Organisation	Phone	Email
Consents Compliance Team	TBC	Canterbury Regional Council		
Project Manager	TBC			

Appendix A: Daily Log Form

Daily Dust Inspection Log

Date: _____________________ Time: ___________________

Inspection by: ____

Current weather conditions (e.g. sunny, cloudy, rainy): ________________________________

Wind speed and direction (e.g. light, moderate, strong): _______________________________

Weather forecast for next 24 hours (e.g. rainy, windy): ________________________________

Area(s) inspected: ____

Scope of Inspection	**Circle Relevant Item**	**Comments**
Is there visible dust from site work activities, stockpiles, earthworks areas, or material disturbance areas or site access roads?	Y N N/A	
Are unsealed surfaces dry and need spraying with water?	Y N N/A	
Are any exposed earthworks or material disturbance areas visibly dry and need water spray?	Y N N/A	
Stockpiles covered/stabilised where needed?	Y N N/A	
Are there any signs of dust going off site as a result of site activities? (Inspect land adjacent to the site exits and adjoining roads for the presence of dust deposits)	Y N N/A	
If wind speeds are strong or forecast to be strong (over 5 m/s) are additional inspection and mitigation measures being put in place? (e.g. increase water application, restrictions on dusty activities)	Y N N/A	
Are watering systems (e.g. sprinklers) operating effectively to minimise dust?	Y N N/A	
Are trucks carrying loose (uncovered) material entering or leaving the site?	Y N N/A	
How frequently has water sprinkling/spraying been used today (i.e. number of sprinklers, time, area watered)		

Scope of Inspection	**Circle Relevant Item**	**Comments**
Note any dust control equipment malfunctions (and remedial actions taken as appropriate)		
Any unusual on-site activities today?		
Complaints received/community feedback		

Appendix B: Complaint Recording Form

DUST COMPLAINT & ASSESSMENT FORM

PART A: Complaint Details

Date: Time:

Complaint Received By:

Name:

Address:

Contact phone numbers:

Possible source:

Anonymous: Y/N

Is dust occurring now?

Complaint details (include impacts/effects experienced by complainant:

PART B: Complainant Location Assessment

Date: Time:

Assessors Name:

Person spoken to at complaint location:

Reason for investigation: COMPLAINT/PROACTIVE

Complaint details (include impacts/effects experienced by complainant:

INITIAL IMPRESSIONS:

Type of dust

Time of the intial impression:

Any visible dust deposits: Y/N

Plume width (if known):

VISIBLE DUST DEPOSITS

Describe approximate quantites and extent

When was surface last cleaned?

Frequency of cleaning:

Describe the appearance of the deposits:

Colour

Shape

Size

Crystalline or powdery

Hard, soft

Any odour

Water soluble

Other

Weather Data (see over)

Wind direction:

Wind velocity:

Cloud cover:

Temperature:

Rainfall in past 24 hrs:

Photos Taken: Y/N

Samples taken Y/N

Diagram/description of where photos were taken.

Diagram/description of where samples were taken:

Sample collection: Use a small paintbrush (clean) to sweep samples of the dust onto a sheet of paper and then into a clean plastic bag. At least half a teaspoonful will be required for analysis. Lesser amounts may be colected on strips of clear cellotape, which should then be stuck onto sheets of clear plastic to preserve the samples. Label all samples and record date, time, location, etc on a separate sheet of paper if required.

Based on your assessment on this occasion, which of the following applies:

☐ I did not find any dust
☐ I did find dust and consider it would not be objectionable at any location for any duration or frequency
☐ I did find dust and consider it would be objectionable if it became continuous
☐ I did find dust and consider it would be objectionable if it occurred on a regular or frequent basis
☐ I did detect dust and consider it to be objectionable even in periods of short duration.

FINAL CHECKLIST

☐ Upwind assessment completed. Record details below. If not, detail reason:
☐ Aerial photo/sketch showing location of assessment and upwind assessment attached
☐ Are there potential witness statements to obtain YES/NO

REMARKS

PART C: Off-site dust and 360° assessment

Assess the dust upwind of the suspected source and if possible conduct a 360° sweep around the source assessing the odour at different points

OTHER POTENTIAL SOURCES **Time:**

Check for road works, ploughing, construction activities, burn-offs, unsealed roads, unsealed sites

Site 1:
Wind direction: Wind strength: Wind stability: GPS Loc:
Visible dust: Desciption of dust
Comment:

Site 2:
Wind direction: Wind strength: Wind stability: GPS Loc:
Visible dust: Desciption of dust:
Comment:

Site 3:
Wind direction: Wind strength: Wind stability: GPS Loc:
Visible dust: Description of dust:
Comment:

Diagram of Suspected source, dust assessment sites and dust plume:

N

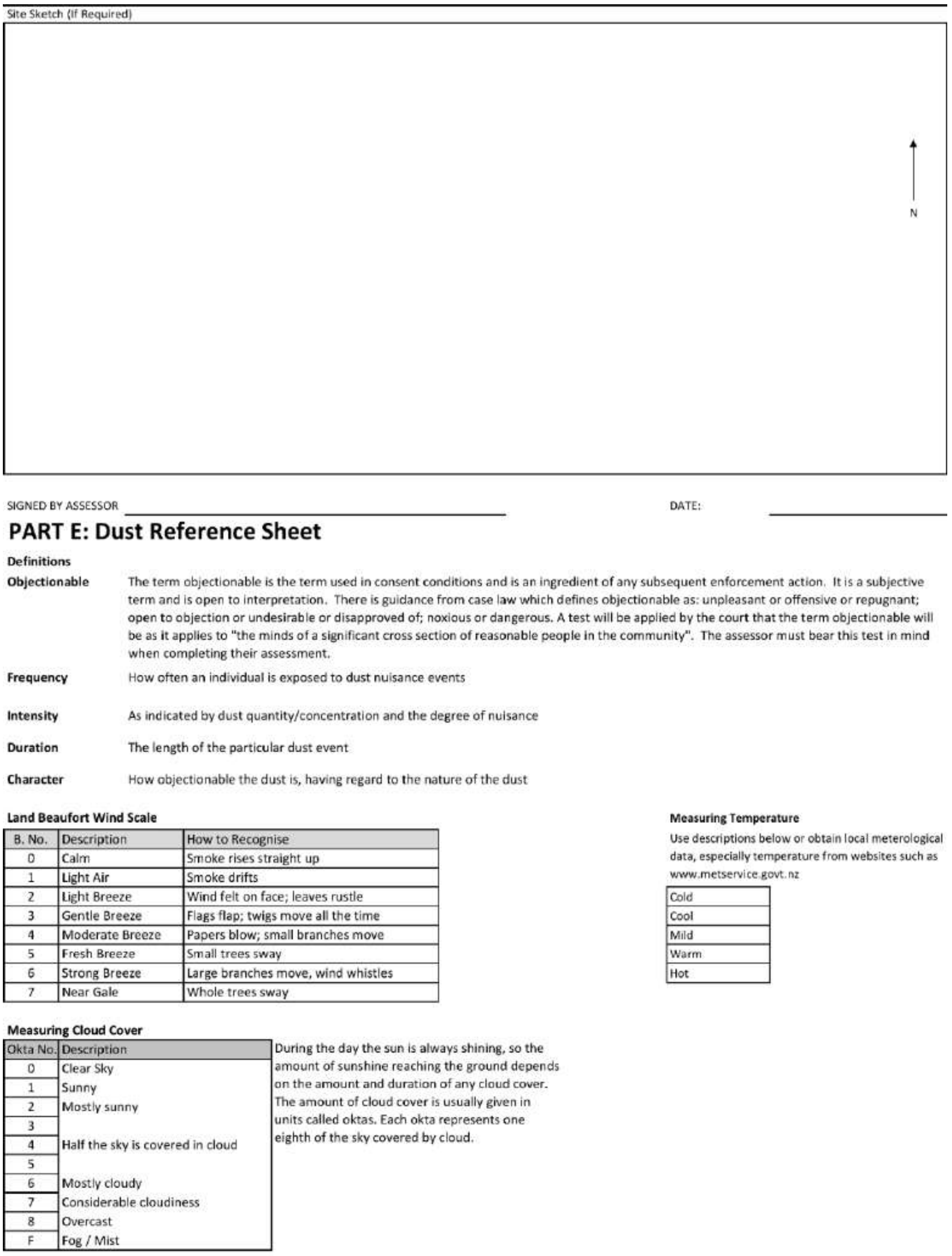
COMMENTS

PART D: Source On-site Investigation

If source of dust identified, visit site, identify yourself and show warrant. Explain the findings of your investigation to staff.

Date: Time: Source Identified:
Staff spoken to::
Position:
Staff contact phone number:
Current site operations:
Reason/explanation given for dust
Other Comments

Monitoring results/samples/other records



Site Sketch (If Required)

SIGNED BY ASSESSOR ______________________ DATE: ____________

PART E: Dust Reference Sheet

Definitions

Objectionable	The term objectionable is the term used in consent conditions and is an ingredient of any subsequent enforcement action. It is a subjective term and is open to interpretation. There is guidance from case law which defines objectionable as: unpleasant or offensive or repugnant; open to objection or undesirable or disapproved of; noxious or dangerous. A test will be applied by the court that the term objectionable will be as it applies to "the minds of a significant cross section of reasonable people in the community". The assessor must bear this test in mind when completing their assessment.
Frequency	How often an individual is exposed to dust nuisance events
Intensity	As indicated by dust quantity/concentration and the degree of nuisance
Duration	The length of the particular dust event
Character	How objectionable the dust is, having regard to the nature of the dust

Land Beaufort Wind Scale

B. No.	Description	How to Recognise
0	Calm	Smoke rises straight up
1	Light Air	Smoke drifts
2	Light Breeze	Wind felt on face; leaves rustle
3	Gentle Breeze	Flags flap; twigs move all the time
4	Moderate Breeze	Papers blow; small branches move
5	Fresh Breeze	Small trees sway
6	Strong Breeze	Large branches move, wind whistles
7	Near Gale	Whole trees sway

Measuring Temperature

Use descriptions below or obtain local meterological data, especially temperature from websites such as www.metservice.govt.nz

Cold
Cool
Mild
Warm
Hot

Measuring Cloud Cover

Okta No.	Description
0	Clear Sky
1	Sunny
2	Mostly sunny
3	
4	Half the sky is covered in cloud
5	
6	Mostly cloudy
7	Considerable cloudiness
8	Overcast
F	Fog / Mist

During the day the sun is always shining, so the amount of sunshine reaching the ground depends on the amount and duration of any cloud cover. The amount of cloud cover is usually given in units called oktas. Each okta represents one eighth of the sky covered by cloud.

Appendix E: Landform Design Principles

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solutions *for your environment*

19 February 2024

c/o Jacky Clarke
Timaru District Council
2 King George Place
TIMARU 7910

PEEL FOREST LANDFORM DESIGN PRINCIPLES – GEOTECHNICAL AND STORMWATER MANAGEMENT

1.0 Introduction

Pattle Delamore Partners Limited (PDP) have been engaged by Timaru District Council (TDC) to provide stormwater and geotechnical engineering advice to assist in construction phase works for the permanent landform for Peel Forest Landfill remedial works. The intent of this document is to provide generalised advice to assist during the earthwork's construction phase.

This letter should be read in conjunction with the Remedial Action Plan (RAP) which has also been prepared by PDP for TDC dated February 2024.

2.0 Background

2.1 Site Setting

The landfill is situated within a generally north to south trending erosional gully located on top of a river cut terrace approximately 30 m in height. The landfill has experienced loss of waste into the Rangitata River from erosion and instability of the river terrace caused during rainfall events over the past couple of years. Erosion and slope instability of landfill waste within the gully are attributed to stormwater flow through the gully. Larger scale river erosion and river terrace failures have been remediated through modifications to the river morphology and is separate to this scope.

The river terrace comprises well graded river gravels with some rounded cobble to boulder sized greywacke gravels. The river terrace is generally over steepened, over time these terraces regress back to long term slope angles of approximately 45° as can be seen across neighbouring slopes.

From the stormwater perspective the landfill is situated immediately west of the Rangitata River (i.e., 'the Rangitata') on a 30-metre-high river terrace. Stormwater leaving Dennistoun Road flows out to the Rangitata River along a shallow drain immediately north of the landfill and a narrow drain that runs to the west of the landfill before flowing out through the landfill valley area. Surrounding land use is rural with a rural residential property to the north and grazing paddock to the west.

2.2 Work Completed to Date

During the landfill removal works it is proposed to lease land from the neighbouring property to be used as a waste triage area, lead contractor base and remediation support area (hereafter, 'contractor's yard'). A topographical survey has already been carried out by Fox Surveys Limited (August 2023) over the area of land proposed to be used as the contractor’s yard to benchmark the topography of the land before it is disturbed.

An additional topographical survey was completed by Fox Surveys on the 11 September 2023 to validate the LiDAR data and pick up general site details to be utilised in design. The topographical survey and pre-existing digital elevation model (DEM) derived from drone photogrammetry have been combined to generate an updated DEM to aid the design process.

To prevent on-going erosion / instability of the landfill mass and migration into the river, temporary erosion works were completed in December 2022 which included grading / pulling back the landfill mass to for a slope back into the gully. This profile was covered with coconut matting (jute) pinned to the slope and sown with grass seed. In addition, a bund was formed at the crest of the gully slope to divert sheet flow water into a culvert and lay flat hose which is directed down to the riverbank. During these works the shallow drain immediately north of the landfill was infilled to prevent runoff over the river terrace.

Additional details on the background of the site can be found in the PDP DSI report.

3.0 General Design Considerations

The purpose of this assessment is to provide the following design considerations:

Temporary Works

Provide advice on a suitable erosion and sediment control measures during landfill removal works including during construction of the Contractor Yard and diversion of stormwater away from the landfill excavation area.

Provide advice on possible geotechnical risks during the landfill removal.

Permanent Landform

1. Provide recommendations on final landform slope angles from a slope stability perspective once the landfill waste is removed. Slope angles must consider the final landform landscaping agreed with stakeholders and be suitable for landscaping purposes.
2. Provide recommendations on a suitable gully base angle to slope catchment stormwater disposal through the final cleared gully, provision for landform modification through benching with cut or fill into or using natural gravels to reduce the flow velocity and erosion.

4.0 Stormwater Design Intent and Considerations - Landfill

4.1 General

The following gives the stormwater design intent to be followed through landfill removal and formation of the final landform. As the actual thickness / extent of the landfill mass is unconfirmed it is likely there will be some amendments during earthworks as such a final design can’t be provided at this stage.

4.2 Catchment Analysis

To assess sizing of the temporary and permanent surface water controls, the overland flow paths from the upgradient catchment, currently discharging through the landfill site have been evaluated using LiDAR for four different event durations as follows:

- The 1 in 5-year average recurrence interval (ARI) flow is estimated as 0.4 m^3/s.
- The 1 in 10-year ARI flow is estimated as 0.7 m^3/s.
- The 1 in 100-year ARI flow is estimated as 3.5 m^3/s.

- The 1 in 250-year ARI flow is estimated as 4.5 m^3/s.

It is recommended the flows used for the construction phase stormwater temporary works design are in the order of magnitude of the 1 in 10-year ARI. It is recommended that the 100-year ARI flows are used for the design of the final landform surface post construction. If the client would prefer a lower level of risk, the 250-year ARI flow could be considered for design for the final landform.

4.3 Landfill Temporary Stormwater Control

During construction, the upgradient catchment stormwater is proposed to be diverted around the landfill site by installing a suitably sized diversion swale along the western boundary of the landfill site. An indicative location for this diversion swale is shown in Figure 1, attached. At this stage, no changes are proposed to the existing 340 mm internal diameter culvert under Dennistoun Road near the landfill site. The diversion swale is proposed to tie into the existing levels of this culvert. The diversion swale will then discharge into the Rangitata River at a point downstream of the exposed landfill works. The diversion swale and controls will be designed in accordance with Environment Canterbury's (ECan's) Erosion and Sediment Control Toolbox (ESCT).

The diversion pathway from the top of the landfill to the Rangitata River will be stabilised to minimise any erosion. Where required, imported material or a flume will be used. The exact flow pathway will likely change throughout the duration of works due to the nature and location of the remediation works proposed.

It is expected that during prolonged rainfall, localised stormwater flows will form within the landfill excavation area during the works. The following control measures are recommended to control landfill stormwater:

- Exposure of the landfill waste must be minimised as much as practicable with provision for temporary cover of exposed areas where rain is forecast. This temporary cover may include geofabric, anchored with sandbags / rocks or small earth bunds.
- Excavation control so that the working surface is near level and graded back on itself to reduce runoff from the site.

4.4 Permanent Landform Stormwater

The permanent landform is intended to include natural in-situ materials with a base channel to convey most of the stormwater flow. Appropriate rip rap sizing will be included to reduce the effects of erosion along this channel, as well as having grades as shallow as possible to aid with minimising erosion.

Once the landfill remediation is complete, stormwater is proposed to be redirected to its original flow path, through the current landfill area and discharging into the Rangitata River. The landform will be graded and formed such to minimise erosion by reducing the velocity of the stormwater flowing through the gully. Sinuosity will be incorporated into the final design where practicable to further reduce grade on the steeper sections.

5.0 Contractor Yard – Temporary Works

The following outlines preliminary recommendations to be incorporated into the temporary contractor yard development.

5.1 Yard Preparation

It is expected that the topsoil will need to be removed from the temporary contractor yard and temporarily stockpiled in a suitable location or used within the diversion bund construction. A separation layer such as Bidim A29 (or similar) will be placed across the yard after the removal of the topsoil. A running / working surface of imported aggregate should be placed to the contractors' requirements to form a near level platform preferentially graded to promote surface water drainage towards appropriate erosion and sediment control measures.

Depending on post works contamination testing, the imported aggregate may be suitable for re-use or may need to be cut to waste at the end of the landfill operations.

5.2 Stormwater Control

It is expected that the topsoil stripped from the site will be stockpiled and used to create stormwater diversion bunds in accordance with ECan's ESCT to manage and control stormwater from the contractor's yard. These bunds will be grassed to provide treatment of the stormwater.

Stormwater from the contractor yard diversion bunds will be directed to discharge into the temporary landfill diversion swale located on the upper western boundary of the landfill. Indicative bund locations are shown in Figure 1, attached. From here it will mix with the upgradient catchment stormwater and discharge into the Rangitata River (avoiding any open landfill area). The flow path from the top of the landfill to the Rangitata River will be stabilised to reduce erosion.

The bund sizing will be in general accordance with ECan's ESCT. Any bunds shall have a maximum side slope of 1V:3H and be compacted with an excavator bucket and grassed. The exact dimensions of the bund will be designed once the area of the contractors' yard is confirmed.

Following project completion, the topsoil from these bunds may be suitable for respreading across the site, subject to contamination suitability testing.

6.0 Final Landform Intent

To date the landfill sub-surface profile has only been confirmed using Ground Penetrating Radar (GPR) which can be in extremely variable. As such there needs to be flexibility in the earthworks required to complete the final landform after removal of the landfill waste. As such the following are general recommendations to be incorporated into form the final landform:

- All landfill waste must be removed as per the RAP with temporary stormwater control measures discussed in Section 4.3 implemented.
- All cut batters into natural gravels must not exceed a gradient of 2.5 horizontal to 1 vertical or a slope angle of 23°. This is to ensure topsoil retention for the landscaping.
- The crest line of all cut batters must be within the landfill cadastral boundaries, a 4 m wide access strip must be allowed for between the northern boundary and the crest of the slope.
- The final landform within the landfill must promote all surface water flow towards the central gully for discharge to the Rangitata River.
- The base angle of the central gully must be such to reduce flow velocity and subsequent surface erosion and discharge of sediment to the river.
- It is expected that the gully channel will disperse directly over the edge of the existing terrace and into the loose gravel material already at the toe. It is probable that in an extreme flood or multiple floods that the toe material will be excavated but prior to this potentially occurring, the toe material will add some initial protection to the terrace.
- Fill will be sourced from natural river gravels cut during the earthworks, assuming the results of contamination testing indicate this material is suitable to remain on site. This material must be stockpiled and placed as outlined in Section 7.0.

- Topsoil should be placed in discrete areas where planting will take place as per the landscaping plan. It is not recommended to place topsoil across the entirety of exposed slopes or within stormwater flow paths within the gully floor.

7.0 Earthworks Specification Recommendations

7.1 General Requirements

The handling and disposal of all identified landfill material is covered in the PDP RAP. These earthwork specifications are only for the cutting into natural river gravel and placing of fill.

Erosion, sediment, and dust control is excluded from this specification, the RAP should be referred to.

The earthworks specification is not fully in accordance with NZS4431:2022 and is not suitable for building on. The purpose of this specification is to ensure the formation of a stable fill area.

7.2 Excavation

It is anticipated that approximately 18,000 m^3 (in situ) of waste could be excavated and removed from the landfill. This does not include an over dig into natural soils impacted by leaching (potentially up to 5,000 m^3). The extent and volumes of excavation is dependent on the actual depth of the landfill waste. The RAP is considered the leading document to guide controls that should be implemented as the landfill waste is being removed.

The existing temporary slope protection measures should be kept in place as long as possible during the earthworks.

Cut areas shall be progressively excavated to form a uniformly graded surface within the batter limits as directed by PDP. The Contractor shall form the excavations in a logical and orderly manner to minimise wastage and ensure safe stable temporary cut batters within the landfill mass and natural ground cuts.

Any unexpected variations in material types, evidence of slope instability, buried vegetation, groundwater flows, or seepages should be immediately reported to the PDP Engineer.

7.3 Cut to Fill – Natural River Gravels

Excavation shall be by excavator and truck operations, planned and managed to the Engineer’s approval such as to maximise the extraction and separation volumes of the various material types. The natural river terrace between the landfill mass and the river must be preserved, i.e. cuts into the natural gravels must be kept to a minimal. The direction and extent of earthworks cuts must be approved by the supervising engineer to ensure no effects on neighbouring properties during cutting.

The Contractor shall undertake continuous visual inspections of materials and shall immediately report to the Engineer any visual changes, slope movement or groundwater that affects the borrow source.

Temporary stockpiles of natural gravels to be used as fill must be kept at least 3 m away from the crestlines of the river terrace and working slopes.

7.4 Spreading of Fill

Prior to compaction, the fill materials shall be spread uniformly in horizontal layers not exceeding 300 mm uncompacted thickness.

To ensure adequate compaction of the materials forming the final fill surface profile, all fill batter faces shall be overfilled as necessary and carefully trimmed back to the required design profile.

7.5 Benching

Where fill abuts sloping ground with a gradient steeper than 1V:4H, the ground being filled shall be benched into for a sufficient distance so that the vertical height of the bench is at least twice the thickness of the compacted fill layer.

7.6 Compaction

The Contractor shall employ sufficient dedicated compaction plant so as to achieve the specified compaction. Compaction plant shall cover the entire area of each layer of fill and give each layer a uniform degree of compactive effort. The combined operations of spreading and compacting shall be undertaken using systematic and properly managed procedures, to the Engineer's approval, so as to ensure that each loose layer receives the required passes of the roller or other approved compaction equipment before further loose material is spread.

7.7 Compaction standards and testing

The tests and testing frequency described and defined in Sections 7.8 and 7.9 will be used to confirm that the placed fill materials meet the required standard, design criteria and parameter values. At any time either prior to or during construction, the Engineer may direct modifications to the compaction standards, frequencies and test methods defined in this Section with the object of ensuring that the design criteria and objectives for the materials and conditions encountered, are achieved.

A compaction trial should be considered to provide a method specification for the compaction of the cut gravels.

7.8 Compacted Fill Acceptance Criteria

The following is acceptance criteria for placed compacted fill:

- The number of blows per 100 mm to drive the Scala penetrometer from a depth of 100 to 300 mm below the fill surface shall be not less than five when carried out to NZS 4402:1986, Test 6.5.2.
- The average Clegg Impact Value from a Clegg Impact Test completed in accordance with ASTM D5874-95 shall not be less than 25.

The base of any excavation prepared for filling shall also be compacted to the relevant standards specified above for fill. If this surface fails the above criteria or contains organic or other unsuitable material as defined by the Engineer, undercutting to a depth specified by the Engineer shall be required.

7.9 Frequency of testing

The frequency of testing shall be as described below and is the minimum considered acceptable. Additional tests and/or changes to the testing frequency may be instructed by the Engineer as the works proceed.

Should any test result fail to meet the required design criteria, the Contractor shall propose remedial measures for the Engineer's approval. Such measures are expected to usually comprise the removal, replacement and satisfactory retesting of any fill within the agreed area of influence of the failed test location.

The minimum required frequency of testing is:

- Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) – heavy compaction, one (1) initial test for each material type and then one (1) test per 5,000 m^3 for that material type.
- Clegg Impact Value, Hardfill compaction, One (1) test per 20 m^2 per 200 mm layer.

The Contractor shall re-work and re-compact areas disturbed by any testing undertaken within the site, to the Engineer's approval.

7.10 Shaping & Topsoiling

The finished shape of the earthworks shall be determined during the earthworks to the intent given in this document or as instructed by the Engineer. The earthworks profiles shall generally be trimmed to match and blend with adjacent sections of undisturbed existing ground.

Topsoiling shall be in accordance with the final landscaping plan to be provided by TDC / AECL, although topsoil shouldn't be placed within the expected drainage pathways.

7.11 Inspections and approvals

The following earthworks inspections are required throughout the construction works.

- Inspection of the temporary stormwater control measures.
- Inspections during landfill removal as outlined in the RAP.
- Inspection of the striped landfill waste when natural gravels are exposed.
- Inspection of benching as required prior to fill placement.
- Inspection to inform the final cut / fill landform.

The frequency of inspections is dependent on the final earthworks programme.

8.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Timaru District Council. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Timaru District Council**.** for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Yours faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared & approved by	Reviewed by
Andrew Smith	**Ingrid Cooper**
Technical Director – Geotechnics	Service Leader - Water Infrastructure

FIGURE 1: PEEL FOREST LANDFILL

GENERIC ESC MEASURES

NOTES:
1. AERIAL IMAGERY SOURCED FROM THE LINZ DATA SERVICE [https://data.linz.govt.nz] AND LICENCED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.

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REVISION: 01 | DATE: 18/12/23 | BY: DT
CLIENT: TDC

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Appendix F: Remedial Action Plan

Remedial Action Plan – Peel Forest Closed Landfill, Dennistoun Road, Peel Forest

Prepared for

Timaru District Council

April 2024

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solutions for your environment

Quality Control Sheet

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DOCUMENT CONTRIBUTORS

Prepared by

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Reviewed by

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Approved by

Scott Wilson

Limitations:

This Remedial Action Plan (RAP) has been prepared on the basis of information provided by Timaru District Council (and others not directly contracted by PDP for the work). PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the RAP. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This RAP has been prepared by PDP on the specific instructions of Timaru District Council for the limited purposes described in the RAP. PDP accepts no liability if the RAP is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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Acronyms

ACM	Asbestos containing material
AFM	Airborne fibre monitoring
ARCP	Asbestos Removal Control Plan
COCs	Contaminants of concern
DMMP	Dust Management and Monitoring Plan
DSI	Detailed Site Investigation
ECan	Environment Canterbury
LARC	Licensed Asbestos Removal Contractor
LEL	Lower explosive limit
LFG	Landfill gas
LWRP	Land and Water Regional Plan
m bgl	Metres below ground level
MfE	Ministry for the Environment
OCP	Organochlorine pesticides
PACM	Presumed asbestos containing material
PAH	Polycyclic aromatic hydrocarbons
PDP	Pattle Delamore Partners Limited
PPE	Personal protective equipment
NESCS	*Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011*
RAP	Remedial Action Plan
ROA	Remedial Options Assessment
SQEP	Suitably Qualified and Experienced Practitioner
TCLP	Toxicity Characteristic Leaching Procedure
TDC	Timaru District Council
TPH	Total petroleum hydrocarbons
TSRC	Target Soil Remedial Criteria
VENM	Virgin Excavated Natural Material

1.0 Introduction

Pattle Delamore Partners Limited (PDP) has been engaged by Timaru District Council (TDC) to prepare a Remedial Action Plan (RAP) for the remediation of the Peel Forest Closed Landfill (also referred to as the Dennistoun Road Landfill) located at the eastern end of Dennistoun Road, Peel Forest (i.e., 'the site' or 'the landfill'). The landfill is accessed via Dennistoun Road from Peel Forest Road. The location of the landfill, key features, and the immediate surroundings are shown in Figure 1, Appendix A.

The landfill, which is currently vacant, covers an estimated total area of 5,025 m^2. This is comprised of 'the main landfill area' (3,420 m^2) and 'the gully area' (1,605 m^2). Multiple flood events in the Rangitata River between 2019 and 2023 caused erosion of the terrace toe resulting in instability of the terrace and subsequent and ongoing collapse of the 30 m high terrace in which the landfill is located. This has resulted in landfill waste becoming exposed on the face of the terrace in the area of the gully with some waste falling onto the riverbed below. The most significant flood flow event of the past several years occurred in early December 2019 with what was considered a 1 in 20-year event generating a peak flow of 2,300 m^3/s; however, other events (e.g., July and August 2022) and overland stormwater flow through the gully area have also resulted in additional terrace edge erosion, exposing more waste and resulting in additional waste material falling onto the riverbed.

Emergency interim remediation and stabilisation works have been undertaken to reduce the immediate threat of the potential loss of additional waste materials into the Rangitata River and/or riverbed, however, these are only temporary mitigative measures and could still be overcome by future flood/rainfall events. These include pulling the waste back from the eroding edge as well as river engineering works to stabilise the terrace toe and redirecting the river flow away from the terrace. A remedial options assessment (ROA) prepared by PDP (2023b) has identified the preferred remedial option for the landfill to be 'Complete Removal of Landfill Body'. This option eliminates the long term liability of the landfill being exposed by future flood events, particularly given the powerful and dynamic nature of the Rangitata River and unpredictability of when the next flood event may occur.

This RAP details the general methodology and controls requirements for the excavation, handling and off-site disposal of landfill materials (including consideration for protection of human health), as well as reinstatement principles and concepts.

2.0 Background

The site was used as a municipal landfill from c.1962 to 2004 and received waste from the local and surrounding settlements. Historical aerial images from the 1960s suggest landfilling originally occurred on top of the terrace, before starting to fill the original gully that existed in the area. Over time waste appears to have been pushed further down the gully with some waste rolling/extending down the gully a considerable distance. Since the landfill closure, the site has been used for grazing horses (up until 2020). The gully area has remained disused and overgrown. The main landfill area, which includes a portion of the turnaround and parking area at the end of Dennistoun Road, sits on a 30 m high terrace of the Rangitata River (i.e., the Rangitata).

The site is fenced along the western extent from the northern to southern boundary. Entry into the site is gained through a gate in the northwestern corner. Fencing once present along the eastern boundary of the main landfill area has been compromised by land erosion.

Interpretation of the geophysical survey carried out at the main landfill area by Southern Geophysical (2021)[1] indicates that landfill waste could range in depth from 6 to 9 metres below ground level (m bgl) over the main landfill area. The thickness of waste further down the gully was found to range from a shallow layer to meters thick in places. An engineered landfill final cover is not known to have been placed when the landfill was closed.

The slope of the main landfill area naturally grades towards the gully area, and surface water from storm events preferentially flows out to the Rangitata via the gully. The gully was likely originally formed associated with erosion from surface water runoff from the wider catchment being directed to this area. Stormwater from the wider catchment continues to be directed towards and down the gully, passing through a shallow drain on the southern side of the main body of the landfill and through a temporary stormwater control system down the gully. The site details and setting are described under Section 4.0.

Significant Rangitata River flood flow events over recent years have resulted in terrace slope failures that have exposed landfill waste along the eastern edge of the main landfill and gully areas. As a result, some of the landfill waste has been released into the Rangitata riverbed. Emergency interim remedial works have pulled the exposed waste back from the gully edge in the terrace and stabilised the gully area, however, some waste material remains on the riverbed within the 'fall' debris zone. This debris is currently adding some stability to the terrace wall so has been left in place but contains some waste material (intermixed with natural soils) and could be quickly eroded during a flood event. Emergency river engineering works to redirect the river and the construction of an embankment were also completed to reduce the immediate threat of the potential loss of the main body of the landfill during future river flood flow events. The emergency interim remediation and stabilisation works are only temporary mitigative measures and could still be overcome by significant future flood and/or rainfall events.

To prevent further and potentially more significant impacts to the Rangitata River and associated users and ecosystem, TDC intends to excavate and remove the landfill waste. Based on current estimates, the landfill body is comprised of approximately

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[1] *Geophysical Investigations 105 Dennistoun Rd, Peel Forest, Canterbury* (Southern Geophysical Ltd., 2021)

18,000 m^3 (in situ) of waste, the majority of which will require off-site disposal to a Class 1 landfill facility (i.e., Redruth Landfill, in this instance).

PDP has carried out landfill waste characterisation and testing at the site between 2019 and 2023 (summarised in Section 6.0). Full details are included in the Detailed Site Investigation (DSI) report (PDP, 2023a). Key findings are that the landfill has a thin (<0.1 m) cover layer and, where bottomed, was not observed to be lined. Waste material included timber, plastic, metal, textiles, building materials and animal bones.

Analysis of the soil matrix component of the landfill identified heavy metals, organochlorine pesticides (OCPs) and total petroleum hydrocarbons (TPH) variously above background levels and Australian and New Zealand Guidelines (ANZG, 2018) default sediment guidelines. Asbestos has been recorded at concentrations exceeding the ALGA (2017)[2] guideline criteria for all land uses. There is no appreciable landfill gas (LFG) generation and leachate does not appear to be significantly affecting groundwater quality beneath the site.

The RAP (**which includes site management procedures**) has been prepared to define the remedial goals as well as outlining the general methodology for the remedial works including the required controls and protocols for the appropriate handling and management of contaminated soils and waste materials during the remediation of the landfill. These management protocols and processes will aid in mitigating potential risks from the landfill waste to human health (i.e., the exposure of remediation personnel and neighbours) and the receiving environment (e.g., via off-site transport of contaminants and waste entrained in dust or stormwater discharges). Additionally, the RAP has been prepared to support obtaining the applicable resource consents required to permit the work in accordance with the relevant regulatory planning frameworks with consideration for resource consents governed by TDC and Environment Canterbury (ECan).

3.0 Roles and Responsibilities

The RAP provides guidance to parties involved in remediation enabling works, remediation earthworks, and post-remediation site reinstatement works, with regard to the intended methodology for the excavation and removal of the landfill waste. It is intended to assist TDC in meeting their legal obligations with respect to health, safety and the environment. However, it is not intended to cover the general site safety procedures required for a typical excavation site. The RAP does not relieve the owner of their legal responsibilities. While this RAP specifically relates to the management of identified contaminated soils and landfill waste, **the lead contractor undertaking the excavation works will need to develop a site-specific health and safety plan (HASP) to supplement this RAP**. **The Licensed Asbestos Removal Contractor (LARC) will also need to prepare an Asbestos Removal Control Plan (ARCP)** since asbestos results from the landfill have triggered Class B licensed asbestos work as per Figure 1 of the ALGA (2017) asbestos guidelines.

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[2] *New Zealand Guidelines for Assessing and Managing Asbestos in Soil* (ALGA Ltd, 2017).

The lead contractor and LARC will be confirmed (by a limited tender process) after the relevant resource consents have been obtained.

3.1 Contact Details

Table 1 below outlines the various organisations and their responsibilities in the context of this RAP. It also provides relevant contact numbers to ensure clear lines of communication are possible. This table will be updated as information becomes available:

Table 1: Roles and Contact Details

Role	Name (organisation)	Contact Number
Site Owner, Occupier and Interested Parties		
Site Owner: LINZ	Annie Timms (LINZ)	021 215 4675
Site Lessee: TDC	Jacky Clarke (TDC)	03 687 7258
Local Iwi/Cultural Consultants	Te Rūnanga o Arowhenua/ Aoraki Environmental Consultancy	03 684 8723
Remedial Works Contractors		
Lead Contractor/Site Supervisor	TBC	TBC
Site Health & Safety Officer	TBC	TBC
Asbestos Removal Contractor	TBC	TBC
Compliance Monitors		
Regional Council Compliance Monitor	TBC	03 687 7800
Timaru District Council Compliance Monitor	TBC	03 687 7200
Environmental Consultants		
Suitably Qualified and Experienced Practitioner (Contaminated Land)	Rowan Freeman / Scott Wilson (PDP)	021 955 429 / 021 215 5414
Geotechnical Engineer/Final Landfill Design and Stability	Andrew Smith (PDP)	021 918 507
Senior Environmental/Engineering Geologist (Site Health & Safety, and Supervision)	Lucy Duffus (PDP) / Jason Grieve (PDP)	021 524 189 / 021 425 056

3.2 Responsibilities

In terms of day-to-day activities relating to the management of the remediation programme, the lead contractor and the SQEP will primarily be involved but will coordinate with TDC and Te Rūnanga o Arowhenua/Aoraki Environmental Consultancy Limited and other relevant subcontractors or experts (e.g., the LARC, the analytical laboratory, etc.) required for progression of the remediation work.

TDC is responsible for:

- Gaining approvals from neighbouring property owners for access to their land to support undertaking of remediation activities as required. This includes land for the establishment of a contractor's yard (i.e., for a waste triage area, lead contractor base, and remediation support areas) and for access to the toe of the terrace (e.g., use of the graded track located in the residential property to the north access the riverbed).
- Liaising with project partners (e.g., Te Rūnanga o Arowhenua and LINZ) and other interested parties/stakeholders as necessary to provide information on the progress of the remedial works and get input on any required change in methodology.
- Establishing media communication protocols and relaying these to the Lead Contractor and the SQEP.
- Any roading improvements and traffic management requirements (i.e., speed limits, road signage, etc.) beyond the remedial area relating to the increased traffic volumes for the transport of material to and from the site.

The **Lead Contractor** is responsible for:

- Liaising with the SQEP, geotechnical engineer and TDC as remediation work progresses.
- Adhering to health, safety, and environmental protection requirements outlined in this RAP over the course of the remediation.
- Day to day site control and overarching health and safety for the protection of site workers.
- Excavation, handling and disposal of the landfill waste in accordance with this RAP, with oversight by the LARC and SQEP.
- The implementation, management and monitoring of the stormwater redirection design, erosion, sediment and dust control systems and associated discharges. This includes sourcing water for dust suppression, equipment and plant, and personnel decontamination.
- Setup, maintenance, and decommissioning of the contractor's yard.
- Monitoring the weather forecast to identify any possible Rangitata River flood/erosion events, which, if identified, could result in remedial works being put on hold until the event has passed and the SQEP and geotechnical

engineer have completed an assessment of the terrace and any exposed and/or released landfill waste.

- Monitoring road conditions during the remedial works and, where necessary, arranging with TDC for the regrading of gravel roads approaching the site likely to be affected by increased truck movements.
- Regular inspections of the Rangitata riverbed and, as far as practicable, retrieval of any waste debris lost over the terrace edge during remedial works.
- Monitoring and record keeping throughout the duration of the works, including maintaining and ultimately providing records of waste disposal to the SQEP.
- Ensuring that their equipment is in good working order ahead of each workday with no oil/hydraulic fluid leaks etc.
- Implementing spill response procedures in the event of a spillage of hazardous substances.
- Maintaining regular contact with the SQEP over the duration of the remediation works, including communicating any foreseeable delays or interruptions that may adversely impact progress of the remedial works.
- Site reinstatement in accordance with site rehabilitation design specifications.

The **Licenced Asbestos Removal Contractor (<u>who can be the lead contractor or be engaged by the Lead Contractor</u>)** is responsible for:

- Preparation and maintenance of the ARCP.
- Establishment and control of the asbestos control zone areas.
- Notification requirements to WorkSafe New Zealand.
- Implementation and management of all asbestos control measures during the disturbance of asbestos contaminated soils.
- Implementation and management of designated asbestos decontamination zones.
- Management and disposal of asbestos contaminated personal protective equipment (PPE) used by workers within the asbestos zones.
- Notifications to neighbouring properties, where required (**with prior TDC and SQEP consultation**).

The **SQEP (PDP)** is responsible for:

- Liaising with key project partners, TDC, the lead contractor and the LARC, as required.

- Providing regular (e.g., weekly) project status reports to TDC regarding the progress of the remediation in terms of timeframes, milestones, any unforeseen significant costs, and potential setbacks.
- Undertaking and benchmarking/validation sampling over the duration of the remedial works.
- Determination of suitable offsite disposal locations for the landfill waste material and obtaining the appropriate disposal documentation, other than those addressed in this Plan.
- Provide general oversight of the site controls and management practices for compliance with the RAP.
- Provide general contaminated land advice, including carrying out all soil quality testing and management requirements for any other unexpected contamination encountered during earthworks (i.e., accidental contamination discovery).
- Provide advice to the lead contractor following any Rangitata River flood event that may occur during the remedial works.
- Coordinate the implementation and oversight of the fibre air monitoring programme during soil disturbance activities.
- Updates to the RAP as/if needed.

3.3 Distribution and Implementation

A copy of the RAP will be distributed to all key project partners identified in Table 1 of the RAP. A copy of this RAP shall be kept on site at all times. **It is the responsibility of the lead contractor to distribute RAP information to any sub-contractors and personnel entering the site and ensure compliance**. The provisions of this RAP are mandatory for all persons (employees, contractors, and sub-contractors) who enter the site while earthworks associated with the remediation are underway.

3.4 Applicability

This RAP has been prepared for the sole use of TDC to guide remediation earthworks management and to comply with all applicable resource consents required to permit the work at the landfill and contractor’s yard only.

The RAP is a living document, subject to updates and adjustments (to be implemented by the SQEP, with input from project stakeholders (i.e., project partners) in response to project needs). The RAP will only apply over the course of the remediation project (i.e., from commencement of contractor’s yard enabling works to the point of site rehabilitation) and is site-specific (i.e., not transferrable to any other site). For clarity, the RAP covers the following areas:

- The main landfill area,
- The gully area,

- The toe of the terrace beneath the landfill on the bed of the Rangitata River,
- Private land (west) – designated contractor's yard,
- Private land (north) – adjacent land and access point for riverbed, and
- The gravel section of Dennistoun Road.

The RAP does not cover any roading upgrades or traffic management related works on the sealed roads between the site and the disposal facility. This is being co-ordinated directly by TDC, however, there will be communication between the Lead Contractor and TDC traffic management team during the works to ensure any issues are identified and resolved quickly.

3.5 Pre-Start Toolbox Meeting

Prior to the commencement of any remedial works at the site, a toolbox meeting will be held onsite between the SQEP, lead contractor and LARC. It is possible that other project partners (e.g., TDC, Aoraki Environmental Consultancy/Te Rūnanga o Arowhenua, ECan, etc.) would also like to attend. The purpose of the toolbox meeting will be to clarify the following for all attending the site:

- Confirmation that all parties on-site understand the objectives of the RAP and remedial excavation works. Confirmation all parties on-site understand the objectives of the Erosion Sediment Control Plan (to be prepared in consultation with the Lead Contractor) and the Dust Management and Monitoring Plan (i.e., DMMP; refer to Section 11.3)
- Provide an overview of the risks and requirements for all parties involved with the implementation of the RAP;
- Site security, media and public communication protocols;
- Accidental Discovery Protocol and accidental discharges of contaminants to the environment over the course of the remediation; and
- Field any subsequent questions relating to appropriate environmental management of the earthworks/site development works.

In addition to the above, the LARC will discuss the contents of the ARCP, particularly the set out of the asbestos work zone, decontamination procedures and health and safety controls.

3.6 Review and Update

The RAP will be reviewed and amended as necessary during the remedial works to ensure the environmental and human health risks associated with asbestos/contaminated soils and waste materials are managed appropriately. Any amendments to the RAP are to be approved by the SQEP prior to the implementation of updates. The updated version of the RAP shall be made available to all relevant parties/project partners as required by relevant consent conditions.

4.0 Site Details and Setting

The site details are presented in Table 2 below.

Table 2: Site Details

Address	East end of Dennistoun Road, Peel Forest, Timaru
Legal Description	Crown Land (under action) Survey Office Plan 3144
Land Owner	Land Information New Zealand (LINZ)
Land Lessee	Timaru District Council
Other Interested Parties	Te Rūnanga o Arowhenua/Aoraki Environmental Consultancy, Environment Canterbury (ECan), Department of Conservation (DOC), Peel Forest Community, Rangitata River Restoration Group
Landfill Area	Approx. 5,025 m^2 (0.5 ha)
Zoning	Rural Zone
Grid Reference	BY19: 6115-3626
Current Land Use	**Main landfill area** – Vacant, hummocky paddock under grass and weeds (Previously used for grazing horses). Western most edge includes a compacted gravel turning circle at the eastern end of Dennistoun Road. **Gully area** – Vacant, downward sloping topography. Interim remedial works have included armouring of the lower gully area face and terrace edge with boulders and the installation of BioCoir coconut matting across the full gully slope which was then seeded with a ryegrass and clover pasture mix. Stormwater from the main landfill area and also the wider catchment drain is directed to a bunded area which drains through culvert with a lay flat hose discharging water directly into the riverbed (i.e. to avoid overland flow erosion effects on the steeper gully section). These temporary stormwater controls were recently installed to reduce the erosion effects on the gully edge from overland stormwater flow.
Surrounding Land Use	Rural Residential –to the north of the site and Dennistoun Road with a livestock grazing paddock located to the west and south. The Rangitata Riverbed bounds the site to the east.

5.0 Regulatory Context

The proposal to remove the waste from the landfill will require an integrated suite of resource consents from TDC and ECan as laid out below.

5.1 NESCS[3]

Remediation and reinstatement of the landfill site will require significant soil/waste disturbance, off-site disposal of contaminated soil and landfill waste, and the importation of clean material for reinstatement. The overall volume of ground disturbance will significantly exceed NESCS triggers (i.e., no more than 25 m^3 per 500 m^2 is disturbed, soil removal and no more than 5 m^3 per 500 m^2 is removed from the site per year). Given the presence of contaminant levels above human health criteria, the proposed soil disturbance works and offsite disposal of hardfill material and soil material falls under a **Restricted Discretionary Activity** (as per Regulation 10(3) of the NESCS).

5.2 Timaru District Plan

A land use consent will be required from the Timaru DC for the development of a temporary contractor's yard in a rural zone, and for earthworks in an area of special interest to Māori.

5.3 Canterbury Land and Water Regional Plan (LWRP)

A discharge consent for construction phase stormwater is required from ECan as well as two land use consents for the excavation in proximity of a river and over an unconfined or semi unconfined aquifer.

6.0 Summary of Previous Site Works/Investigations

The RAP has been informed by previous work and investigations carried out at the landfill. For a comprehensive account, reference should be made to the PDP (2023a) DSI report (attached to the resource consent application and Assessment of Environmental Effects; AEE).

A summary of the key information obtained during the investigation works is as follows:

- A geophysical survey of the landfill indicated the waste was up to 9 m deep within the filled gully area. The total volume of waste was estimated at 18,000 m^3 (in situ). This excludes the waste on the riverbed within the 'fall' debris zone. This is an estimate only as excavation to the base of the waste was not possible in all areas given the unknown nature of the original methodology of forming/placing the waste (i.e. to avoid breaching a containment layer that may be present)
- The groundwater table has been measured between 24.6 and 25.9 m below ground level (bgl) indicating there is at least 15 m of natural soils between the base of the landfill and groundwater table. Groundwater sampling showed no definitive or obvious evidence of leachate impacts in groundwater beneath the site.

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[3] *Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011*.

- A series of shallow test pits were excavated within and around the landfill to aid with the delineation and enable the waste to be characterised. A summary is as follows:
  - A thin cover layer (generally <0.1 m) was observed above the majority of the landfill.
  - The landfill did not appear to be lined, although there were discrete layers of low permeability soils, however, this is likely associated with disposal of material or interim cover as opposed to any direct engineering (i.e., lining) consideration. Test pits in the deepest areas of waste were not possible.
  - Localised perched water was noted entering a test pit at 1.7 m depth. Installation of shallow bores within four of the test pits showed no evidence of any water/leachate when inspected approximately 1 week later.
  - The materials encountered can be divided into 'Cover' (either a thin layer of topsoil or discontinuous layer of sandy gravel); 'Waste Mixture' (a high proportion of anthropogenic waste in a soil matrix); 'Soil-Waste Mixture' (soil with some fragments of waste materials); and 'Visibly Clean Soils'. The proportion of soil in the landfill waste varied between test locations but was the predominant fraction (i.e., accounting for between 54 and 91% of the waste) in all cases.
  - The waste types observed included **Timber** (including fence posts, branches, tree trunks, woodchip, sawdust), **Plastic** (including bale/silage wrap, food and drink containers, netting), **Metal** (including wire, vehicle parts), **Textiles** (including old clothing, rags and shoes, rope, netting), **Building materials** (concrete, brick, asbestos containing fibre cement sheet), and **Animal bones** (a few observed in each screened test hole). The dominant waste type (excluding soil) was plastic in most test pits (up to 76%), with high levels of timber (up to 46%) and metals (up to 25%) also observed.
  - A metal vehicle fuel tank was observed in one location; however, no other large chemical containers were encountered.
  - The surface Cover material showed concentrations below the residential/recreational guideline criteria (i.e., suitable for the current land use).
  - The Waste Mixture and Soil-Waste Mixture material showed the highest concentrations of contaminants with heavy metals, organochlorine pesticides and total petroleum hydrocarbons being recorded above background levels and ANZG (2018) default sediment guidelines.
  - Heavy metals were recorded above the Redruth Landfill screening criteria with zinc also recorded above the Toxicity Characteristic Leaching Procedure (TCLP) leachability criteria. This appears to be an isolated

occurrence with the majority of the samples showing acceptable concentrations for disposal at Redruth Landfill.

  - Asbestos was detected (i.e., within the Waste Mixture only) at concentrations up to 0.01828% w/w and above the recreational land use criteria. Sampling did not necessarily show the presence of asbestos fibres in the soil matrix at all locations tested, however, ACM fragments were visually detected in the majority of the test pits suggesting asbestos was generally present throughout. Asbestos will therefore be the driver for controls around the handling and disposal of the waste/soils.
  - Trial screening successfully segregated bulk waste material using a 25 mm screen, however, waste sorting and finding a suitable reuse/recycling point may prove difficult given the waste was ‘dirty’ and would likely need to be cleaned. The potential for asbestos fibres to be present on the waste material adds further complication for handling and disposal. Items such as large boulders or other smooth surfaces could be cleaned and reused onsite and will be considered during any remedial excavation works.
  - Sampling of the underlying natural soils was limited to three locations and did not include the deepest areas of waste. Results indicate that some degree of leaching has occurred, although does not appear to be widespread or significant and limited to <1 m below the waste. If an additional 1 m of soil was removed from beneath the waste, this would add an additional 5,000 m^3 to the total volume of material to be excavated.

- LFG monitoring within the shallow bores installed within the selected test pits showed generally low levels of LFG and no flow rate (pressure). The two monitoring bores drilled to 25.8 m and 32 m bgl in natural soils between the landfill and river terrace showed no methane was detected; however, carbon dioxide was recorded up to 4.0%. The low-level readings are not unexpected given the age of the landfill and support the observations of minimal organic material in the waste.

Based on the results of the soil sampling, the Waste Mixture would need to be disposed of at a landfill authorised to receive this level of contaminated soils as “special waste”. Some soils, in particular the soils underlying the waste that may need to be excavated to meet remedial goals, may be suitable for disposal at a managed fill facility.

Note – to date, test pits have not been advanced into the vehicle turning area (outside the wooden fence on the northwest end of the landfill) which has also been identified as part of the landfill. Landfill waste within this area could be between 1 to 4 metres thick based on geophysical data and is expected to be comprised of a similar make-up as the waste previously observed in test pits elsewhere on the landfill.

A risk assessment for the landfill in its current state shows that the risks to human health and the environment is either incomplete or considered to be currently low. This is because the site is currently unused and is likely to remain so in the near to distant future, a cover (albeit thin) manages the current risk of direct contact with contaminants in the waste, there is no appreciable LFG generation and leachate does not appear to be significantly affecting groundwater quality beneath the site. However, this risk assessment assumes that the landfill will remain in its current state. The vulnerability of the landfill to erosion means that this is unlikely and the potential for landfill waste exposure as a result of future rainfall/flood events is high and cannot be reliably predicted. Depending on the severity of the rainfall/flood event, this could have catastrophic effects to human health and environmental receptors if the main body of the landfill is exposed and falls into the river. The vulnerability of the landfill to erosion is therefore the driver to mitigating the risks identified for this landfill. As reported in the ROA, the reliability of river protection works is low due to the dynamic and powerful nature of this section of the Rangitata River. Therefore, removal of the landfill waste was the preferred approach to manage the risks identified.

7.0 Purpose and Objectives

This RAP (**which includes earthworks site management procedures**) has been prepared to guide the appropriate management of remedial earthworks at the site and to provide supporting information for relevant resource consent required to permit the work (i.e., under the NESCS and the CLWRP). It also includes Target Soil Remedial Criteria (TSRC; refer to Appendix B) that are to demonstrate the satisfactory remediation of contaminant concentrations within soils remaining in situ following the remedial earthworks.

Note – Dust Management Plans and Erosion, Sediment and Stormwater Management Plans will be prepared separately and later appended as addenda to the RAP (subject to resource consent conditions).

The RAP should be read in conjunction with the resource consent application documents (including accompanying AEE documents).

The RAP sets out and/or provides references for the following procedures:

- Establishment and decommissioning of the site to support the remediation work, including an area immediately west of the landfill that will be leased for use as the ‘contractor’s yard’;
- Methodology for the remedial excavation, handling (including segregation) and disposal of the landfill waste;
- Appropriate management of soils/waste to ensure the protection of site workers and the general public during the disturbance activities;
- Mitigation of dust, sediment and stormwater run-off generated over the period of the remedial works;

- Air monitoring (i.e., for airborne asbestos, odour, dust, etc.);
- Soil quality benchmarking and validation sampling;
- Protocols for accidental discovery of contamination including known or unknown/unexpected contamination types, unexpected volumes, and complex presentations (e.g., ruptured, or intact, unmarked, or marked chemical containers);
- Health and safety to supplement the contractor's health and safety plans for the landfill waste disturbance and removal activities;
- Appropriate off-site disposal and associated documentation;
- Reinstatement principles and concepts; and
- Remediation completion documentation and reporting.

This RAP has been prepared in general accordance with the Ministry for the Environment (MfE) *Contaminated Land Management Guidelines No. 1: Reporting on Contaminated Sites in New Zealand (Revised 2021)* (MfE, 2021a) (CLMG No. 1) and has been informed by the findings of the PDP (2023a) DSI and the PDP (2023b) Remedial Options Assessment (ROA). The ROA is held by TDC and should be reviewed for full context, in terms of the steps and considerations involved in the ROA process.

The RAP has been reviewed and signed-off by suitably qualified and experienced practitioners (SQEPs) as outlined by the NESCS[4].

8.0 Remedial Targets

Remediation targets dictate the end point at which the landfill site will be considered remediated. In developing the remedial targets for the remediation, two key drivers have been considered:

- **Cultural/Social** - includes consideration for potential human health, environmental ethics and guardianship, and aesthetic impacts.
- **Environmental** - includes consideration for potential impacts to groundwater, surface water, ecology and natural resources/amenities.

The following three remediation goals have been developed to satisfy the key remediation drivers:

Remedial Goal 1 - Visible Waste Removal

To remove all visible waste materials within the main landfill body and gully areas (as far as reasonably practicable). This includes the waste materials mixed within the debris at the toe of the terrace where waste is known to have fallen onto the riverbed.

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[4] *Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.*

It is assumed that the majority if not all of the risks to cultural/social and environmental indicators will be eliminated by achieving this remedial goal.

Note – this remedial target could be limited if there is cause for concern in terms of obvious risks to the physical health and safety of workers undertaking or overseeing the landfill remediation (e.g., risk of sudden land loss).

Remedial Goal 2 – Target Soil Remedial Criteria

A remedial excavation over dig of up to 1 m may be required over parts of the remedial excavation to remove underlying natural soil that has been impacted by contaminant leaching from the landfill waste.

Proposed Target Soil Remedial Criteria (TSRC) have been selected and proposed to be used as the benchmark for satisfactory remediation of contaminants concentrations within soils remaining in-situ. The proposed TSRC were selected after consideration for the receptors (i.e., should waste and contaminants be released from the landfill) as follows:

- Protection of human health – although this land area is not intended to be routinely occupied, it is possible that people could occasionally be present (i.e., general public or maintenance workers).
- Protection of terrestrial biota – includes protection of soil microbes, invertebrates, plants and wildlife.
- Protection of ecological receptors – the remaining soils will continue to be vulnerable to erosion and could be mobilised during future storm and flood events and enter the Rangitata River system.

Based on the key receptors highlighted, the following criteria were considered:

- Background Concentrations - Regional – Intergrade Soil Group (ECan, 2007; MfE, 1998);
- Human Health Soil Contaminant Standards (MfE, 2011a and 2011b; and NEPC, 2013);
- Ecological Soil Guidelines (Landcare Research, 2016 and update 2019); and
- Default Guideline Values for Sediment Quality (ANZG, 2018).

PDP’s memorandum to TDC (27 October 2023) provides the rational and values for the proposed TSRC (refer to Appendix B). The TSRC are presented in Table 3 below.

Table 3: Remedial Soil Targets

Parameter (All parameters in mg/kg unless otherwise stated)		**Proposed Target Soil Remedial Criteria**
Heavy Metals		
Arsenic		**20**
Cadmium		**1.5**
Chromium		**80**
Copper		**65**
Lead		**50**
Nickel		**21**
Zinc		**170**
Organochlorine Pesticides (OCP)		
ΣDDT		**0.431**
Petroleum Hydrocarbons		
Benzo(a)pyrene eq.		**2.8**
Total polycyclic aromatic hydrocarbons (PAHs)		**10**
TPH	C_7-C_9	**280**
	C_{10}-C_{14}	
	C_{15}-C_{36}	
Asbestos		
Asbestos		**No detectable asbestos**
Additional Contaminants		
Should any additional contaminants/contamination sources be encountered during the remedial work, these will be dealt with under the contamination accidental discovery protocol (Section 16.0). Contaminant specific remedial target criteria will be developed as part of this approach.		

In addition to validation testing of the remediated landfill area, testing of the contractor’s yard will be required after it is decommissioned. The trigger levels for comparison of these results will be the higher value of either the Environment Canterbury reference background levels or the maximum concentration obtained during a benchmarking investigation undertaken prior to commencing waste removal activities.

Remedial Goal 3 - Site Reinstatement

Upon completion of the remediation works, the landfill site will be reinstated in accordance with the final design agreed to by the project partners.

The contractor’s yard will be returned to as close to the original state (i.e., gradient, topography, topsoil type, etc.) as is practicable, using topographic survey outputs (obtained in August 2023) as a reference.

9.0 Remedial Methodology

9.1 Phases and Tasks

At a high level the remediation of the landfill will include the following key steps:

- **Contractor’s Yard Definition** – TDC has sought and obtained permission to use private land immediately west of the landfill as a contractor’s yard (for waste stockpiling, sorting/separation, lead contractor office, storage, and restrooms, etc.).

  A topographical survey has already been carried out (August 2023) over the area of land proposed to be used as the contractor’s yard to benchmark the topography of the land before it is disturbed. The topographical survey will be used to guide appropriate reinstatement of the farmland upon completion of remediation works.

  The extent of the area with provisional agreement to be leased for the duration of the remedial works is presented in Figure 2 in Appendix A.

  The layout of the contractor’s yard will be confirmed in consultation with the lead contractor to ensure the space is optimised for efficient waste management during the remedial works. This space will be used as the primary entrance to the remedial work area and will include the administration/office, parking, personnel decontamination areas and waste triage/processing areas.

- **Pre-Remedial Works Soil Benchmarking** – Testing of surface soils at two spatially separate pieces of land (located adjacent to the landfill) will be carried out prior to the commencement of remedial works. The first location is the land situated immediately west of the landfill that will be used as the contractor’s yard (currently used for grazing deer). The second location is the land situated immediately to the north of the landfill that is occupied by a rural/residential dwelling (refer to Section 14 for further details).

  Soil quality benchmarking at both locations is a proactive step by TDC to understand current soil quality ahead of the remedial works, which could inadvertently cause contamination of surficial soils.

The results will serve as a reference for validation testing at both areas at the end of the remedial works. The soil quality testing will be undertaken by the SQEP, who will determine the distribution and frequency of test locations at each of the two pieces of land subject to soil quality benchmarking.

- **Site Establishment** (general methodology only as it may differ slightly following discussions with the contractor once engaged).
  - Removal of the current fencing at the western side of the landfill, and the establishment of new temporary fencing around the extent of the contractor’s yard with scrim/litter fencing signposted with relevant ‘hazards on site’ posters. Fencing will need to be sufficient to keep out livestock which will be grazing the remainder of the paddock to the south and west.
  - Removal of the topsoil from the surface of the contractor’s yard and used to form bunds around the boundary of the yard area. Bunds to be seeded with grass and maintained over the duration of the works. Physical stormwater and ESCP controls will be concurrently installed. Benchmarking of the contractor’s yard will be undertaken at this point (i.e. after the topsoil has been removed). A separation layer such as Bidim A29 (or similar) will be placed across the yard. Cleanfill may need to be imported to create a suitable base for vehicle and plant movements within the contractor’s yard. This will be confirmed in consultation with the geotechnical engineer and the lead contractor. Additional benchmarking may be required depending on the source of the fill material. Additional details of the temporary works are provided in the ‘Peel Forest Landform Design Principles – Geotechnical And Stormwater Management’ letter (Appendix D).
  - Stormwater management controls shall be implemented for site stormwater and to divert catchment wide stormwater through the operational area. These requirements are outlined in the ‘Peel Forest Landform Design Principles – Geotechnical And Stormwater Management’ letter (Appendix D).
  - Site security measures (e.g., fencing and live feed cameras) will be installed (x 2 cameras – one with a view of the contractor’s yard and the second showing the active remediation area). Live feed cameras will be used for security, but also to enable remote monitoring of site conditions by the consultant.
  - Stabilised entry/exit vehicle accessways will be established off Dennistoun Road, ideally at the northwestern corner of the contractor’s yard.

  - Access to the landfill area for plant and/or trucks will be established at the eastern end of the contractor's yard. A pathway for stormwater from the wider catchment will be maintained to allow water pass through the area.
  - Placement of the site office and staff facilities including lunchroom, toilet and handwashing facilities. This will ideally be powered so it is possible to recharge equipment on site, such as personal gas alerts and air monitoring pumps.
  - Water source for dust suppression activities and decontamination of plant (as required) which will be required throughout the remedial works to suppress dust associated with the following sources:
    - the gravelled portion of Dennistoun Road;
    - the contractors yard surface
    - Soil/landfill waste stockpiles
    - truck loading area
    - remedial excavations
    - wheel wash (if required)
    - decontaminating plant (i.e. excavator buckets in contact with asbestos containing waste)
    - Washing down larger boulders/materials for retention on site/offsite disposal.

    NOTE: This may be a water truck(s) however the refill point is to be confirmed as it is unlikely there is one in the immediate vicinity. The time taken for refilling and the likely volume of water required on site will need to be considered.

- In accordance with the Dust Management Plan, installation of a wind speed gauge which will be used to inform the potential need for additional dust mitigation measures.
- Definition of triage areas for temporary stockpiling of material that requires testing to support the final disposal location of the material. The triage areas will need to accommodate multiple stockpiles at times during the works.
- Placement of skips for larger waste items/hazardous waste items.
- Definition of the asbestos work zone and decontamination areas – including a wash down area for plant and facilities for personal decontamination. Asbestos work areas will be established in accordance with ARCP, which is to be prepared by the LARC.
- Completion of roading upgrades and traffic management requirements (outside the scope of this RAP).

- Installation of a noticeboard at a suitable location within the local Peel Forest area to notify the community of progress of the project.
- **Remedial Excavation** – It is anticipated that approximately 18,000 m^3 (in situ) of waste could be excavated and removed from the landfill. This does not include an over dig into natural soils impacted by leaching. The extent of the over dig will be determined by the SQEP in conjunction with the geotechnical engineer and lead contractor, but is anticipated to be <1 m in additional cut depth (approx. 5,000 m^3).

  The specific methodology and heavy machinery used for the excavation and removal of the landfill waste will be defined in consultation with the geotechnical engineer and lead contractor involved in the remedial work. However, the general methodology shall comprise the following:

  - The landfill area is to be broken down into sections so only small manageable areas are open at one point in time.
  - At the completion of the remedial works of the main landfill body and gully areas, an assessment of the removal of the waste intermixed within the debris at the toe of the terrace shall be made in consultation with the geotechnical engineer to determine whether the work can be undertaken safely.
  - Works are to be undertaken in accordance with the controls outlined in this RAP (asbestos, LFG, leachate, dust and erosion and sediment control measures).
  - Removal of vegetation in the area to be remediated. This will include removal of some trees. The above ground portion of the vegetation is considered uncontaminated provided it is segregated appropriately.
  - Excavation and removal of the waste material in a controlled manner with a spotter present at all times to inspect the cut area for signs of hazardous materials/chemicals and implementation of the accidental discovery protocol.
  - All waste/soil is to be treated as containing asbestos unless proven otherwise.
  - Waste material is to be preferably placed directly into the trucks/ bins for disposal, however, given the nature of the site (slopes and uneven surfaces), this may not always be possible and stockpiling and double handling waste may be necessary.
  - Materials that are too large for the waste bins are to be separated and managed in the triage area until a disposal solution is determined.
  - Materials that have the potential to be cleaned and redirected from the landfill waste disposal are to be segregated and stockpiled in the triage area and a cleaning/testing strategy determined in conjunction with the SQEP. This includes smooth surfaced items such as railway irons and

  boulders that have the potential to be easily cleaned and redirected from the landfill waste stream.

  - Soils that have no or very little visible waste is to be segregated and stockpiled in the triage area for testing and determination of the appropriate disposal location (i.e. possible divert from the landfill waste stream).
  - Significant water/leachate is not expected to be encountered. However, a vacuum truck shall be utilised with disposal of any pockets of water/leachate encountered at a suitably licensed liquid waste treatment facility (i.e., ChemWaste or EnviroWaste).

- **Waste Processing/triage** – Part of the contractor's yard will be used for stockpiling of materials that may be able to be redirected from the landfill waste stream and either recycled, reused onsite or taken to an alternative disposal facility.
- The waste processing location within the yard is to be confirmed with the lead contractor and LARC. Any material stockpiled in the contractor's yard shall be managed assuming it may contain elevated levels of contaminants (including asbestos) until proven otherwise.
- Further details of the waste processing activities and controls are presented in Section 12.
- **Monitoring of Rangitata Riverbed** – The Rangitata Riverbed will be routinely inspected for waste materials that may have been inadvertently lost over the terrace edge during remedial excavation activities. Where practicable these waste materials will be hand-picked and removed from the riverbed. Access to the riverbed will likely be through the rural/residential property to the north of the site via an existing vehicle track that runs along the eastern edge of the property (i.e., subject to TDC obtaining approval from the landowner).
- **Remediation Area Validation** – This will involve visual and quantitative (soil quality analysis) checks to confirm that the landfill area has been remediated to the remedial goals outlined in this RAP (see Section 8).
- Additional validation work (including soil quality analysis and landfill waste recovery) shall be undertaken over the contractor's yard (based on potential for incidental contamination from landfill waste handling and sorting) and the toe of the terrace immediately east of the landfill (resulting from landfill waste falling from above).
- Remediation validation will be carried out by the SQEP who will consult with relevant partners (i.e., TDC/Te Rūnanga o Arowhenua, and ECan) as/if required throughout the process.
- **Reinstatement Works** – A reinstatement contoured plan has not been prepared as the level of cut is unknown and will be dependent on meeting remedial goals #1 and #2. Large scale filling of the remediated area is not

being proposed, although some general contouring and importing materials will be required depending on the quality of the material encountered.

- The final site surface will be suitable for re-establishment of vegetation and allow for stormwater conveyance to the Rangitata riverbed. The types of vegetation or plantings chosen for landscaping the reinstated site will be subject to consultation with TDC, Te Rūnanga o Arowhenua and LINZ.

  The principles of the final reinstatement shall include the following:

  - The final landform must promote all surface water flow towards the central gully for discharge to the Rangitata River.
  - Reinstatement of a vehicle turn around areas at the end of Dennistoun Road and construction of a fence to secure the area from vehicular traffic and protection from the terrace edges.
  - All cut batters into natural gravels must not exceed a gradient of 2.5 horizontal to 1 vertical or a slope angle of 23°.
  - The crest line of all cut batters must be within the landfill cadastral boundaries, a 4 m wide access strip must be allowed for between the northern boundary and the crest of the slope.
  - The base angle of the central gully must be such to reduce flow velocity and subsequent surface erosion and discharge of sediment to the river.
  - Topsoil should be placed in discrete areas where planting will take place as per the landscaping plan. It is not recommended to place topsoil across the entirety of exposed slopes or within stormwater flow paths within the gully floor.

  This is discussed in more detail in the ‘Peel Forest Landform Design Principles’ letter (Appendix D).

  A permanent access track to the riverbed has not been considered as this will require ongoing monitoring and maintenance.

- **Site Disestablishment –** Vehicle entry/exit points to the contractor’s yard will be removed along with the imported fill placed across the contractor’s yard, with the material either placed within the remedial excavation (if testing deems it suitable) or disposed of at an appropriate facility with the required approval.

  A surface scrape will be undertaken across the contractor’s yard and other operational areas prior to undertaking validation soil sampling to ensure contaminants associated with the remedial works are not present. If contaminated soils are present above benchmark concentrations, additional soil removal will be undertaken until soil sampling results are acceptable.

  Following confirmation of acceptable contaminant concentrations across the yard, the topsoil will be placed back across the area and reseeded. As much as practicable, fencing will be replaced and reinstated to the current configuration on the property used for the contractor's yard; however, fencing configuration could change at the remediated landfill site, to accommodate the agreed final design.

- **Site Validation Reporting –** The purpose of the Site Validation Report (SVR) is to document the remediation works from commencement to completion. Specifically, the SVR documents whether the stated objectives of the remediation programme have been achieved. The SVR also documents unforeseen circumstances that have led to a deviation from this RAP, and how these are managed. Information about final remediation depths, extents, waste disposal volumes and tonnages, and implementation of site reinstatement will also be documented.

  The SVR will be prepared by the SQEP in general accordance with MfE CLMG No. 1 and will be submitted to TDC and ECan.

The total time that will be required for the remediation to progress through from start to completion is unknown but is expected to be in the order of between nine to twelve months. This remediation programme estimate considers downtime from active remediation work due to unforeseen circumstances.

9.2 Remediation Oversight

The SQEP and/or lead contractor are responsible for overall remedial works and oversight ensuring that all controls and site management requirements detailed in the RAP are adhered to. This includes, but is not limited to:

- Adhering to all relevant resource consent conditions governing the remediation of the landfill.
- Implementing appropriate responses to all, if any, accidental contamination discoveries or contamination discharges.
- Appropriate handling or disposal of waste materials to the designated waste disposal facility (i.e., with relevant approvals).
- Upkeep of physical controls recommended by the site specific ESCP.
- Record keeping (site photographs, records of site visitors, records of complaints, regular collection of remediation progress photographs, etc.).
- Ensuring the site (including the contractor's yard) and any gear remaining on-site, while the site is unattended is secure.
- Ensuring that appropriate fencing (and construction scrim/litter fences) and site hazard signage remain intact throughout the remediation.
- Installing and monitoring security cameras from which to inspect the site during weekends and public holidays and for the SQEP to remotely monitor progress when not on site.

- Ensuring that haulage vehicles using Dennistoun Road adhere to the appropriate speed limits.
- Keeping periods of site work within the hours and days of the week specified by the AEE (i.e., to ensure reduction of traffic and noise nuisance effects) and ensure adequate site security, especially where the site could be left unattended for an extended time (e.g., long weekends and/or public holidays).
- Ensuring that all plans controlling the work (e.g., dust management plan, ESCP, ARCP, etc.) are adhered to.
- Confirmation of appropriate off-site landfill waste disposal to Redruth Landfill or another appropriately licensed facility.

Since the remediation is expected to carry on over many months and involves a complex and sensitive site, in terms of possible community and media interest, and known and potential contaminants of concern (COCs), full-time oversight by the lead contractor and/or the SQEP will be required. The SQEP and lead contractor will liaise to ensure this occurs.

In addition, the cultural consultant (i.e., Te Rūnanga o Arowhenua) will also attend and monitor the remedial works as required.

The following sections outline the risks to human health and the environment and the mitigation measures that need to be implemented to ensure the risks are suitably managed.

10.0 Potential Human Health Risk for Site Workers

The typical composition of landfill waste, coupled with the period that the landfill received waste means that hazardous substances/materials are likely to be encountered as part of the complete removal of the landfill waste. As such, controls and management will be required during the disturbance works to mitigate undue exposure/potential risks to excavation workers and other contractors involved in the earthworks phase of the development.

10.1 Asbestos

Based on the previous soil sampling at the landfill (i.e., PDP, 2023a), asbestos is a primary contaminant requiring special management (i.e., handling, and appropriate disposal). As noted in Section 6, soils with elevated asbestos concentrations have been detected within the materials described as 'Waste Mixture'[5]. These materials generally accounted for 50% or greater of the overall waste make-up in test pits.

The primary risk driver for asbestos exposure is inhalation of airborne asbestos fibres. If there is no airborne asbestos present, there is no risk to human health.

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[5] *'Waste Mixture' - Higher proportion of waste including metal, timber (including some pockets of sawdust), plastics, textiles, and small fragments of glass, and presumed asbestos containing material (PACM).*

There is no definitive relationship between potential airborne fibre concentrations (i.e., the primary risk driver) and the asbestos content of a soil.

There is a risk that asbestos fibres can be released during remediation of the landfill, which could present a human health risk not only to excavation workers but also to those on neighbouring properties and the general public. This RAP is therefore directed at controlling site works to avoid fibres becoming airborne during such activities.

10.2 Other Contaminants

Soil sampling showed relatively low-level concentrations tested in soils, therefore there is considered to be an acceptably low risk to site workers for the majority of the works provided the provisions of this RAP are adhered to. However, landfill waste is inherently heterogeneous and hazardous materials/chemicals may be encountered during the remedial works. The contamination accidental discovery protocol shall be implemented in the event potential hazardous materials/chemicals are discovered and suitable mitigation measures to protect human health and the environment will be implemented (refer Section 16).

10.3 Landfill Gas

Ground gas monitoring has not identified a significant LFG risk and the waste materials were generally observed to be inert rather than organic, which would have the higher potential to generate hazardous landfill gases. There is the possibility that deeper landfill waste, not yet investigated, may contain more organic waste and that some pockets of LFG may still be present and could be encountered during the intrusive works.

Health and safety issues associated with the potential for LFG being encountered during the site works include:

- Inhalation of toxic vapours by personnel involved in the construction works;
- Explosion risk associated with any hot work activities carried out at the site; and
- Asphyxiation risk for personnel entering low lying areas where gases may displace oxygen levels.

The risk is currently considered to be low based on the results of LFG monitoring and the observed contents of the fill material being predominantly inert wastes. Furthermore, given the disturbance activities will occur in an open area (i.e., not enclosed or confined), there will be higher dilution and atmospheric dispersion of any residual ground gas. Irrespective of this, given the high consequence if LFG is unknowingly encountered, provisions for monitoring of atmospheric conditions via a personal gas monitor is recommended (see Section 20.3).

10.4 Leachate

No testing of any leachate has been possible to date to understand the leachate composition and potential risks to human health and the environment. Landfill leachate is a complex liquid that is formed from the composition of the waste material that is present. The composition is likely to contain high organics including nitrogen, as well as heavy metals and other components associated with any hazardous chemicals present.

Any leachate that is observed shall be considered to be hazardous and managed in accordance with this RAP. Provided the provisions of this RAP are adhered to, including appropriate erosion and sediment controls, decontamination and good hygiene practices are followed, the risk to site workers and the environment are considered to be low.

11.0 Earthwork Controls During Excavation/Soil Disturbance Works

Given the variable nature of fill material present within the landfill, coupled with elevated asbestos fines and ACM concentrations identified, appropriate asbestos controls will need to be implemented to manage exposure risks during any excavation/disturbance of the landfill waste. Asbestos will be the driver for controls during the remedial works, although additional controls may be adopted through the accidental discovery protocol.

This section discusses specific measures and controls in relation to potential human health risks associated with exposure to asbestos as a result of excavation and disturbance of the landfill waste. Note that by default, the management of asbestos impacted soils will also appropriately manage other soil contaminants that have been identified at the site.

11.1 Statutory Requirements, Codes of Practice and Guidelines

There are a number of regulatory requirements, codes of practice and guidelines that apply to the assessment, management and removal of asbestos (including in soil) in New Zealand. The most important of these are:

- *Health and Safety at Work Act 2015*;
- *Health and Safety at Work (Asbestos) Regulations 2016* (referred to as the ‘Asbestos Regulations’);
- *Approved Code of Practice: Management and Removal of Asbestos* (WorkSafe NZ, 2016) (referred to as the ‘ACOP’); and
- *New Zealand Guidelines for Assessing and Managing Asbestos in Soil* (ALGA, 2017).

11.2 Asbestos Risk - Control Measures

Based on the tested concentrations of asbestos in soil/landfill waste, the earthworks associated with the remediation of the landfill would be classified as **Class B**

'licenced asbestos work' (refer to the Figure 1. '*Decision flowchart for work involving asbestos in soil'* in the ALGA document). In line with this, a Licensed Asbestos Removal Contractor (i.e., LARC) will need to be engaged to control and supervise the disturbance activity and an ARCP prepared. The ARCP should be submitted to the SQEP for review and include further details regarding:

- Description of works and the asbestos isolation areas within the site;
- Details of site establishment, daily controls and handover and completion of works;
- Layout of asbestos works area including the entry/exit points, signage locations, decontamination unit locations for plant and contractors, etc;
- Wind speed restrictions, including cessation of earthworks if dust suppression measures cannot effectively control the generation of dust; and
- Details of dust suppression measures, waste management (including the management of any stockpiled material) and disposal and decontamination procedures.

All practicable measures to avoid tracking or inadvertently removing soils from the work area by site workers or plant and machinery shall be implemented. Good hygiene practices shall also be adopted (refer to Section 20.4).

Following the completion of the disturbance activities, all plant and equipment that comes into contact with the asbestos impacted soils are to be appropriately decontaminated prior to leaving the site.

Visual monitoring shall be undertaken by the SQEP and/or lead contractor during all the remedial earthworks to check for signs of ACM and the accidental discovery of caches of contaminants (e.g., demolition waste placed deeper than previously observed, stained or odorous soils). If identified, accidental discovery protocols are applicable (refer to Section 16.0), and the SQEP contacted to assess the identified hazard at the site.

Provided procedures within this RAP and the ARCP are adhered to, there should not be significant human health effects associated with the presence of asbestos in soil during the disturbance activities.

11.2.1 Air Monitoring

Previous airborne fibre monitoring (AFM) undertaken by PDP both at the site during interim remedial and landfill characterisation works, and in similar projects, have shown that if the excavation and removal activities are carried out in accordance with the management procedures and dust suppression measures outlined in this RAP, then asbestos fibres are unlikely to be detected in air.

However, in accordance with the ALGA (2017) guideline document, AFM will be undertaken during the disturbance of the landfill material to provide reassurance that the methods and controls being implemented are not generating potential airborne asbestos fibres.

The requirement and frequency of AFM will be determined by the SQEP in consultation with the LARC. It is anticipated that air monitoring will initially occur daily. Assuming acceptable laboratory results are recorded, AFM frequency will decrease as works progress to a minimum of twice weekly as these early results will indicate satisfactory control measures and dust suppression. AFM frequency will be reviewed should elevated results be recorded. AFM will not be completed in wet weather (i.e., a natural dust suppressant).

AFM will be positioned to target landfill excavation activities and also in the vicinity of any stockpiles and processing areas within the contractor’s yard. The positions of the monitoring points will also be influenced by wind direction.

The results of any monitoring should be made available immediately to the LARC. If elevated concentrations of fibres are detected (i.e., trigger level of >0.01 fibres/mL of air) then the LARC shall cease work and the methodologies and dust control measures reviewed and modified where necessary to allow work to continue. Any changes to the work methodologies or management measures and controls are to be discussed with the SQEP.

All AFM must be carried out in accordance with the Asbestos Regulations and the samples analysed by an accredited laboratory in accordance with the National Occupational Health and Safety Commission Australia – NOHSC:3003(2005) *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres* 2nd Edition.

11.2.2 Adjacent Landowner Reassurance Soil Sampling

To provide reassurance to the neighbouring property bounding the landfill to the north, it is proposed that the SQEP collect up to four soil samples within the neighbouring property for semi-quantitative asbestos analysis. It is anticipated that this soil sampling activity will be completed as follows:

1. Prior to works commencing to form a baseline for comparisons of future results.
2. Up to three times during the remedial works (i.e., approximately every three to four months).
3. Following completion of the remedial works and removal of asbestos controls.

The purpose of the soil sampling is to demonstrate that the asbestos present within the landfill waste is not being spread outside of the work area and onto the neighbouring property to the north during the excavation and removal activities.

Should any asbestos impact be identified, the SQEP will report this to TDC along with recommended interim management measures to feed back to the site owner. A remedial strategy will then be derived and implemented in consultation with TDC and the landowner.

11.3 Dust Control Measures

Dust control measures will be laid out in a comprehensive standalone DMMP that will be an addendum to this RAP. Further details will be provided in the ARCP. The remainder of this section provides a high-level approach to dust control, supplemental to the DMMP.

Soil disturbance activities across the landfill and contractor's yard will be carried out in a manner that results in minimal dust generation, particularly since asbestos has been detected at concentrations that trigger Class B licensed asbestos work. In addition, exposed surface soils and the unsealed road leading to the site can be a source of dust generation during strong wind events, especially when tracked over by heavy machinery and trucks.

Windblown sediments/dust can become a significant form of air pollution from earthworks and also be a nuisance. Dust is to be managed so that no nuisance dust extends beyond the property boundary. The lead contractor is responsible for implementing dust mitigation measures.

- Advising all site workers of the need to minimise dust by the responsible operation of machinery;
- Maintaining a water supply on site (e.g., water cart, K-Line irrigation, etc.) for the dampening down of soils on a regular basis, particularly during hot/dry and windy periods, ensuring water application does not generate surface flow runoff. This applies to the landfill, contractor's yard and the unsealed portion of Dennistoun Road which will support truck movements. If dusty conditions persist, consideration of applying a polymer (soil stabiliser such as Stonewall, or similar product) to the exposed surfaces shall be made by the lead contractor;
- Avoid the spreading of soil beyond the work areas by vehicle movements and daily tidying up of excavation works;
- Suspending dust generating activities when dust control measures become ineffective due to increased wind speed. The objective of these measures is to prevent visible dust emissions beyond the site boundary;
- Limiting vehicle access and speed (<5 km/hr) and controlling traffic movements to minimise dust generation and transport of affected soil on vehicle tyres; and,
- Any temporarily stockpiled soils (i.e., imported approved 'clean' fill) shall be kept damp or covered with a geotextile fabric (or similar) to prevent dust generation.

11.4 Erosion and Sediment Control Plan

Erosion and sediment and stormwater management controls will be laid out in a comprehensive standalone site-specific ESCP document. This document will be prepared by PDP in consultation with the lead contractor once they have been engaged to ensure controls compliment the contractors site set up and excavation plan. The information relating to erosion and sediment control in the remainder of this section provides a high-level approach, supplemental to the ESCP.

There is the potential for sediment to be mobilised when entrained in stormwater from the landfill site and the contractor’s yard during the remedial earthworks. As such, stormwater and erosion and sediment control measures will need to be implemented at all times during the remedial earthworks and are to be undertaken in accordance with the Erosion and Sediment Control Toolbox developed by ECan (http://esccanterbury.co.nz/).

11.4.1 Perimeter Control Measures

Perimeter fencing will be installed where practical around the landfill and contractor’s yard areas, utilising existing fencing where possible, to provide separation between the remedial activities and neighbouring sites. The exception will be improving fencing along the eastern landfill boundary which forms the terrace edge.

11.4.2 Site Access

Site access will be confirmed with the selected contractor but is expected to be from Dennistoun Road into the northwestern corner of the contractor’s yard.

Throughout the earthwork’s mobilisation, it is important to minimise any sediment tracked off site in vehicle tyres, which will reduce the spread of sediment over public roads.

In order to prevent sediments being tracked off site, the following solutions shall be used:

- **Stabilised Entranceway:** Stabilised all weather access shall be established at the entrance to the site by laying a base of 50-150 mm washed aggregate over a needle punched geotextile membrane. The minimum length of these entranceways is 10 m, with a minimum width of 4 m. The stabilised entranceway shall be contoured to suit the entrance point. Refer to Appendix E for an example of a stabilised entranceway.
- **Wheel Wash:** A wheel wash may be required should the stabilised entry point(s) not sufficiently manage sediment being tracked off-site.

Furthermore, in addition to the above measures, any sediment that is tracked off-site shall be immediately removed as far as practicable to prevent it becoming entrained in stormwater, and to not cause a nuisance.

11.4.3 Exposed Surface Control Measures

It is important to ensure that stormwater runoff from any disturbed soil does not leave the site in an uncontrolled manner. During site remedial earthworks, stormwater will be allowed to infiltrate through the existing site soils as an initial natural passive means of stormwater disposal, which is also the existing stormwater discharge method. All practicable measures shall be undertaken to minimise the discharge of sediment-laden stormwater offsite.

Appropriate options for dealing with stormwater discharges include the following options:

- **Dirty/clean water diversion bund:** A topsoil bund can be used as a temporary barrier to ensure all sediment laden stormwater is retained in the landfill and the landfill waste processing areas of the contractor's yard and that clean stormwater does not enter. A checklist and image of diversion bunds are provided in Appendix E.
- **Silt fence:** A silt fence could be installed on downgradient edges of the contractor's yard, to further ensure that sediment-laden runoff does not escape to the neighbouring sites. The silt fences must be installed in accordance with the checklist provided in Appendix E.

11.4.4 Location of Control Measures

Erosion and sediment control measures shall be positioned by the contractor prior to commencement of earthworks. Site plans showing the recommended locations of the erosion and sediment control measures will be included in the site specific ESCP.

The ESCP may be amended for the purpose of improving the efficacy of the erosion and sediment control measures but should not result in reduced discharge quality. Any amendments by the contractor or project manager need to be submitted in writing to TDC and/or ECan. Changes shall not be implemented until notified by Council's Team Leader Monitoring & Enforcement of the authorisation.

11.4.5 Discharge of Sediment-Laden water

The discharge of sediment laden water is to be to land within the site (i.e., within the remedial excavation footprint). Sediment-laden water shall be managed and retained within the site boundaries and should not enter neighbouring areas, the, the Rangitata River or the road.

11.4.6 Rainfall Response and Contingency

Work in heavy rain shall be avoided. In the event water ponding onsite is a problem, then a vacuum truck can be utilised for off-site disposal of excess water. Given the contaminant concentrations present over parts of the site (including heavy metals, asbestos and detectable TPH), the water must be taken to a suitable facility for disposal. Guidance will be provided by the contaminated land specialist should a vacuum truck be required.

11.4.7 General Inspections

Any erosion and sediment control measures implemented shall be visually inspected by the lead Contractor during active site works**, prior to any rain** that is forecast, as well as **after each rainfall event** where more than 5 mm of rainfall occurs. Following inspections, any accumulated sediment shall be deemed contaminated and removed immediately with the other identified contaminated soils/landfill waste. Any damaged or deficient components or structures shall be repaired.

Should any stormwater be observed migrating beyond the Works Area, the source of the water shall be identified, and measures shall be taken to ensure the source of the water is channelled towards the correct discharge location within the site.

11.4.8 Decommissioning

All exposed surfaces shall be stabilised once the remedial earthworks are completed. All spoil and other waste material from the works shall be removed from site under the guidance of the contaminated land specialist. Erosion and sediment control measures shall not be removed until the site has been stabilised.

11.5 Litter Control Measures

Landfill waste disturbance may result in loose waste such as bale/sileage wrap becoming windblown litter. The lead contractor should take all reasonable steps to prevent the generation and accumulation of litter on site and in the vicinity of the site.

Inspections of the site and surrounding area should be completed regularly and litter removed as required. Scrim/litter fencing is proposed for around the contractors yard. The requirement for mobile litter fencing around the landfill excavation work area should be considered as the project progresses.

The size of the exposed face of the landfill should, as far as practicable, be minimised.

The noticeboard within the local Peel Forest Area should contain a phone number for the site manager to allow members of the public to report any observed litter issues.

12.0 Controls During Waste Processing Activities

As previously discussed, waste processing activities will be carried out as part of the remedial strategy at the site. The intention is separate out items that could be redirected from landfill (i.e. boulders) and larger items unable to fit into the waste bin.

Given the presence of asbestos in the landfill material, it is considered possible that asbestos (ACM and or asbestos fines) will be adhered to larger fragments within the landfill, unless proven otherwise. Due to the potential presence of ACM fragments and asbestos fines, the handling and sorting activity will require control measures to ensure the following:

- ACM fragments are not inadvertently crushed in the process;
- Any adhered asbestos fines in soils on the surface of cobbles/boulders/waste fragments are immobilised during the handling and process; and
- Airborne asbestos is eliminated, so far as is reasonably practicable;

Details of the process to be followed and relevant control measures are further discussed below. Further details of the waste processing methodology should be included in the ARCP. The asbestos removalist will need to provide guidance and supervision throughout this process.

This activity will take place at least 50 m from the residential dwelling that neighbours the site to the north.

12.1 Segregation of Waste for Processing

As mentioned, it is likely that the main materials to be separated out will be cobbles and boulders of greywacke, with some larger waste fragments that will be relatively easy to wash down (i.e., not too degraded and with smooth surfaces).

The method of segregation is to be agreed with the lead contractor but is likely to include some screening with the excavator/loader and some hand picking by site staff overseen by the SQEP.

In addition, visually clean layers of material encountered within the landfill maybe separated out, temporarily stockpiled and sampled by the SQEP to determine whether it could be reused on site or disposed of at a facility other than Redruth landfill.

If materials are to be stockpiled for longer than 2 weeks, consider covering with geotextile or polymer to manage dust.

12.2 Visual Inspection

A visual assessment of segregated materials shall be undertaken by the onsite asbestos supervisor. The supervisor will check material for any visual signs of ACM. This could be present as fragments of ACM adhered loosely to the surface of the cobbles/boulders/waste fragments.

Individual fragments of ACM will be picked out and disposed of to Redruth Landfill along with the bulk of the landfill waste.

12.3 Cleaning Process

The following process shall be adopted for any material clean works:

- A low earth bund (i.e., 0.25 m height) should be constructed around a dedicated cleaning area and a double layer of bidim cloth laid across it.
- Using dust suppression, the segregated material should be placed in small volumes on the bidim cloth and cleaned with a fine mist or running water pressure. An excavator with a root rake bucket would be effective to lift the material for complete cleaning.

Note - No high-pressure sprays can be used in the cleaning process due to the possibility of mobilising asbestos fines.

- Once cleaned, the material will be separated into piles no more than 16 m^2 in footprint and water will be applied via a sprinkler system to manage any possible dust generation during handling. It is important to separate materials into small piles to facilitate the validation sampling.

- Throughout the duration of the waste processing works the current weather conditions will be monitored by the lead contractor and asbestos supervisor and if wind conditions are unfavourable, works will cease until such time as the wind dies down.
- PDP will undertake reassurance AFM when waste processing is being undertaken. The number and placement of pumps will be determined by PDP. Monitoring results will be provided to the lead contractor and asbestos supervisor daily.
- The bidim and associated sediments shall be removed as asbestos containing waste. This area shall be regularly maintained (kept damp) and cleanout and reinstated (as required).

12.4 Validation Sampling

- Representative composite swab samples will be collected by PDP for laboratory asbestos analysis from each pile of cleaned material.
- If samples return a negative result the materials in this pile will be deemed asbestos free and the concrete will be acceptable for reuse on site.
- If a sample returns a positive result the material within this pile will need to go through the Cleaning Process and be retested.
- If a pile is repeatedly returning positive results, it may be more appropriate to dispose of it along with the rest of the landfill waste to a suitably licensed facility.
- The frequency of sampling will be determined by the SQEP but is expected to involve testing of each pile during the initial phases of the work, and reducing if these results indicate the procedure is successful.

13.0 Disposal Options

All waste generated during the remediation programme, which cannot be recovered and re-used on-site (e.g., coarse gravel and large cobbles) or redirected to a licensed managed fill or recycling facility, will be removed to Redruth Landfill (Redruth; Class 1 Landfill), Timaru. Written approval for disposal of the waste generated during the remediation to Redruth is provided under Appendix G. The lead contractor is responsible for ensuring that all wastes generated during the remediation are appropriately disposed and that all records of waste disposal are obtained and provided to the SQEP.

All soil disposal records will need to be documented by way of a soil waste transfer manifest, recording the disposal location and the volumes and/or tonnages of soil removed offsite. A copy of a generic form, which could be used for tracking material to the disposal facility is presented in Appendix G.

Other options for disposal include Frews Managed Landfill for soil with no or very little visible waste and concentrations that meet the acceptance criteria of the facility. Determination of the suitability of disposal to Frews shall be determined by the SQEP.

Provided vegetative waste has not been in contact with waste material, this shall be deemed to be free of contamination and removed accordingly.

Materials that have been cleaned and redirected from the landfill waste stream may be suitable for recycling. This shall be determined through testing under the direction and approval of the SQEP.

14.0 Characterisation/Benchmarking/Validation Sampling

All testing will be undertaken by the SQEP who will determine the distribution and frequency of test locations and also the analytes required to be tested. The following soil sampling will be required over the duration of the remedial works:

- Benchmark/validation soil sampling across any neighbouring land proposed to be leased for the contractor’s yard and/or used for vehicle access to the riverbed (e.g., for fallen waste retrieval) prior to use of these areas. Sampling is to be completed on the intended soils that will form the surface of the operational areas (i.e. not any topsoil that is temporarily stockpiled). The benchmarking results will serve as a reference for the validation testing at the end of the remedial works. The trigger levels for validation of these areas will be the higher value of either the Environment Canterbury reference background levels or the maximum concentration obtained during a benchmarking investigation undertaken prior to commencing waste removal activities.
- Characterisation sampling of any material that appears visually ‘clean’ (i.e., minimal waste fragments and no staining or odours) within the landfill that has been suitably segregated and stockpiled. This will determine whether this material could be disposed of at a facility other than Redruth landfill or, if geotechnically suitable, remain on site to be used to backfill the remedial excavation.
- Validation of materials removed from the waste and cleaned for redirection from the landfill waste stream (i.e. boulders and other smooth surfaced items).
- Validation soil sampling within the remediated area to confirm that the contaminant concentrations in the remaining soils meet the adopted Target Soil Remedial Criteria.
- Characterisation sampling to determine the level of contaminants present in areas where the Accidental Discovery Protocol has been implemented to assist with undertaking an assessment of the risk to human health and the environment.

15.0 Dewatering/Leachate Removal

Given the depth of groundwater (approximately 25 m bgl), dewatering may not be necessary during remedial excavation and general ground disturbance activities.

During previous test pitting at the site, minor seeps have been observed at isolated locations across the landfill area at depths between approximately 1.7 to 2.1 m bgl. This suggests perched water/leachate volumes within the landfill are not significant, however waste >4 m bgl has not been investigated and it is possible larger volumes of leachate may be encountered with depth. For short term dewatering activities, a vacuum truck could be utilised with disposal of the water/leachate at a suitably licensed liquid waste treatment facility (i.e., ChemWaste or EnviroWaste).

16.0 Contamination Accidental Discovery Protocol

Due to the past use of the site as a landfill that accepted a variety of waste, the likelihood of encountering contamination at concentrations that exceed those reported during previous testing at the site (i.e., PDP, 2023) is considered to be high. Furthermore, encountering unexpected concentrations or caches of waste is possible since test pits advanced at the landfill to date have not achieved the total landfill depth.

This section details the Accidental Discovery Protocol in the event obvious contamination sources and waste (e.g., drums or containers, or caches of unknown and potentially hazardous substances) are encountered during the remediation earthworks.

Typical indicators of contaminated soils or other potential sources of contamination include:

- Stained or discoloured soils (black, grey or green staining);
- Petroleum hydrocarbon or solvent odours/vapours;
- Waste material, including putrescible waste, general and/or commercial/industrial rubbish;
- Caches of asbestos containing materials (ACM; e.g., cement sheet fragments);
- Detection of high vapour/gas concentrations (e.g., methane, hydrogen sulphide, etc.) on personal gas alerts, PID and FID; and,
- Chemical containers/drums (marked and unmarked).

If the above visual, olfactory, device monitored indicators of contamination are encountered, then the following actions must be taken:

- Excavation works in that area should cease immediately and the lead contractor contacted. **The lead contractor must notify the SQEP** (if occurrence is not detected by the SQEP) who will evaluate the potential risk to human health and the receiving environment. In the event of an uncontrolled discharge of contaminants, take all practical steps to contain the discharge and prevent further discharge;

- Any intact chemical containers shall be segregated and isolated within a contained area (i.e. bin) for formal identification and specialist disposal (i.e., ChemWaste or EnviroWaste).
- If contaminants have been discharged to ground or the area of hazardous material/chemicals extends further into the waste pile, the area of concern must be fenced, barricaded, or isolated (e.g., by soil cover placement) to prevent unrequired site workers from entering the area.
- Personnel must not enter excavations or subsurface confined spaces where volatile compounds are present (i.e. possible toxic or hazardous atmospheric zones) without approval/permission by a person qualified to issue permits; and
- The contaminated land specialist shall be contacted immediately to determine the appropriate course of action in relation to the environmental and human health requirements and the need to characterise the soils to assess the risk to site workers both during the site development or once the site has been completed.

Note - To detect vapours, a suitable monitoring device shall be used (see Section 20.3). **Personnel attending the remediation must not sniff materials recovered from the remedial excavation regardless of the material's appearance or touch such materials without appropriately gloved hands (i.e., cut and/or chemical gloves). Personnel on-site will not enter remedial excavations greater than 1 m deep or subsurface confined spaces, as volatile compounds and/or landfill gases could be present.**

17.0 Archaeological/Cultural Discoveries

Under the *Heritage New Zealand Pouhere Taonga Act 2014*, an archaeological site is defined as any place associated with pre-1900 human activity, where there is material evidence relating to the history of New Zealand. For sites solely of Māori origin, this evidence may be in the form of accumulations of shell, bone, charcoal, burnt stones, etc. In later sites, artefacts such as bottles or broken glass, ceramics, metals, etc, may be found or evidence of old foundations, wells, drains, tailings, races or other structures. Human remains/koiwi tangata may date to any historic period.

It is unlawful to destroy, damage, or modify the whole or any part of an archaeological site without the prior authority of Heritage New Zealand Pouhere Taonga. The *Heritage New Zealand Pouhere Taonga Act 2014* provides for substantial penalties for unauthorised damage or destruction.

In the event of any discovery of koiwi tangata (human skeletal remains), waahi taoka (resources of importance), waahi tapu (places or features of special

significance) or other Māori artefact material, earthmoving operations in the affected area will cease immediately. The lead contractor will then:

i. *notify the Council, Tangata whenua and Heritage New Zealand Pouhere Taonga and in the case of skeletal remains, the New Zealand Police.*

ii. *allow a site inspection by Heritage New Zealand Pouhere Taonga and the appropriate runanga and their advisors, who must determine whether the discovery is likely to be extensive, if a thorough site investigation is required, and whether an Archaeological Authority is required.*

Any koiwi tangata discovered must be handled and removed by tribal elders responsible for the tikanga (custom) appropriate to its removal or preservation.

Site work may recommence following consultation with the Council, Heritage New Zealand, Tangata whenua, and in the case of skeletal remains, the New Zealand Police, provided that any relevant statutory permissions have been obtained.

In the event of any discovery of any feature or archaeological material that predates 1900, or heritage material, or disturbs a previously unidentified archaeological or heritage site, earthmoving operations in the affected area will cease immediately. The project manager will then:

i. advise the Council, Heritage New Zealand, and in the case of Māori features or materials, the Tangata whenua, and if required, must make an application for an Archaeological Authority pursuant to the Heritage New Zealand Pouhere Taonga Act 2014;

ii. arrange for a suitably qualified archaeologist to undertake a survey of the site.

Site work may recommence following consultation with the Council.

18.0 Additional Considerations

18.1 Traffic Management

The remediation of the landfill will require the movement of numerous truckloads of waste to be transported off-site. This is likely to cause higher than normal heavy vehicle traffic in and out of the site along Peel Forest Road and Dennistoun Road. It is understood at the time of preparing this RAP that TDC currently have no roading improvements planned along Dennistoun Road, with the exception of regular regrading. It should be noted that only high-level discussions have been undertaken to date.

Where necessary, TDC will engage roading experts (internal and/or external to TDC) in regard to roading improvements. It is suggested that the lead contractor will need to be consulted as part of that process and should also complete regular inspections of the road to identify if/where improvements are required.

It is not expected that ongoing traffic management will be required over the entirety of the remediation; however, road signage, including temporary speed limits, along the inbound and outbound route to the site will need to be installed and maintained by a traffic management provider engaged by TDC to mitigate risks to other road users. Traffic management may also be required during regrading activities and any other road improvements required over the course of the remedial works.

18.2 Spill Response and Emergency Procedures

The Lead Contractor is responsible for providing and maintaining an adequate spill response kit onsite. **Any spill** must be reported immediately. The spill report form (refer to Appendix F) must be completed in the event of a spill of >5 L. The form is to be kept onsite for the duration of the project in an accessible location.

Practicable steps will be implemented to ensure oil and fuel leaks are prevented from vehicles and machinery, including the following:

- Fuel will be stored securely or removed from the site overnight; and
- A spill kit, capable of absorbing the quantity of oil and petroleum products that may be spilt on site at any one time, will always be kept on site.

In the event of a spill of fuel or any other hazardous substance, the spill will be cleaned up as soon as practicable, the stormwater system shall be inspected and cleaned, and a recurrence should be prevented.

Any incidents that result in off-site effects including, but not limited to odour, dust, or discharge of water, shall be reported to TDC's Monitoring Officer immediately unless otherwise permitted or authorised by resource consent. This shall be conducted by the lead contractor onsite.

18.3 Imported Fill Material

All backfill material imported to the site, shall meet the requirements of 'clean fill' as defined by WasteMINZ (2023)[6], meaning that the material will *comprise VENM* (virgin excavated natural material)*, such as clay, soil and rock that are free of combustible, putrescible, degradable or leachable components*. In addition, clean topsoil will need to be imported to the site for surface reinstatement and landscaping purposes. All materials imported to reinstate the site must exclude any potentially hazardous content and must not be contaminated by or mixed with any other non-cleanfill material. Any material not sourced from a quarry or pristine riverbed may require additional testing or certification prior to being used on site. Import of clean materials to the site will be overseen by the SQEP (including screening of materials upon arrival to the site). Any materials received on-site that is unsuitable as clean fill will be returned to the source site.

18.4 Public and Media Interest

If the site, or anyone approved to be undertaking work on the landfill during the remediation, is approached by the media or members of the public with questions about the remedial works, this could pose issues for their health and safety.

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[6] *Technical Guidelines for Disposal to Land* (WasteMINZ, 2023; Revision 3.1).

Unknown site visitors are unlikely to possess appropriate PPE and be familiar with site-specific health and safety protocols and should be directed calmly away from the site by the lead contractor or SQEP and be referred to TDC's media liaison. Additionally, if the site is approached by any unmanned aerial vehicles (UAV; e.g., drone) not belonging to the SQEP or anyone contracted to undertake and/or document the remediation, TDC's point of contact should be notified.

19.0 Dis-Establishment of Asbestos Controls on Remedial Earthworks

The presence of ACM and detected asbestos fibres and fines above the ALGA (2017) guidelines has typically been associated with the materials referred to as 'Waste Mixture' in the landfill. Once visible evidence of this material is removed all remaining work associated with the reprofiling of the landfill area can be undertaken under generic earthwork controls without the asbestos-specific measures subject to:

- validation soil sampling results demonstrating no asbestos impacts remain; and
- the requirements of the ARCP.

This approach is transferrable to the designated contractor's yard as/if needed.

It is expected that at this point, the LARC will hand over the control of site to the lead contractor, and relevant clearance certificates provided.

It is however recommended that nuisance dust and sediment and stormwater run-off are continued to be managed appropriately.

20.0 Health and Safety Considerations

20.1 General

This section discusses safety and subsequent protocols in relation to potential human and environmental hazards associated with exposure during the landfill remediation.

The RAP is not intended to relieve the lead contractor of their responsibility for the health and safety of their workers, contractors and the public, or their responsibility for protection of the environment. It is recommended that the lead contractor develop a site-specific health and safety plan (HASP) to complement this RAP and to address other health and safety requirements that may be applicable to their particular works.

Based on the current information, the likely key contaminant of concern is asbestos in terms of a risk that asbestos fibres/fines can be released into the air during the soil disturbance/excavation activities, which could present a human health risk to workers onsite and beyond the site boundary. In addition to asbestos, other COCs and landfill gases could be present at concentrations not detected during previous investigations. Provided procedures within this RAP are adhered to, there are not expected to be any significant human health or environmental effects during the remediation works.

As a general principle, to mitigate any potential adverse effects to the identified contaminants, all site workers are to be advised of the potential risks associated with the site and in the use of all safety and PPE and personal hygiene procedures before the commencement of remediation excavation works.

Further hazards (e.g., physical hazards such as loose or unstable ground) may be identified during the course of the remediation works. The lead contractor is responsible for reviewing any new work element and assessing whether there are any new associated hazards, and whether these can be eliminated, isolated or minimised. The lead contractor shall then instruct all staff on the health and safety procedures associated with the new hazard and update the site HASP.

20.2 Personal Protective Equipment

Protective and safety equipment must be made available to all site workers during the soil disturbance/excavation works at the site. In particular, during soil disturbance works associated with the existing site soils all contractors will need to wear the appropriate PPE for asbestos related excavation works.

As such, PPE shall include but not be limited to the following:

- P2 dust masks or half face respirators (**the type of mask to be determined by the LARC and defined in the ARCP**);
- Disposable Tyvek suit and gloves;
- Boot covers or the use of a boot washing system to be established to prevent site workers tracking material outside of the work zone; and
- Goggles or safety spectacles during windy/dusty conditions.

Standard PPE for a typical commercial development site will be required outside of soil disturbance works associated with the existing site soils. First aid equipment will be available at the site (e.g., eye wash kits).

20.3 Personal and Ambient Air Monitoring for Landfill Gas

While considered to be low risk based on current information, there is a potential for landfill gas to be present during disturbance works. As such, the following monitoring and safety measures shall be implemented:

- No personnel should enter the excavation areas deeper than 1 m unless they are trained and experienced in confined space entry;
- At least one person, ideally the excavation spotter, is recommended to wear a personal gas alert unit appropriately calibrated for landfill gas monitoring.
- Monitoring of ambient air using landfill gas meter is also recommended.

- No flames, smoking or sparking equipment are to be permitted within at least 8.0 m of the edge of the excavation area. Appropriate site hazard signage is to be clearly visible at the site boundary.

The following landfill gas monitoring trigger limits shall be used in accordance with the New Zealand Workplace Exposure Standards (WorkSafe New Zealand, 2022):

- Methane (CH_4) 0.5% (i.e. LEL 10%)
- Carbon Dioxide (CO_2) 5%,
- Oxygen (O_2) shall be between 19.5% and 21%,
- Hydrogen Sulphide (H2S) 10 ppm for 15 mins, and
- Carbon Monoxide (CO) 200 ppm for 15 mins.

In any event the alarms of the gas alert meter are triggered works should immediately cease and all personnel must leave site and assemble at a pre-designated area for at least an hour or until normal atmospheric conditions have been reached. The designated evacuation area will be agreed in consultation with the lead contractor. Site access along Dennistoun Road should be monitored to ensure no one inadvertently enters the work area. Advice from the SQEP shall be immediately obtained before entering the area or recommencing work.

20.4 Personal Hygiene

Site personnel will be made aware of the importance of personal hygiene. Direct skin contact with potentially affected soils and dust should be avoided but if contact does occur it shall be washed off before eating/leaving site. The following general measures will be implemented during the excavation works undertaken across the site:

- Establish designated personnel break and restroom areas away from the identified areas containing impacted soils;
- Hands and other exposed parts of the body are to be washed prior to entering the designated eating and break areas, and on leaving the site. Water will be available on site for hand washing **(lead contractor and TDC to coordinate water supply);**
- Any protective gloves worn must be removed prior to eating, drinking or smoking; and
- No eating or drinking will be allowed within areas suspected or confirmed to be contaminated outside the designated eating area.

21.0 Record Keeping

The lead contractor shall provide the following information to the SQEP within 1 month of the completion of the landfill remediation works:

- Excavation depths across the site should be surveyed/recorded and photographs taken by the lead contractors and the SQEP during the earthworks;
- The depth of any natural material layers placed as part of site rehabilitation;
- Copies of the weighbridge receipts for all waste material removed from the site showing its disposal location and volume;
- Records of the location and dimensions of any excavation where additional sources of site contamination are encountered or whether unusual soil staining and/or odour are observed during the earthworks;
- Records of the LARC's clearance certificates (where/if applicable);
- Copies of air monitoring results; and
- Details of any complaints and/or visits from local or regional councils for contaminated land related issues (i.e. discharges from the site).

At the completion of the works the SQEP shall provide details of any additional soil sampling undertaken. A site validation report will be completed and distributed to TDC and ECan for their records.

22.0 Future Site Controls

Following completion of the remedial works, site rehabilitation works will be carried out in accordance with the final design specifications; **possibly subject to change depending on circumstances encountered during remediation works**).

It is expected that the site will be rehabilitated with clean imported fill and imported landscaping materials. Assuming the remedial goals are achieved, landfill waste will be completely removed from the site and little or no residual contamination is expected to remain in-situ. On this basis, there will be no requirement for any ongoing liability for management or maintenance of the site in terms of contamination or landscaping, and following initial landscaping/revegetation, the site will be allowed to return to a natural state.

23.0 References

ALGA, November 2017. *New Zealand Guidelines for Assessing and Managing Asbestos in Soil*.

ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.

Environment Protection and Heritage Council incorporating National Environment Protection Council 2003. *Guidelines for the Management of Plastic Bag Litter at landfill Sites.*

Health and Safety at Work (Asbestos) Regulations 2016.

Ministry for the Environment, 2021. *Hazardous Activities and Industries List*. Ministry for the Environment, Wellington.

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Ministry for the Environment 2011b. *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011).* Ministry for the Environment, Wellington.

Pattle Delamore Partners Ltd., 2023a. *Landfill Waste Characterisation and Detailed Site Investigation – Peel Forest Closed Landfill, Dennistoun Road, Peel Forest.*

Pattle Delamore Partners Ltd., 2023b. *Remedial Options Assessment: Peel Forest Closed Landfill, Dennistoun Road, Peel Forest*

Pattle Delamore Partners Ltd, February 2024. *Peel Forest Landform Design Principles – Geotechnical and Stormwater Management*

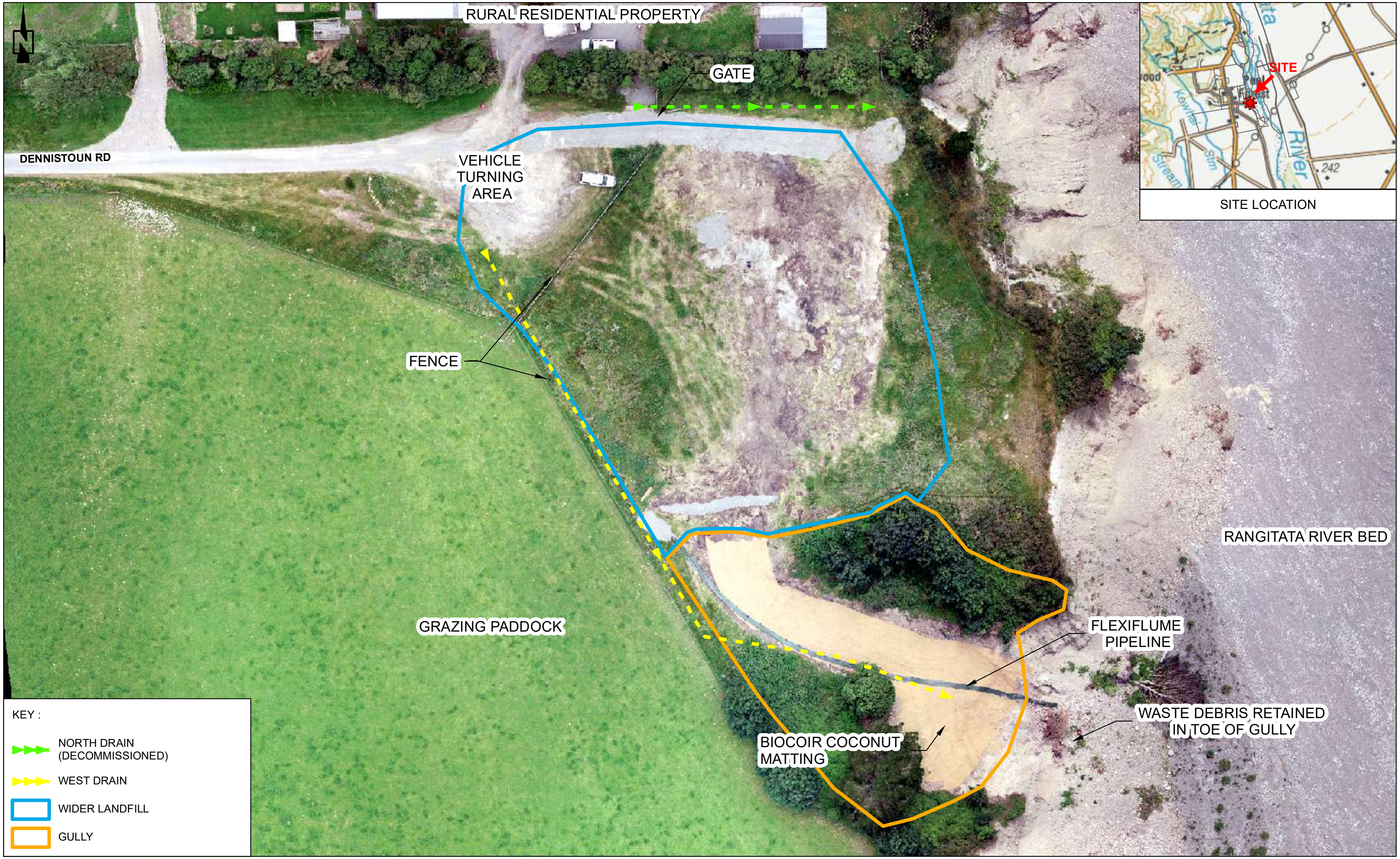
Resource Management (National Environment Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

WasteMINZ, 2022. *Technical Guidelines for Disposal to Land (Revision 3)*

WorkSafe New Zealand, April 2022. *Workplace Exposure Standards and Biological Exposure Indices (13th edition)*

Appendix A: Figures

PEEL FOREST LANDFILL, DENNISTOUN ROAD, PEEL FOREST



SOURCE:
1. UAV IMAGERY FLOWN BY PATTLE DELAMORE PARTNERS LIMITED DECEMBER 2022 (<2 M ACCURACY).
2. CADASTRAL INFORMATION AND INSET SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/
AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

FIGURE 1 : PEEL FOREST LANDFILL FEATURES (DECEMBER 2022)

SCALE : 1:750 (A4)

0 2.5 5 10 15 20 25

METRES

PEEL FOREST LANDFILL, DENNISTOUN ROAD, PEEL FOREST

SOURCE:
1. AERIAL IMAGERY (FLOWN 2021) SOURCED FROM CANTERBURY MAP PARTNERS ADMINISTERED BY ENVIRONMENT CANTERBURY.
2. CADASTRAL INFORMATION AND INSET SOURCED FROM THE LINZ DATA SERVICE https://data.linz.govt.nz/ AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 I

FIGURE 2 : PROPOSED APPROXIMATE EXTENT OF AREA TO BE LEASED FOR THE CONTRACTORS YARD

SCALE : 1:1,250 (A4)

0 5 10 20 30 40 50

METRES

PATTLE DELAMORE PARTNERS LTD

C02450Z008_RAP_FIG2.mxd 10/11/2023 ISSUE 1

Appendix B: Target Soil Remedial Criteria Memo

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memorandum

TO	Timaru District Council	FROM	Lucy Duffus
	c/o Vincie Billante	DATE	27 October 2023
RE	Target Soil Remedial Criteria – Peel Forest Closed Landfill		

1.0 Introduction and Background

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on behalf of the Timaru District Council (TDC) to indicate the remediation criteria that are proposed to be used to demonstrate the satisfactory remediation of contaminant concentrations within soils remaining in situ following the remedial earthworks (i.e. the removal of visible waste and impacted soils) at the Peel Forest closed landfill (i.e., ‘the landfill’ or ‘the site’).

In addition to the removal of all visible waste and waste impacted soils, a remedial excavation over dig of up to 1 m is currently being proposed based on preliminary investigations to remove underlying natural materials that have been impacted by contaminant leaching from the main landfill body. Additional material may need to be removed depending on contaminant levels in the soils. The contaminant levels present within the remaining natural soils will form one of the key remedial end points. Determination of what levels of contaminants are suitable to remain at the completion of the remedial works is important to define and gain support from the key stakeholders at this early stage as this can have significant impacts on the costs.

2.0 Considered Target Remedial Criteria

To determine the most appropriate remedial criteria, an assessment of the key receptors at the completion of the remedial works has been undertaken. These include the following:

- Protection of human health – although this land area is not intended to be routinely occupied, it is possible that people could occasionally be present (i.e., general public or maintenance workers).
- Protection of terrestrial biota – includes protection of soil microbes, invertebrates, plants and wildlife.
- Protection of ecological receptors – the remaining soils will continue to be vulnerable to erosion and could be mobilised during future storm and flood events and enter the Rangitata River system.

On the basis of the key receptors, the following criteria have been considered and are presented in Table 1:

- Background Concentrations - Regional – Intergrade Soil Group (ECan, 2007; MfE, 1998)
- Human Health Soil Contaminant Standards (MfE, 2011a and 2011b; and NEPC, 2013)
- Ecological Soil Guidelines (Landcare Research, 2016 and update 2019)

- Default Guideline Values for Sediment Quality (ANZG, 2018)

The key contaminants of concern that have been considered include heavy metals, petroleum hydrocarbons, organochlorine pesticides and asbestos. These are considered the primary contaminants of concern from an ongoing risk posed to human health and the environment by any remaining impacts. Additional contaminants may be included depending on what is uncovered/encountered during the remedial excavation.

2.1 Background Concentrations (ECan, 2007; MfE, 1998)

Achieving heavy metal background concentrations for the soil group in which the site is located would appear to be the ideal outcome and may be achieved in some areas, however this can be hard and costly to achieve across the entire site due to these concentrations being so low. Any slight exceedances in remaining visibly clean soils following the removal of all visible waste and the over dig would result in the requirement to continue to excavate and remove even more material from the site when in fact the concentrations reported may not present a risk to human health or the environment. This could lead to significant additional soil removal with little to no environmental benefit.

Negative impacts of removing soils that do not pose a risk to human health or the environment include:

- Direct costs associated with additional time on-site, effort to excavate and dispose of an unknown volume of natural materials;
- Direct costs associated with the potential need to import/source additional material (clean fill) for reinstatement;
- Negative impacts of the sustainability of the remedial works (i.e., more plant and truck movements); and
- Possible increase in the potential to destabilise the remedial excavation walls.

Whilst OCP compounds are anthropogenic it is important to note that due to their historical ubiquitous application in agriculture, parklands, and turf management they can be considered to also be present at low but detectable ‘background’ concentrations (MfE, 1998). While there is no official ECan background soil concentrations, ECan has recognised that some OCPs are ubiquitous in the environment and has adopted an interim ‘background’ level (0.431 mg/kg) for ∑DDT (OCP compounds).

2.2 Human Health Soil Contaminant Standards (MfE, 2011a and 2011b; and NEPC, 2013)

As the site will remain vacant and not routinely be used by humans following successful remediation and reinstatement, typical land use scenarios for protection of human health (i.e., residential – standard and rural/lifestyle, recreational, and commercial/industrial) are not directly relevant. Of the typical land use scenarios available for protection of human health, the site is considered to align best with the recreational land use (refer to Table 1); however, the site will not be designated for recreational use so these guidelines have been included for reference only. For those guidelines without a recreational land use scenario (i.e., MfE, 2011b), residential land use has been included as a conservative approach.

2.3 Soil Guideline Values For The Protection Of Ecological Receptors (Eco-SGVs 2016/2019)

The ecological soil guideline values (Eco-SGVs) have been developed to protect terrestrial biota (soil microbes, invertebrates, plants, wildlife and livestock) and provide a useful way to readily assess the potential environmental impact from environmental contaminants. These guidelines have been developed and promoted by Landcare Research and although they have not been recognised formally, are being used to provide an assessment of the soil quality to protect terrestrial biota. A land use scenario of ‘non-food production land’ has been used as it best fits the intended land use and values shown in Table 1.

2.4 Default Guideline Values for Sediment Quality (ANZG, 2018)

The vulnerability of the landfill to erosion (i.e., due to the potential for significant future flood events) and the release of contaminated material/soil into the Rangitata River is the main driver for remediation. Even after the remedial works are completed the river will continue to remain one of the key receptors as the remaining soils will still be vulnerable to erosion and could be mobilised during future storm and flood events and enter the Rangitata River system. Therefore, comparison to the toxicant default guideline values (DGV) for sediment quality in the ANZG (2018) is suitable in this instance, albeit not directly comparable and considered a conservative approach. The DGV have been derived to define a concentration level below which there is a low risk of unacceptable effects occurring. The applicable DVG's are shown in Table 1 below.

3.0 Proposed Target Remedial Criteria

Table 1 summarises the considered remedial criteria for specific parameters and outlines the proposed adopted Target Soil Remedial Criteria that is intended to be applied as the contaminant remedial end point.

The human health contaminant standards were the highest levels for all contaminants considered and therefore not limiting for the remedial end point. In addition, the background concentrations have not been adopted as reaching background levels could be extremely difficult to achieve and could result in significant cost to the project for little to no environmental benefit. The exception being DDT, which is considered ubiquitous in the agricultural setting and therefore considered applicable in this instance and has been adopted. The remainder of the adopted remedial criteria are based on the lower concentration of either the Eco-SGV's and sediment DGV (ANZG, 2018). This aligns with the primary receptors identified for the project.

Should any additional contaminants/contamination sources be encountered during the remedial work, these will be dealt with under the accidental discovery protocol outlined in the Remedial Action Plan. Contaminant specific remedial target criteria will be developed as part of this approach.

Table 1: Target Remedial Criteria for Remaining Soils [1]

Parameter *(All parameters in mg/kg unless otherwise stated)*		**Human Health Based Soil Contaminant Standard – Recreational Land Use**	**Environment Canterbury Background Concentrations- Regional – Intergrade soil type**	**Eco-SGV** **Non-Food Production Land**	**DGV for Sediment Quality**	**Proposed Target Soil Remedial Criteria**
Heavy Metals						
Arsenic		80	7.0	20	20	**20**
Cadmium		400 [2]	0.14	4.8	1.5	**1.5**
Chromium		2,700 [3]	25.9	190	80	**80**
Copper		>10,000	16.3	100 [6]	65	**65**
Lead		880	30.3 (135.8)	280	50	**50**
Nickel		1,200	16.4	-	21	**21**
Zinc		30,000	83.5 (147.75)	170 [6]	200	**170**
Organochlorine Pesticides (OCP)						
ΣDDT		400 [4]	0.431	2.4	0.0012 [5]	**0.431**
Petroleum Hydrocarbons						
Benzo(a)pyrene eq.		40	-	2.8	-	**2.8**
Total PAHs		-	-	-	10	**10**
TPH	C_7-C_9	-	-	110	280	**280**
	C_{10}-C_{14}	-	-	70		
	C_{15}-C_{36}	-	-	300		

Table 1: Target Remedial Criteria for Remaining Soils [1]

Parameter ***(All parameters in mg/kg unless otherwise stated)***	**Human Health Based Soil Contaminant Standard – Recreational Land Use**	**Environment Canterbury Background Concentrations-Regional – Intergrade soil type**	**Eco-SGV** **Non-Food Production Land**	**DGV for Sediment Quality**	**Proposed Target Soil Remedial Criteria**
Asbestos					
Asbestos	0.001 % weight for weight asbestos fines; and 0.02 % bonded ACM	-	-	-	**No detectable asbestos**
Additional Contaminants					
Should any additional contaminants/contamination sources be encountered during the remedial work, these will be dealt with under the accidental discovery protocol outlined in the Remedial Action Plan. Contaminant specific remedial target criteria will be developed as part of this approach.					

Notes:

1. *The final validation analysis suite is yet to be determined and subsequently some of the individual parameters listed here may not be included.*
2. *Based on a default pH of 5.*
3. *Soil contaminant standard for Cr VI used as a conservative approach.*
4. *Results for DDT, DDD and DDE summed.*
5. *Normalised to 1% organic carbon (OC) within the limits of 0.2 to 10%. Thus if a sediment has (i) 2% OC, the '1% normalised' concentration would be the measured concentration divided by 2, (ii) 0.5% OC, then the 1% normalised value is the measured value divided by 0.5, (iii) 0.15% OC, then the 1% normalised value is the measured value divided by the lower limit of 0.2.*
6. *Values based on the Updated Ecological Soil Guideline Values for copper and zinc in a 'typical soil type' with 'aged' contamination (June 2019)*

4.0 References

ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.

Environment Canterbury, 2007. Background concentrations of selected trace elements in Canterbury soils. Addendum 1: Additional samples and Timaru specific background levels. Environment Canterbury Report R07/1/2.

Landcare, 2016. Development of Soil Guideline Values for the Protection of Ecological Receptors (Eco-SGVs): Technical Document. JE Cavanagh, K Munir. Landcare Research New Zealand Limited.

Landcare, 2019. Updating the Ecological Soil Guideline Values (Eco-SGVs). JE Cavanagh. Landcare Research New Zealand Limited.

Ministry for the Environment, 1998. Ambient Concentrations of Selected Organochlorines in Soils. Ministry for the Environment, Wellington.

Ministry for the Environment, 2011a. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Ministry for the Environment, Wellington.

Ministry for the Environment 2011b. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011). Ministry for the Environment, Wellington.

National Environment Protection Council, 2013. Guideline on the Investigation Levels for Soil and Groundwater. National Environment Protection Council Australia.

5.0 Limitations

This document has been prepared by Pattle Delamore Partners Limited (PDP) on the specific instructions of Timaru District Council for the limited purposes described in the document. PDP accepts no liability if the document is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Yours faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared by	Reviewed and approved by
Lucy Duffus	**Scott Wilson**
Senior Environmental Geologist	Contaminated Land – Technical Director

Appendix C: Land Lease Approvals

Lucy Duffus

Subject: FW: Re: Lease of land for the closed landfill removal
Attachments: image307558.png; image307558.png; 20231005_ProposedLeaseArea.pdf

---------- Forwarded message ---------
From: Mark Tapley <mark@pfe.nz>
Date: 17/10/2023 21:59
Subject: Re: Lease of land for the closed landfill removal
To: Vincie Billante <Vincie.Billante@timdc.govt.nz>
Cc: Graham Carr <graham@pfe.nz>

Sorry it slipped through my radar. It will be fine to lease that section but it will need to be deer fenced off so we can still graze the remaining paddock. If you can agree to this I see no problem. I've got a huge day tomorrow so can't talk tomorrow but if you call me Thursday morning we can go through the details

Regards,

Mark Tapley
Peel Forest Estate
+64277799008

> On 17/10/2023, at 10:58 AM, Vincie Billante <Vincie.Billante@timdc.govt.nz> wrote:
>
> Hi Mark
>
> I'm following up on my previous emails regarding the above. I need to get this sorted urgently as we need to have this confirmed for the consent application – can I urgently get either a teams meeting with you and Graham, or come out to see you this week, to get it sorted??
>
> Please make contact with me either via email or phone me on 0274-388-326.
>
> Again, attached is area we are talking about.
>
> Many thanks, hope to hear from you soon.
>
> Kindest regards,
> Vincie

Vincie Billante | LTP Project Lead

Timaru District Council | PO Box 522 | Timaru 7940
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Appendix D: Peel Forest Landform Design Principles – Geotechnical and Stormwater Management

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19 February 2024

c/o Jacky Clarke
Timaru District Council
2 King George Place
TIMARU 7910

PEEL FOREST LANDFORM DESIGN PRINCIPLES – GEOTECHNICAL AND STORMWATER MANAGEMENT

1.0 Introduction

Pattle Delamore Partners Limited (PDP) have been engaged by Timaru District Council (TDC) to provide stormwater and geotechnical engineering advice to assist in construction phase works for the permanent landform for Peel Forest Landfill remedial works. The intent of this document is to provide generalised advice to assist during the earthwork's construction phase.

This letter should be read in conjunction with the Remedial Action Plan (RAP) which has also been prepared by PDP for TDC dated February 2024.

2.0 Background

2.1 Site Setting

The landfill is situated within a generally north to south trending erosional gully located on top of a river cut terrace approximately 30 m in height. The landfill has experienced loss of waste into the Rangitata River from erosion and instability of the river terrace caused during rainfall events over the past couple of years. Erosion and slope instability of landfill waste within the gully are attributed to stormwater flow through the gully. Larger scale river erosion and river terrace failures have been remediated through modifications to the river morphology and is separate to this scope.

The river terrace comprises well graded river gravels with some rounded cobble to boulder sized greywacke gravels. The river terrace is generally over steepened, over time these terraces regress back to long term slope angles of approximately 45° as can be seen across neighbouring slopes.

From the stormwater perspective the landfill is situated immediately west of the Rangitata River (i.e., 'the Rangitata') on a 30-metre-high river terrace. Stormwater leaving Dennistoun Road flows out to the Rangitata River along a shallow drain immediately north of the landfill and a narrow drain that runs to the west of the landfill before flowing out through the landfill valley area. Surrounding land use is rural with a rural residential property to the north and grazing paddock to the west.

2.2 Work Completed to Date

During the landfill removal works it is proposed to lease land from the neighbouring property to be used as a waste triage area, lead contractor base and remediation support area (hereafter, 'contractor's yard'). A topographical survey has already been carried out by Fox Surveys Limited (August 2023) over the area of land proposed to be used as the contractor's yard to benchmark the topography of the land before it is disturbed.

An additional topographical survey was completed by Fox Surveys on the 11 September 2023 to validate the LiDAR data and pick up general site details to be utilised in design. The topographical survey and pre-existing digital elevation model (DEM) derived from drone photogrammetry have been combined to generate an updated DEM to aid the design process.

To prevent on-going erosion / instability of the landfill mass and migration into the river, temporary erosion works were completed in December 2022 which included grading / pulling back the landfill mass to for a slope back into the gully. This profile was covered with coconut matting (jute) pinned to the slope and sown with grass seed. In addition, a bund was formed at the crest of the gully slope to divert sheet flow water into a culvert and lay flat hose which is directed down to the riverbank. During these works the shallow drain immediately north of the landfill was infilled to prevent runoff over the river terrace.

Additional details on the background of the site can be found in the PDP DSI report.

3.0 General Design Considerations

The purpose of this assessment is to provide the following design considerations:

Temporary Works

Provide advice on a suitable erosion and sediment control measures during landfill removal works including during construction of the Contractor Yard and diversion of stormwater away from the landfill excavation area.

Provide advice on possible geotechnical risks during the landfill removal.

Permanent Landform

1. Provide recommendations on final landform slope angles from a slope stability perspective once the landfill waste is removed. Slope angles must consider the final landform landscaping agreed with stakeholders and be suitable for landscaping purposes.
2. Provide recommendations on a suitable gully base angle to slope catchment stormwater disposal through the final cleared gully, provision for landform modification through benching with cut or fill into or using natural gravels to reduce the flow velocity and erosion.

4.0 Stormwater Design Intent and Considerations - Landfill

4.1 General

The following gives the stormwater design intent to be followed through landfill removal and formation of the final landform. As the actual thickness / extent of the landfill mass is unconfirmed it is likely there will be some amendments during earthworks as such a final design can't be provided at this stage.

4.2 Catchment Analysis

To assess sizing of the temporary and permanent surface water controls, the overland flow paths from the upgradient catchment, currently discharging through the landfill site have been evaluated using LiDAR for four different event durations as follows:

- The 1 in 5-year average recurrence interval (ARI) flow is estimated as 0.4 m^3/s.
- The 1 in 10-year ARI flow is estimated as 0.7 m^3/s.
- The 1 in 100-year ARI flow is estimated as 3.5 m^3/s.

- The 1 in 250-year ARI flow is estimated as 4.5 m^3/s.

It is recommended the flows used for the construction phase stormwater temporary works design are in the order of magnitude of the 1 in 10-year ARI. It is recommended that the 100-year ARI flows are used for the design of the final landform surface post construction. If the client would prefer a lower level of risk, the 250-year ARI flow could be considered for design for the final landform.

4.3 Landfill Temporary Stormwater Control

During construction, the upgradient catchment stormwater is proposed to be diverted around the landfill site by installing a suitably sized diversion swale along the western boundary of the landfill site. An indicative location for this diversion swale is shown in Figure 1, attached. At this stage, no changes are proposed to the existing 340 mm internal diameter culvert under Dennistoun Road near the landfill site. The diversion swale is proposed to tie into the existing levels of this culvert. The diversion swale will then discharge into the Rangitata River at a point downstream of the exposed landfill works. The diversion swale and controls will be designed in accordance with Environment Canterbury's (ECan's) Erosion and Sediment Control Toolbox (ESCT).

The diversion pathway from the top of the landfill to the Rangitata River will be stabilised to minimise any erosion. Where required, imported material or a flume will be used. The exact flow pathway will likely change throughout the duration of works due to the nature and location of the remediation works proposed.

It is expected that during prolonged rainfall, localised stormwater flows will form within the landfill excavation area during the works. The following control measures are recommended to control landfill stormwater:

- Exposure of the landfill waste must be minimised as much as practicable with provision for temporary cover of exposed areas where rain is forecast. This temporary cover may include geofabric, anchored with sandbags / rocks or small earth bunds.
- Excavation control so that the working surface is near level and graded back on itself to reduce runoff from the site.

4.4 Permanent Landform Stormwater

The permanent landform is intended to include natural in-situ materials with a base channel to convey most of the stormwater flow. Appropriate rip rap sizing will be included to reduce the effects of erosion along this channel, as well as having grades as shallow as possible to aid with minimising erosion.

Once the landfill remediation is complete, stormwater is proposed to be redirected to its original flow path, through the current landfill area and discharging into the Rangitata River. The landform will be graded and formed such to minimise erosion by reducing the velocity of the stormwater flowing through the gully. Sinuosity will be incorporated into the final design where practicable to further reduce grade on the steeper sections.

5.0 Contractor Yard – Temporary Works

The following outlines preliminary recommendations to be incorporated into the temporary contractor yard development.

5.1 Yard Preparation

It is expected that the topsoil will need to be removed from the temporary contractor yard and temporarily stockpiled in a suitable location or used within the diversion bund construction. A separation layer such as Bidim A29 (or similar) will be placed across the yard after the removal of the topsoil. A running / working surface of imported aggregate should be placed to the contractors' requirements to form a near level platform preferentially graded to promote surface water drainage towards appropriate erosion and sediment control measures.

Depending on post works contamination testing, the imported aggregate may be suitable for re-use or may need to be cut to waste at the end of the landfill operations.

5.2 Stormwater Control

It is expected that the topsoil stripped from the site will be stockpiled and used to create stormwater diversion bunds in accordance with ECan's ESCT to manage and control stormwater from the contractor's yard. These bunds will be grassed to provide treatment of the stormwater.

Stormwater from the contractor yard diversion bunds will be directed to discharge into the temporary landfill diversion swale located on the upper western boundary of the landfill. Indicative bund locations are shown in Figure 1, attached. From here it will mix with the upgradient catchment stormwater and discharge into the Rangitata River (avoiding any open landfill area). The flow path from the top of the landfill to the Rangitata River will be stabilised to reduce erosion.

The bund sizing will be in general accordance with ECan's ESCT. Any bunds shall have a maximum side slope of 1V:3H and be compacted with an excavator bucket and grassed. The exact dimensions of the bund will be designed once the area of the contractors' yard is confirmed.

Following project completion, the topsoil from these bunds may be suitable for respreading across the site, subject to contamination suitability testing.

6.0 Final Landform Intent

To date the landfill sub-surface profile has only been confirmed using Ground Penetrating Radar (GPR) which can be in extremely variable. As such there needs to be flexibility in the earthworks required to complete the final landform after removal of the landfill waste. As such the following are general recommendations to be incorporated into form the final landform:

- All landfill waste must be removed as per the RAP with temporary stormwater control measures discussed in Section 4.3 implemented.
- All cut batters into natural gravels must not exceed a gradient of 2.5 horizontal to 1 vertical or a slope angle of 23°. This is to ensure topsoil retention for the landscaping.
- The crest line of all cut batters must be within the landfill cadastral boundaries, a 4 m wide access strip must be allowed for between the northern boundary and the crest of the slope.
- The final landform within the landfill must promote all surface water flow towards the central gully for discharge to the Rangitata River.
- The base angle of the central gully must be such to reduce flow velocity and subsequent surface erosion and discharge of sediment to the river.
- It is expected that the gully channel will disperse directly over the edge of the existing terrace and into the loose gravel material already at the toe. It is probable that in an extreme flood or multiple floods that the toe material will be excavated but prior to this potentially occurring, the toe material will add some initial protection to the terrace.
- Fill will be sourced from natural river gravels cut during the earthworks, assuming the results of contamination testing indicate this material is suitable to remain on site. This material must be stockpiled and placed as outlined in Section 7.0.

- Topsoil should be placed in discrete areas where planting will take place as per the landscaping plan. It is not recommended to place topsoil across the entirety of exposed slopes or within stormwater flow paths within the gully floor.

7.0 Earthworks Specification Recommendations

7.1 General Requirements

The handling and disposal of all identified landfill material is covered in the PDP RAP. These earthwork specifications are only for the cutting into natural river gravel and placing of fill.

Erosion, sediment, and dust control is excluded from this specification, the RAP should be referred to.

The earthworks specification is not fully in accordance with NZS4431:2022 and is not suitable for building on. The purpose of this specification is to ensure the formation of a stable fill area.

7.2 Excavation

It is anticipated that approximately 18,000 m^3 (in situ) of waste could be excavated and removed from the landfill. This does not include an over dig into natural soils impacted by leaching (potentially up to 5,000 m^3). The extent and volumes of excavation is dependent on the actual depth of the landfill waste. The RAP is considered the leading document to guide controls that should be implemented as the landfill waste is being removed.

The existing temporary slope protection measures should be kept in place as long as possible during the earthworks.

Cut areas shall be progressively excavated to form a uniformly graded surface within the batter limits as directed by PDP. The Contractor shall form the excavations in a logical and orderly manner to minimise wastage and ensure safe stable temporary cut batters within the landfill mass and natural ground cuts.

Any unexpected variations in material types, evidence of slope instability, buried vegetation, groundwater flows, or seepages should be immediately reported to the PDP Engineer.

7.3 Cut to Fill – Natural River Gravels

Excavation shall be by excavator and truck operations, planned and managed to the Engineer’s approval such as to maximise the extraction and separation volumes of the various material types. The natural river terrace between the landfill mass and the river must be preserved, i.e. cuts into the natural gravels must be kept to a minimal. The direction and extent of earthworks cuts must be approved by the supervising engineer to ensure no effects on neighbouring properties during cutting.

The Contractor shall undertake continuous visual inspections of materials and shall immediately report to the Engineer any visual changes, slope movement or groundwater that affects the borrow source.

Temporary stockpiles of natural gravels to be used as fill must be kept at least 3 m away from the crestlines of the river terrace and working slopes.

7.4 Spreading of Fill

Prior to compaction, the fill materials shall be spread uniformly in horizontal layers not exceeding 300 mm uncompacted thickness.

To ensure adequate compaction of the materials forming the final fill surface profile, all fill batter faces shall be overfilled as necessary and carefully trimmed back to the required design profile.

7.5 Benching

Where fill abuts sloping ground with a gradient steeper than 1V:4H, the ground being filled shall be benched into for a sufficient distance so that the vertical height of the bench is at least twice the thickness of the compacted fill layer.

7.6 Compaction

The Contractor shall employ sufficient dedicated compaction plant so as to achieve the specified compaction. Compaction plant shall cover the entire area of each layer of fill and give each layer a uniform degree of compactive effort. The combined operations of spreading and compacting shall be undertaken using systematic and properly managed procedures, to the Engineer's approval, so as to ensure that each loose layer receives the required passes of the roller or other approved compaction equipment before further loose material is spread.

7.7 Compaction standards and testing

The tests and testing frequency described and defined in Sections 7.8 and 7.9 will be used to confirm that the placed fill materials meet the required standard, design criteria and parameter values. At any time either prior to or during construction, the Engineer may direct modifications to the compaction standards, frequencies and test methods defined in this Section with the object of ensuring that the design criteria and objectives for the materials and conditions encountered, are achieved.

A compaction trial should be considered to provide a method specification for the compaction of the cut gravels.

7.8 Compacted Fill Acceptance Criteria

The following is acceptance criteria for placed compacted fill:

- The number of blows per 100 mm to drive the Scala penetrometer from a depth of 100 to 300 mm below the fill surface shall be not less than five when carried out to NZS 4402:1986, Test 6.5.2.
- The average Clegg Impact Value from a Clegg Impact Test completed in accordance with ASTM D5874-95 shall not be less than 25.

The base of any excavation prepared for filling shall also be compacted to the relevant standards specified above for fill. If this surface fails the above criteria or contains organic or other unsuitable material as defined by the Engineer, undercutting to a depth specified by the Engineer shall be required.

7.9 Frequency of testing

The frequency of testing shall be as described below and is the minimum considered acceptable. Additional tests and/or changes to the testing frequency may be instructed by the Engineer as the works proceed.

Should any test result fail to meet the required design criteria, the Contractor shall propose remedial measures for the Engineer's approval. Such measures are expected to usually comprise the removal, replacement and satisfactory retesting of any fill within the agreed area of influence of the failed test location.

The minimum required frequency of testing is:

- Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) – heavy compaction, one (1) initial test for each material type and then one (1) test per 5,000 m^3 for that material type.
- Clegg Impact Value, Hardfill compaction, One (1) test per 20 m^2 per 200 mm layer.

The Contractor shall re-work and re-compact areas disturbed by any testing undertaken within the site, to the Engineer's approval.

7.10 Shaping & Topsoiling

The finished shape of the earthworks shall be determined during the earthworks to the intent given in this document or as instructed by the Engineer. The earthworks profiles shall generally be trimmed to match and blend with adjacent sections of undisturbed existing ground.

Topsoiling shall be in accordance with the final landscaping plan to be provided by TDC / AECL, although topsoil shouldn't be placed within the expected drainage pathways.

7.11 Inspections and approvals

The following earthworks inspections are required throughout the construction works.

- Inspection of the temporary stormwater control measures.
- Inspections during landfill removal as outlined in the RAP.
- Inspection of the striped landfill waste when natural gravels are exposed.
- Inspection of benching as required prior to fill placement.
- Inspection to inform the final cut / fill landform.

The frequency of inspections is dependent on the final earthworks programme.

8.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Timaru District Council. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Timaru District Council**.** for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Yours faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared & approved by	Reviewed by
Andrew Smith	**Ingrid Cooper**
Technical Director – Geotechnics	Service Leader - Water Infrastructure

\\chcfiles\jobs\C02450-C02499\C02450_Timaru DC_Landfills\100_Peel_Forest_Landfill\006_Design\GIS\C02450100_Stormwater_Geotech_Figure.qgz

pdp

FIGURE 1: PEEL FOREST LANDFILL

GENERIC ESC MEASURES

NOTES:
1. AERIAL IMAGERY SOURCED FROM THE LINZ DATA SERVICE [https://data.linz.govt.nz] AND LICENCED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.

0 15 30 m
METERS
SCALE : 1:800 (A4)

REVISION: 01 | DATE: 18/12/23 | BY: DT
CLIENT: TDC

Appendix E: Erosion Sediment Control

CHECKLIST 1: ‘Clean water’ or ‘dirty water’ diversion channel and bund

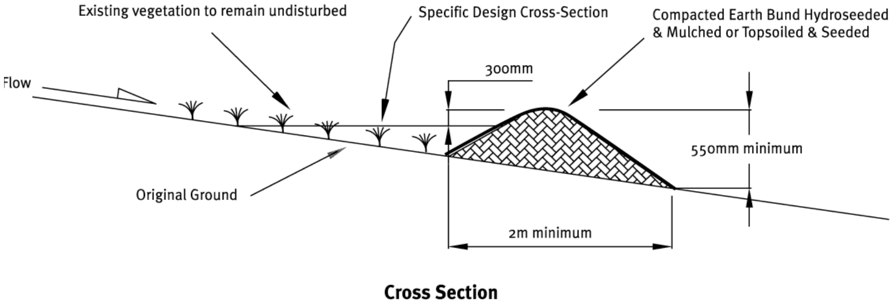
Contractor:	Date:	Consent number:	Site:
	Time:		

Construction checklist Check back to Managing ‘clean water’ and Managing ‘dirty water’ sections for full information. Also see the Figures over the page.	Yes ✓	No ✗ (Add comments to explain)
Route avoids trees, services, fence lines or other natural or built features		
Channels are trapezoidal or parabolic in shape		
Internal side slopes are no steeper than 3:1 External side slopes are no steeper than 2:1		
Drains are constructed with a uniform grade along the invert (as sudden decreases may cause sediment to accumulate causing the bank to overtop)		
Bunds are well compacted		
Outlets are stable and protected as needed		
Diversions are stabilised to prevent erosion		
Perimeter diversions are regularly maintained		
If necessary, specific geotechnical design is followed to ensure the stability and integrity of the structure		
Inspection and maintenance checks are done, dated and recorded, along with any comments		

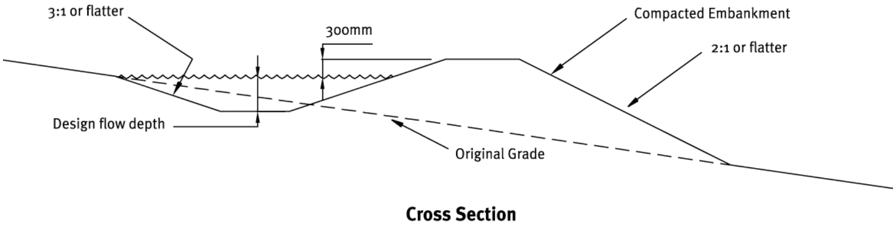
Note: this is an on-site, self-check list for contractors to use. Keep your completed checklists to show Compliance Officers your set up, monitoring and maintenance, if requested.

Signature:

CHECKLIST 1 FIGURES: 'Clean water' or 'dirty water' diversion channel and bund



Cross section of a clean water diversion



Cross section of dirty water diversion

CHECKLIST 5: Stabilised entranceway

Contractor:	Date: Time:	Consent number:	Site:

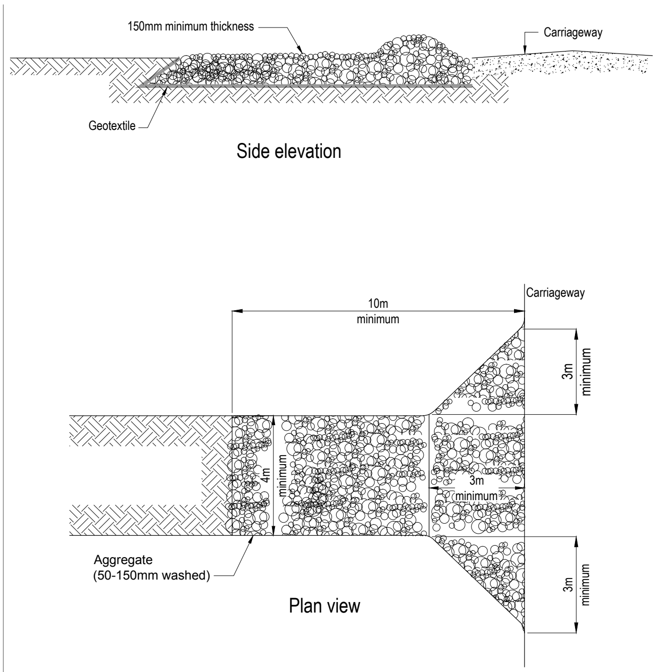
Construction checklist Check back to 'Stabilised entranceway' section for full information. Also see the Figures over the page.	Yes ✓	No ✗ (Add comments to explain)
Area has been cleared of unsuitable material and smooth graded		
Woven geotextile has been placed over the area, and is properly pinned and overlapped		
At least 10 m of aggregate has been placed (extending from site boundary), 4 m wide and minimum 150mm deep, using 50–150 mm washed aggregate		
Vehicles cannot bypass the entranceway		
Street sweep/suction is done and date recorded		
Inspection and maintenance checks are done, recorded and dated, along with any comments		

Note: this is an on-site, self-check list for contractors to use. Keep your completed checklists to show Compliance Officers your set up, monitoring and maintenance, if requested.

Signature:

CHECKLIST 5 FIGURES: Stabilised entranceway

Stabilised entranceway *(Source: SouthernSkies)*



Stabilised entranceway

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

CHECKLIST 17: Silt fence

Contractor:	Date: Time:	Consent number:	Site:

Construction checklist Check back to sections 5.3 [link] for full information. Also see the Figures over the page.	Yes ✓	No ✗ (Add comments to explain)
The silt fence material suits the site conditions and is used to the manufacturer's specifications		
Silt fences are installed along the contour		
There is a trench at least 100 mm wide and 200 mm deep along the proposed line of the silt fence		
Support posts/steel waratahs are installed at least 1.5 m long and 2–4 m apart		
Support posts/waratahs are installed on the downslope edge of the trench, with silt fence fabric on the upslope side of the support posts to the full depth of the trench. The trench is backfilled with compacted soil		
The top of the silt fence fabric is reinforced with a support made of high tensile 2.5 mm diameter galvanised wire. The wire is tensioned using permanent wire strainers attached to angled waratahs at the end of the silt fence		
The silt fence fabric is doubled over and fastened to the wire with silt fence clips at 500 mm spacings		
Where ends of the silt fence fabric come together, they are overlapped, folded and stapled/screwed to prevent sediment bypass		
Inspection and maintenance checks are done, recorded and dated, along with any comments		

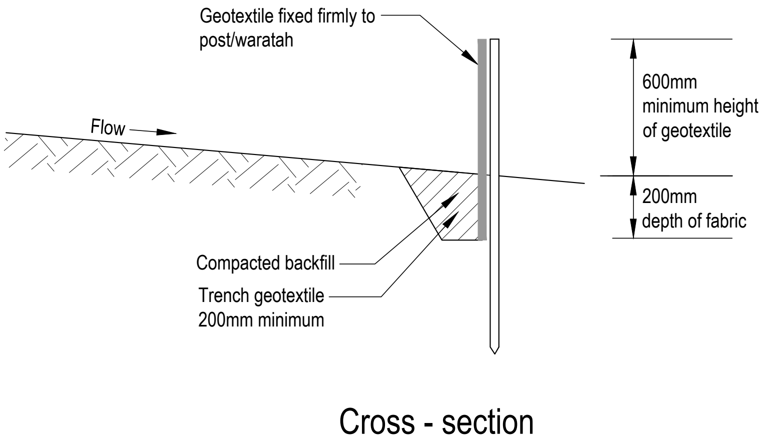
Note: this is an on-site, self-check list for contractors to use. Keep your completed checklists to show Compliance Officers your set up, monitoring and maintenance, if requested.

Signature:

CHECKLIST 17 FIGURES: Silt fence

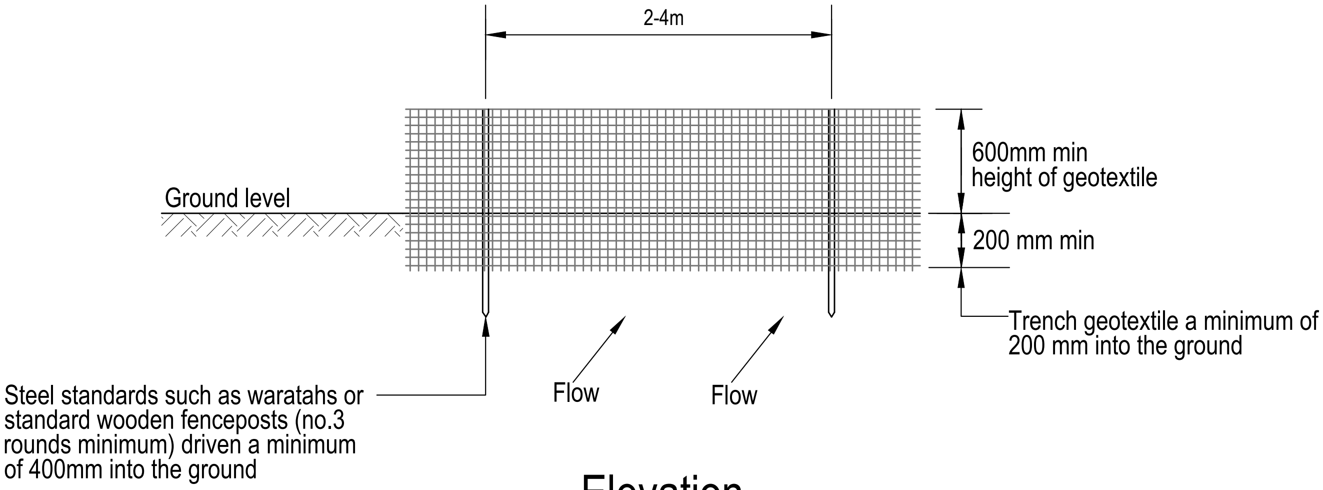
Slope steepness %	Slope length (m) (maximum)	Spacing of returns (m)	Silt fence length (m) (maximum)
Flatter than 2%	Unlimited	N/A	Unlimited
2 - 10%	40	60	300
10 - 20%	30	50	230
20 - 33%	20	40	150
33 - 50%	15	30	75
> 50%	6	20	40

Silt fence design criteria

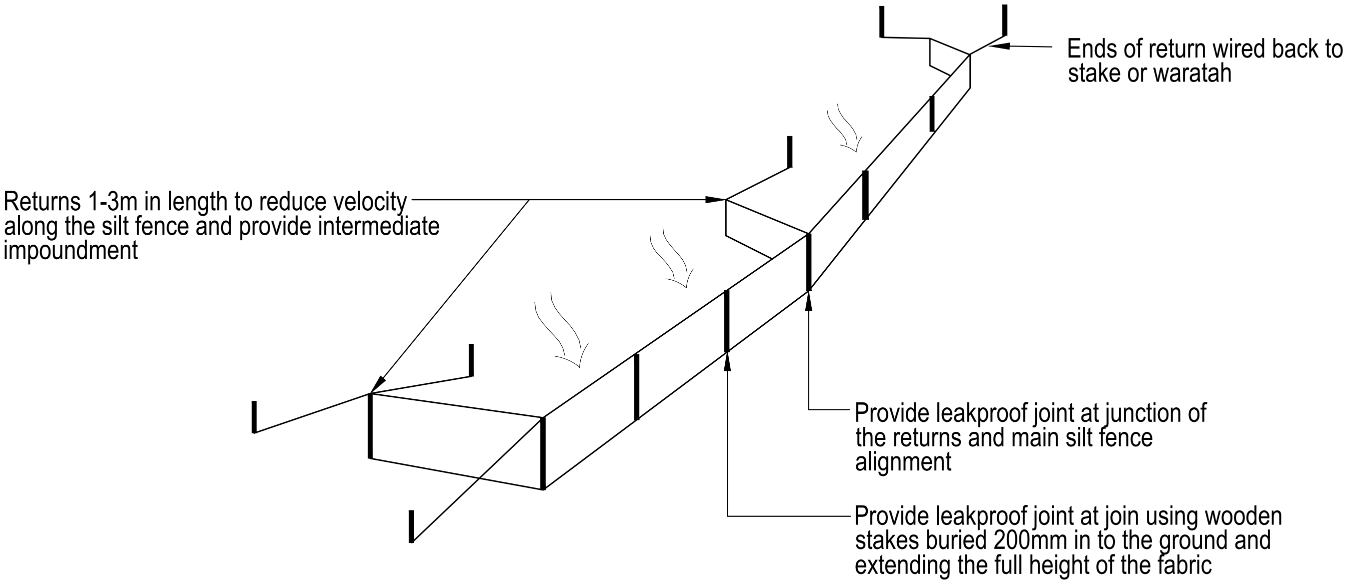


Silt fence cross section

CHECKLIST 17 FIGURES: Silt fence



Elevation



Silt fence with returns and support wire

Schematic of a silt fence

Appendix F: Spill Report Form

Environmental Incident Report

Date **Time of Incident**

Description of Incident (cause)

Contaminants spilt

Description of Response Procedure

Description of Clean up and Disposal

List of Authorities Informed

Comments

Signed: ……………………………… **Position:** ………………………………

Appendix G: Redruth Landfill Disposal Approval & Manifest Form

MANIFEST FOR MOVEMENT OF CONTAMINATED SOIL

SECTION 1 To be completed by the Waste Removal Contractor

MANIFEST No.(e.g. CJ310123/1)……………………………..

PDP PROJECT No……………………………………… PDP SITE SUPERVISOR………………………………

SITE NAME……………………………………………… SITE No…………………………………………………..

CLIENT ....

LOCATION ....

....

CONTRACTOR ....

DESCRIPTION OF REMOVED SOIL Backfill Natural Ground

Clay Silt Sand Scoria Rock GAP 7

DESCRIPTION OF CONTAMINANT Petrol Diesel Other ....

COMMENTS ....

DECLARATION BY REMOVAL CONTRACTOR

I declare that the above waste is accurately described and is in a proper condition for transport in accordance with the applicable national and local regulations.

Name .... Signature .... Quantity of Waste .... m³

Title .... Date .... Weight of Waste .... kg

SECTION 2 To be completed by Environmental Consultant (following approval from client).

I approve the removal from site of the waste consignment described above;

Name .... Signature .... Quantity of Waste .... m³

Title .... Date .... Weight of Waste .... kg

SECTION 3 To be completed by Transporter

I acknowledge the receipt of the waste consignment described above;

Name .... Signature .... Quantity of Waste .... m³

Title .... Date .... Weight of Waste ....kg

SECTION 4 To be completed by Disposer/Storer

I declare that the waste consignment described above has been received

Location ....

Name .... Signature .... Quantity of Waste .... m³

Title .... Date .... Weight of Waste .... kg

Method of Disposal (please circle) landfill managed fill treatment storage recycling

SECTION 5

RETURN THE COMPLETED FORM TO:

PATTLE DELAMORE PARTNERS LIMITED
PO BOX 389, CHRISTCHURCH, 8140

PATTLE DELAMORE PARTNERS LIMITED
PO BOX 9528, AUCKLAND, 1149

PATTLE DELAMORE PARTNERS LIMITED
PO BOX 6136, WELLINGTON, 6141

THIS FORM HAS TO BE COMPLETED IN CONJUCTION WITH THE ACCOMPANYING DANGEROUS GOODS FORM AND RETURNED AS ABOVE

TIMARU DISTRICT COUNCIL

2 King George Place
PO BOX 522 Timaru

‘WASTE MANIFEST’

APPLICATION FOR DISPOSAL OF HAZARDOUS OR SPECIAL WASTE

GENERAL INFORMATION

1. The customer must complete section 1 and 3 of the form below and send it to sachin.narkhede@timdc.govt.nz for approval. On receiving approval contact Ku Brown at EnviroWaste to arrange the time for disposal. Ku Brown - Ku.Brown@envirowaste.co.nz ; 027 404 7459. Notice period to contractor (EnviroNZ) should be atleast 24hrs prior to disposal.
2. Hazardous waste/Asbestos waste has to be double wrapped during transportation and disposal. PPE’s must be used all the times during handling hazardous waste.
3. The applicant shall provide all relevant information and documentation, including details showing that disposal is the last option.
4. The applicant shall not give less than three working days notice to waste team for approval to dispose of the Waste at the disposal sites.
5. Waste will not be accepted for disposal on Saturday, Sunday or on a public holiday.
6. Waste transport vehicles shall provide suitable sample points.
7. The Applicant hereby states that all the information contained in the Manifest is true and correct in every respect and that no material information (including any known or suspected hazards) has been omitted, and the Applicant acknowledges that the Timaru District Council relies entirely on the accuracy of such information in exercising its judgement on the appropriate methods of treatment and disposal and the associated risks.
8. The Applicant hereby accepts full responsibility for any loss or damage, of whatsoever kind (including direct, indirect, special or consequential loss) arising as a result of any inaccuracy in or omission from the information provided by the Applicant and agrees to fully indemnify the Timaru District Council for any claims which may be made against The Timaru District Council arising from such inaccuracies or omissions.
9. This manifest is valid for 3 months from the date of issue.
10. The Charge Per Tonne is based on the current 2023 – 2024 Fees and Charges and is therefore subject to change with effect from 1st July 2024.

IMPORTANT INFORMATION

1. All Wastes will be considered but not necessarily accepted for disposal.
2. The Applicant shall provide attached documentation to prove that all options of Reuse/Recycle/Recovery has been fully investigated before considering disposal as a last option.
3. The Applicant shall attach any appropriate material safety data sheets with the application.
4. The Applicant shall attached suppliers/manufacturers recommendations for disposal.
5. Should a Generator, Waste Disposal Contractor or Transporter fail to comply with the 'conditions' (listed over) then Wastes may no longer be accepted for disposal from that person or company.
6. Any person discharging or depositing undeclared Waste at any Timaru District Council site may be prosecuted.
7. Random sampling and analysis of wastes will be carried out to ensure compliance to the Waste Manifest.
8. The Transportation of non-segregated incompatible loads of Hazardous Waste is prohibited in terms of New Zealand Standard 533: 1988. (7.2) and may lead to prosecution pursuant to the Transport Act (1998).
9. The Timaru District Council has a responsibility under Section 31 f the Resource Management Act 1991, to control any actual or potential effects of the use of land, including the implementation if rules of the prevention and mitigation of adverse effects of the disposal of Hazardous or Special Substances.

COUNCIL CONTACTS

For enquiries regarding waste disposal contact the

WASTE MINIMISATION UNIT at the Timaru District Council.

PHONE: 03 687 7200 EMAIL: sachin.narkhede@timdc.govt.nz or WasteMin@timdc.govt.nz

Section 1: APPLICANT DECLARATION BY PERSON DISPOSING OF SOLID WASTE		
Waste Manifest number TDC to assign refer # 1477058	66 2324	
Is it one-off disposal or multiple? TDC to organise JDE number for customer if they require account at weighbridge and if its multiple disposal	Multiple disposals	
Applicant Information (Name of Individual/Company/Business paying the disposal fees	Timaru District Council (Waste Unit)	
Phone/cell phone	3687-7700	
Address	PO Box 522	
Consultant Name & Address	Pattle Delamore Partners, Christchurch	
Waste Description	Closed landfill solid waste	
Waste form : Solid or Liquid	Solid	
Waste category **Refer the instructions at the end of the form**	**Waste Category (Table A):** 17	**L-CODE:** 17 06
	Hazard Class (Table B): **9**	**Estimated quantity (m^3) :** 30,000
Current storage location	Peel Forest Closed Landfill	
I hereby declare the above consignment is accurately described.		
Name	Vincie Billante	
Designation	Special Projects Consultant, TDC	
Signature		
Date	20 Nov 2023	

Section 2: WASTE ASSESSMENT BY TIMARU DISTRICT COUNCIL	
Product inspected: No	**Information Checked: Yes**
Code: WIC (Waste In Closed Landfill)	**Charge per tonnes $ 323/tonne**
Disposal/Recovery Recommendations: Bury as per hazardous waste regulations in the designated area	
I certify that the consignment described above (delete/strike out non-applicable). **Is Acceptable for Disposal**	**~~Is not Acceptable for Disposal~~**
Name	Sachin Narkhede
Designation	Waste Assets and Compliance Technician
Signature	Sachin
Date	13.12.2023

Section 3: TRANSPORTER INFORMATION **CANNOT BE COMPLETED UNTIL TENDERED** **This section to be completed by Transporter of the Waste prior to arrival at site, email this to all parties (use Reply all).**	
Company Name	
Vehicle Reg No.	
Date	
Estimated volume of load	
I acknowledge receipt of the above described waste for transport, and that it is suitable for transport	
Name	
Designation	
Signature	
Date	

Transporter to contact Ku Brown, by phone 027 404 7459 to arrange time of delivery.

Section 4: DISPOSAL INFORMATION **This section to be completed by the weighbridge operator and emailed to all parties (use reply all).**	
Disposal Date	
Weighbridge docket No	
Nett Weight of Load	
Sample Taken: Y/N	
I acknowledge receipt of the above described waste	
Signature	
Designation	
Date	

DISPOSAL CONDITIONS:

SOLID WASTE:

1. No liquid wastes shall be accepted for disposal to landfill. For waste to be considered non-liquid it must meet one of the following requirements:
    - a solids content of at least 20% and liberate no free liquids when transported; or
    - no free liquids when tested in accordance with the US EPA Paint Filter Liquids Test (US EPA Method 9095A 1996) and liberate no free liquids when transported.
2. Medical wastes shall only be accepted in accordance with NZS 4304:2002 ‘Healthcare Waste Management’, or subsequent amendments.

3. Asbestos waste shall be accepted only in accordance with the Asbestos Regulations 1998, or subsequent amendments.

4. The following waste are not acceptable for disposal at the landfill:

   i) wastes marked with an asterisk on the NZ Waste List (L Code), with the following exceptions:

      - solid wastes which, following testing using the US EPA Toxicity Characteristic Leaching Procedure (TCLP), result in leachable concentrations of contaminants less than the leachable concentration values listed in Hazardous Waste Guidelines (MIE, 2004); or
      - solid wastes which, following testing for total concentration, result in total concentration values less than the screening criteria listed in Hazardous Waste Guidelines (MIE, 2004): or
      - any asterisked waste stream from the waste list identified as containing asbestos – if they are labelled, packaged and disposed in accordance with the requirements laid out in the Asbestos Regulations 1998: or
      - small quantities of waste products containing potentially hazardous components that are not likely to have adverse effects on the environment, such as can reasonably be expected to be contained in the municipal waste stream.

   ii) wastes or substances classified as explosive, flammable, oxidizing or corrosive under the Hazardous Substances and New Organisms Act 1996.

TABLE A – NEW ZEALAND WASTE LIST WASTE CATEGORIES

01 Wastes resulting from exploration, mining, quarrying, and physical and chemical treatment of minerals

02 Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing

03 Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard

04 Waste from leather, fur and textile industries

05 Waste from petroleum refining, natural gas purification and pyrolytic treatment of coal

06 Wastes from inorganic chemical processes

07 n/a

08 Wastes from the manufacture, formulation, supply and use of coatings (paints, varnishes and vitreous enamels), adhesives, sealants and printing inks

09 Waste from the photographic industry

10 Wastes from thermal processes

11 Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydro-metallurgy

12 Wastes from shaping and physical and mechanical surface treatment: of metals and plastics

13 n/a

14 Waste organic solvents, refrigerants and propellants (except 07 and 08)

15 Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified

16 Wastes not otherwise specified in the list

17 Construction and demolition wastes (including excavated soil from contaminated sites).

18 Wastes from human or animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care)

19 Wastes from waste management facilities, off-site waste water treatment plants and the preparation of drinking water and water for industrial use

20 Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions

NZ WASTE LIST L-CODE:

These codes area available on the Ministry for the Environment (MfE) website (www.mfe.govt.nz) under 'Hazardous Wastes"
https://environment.govt.nz/guides/new-zealand-waste-list-l-code/

Further information and procedures for identifying hazardous waste is given in MfE 'Guidelines for the Management of Hazardous Waste'.

TABLE B – LIST OF HAZARD CLASSIFICATIONS

Hazard Characteristics Class

1 Explosives

An explosive substance or waste is a solid or liquid substance or waste(or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and as such a speed as to cause damage to the surroundings.

3 Flammable Liquids

The word 'flammable' has the same meaning as 'inflammable'. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of the dangerous characteristics) which give off a flammable vapor at temperatures of not more than 61 degrees Celsius.

4.1 Flammable Solids

Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.

4.2 Substances or Wastes Liable to Spontaneous Combustion

Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire.

4.3 Substances or Wastes which, in Contact with Water, Emit Flammable Gases

Substances or wastes which, by interaction with water, are liable so become spontaneously flammable or to give off flammable gases in dangerous quantities.

5.1 Oxidizing Substances

Substances or wastes which, while in themselves are not necessarily combustible, may generally by yielding oxygen cause, or contribute to, the combustion of other materials.

5.2 Organic Peroxides

Organic substances or wastes which contain the bivalent –o-o- structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition.

6.1 Acutely Toxic

Substances or wastes liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact.

6.2 Infectious Substances

Substances or wastes containing viable micro-organism or their toxins which are known or suspected to cause disease in animals or humans.

7 Radioactive Material

Spontaneously emits radiation greater than background level. Includes alpha, beta, gamma, x-rays, neutrons, high energy electrons, protons, other atomic particles.

8 Corrosives

Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or in the case of leakage, will materially damage, or even destroy, other goods or the means of transport, they may also cause other hazards.

9 Ecotoxic

Substances or wastes which if released, present or may present, immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.

ASBESTOS NOTES

WASTE CATEGORY: TABLE A…………………………………….17
NZ WASTE LIST L-CODE…………………………………………………..17 06
INSULATION MATERIALS CONTAINING ASBESTOS…................17 06 01
CONSTRUCTION MATERIALS CONTAINING ASBESTOS …………..17 06 05
https://www.worksafe.govt.nz/topic-and-industry/asbestos/

Appendix G: Accidental discovery form

APP4 - Form confirming a commitment to adhering to an Accidental Discovery Protocol

Name of person / company authorising the earthworks (landowner or manager):

____

Name of person / company physically undertaking earthworks:

____

Location at which works will occur:____

____

______

Methods to ensure awareness of and compliance with protocol:______________

____

____

______

Contact details: **Contact name**:____

Contact number/s:______________________________________

Contact email:____

Agreed Accidental Discovery Protocol:

In the event of an accidental discovery of any archaeological material (evidence of archaeological material can include oven stones, charcoal, shell middens, ditches, banks and pits, building foundations, artefacts of Māori and Non-Māori origin or human burials) during the undertaking of earthworks the following steps will be taken:

1. All work on the site will cease immediately. The contractor/works supervisor will shut down all equipment and activity.

2. The contractor/works supervisor/landowner will take immediate steps to secure the site (tape it off) to ensure the archaeological material is left undisturbed and the site is safe in terms of health and safety requirements.

3. The contractor/works supervisor/landowner will notify Heritage New Zealand, Te Rūnanga o Arowhenua and any required statutory agencies if this has not already occurred.

4. Site access will be provided to Heritage New Zealand and Te Rūnanga o Arowhenua to enable appropriate procedures and tikanga to be undertaken.

5. If the material is confirmed by Heritage New Zealand as being archaeological, under the terms of the Heritage New Zealand Pouhere Taonga Act, the landowner will ensure that an archaeological assessment is carried out by a qualified archaeologist, and if appropriate, an archaeological authority is obtained from Heritage New Zealand before work resumes.

6. If evidence of burials or human remains/kōiwi tangata are uncovered, following steps 1 to 2 being taken, Heritage New Zealand, the New Zealand Police and Te Rūnanga o Arowhenua will be contacted immediately. The area must be treated with discretion and respect and the kōiwi tangata/human remains dealt with according to law and tikanga.

7. Works at the site area will not recommence until an archaeological assessment has been made, all archaeological material has been dealt with appropriately, and approval to recommence has been given by Heritage New Zealand and, if human remains are involved, the New Zealand Police. All parties will work towards work being recommenced in the shortest possible timeframe while ensuring that archaeological and cultural requirements are complied with.

I/we confirm that I/we have read and understood the information above and make a commitment to adhere to the Accidental Discovery Protocol as set out above when undertaking earthworks.

Signature:____

Name (please print):____

Date:____

Appendix H: Proposed draft conditions

Environment Canterbury

LIMITS

1. The discharge shall only be construction phase stormwater generated from exposed areas to land at eastern end of Dennistoun Road, Peel Forest, legally described as Survey Office Plan 3144 (landfill) and Lot 3 DP 343513 (Contractor's yard) as shown on Plan CRCXXXX, which is attached to and forms part of this resource consent.
2. Sediment laden stormwater shall be discharged:
    a. In accordance with the Erosion and Sediment Control Plan (ESCP) required by Condition (X) of this resource consent; and
    b. Onto and/or into land within Survey Office Plan 3144 (landfill) and Lot 3 DP 343513 (Contractor's yard) as shown on Plan CRCXXXXXX attached to and forming part of this consent.
3. The discharge of construction phase stormwater under this consent shall not:
    a. Enter neighbouring properties;
    b. Result in sediment or any other contaminant contained in the discharge being discharged beyond the boundary of the site.
    c. Exacerbate flooding on surrounding sites; and
    d. Be discharged directly to groundwater.
4. Stormwater shall not pond on site for longer than 48 hours after the cessation of any storm event.

PRIOR TO THE COMMENCEMENT OF WORKS

5. Prior to the works described in condition (1) the consent holder shall ensure that all personnel working on the site are made aware of and have access to the contents of this consent document and all associated erosion and sediment control plans and methodology.
6. The Canterbury Regional Council, Attention Regional Leader Monitoring and Compliance shall be notified no less than 48 hours prior to the commencement of works.

EROSION AND SEDIMENT CONTROL

7. The discharges during the construction phase of the development shall occur in accordance with the Erosion and Sediment Control Plan (ESCP), prepared by Pattle Delamore Partners and dated August 2022, which is attached to and forms part of this resource consent.

1. The ESCP may be amended at any time. Any amendments shall be:
    a. Only for the purpose of improving the efficacy of the erosion and sediment control measures and shall not result in reduced discharge quality; and
    b. Consistent with the conditions of this resource consent; and
    c. Submitted in writing to the Canterbury Regional Council, Attention: Regional Leader Monitoring and Compliance, prior to any amendment being implemented.
    d. The applicant shall apply best practice and all practicable measures to mitigate sediment transport off-site.

2. Stockpiling of contaminated material shall be avoided where possible. In the event that stockpiling of suspected or confirmed contaminated material is required, then the stockpiles shall be managed as below:
    a. Stockpiled material shall be placed on bidim or plastic sheeting or similar to prevent contamination of underlying ground by the stockpiled materials;
    b. Stockpiles shall have a perimeter bund or berm installed to prevent stormwater runoff leaving the area and stormwater from other areas entering the stockpile area;
    c. Stockpiled material shall be covered or wetted during dry and windy conditions; and
    d. If significant rainfall is forecast, the stockpiled material shall be covered by a suitable material to prevent the ingress of rainwater into the material.

ACCIDENTAL DISCOVERY OF CONTAMINATED MATERIAL

3. In the event that any unexpected, contaminated soil or material is uncovered by the works, an accidental discovery protocol shall be implemented, including but not limited to the following steps:
    a. Earthworks within ten metres of unexpected contaminants shall cease immediately;

b. All practicable steps shall be taken to prevent the contaminated material becoming entrained in stormwater. Immediate steps shall include, where practicable:

   i. diverting any stormwater runoff from surrounding areas away from the contaminated material; and

   ii. minimising the exposure of the contaminated material, including covering the contaminants with an impervious cover;

c. Notification of the Canterbury Regional Council, Attention: Contaminated Sites Manager, within 24 hours of the discovery;

d. Earthworks within ten metres of unexpected contaminants shall not recommence until a suitably qualified and experienced contaminated land practitioner (SQEP) confirms to Canterbury Regional Council, Attention: Regional Leader – Compliance Monitoring that continuing works does not represent a significant risk to the environment;

e. All records and documentation associated with the discovery shall be kept and copies shall be provided to the Canterbury Regional Council upon request.

SPILLS

4. All practicable measures shall be taken to avoid spills of fuel or any other hazardous substances within the site. These measures shall include:

   a. Refuelling of machinery and vehicles shall not occur within 20 metres of:

      i. open excavations;

      ii. exposed groundwater;

      iii. surface water bodies; or

      iv. stormwater devices.

   b. A spill kit shall be kept on site that is capable of absorbing the quantity of oil and petroleum products that may be spilt on site at any one time, remains on site at all times.

5. In the event of a spill of fuel or any other hazardous substance, the spill shall be cleaned up as soon as practicable, the stormwater system shall be inspected and cleaned and measures taken to prevent a recurrence:

   a. The Canterbury Regional Council, Attention: Regional Leader Monitoring and Compliance, shall be informed within 24 hours of a spill event and the following information provided:

      i. The date, time, location and estimated volume of the spill;

    ii. The cause of the spill;
    iii. The type of hazardous substance(s) spilled; Clean up procedures undertaken;
    iv. Details of the steps taken to control and remediate the effects of the spill on the receiving environment;
    v. An assessment of any potential effects of the spill; and
    vi. Measures to be undertaken to prevent a recurrence.

UPON COMPLETION OF WORKS

6. Erosion and sediment control measures shall not be decommissioned until the site is stabilised and the stormwater system for the developed site is functioning. Decommissioning the measures shall be undertaken in the following order:
    a. All disturbed areas shall be stabilised and/or re-vegetated as soon as practicable following completion of the works;
    b. Any visible debris, litter, sediment and hydrocarbons shall be removed from all sediment control measures and disposed at a suitable facility; and
    c. Erosion and sediment control measures shall be removed.
7. Upon completion of works and the removal of erosion and sediment control measures, any visible sediment accumulated on impervious surfaces within or immediately adjacent to the works site shall be removed to minimise the risk of sediment becoming entrained in stormwater. All sediment removed shall be disposed of at a suitable facility.

ADMINISTRATION

8. The Canterbury Regional Council may, once per year, on any of the last five working days of May or November, serve notice of its intention to review the conditions of this consent for the purposes of:
    a. Dealing with any adverse effect on the environment which may arise from the exercise of this consent; or
    b. Requiring the consent holder to carry out monitoring and reporting instead of, or in addition to, that required by the consent.

Timaru District Council

The Timaru District Council shall be notified of the start of earthworks at least five (5) working days prior to the earthworks commencing on the site. The notification shall be emailed to **.

All works on site shall be undertaken in accordance with the approved Remediation Action Plan.

All contaminated soils and landfill material removed from the site must be disposed of at a facility whose waste acceptance criteria permit the disposal.

Within three (3) months of the completion of the earthworks a Site Validation Report (SVR) shall be prepared and submitted to Council.

The SVR shall include as a minimum

- Volumes of materials moved on site;
- Details of any variations to the proposed work plan;
- Details of any discharges or contingency measures employed during the earthworks;
- Photographic evidence of the site works;
- Evidence the objectives of the final site remediation have been met with regard to remedial targets described in the Remediation Action Plan.
- Evidence of the disposal of any soils off site to an authorised facility.

The SVR shall be written in accordance with the Ministry for the Environment Guidelines for Reporting on Contaminated Sites in New Zealand (revised 2021).

Delivery of the SVR may be by way of email to **

Appendix I: Aoraki Environmental letter

AORAKI
ENVIRONMENTAL
CONSULTANCY LTD

22 February 2024

Jacky Clarke
Programme Delivery Manager
Timaru District Council
[*delivered to: jacky.clarke@tdc.govt.nz*]

Kia ora Jacky

REVIEW OF ASSESSMENT OF ENVIRONMENTAL EFFECTS FOR PEEL FOREST CLOSED LANDFILL

Thank you for providing the opportunity to review the draft Assessment of Environmental Effects prepared by Pattle Delamore Partners Limited (PDP) for Peel Forest closed landfill.

Aoraki Environmental Consultancy (AEC) has worked closely with the Council and PDP on the proposed removal of the landfill and its restoration. The work by AEC being on behalf of Te Rūnanga o Arowhenua. This work has included working with PDP on the drafting of the assessment of environmental effects. AEC contributed drafting suggested wording for relevant sections which we note has been incorporated into the Assessment.

AEC has no recommended changes to the Assessment of Environmental Effects as drafted. The contents as they relate to matters of concern to Rūnanga and how these have been written is accurate.

It was discussed with PDP as to whether a letter from Arowhenua was required to accompany the consent application package. The intent of the letter being to affirm the role AEC has had in drafting the report and the contents of the Assessment as being accurate. Hopefully this reply serves that function if a letter is necessary but we can prepare another letter if required.

We request that, as the Council has done to date, the Council keeps us informed of the progress of remediation of Peel Forest including through the consenting process. AEC is happy to assist in any matters that arise during consenting.

Please contact the undersigned in the first instance if you have any questions or require further clarification.

Ngā mihi

Ally Crane
General Manager
Aoraki Environmental Consultancy Limited
Mobile: 027 622 3460 | Office: 03 684 8723

Appendix J: Statutory Assessment

Table 9: Permitted Rules Assessment

Canterbury Land and Water Regional Plan Rules

Rule No.	Description	Compliance Comment
5.163	The introduction or planting of any plant, or the removal and disturbance of existing vegetation in, on or under the bed of a lake or river and any associated discharge of sediment or sediment-laden water in circumstances where sediment may enter surface water is a permitted activity, provided the following conditions are met:	The toe of the fallen material clearly lies on the riverbed. The small amount of vegetation that requires removal to access the landfill may be close enough to the edge to be part of the river 'bed' even if several meters above the river water level.
	1. The activity does not prevent access to lawfully established structures, including flood protection works, or to flood control vegetation; and	**N/A** there are no structures, flood protections works or flood control vegetation.
	2. No vegetation used for flood control or bank stabilisation is disturbed, removed, damaged or destroyed without the prior written permission of the person or agency responsible for maintaining that vegetation for flood control purposes; and	**N/A**
	3. No woody vegetation is disposed of in, on, over or under the bed of a lake or river other than for in situ decomposition of sprayed weeds that were growing in, on, over or under the bed; and	Any vegetation requiring disposal will be removed from the site to an authorised facility.
	4. Introduction or planting of vegetation in, on, or under the bed of any lake or river is not of a species listed in the Biosecurity NZ Register of Unwanted Organisms or the Canterbury Pest Management Strategy; and	Species will be native and chosen by Arowhenua.

Table 9: Permitted Rules Assessment

	5. Introduction or planting of vegetation in, on, or under the bed of any river or lake listed as a high naturalness waterbody in Section 6 to 15 is only of indigenous plant species that naturally occur in the catchment; and	**N/A**
	6. Vegetation clearance in, on, or under the bed of any river or lake listed as a high naturalness waterbody in Section 6 to 15 is only of: (a) non-indigenous species; or (b) indigenous species that form the understorey of plantation forest that is being harvested and a minimum 5 m set back from the river or lake is provided upon replanting (if replanting occurs); and	**N/A**
	7. Vegetation clearance does not occur in a salmon spawning site listed in Schedule 17, or in any inanga spawning habitat during the period of 1 January to 1 June inclusive; and	**N/A**
	8. In a flood control rating district scheme area, the introduction or planting of any plant, has the prior written permission of the person or agency responsible for maintaining that vegetation for flood control purposes; and	**N/A**
	9. From 5 September 2015, and within the bed of the Clarence, Waiau, Hurunui, Waimakariri, Rakaia, Rangitata, and Waitaki rivers, vegetation clearance or cultivation does not result in a reduction in the area or diversity of existing riverbed vegetation, unless the activity is for the purpose of the operation, maintenance, upgrade or repair of infrastructure; and	The planned planting will increase the area and diversity of riverbed vegetation.

Table 9: Permitted Rules Assessment

	10. Except in relation to recovery activities, or the establishment, maintenance, repair or upgrading of network utilities and fencing, the concentration of total suspended solids in the discharge does not exceed: a) 50g/m3 where the discharge is to any Spring-fed river, Banks Peninsula River, or to a lake, except when the background total suspended solids in the waterbody is greater than 50g/m3 in which case the Schedule 5 visual clarity standards shall apply; or b) (b) 100g/m3 where the discharge is to any other river or to an artificial watercourse except when the background total suspended solids in the waterbody is greater than 100g/m3 in which case the Schedule 5 visual clarity standards shall apply.	a) N/A b) (b) total suspended solids in the discharge will not exceed 100g/m^3
5.177	The use of land for the deposition of more than 50 m3 of material in any consecutive 12 month period onto land which is excavated to a depth in excess of 5 m below the natural land surface and is located over an unconfined or semi-confined aquifer, where the seasonal high water table is less than 5 m below the deepest point in the excavation…	**N/A** More than 50 m3 of material will be deposited within a 12 month period however the seasonal high water table is at least 10m below the deepest point in the excavation.
Canterbury Air Regional Plan Rules		
7.32	The discharge of dust to air beyond the boundary of the *property* of origin from the construction of buildings, land development activities, unsealed surfaces or unconsolidated land, is a permitted activity provided the following conditions, where applicable, are met:	

Table 9: Permitted Rules Assessment

	1. The building to be constructed is less than 3 stories in height, or where the building is greater than 3 stories in height, a dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and	**N/A**
	2. The area of unsealed surface or unconsolidated land is less than 1000m2, or where the area of unsealed surface or unconsolidated land is greater than 1000m2 a dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and	The area of unsealed surface is greater than 1000 m2 and a dust management plan has been prepared in accordance with Schedule 2. Appendix D.
	3. The discharge does not cause an offensive or objectionable effect beyond the boundary of the *property* of origin, when assessed in accordance with Schedule 2.	Management and mitigation measures in the dust management plan will ensure that there is no offensive or objectionable effect beyond the boundary of the property of origin.
7.47	The discharge of contaminants into air from the storage, transfer, handling, treatment or disposal of waste, that was established on or before 1 June 2002, and where the CRC did not require a resource consent for the discharge of contaminants into air from that activity on or before 1 June 2002, is a permitted activity provided the following conditions are met:	The landfill was established in the 1960s.
	1. The discharge does not cause an offensive or objectionable effect beyond the boundary of the property of origin, when assessed in accordance with Schedule 2; and	Management and mitigation measures in the dust management plan and remediation action plan will ensure that there is no offensive or objectionable effect beyond the boundary of the property of origin.

Table 9: Permitted Rules Assessment

	2. The discharge is not from the treatment or discharge of hazardous substances; and	There is no treatment or discharge of a hazardous substance (potential asbestos fibres).
	3. There is no increase in the scale, intensity, frequency or duration of the effects of the discharge of contaminants into air from the activity	The landfill contents are to be removed reducing the scale of all adverse effects to zero
7.3	The discharge of odour, dust or smoke into air that is not managed by any other rule in this Plan is a permitted activity provided the following conditions are met:	Landfill contents may be odorous.
	1. The discharge does not cause or is not likely to cause an adverse effect beyond the boundary of the property of origin; and	Management and mitigation measures in the dust management plan and remediation action plan will ensure that there is no offensive or objectionable effect beyond the boundary of the property of origin.
	2. The discharge does not cause an offensive or objectionable effect beyond the boundary of the *property* of origin when assessed in accordance with Schedule 2.	Management and mitigation measures in the dust management plan and remediation action plan will ensure that there is no offensive or objectionable effect beyond the boundary of the property of origin.

Table 10: Rules Assessment

Rule No.	Description	Compliance Comment
Construction-Phase Stormwater Discharges		
5.94A	The discharge of construction-phase stormwater, other than into or from a reticulated stormwater system, to a surface waterbody, or onto or into land in circumstances where a contaminant may enter groundwater or surface water, is a permitted activity, provided the following conditions are met:	
	The area of disturbed land from which the discharge is generated is less than: a) 1,000 m^2 for any construction-phase stormwater generated as a result of work carried out in an area shown as High Soil Erosion Risk on the Planning Maps; or b) two hectares in any other location; and	**Does not comply:** The area of disturbed land from which the discharge is generated is more than 2 hectares (approximately 11 hectares being both the contractor's yard and landfill areas).
	The concentration of total suspended solids in the discharge shall not exceed: a) 50g/m3 where the discharge is to any spring-fed river, Banks Peninsula river, or to a lake except when the background total suspended solids in the waterbody is greater than 50g/m3 in which case the Schedule 5 visual clarity standards shall apply; or	**Complies:** The construction-phase stormwater will be discharged across the site into a soakage area, with percolation into groundwater, not any surface water. .

Table 10: Rules Assessment

Rule No.	Description	Compliance Comment
	b) 100g/m3 where the discharge is to any other river or to an artificial watercourse except when the background total suspended solids in the waterbody is greater than 100g/m3 in which case Schedule 5 visual clarity standards shall apply; and	
	The discharge does not result in an increase in the flow in the receiving waterbody at the point of discharge of more than 1% of a flood event with an Annual Exceedance Probability of 20% (one in five year event); and	**Complies-N/A:** No receiving waterbody other than groundwater.
	The discharge is not from, into or onto contaminated or potentially contaminated land; and	**Does not comply:** The application site is contaminated.
	The discharge does not contain any hazardous substance; and	**Complies**: The contaminants are not considered hazardous substances.
	The discharge does not occur within a Community Drinking-water Protection Zone as set out in Schedule 1.	**Complies:** The discharge will not be within a Community Drinking Water Protection Zone.
Earthworks Over Aquifers		
5.175	The use of land to excavate material is a permitted activity, provided the following conditions are met:	
	1. Over the Coastal Confined Gravel Aquifer System, as shown on the Planning Maps:	**N/A** – The site is not located within the Coastal Confined Aquifer System area.

Table 10: Rules Assessment

Rule No.	Description	Compliance Comment
	a. there is more than 1 m of undisturbed material between the deepest part of the excavation and Aquifer 1; and b. if more than 100 m³ of material is excavated, the excavation does not occur within 50 m of any surface waterbody; or	
	4. Over an unconfined or semi-confined aquifer: a. the volume of material excavated is less than 100 m³; or b. the volume of material excavated is more than 100 m³ and: i. there is more than 1 m of undisturbed material between the deepest part of the excavation and the ~~seasonal high water table~~ highest groundwater [1]level; and ii. the excavation does not occur within 50 m of any surface waterbody.	**Complies –** A separation of 1 metre will be maintained between the deepest excavations and the highest groundwater levels for the site (at least 4.9 metres), and the works will not occur within 50 metres of a surface waterbody.

Notes:

1. *Deletions and additions from Plan Change 7 to the LWRP.*

Table 11: National Policy Statement for Freshwater Management 2020

Objectives/Policies	Comments
Objectives	
2.1 Objective a. The objective of this National Policy Statement is to ensure that natural and physical resources are managed in a way that prioritises: i. first, the health and well-being of water bodies and freshwater ecosystems ii. second, the health needs of people (such as drinking water) iii. third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.	As addressed in Section 8.8 of this report, the health and wellbeing of water bodies and freshwater ecosystems will be protected and maintained during the works and discharge. The removal of the contaminated material will reduce the leaching of contaminants to groundwater, which ultimately flows into the Rangitata River. The proposed RAP for the site will also mitigate the risk of mobilised sediment entering surface or groundwater. The positive effects arising from the proposal are assessed in Sections 8.2 and 8.12 of the AEE.
Policies	
Policy 1: Freshwater is managed in a way that gives effect to Te Mana o te Wai.	As detailed in Section 8.8 of this report, protecting the health of freshwater is prioritised though the use of a range of mitigation measures which are included in the RAP for the site.
Policy 2: Tangata whenua are actively involved in freshwater management (including decision-making processes), and Māori freshwater values are identified and provided for.	Te Rūnanga o Arowhenua has been engaged and involved with the preparation of these consent applications and in the planting and landscaping plans for the remediated land fill site. This policy has been implemented.
Policy 3: Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments.	The effects on the receiving environment are being managed through the application of a comprehensive ESCP and SMP for the site.

Table 11: National Policy Statement for Freshwater Management 2020

Objectives/Policies	Comments
Policy 4: Freshwater is managed as part of New Zealand's integrated response to climate change.	NA – There will be no adverse impact on climate change as a result of this activity.
Policy 6: There is no further loss of extent of natural inland wetlands, their values are protected, and their restoration is promoted.	NA – There are no wetlands in close proximity to the site.
Policy 7: The loss of river extent and values is avoided to the extent practicable.	There will be no loss of river extent and/or values as a result of this activity. River values will be improved by the removal of the waste.
Policy 8: The significant values of outstanding water bodies are protected.	The Rangitata River is one of many braided rivers specifically identified in the RPS. The values of the Rangitata River will be protected during works and enhanced by the removal of landfill material.
Policy 9: The habitats of indigenous freshwater species are protected.	There will be no discharge to surface water. The effects of discharges are being managed through the application of a comprehensive SMP and ESCP. Once complete, the effect of leachate from the closed landfill on freshwater fish will be permanently removed.
Policy 10: The habitat of trout and salmon is protected, insofar as this is consistent with Policy 9.	There will be no discharge to surface water.
Policy 11: Freshwater is allocated and used efficiently, all existing over-allocation is phased out, and future over-allocation is avoided.	N/A – No freshwater is to be taken as part of this consent.

Table 11: National Policy Statement for Freshwater Management 2020

Objectives/Policies	Comments
Policy 12: The national target (as set out in Appendix 3) for water quality improvement is achieved.	The proposed discharge will not decrease the quality of groundwater but does support the removal of contaminated material from the site which in turn improves groundwater quality.
Policy 15: Communities are enabled to provide for their social, economic, and cultural wellbeing in a way that is consistent with this National Policy Statement.	Cultural wellbeing will be improved as detailed in section 8.12.

Table 12: National Policy Statement for Highly Productive Land

Objective		**Comment**
Highly productive land is protected for use in land-based primary production, both now and for future generations.		The small area of productive land will be used on a temporary basis and the soils preserved for return upon the completion of the project. With erosion and sediment controls in place there will be no loss of productive soils in the long term.
Policy		
1	Highly productive land is recognised as a resource with finite characteristics and long-term values for land-based primary production.	The area of land will only be used on a temporary basis and returned to productive use.
4	The use of highly productive land for land-based primary production is prioritised and supported.	The leased area represents a fraction of the land parcel still available for productive use and will be returned to productive use.
8	Highly productive land is protected from inappropriate use and development.	The area of productive land will be used on a temporary basis to support the remediation of land immediately adjacent. It will be returned to productive use once remediation is complete.
Part 3 Implementation		
3.9	**Protecting highly productive land from inappropriate use and development** **(2)** A use or development of highly productive land is inappropriate except where at least one of the following applies to the use or development, and the measures in subclause (3) are applied:	The use of productive land for a temporary contractor's yard is a very small scale use of a much larger land parcel that will not be impacted permanently by the activity in any way.

Table 12: National Policy Statement for Highly Productive Land

Objective		Comment
	(g) it is a small-scale or temporary land-use activity that has no impact on the productive capacity of the land: **(3)** Territorial authorities must take measures to ensure that any use or development on highly productive land: (a) minimises or mitigates any actual loss or potential cumulative loss of the availability and productive capacity of highly productive land in their district; and (b) avoids if possible, or otherwise mitigates, any actual or potential reverse sensitivity effects on land-based primary production activities from the use or development.	The soil will be stockpiled and protected whilst work on the contaminated parts of the land takes place and will be returned once work is completed. There will be no loss of actual or potential productive capability. The ongoing use of the balance of the land for productive use can continue.

Table 13: Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011

Regulation		Comment
10	**Restricted Discretionary activities**	
(1)	This regulation applies to an activity described in any of regulation 5(2) to (6) on a piece of land described in regulation 5(7) or (8) that is not a permitted activity or a controlled activity.	The activity is soil disturbance in excess of a permitted activity and in a HAIL site (G3) where contaminants have been found at levels above the soil contaminant standards.
(2)	The activity is a restricted discretionary activity while the following requirements are met: a) (a) a detailed site investigation of the piece of land must exist: b) (b) the report on the detailed site investigation must state that the soil contamination exceeds the applicable standard in regulation 7: c) (c)the consent authority must have the report	(a) The DSI is at Appendix C (b) The soil contamination does exceed the applicable standard (c) The consent authority (TDC) has the report as part of this AEE.

Table 14: Canterbury Regional Policy Statement

Objective		**Comment**
Chapter 7: Fresh Water		
7.2.1	Sustainable management of fresh water	It is considered that the application is consistent with the sustainable management of fresh water. As per the assessment of effects (Section 8.0), the effect of the proposal is considered to be less than minor in terms of potential adverse effects on water quality, and ecology. During construction, management plans such as an ESCP will be in place to minimise the potential for discharges of contaminants. Once complete, the project will improve water quality by removing a contaminant source. Overall, the proposal is considered to be consistent with the objectives and policies of Chapter 7.
7.2.3	Protection of intrinsic value of waterbodies and their riparian zones	
7.3.1	Adverse effects of activities on the natural character of fresh water	
7.3.3	Enhancing fresh water environments and biodiversity	
Chapter 9: Ecosystems and indigenous biodiversity		
9.2.2	Restoration or enhancement of ecosystem functioning and indigenous biodiversity, in appropriate locations…	The proposal removes landfill contents and restores the land with indigenous species suitable for a riverbank environment. The proposal is considered consistent with Chapter 9.
9.3.4	Promote ecological enhancement and restoration	

Table 14: Canterbury Regional Policy Statement

Objective		Comment
Chapter 10: Beds of rivers and lakes and their riparian zones		
10.2.1	Enable subdivision, use and development of river and lake beds and their riparian zones while protecting all significant values of those areas, and enhancing those values in appropriate locations.	The proposal removes contaminants from the riparian margins and enhances this area with indigenous vegetation. It is considered that the proposal is consistent with Chapter 10.
Chapter 14: Air		
14.2.2	Enable the discharges of contaminants into air provided there are no significant localised adverse effects on social, cultural and amenity values, flora and fauna, and other natural and physical resources.	A comprehensive Dust Management Plan has been prepared to mitigate the potential for localised adverse effects. It is considered that the proposal is consistent with Chapter
Chapter 17: Contaminated Land		
17.2.1	Protection from adverse effects of contaminated land	The proposal is to remove all contamination that is feasible to do. Management plans (RAP) will be in place during construction to minimise the potential discharge of contaminants from the site in stormwater, thereby protecting the receiving environment. It is considered that the proposal is consistent with Chapter 17.
17.3.2	Development of, or discharge from contaminated land	
17.3.3	Contaminants may remain in the land	

Table 15: Canterbury Land and Water Regional Plan

Objective		Comment
3.1	Land and water are managed as integrated natural resources to recognise and enable Ngāi Tahu culture, traditions, customary uses and relationships with land and water.	Ngāi Tahu values have been reflected through the involvement of Te Runanga o Arowhenua.
3.2	Water management applies the ethic of ki uta ki tai – from the mountains to the sea – and land and water are managed as integrated natural resources recognising the connectivity between surface water and groundwater, and between fresh water, land and the coast.	This proposal recognises the connectivity between surface water and groundwater and between fresh water, land and the coast. Appropriate mitigation measures have been proposed to protect these environments. This recognition of the interconnectivity, in particular of soil contamination, leaching through groundwater into surface water is one of the drivers of the project.
3.6	Water is recognised as essential to all life and is respected for its intrinsic values.	The intrinsic value of water has been considered. Mitigation measures, as specified in the RAP will be implemented during construction to protect the water quality.
3.8	The quality and quantity of water in fresh water bodies and their catchments is managed to safeguard the life-supporting capacity of ecosystems and ecosystem processes, including ensuring sufficient flow and quality of water to support the habitat and feeding, breeding, migratory and other behavioural requirements of indigenous species, nesting birds and, where appropriate, trout and salmon.	Mitigation measures, as specified in the RAP will be implemented during the removal of the fill and restoration of the surface to protect water quality.

Table 15: Canterbury Land and Water Regional Plan

Objective		Comment
3.12	When setting and managing within limits, regard is had to community outcomes for water quality and quantity.	The potential adverse effects on groundwater and surface water is considered to be less than minor, and in the long-term will improve water quality. This will help the community to reach their freshwater objectives for the catchment.
3.13	Groundwater resources remain a sustainable source of high quality water which is available for abstraction while supporting base flows or levels in surface water bodies, springs and wetlands and avoiding salt-water intrusion.	The potential adverse effect on groundwater is considered to be less than minor, and once the project is complete, groundwater quality may improve.
3.19	Natural character values of freshwater bodies, including braided rivers and their margins, wetlands, hāpua and coastal lagoons, are protected.	The proposal protects and restores part of the margin of a major braided river, the Rangitata, which will improve and protect the previously damaged natural character of the river in this location.
3.23	Soils are healthy and productive, and human-induced erosion and contamination are minimised.	The proposal ensure that soils are not lost to either erosion or further contamination with the removal of the landfill.
3.24	All activities operate at good environmental practice or better to optimise efficient resource use and protect the region's fresh water resources from quality and quantity degradation.	Provided that the activity is undertaken as described in this report, as well as the RAP, it is considered that this objective will be achieved.

Table 16: Canterbury Land and Water Regional Plan – Strategic Policies

Strategic Policies		**Comment**
4.1	Lakes, rivers, wetlands and aquifers will meet the fresh water outcomes set in 6 to 15 within the specified timeframes. If outcomes have not been established for a catchment, then each type of lake, river or aquifer should meet the outcomes set out in Table 1 by 2030.	Mitigation measures will be implemented as specified in the SMP and ESCP. Provided that the activity is undertaken in accordance with these plans, and as described in this report, the activity will not result in a freshwater outcome not being met. Once the contamination source has been removed, freshwater quality is more likely to be meet the specified freshwater outcomes. The proposal is considered to be consistent with these policies.
4.2	The management of lakes, rivers, wetlands and aquifers will take account of the fresh water outcomes, water quantity limits and the individual and cumulative effects of land uses, discharges and abstractions will meet the water quality limits set in Sections 6 to 15 or Schedule 8 and the individual and cumulative effects of abstractions will meet the water quantity limits in 6 to 15.	
Sub-Region Section Development		
4.11	The setting and attainment of catchment specific water quality and quantity outcomes and limits is enabled through: a. limiting the duration of any resource consent granted under the region-wide rules in this Plan to a period not exceeding five years past the expected notification date (as set out in the Council's Progressive Implementation	Consent durations of 5 years are sought for the proposal. The proposal is considered to be consistent with this policy.

Table 16: Canterbury Land and Water Regional Plan – Strategic Policies

Strategic Policies		**Comment**
	Programme) of any plan change that will introduce water quality or water quantity provisions into Sections 6 – 15 of this Plan; but allowing, where appropriate, a longer resource consent duration for discharge permits granted to irrigation schemes or principal water suppliers under the region-wide nutrient management rules in this Plan, provided those permits include conditions that restrict the nitrogen loss from the land and enable a review of the consent under section 128(1) of the RMA.	
Discharge of Contaminants to land or water		
4.12	There are no direct discharges to surface water bodies or groundwater of: (a) untreated sewage, wastewater (except as a result of extreme weather related overflows or system failures) or bio-solids; (b) solid or hazardous waste or solid animal waste; (c) animal effluent from an effluent storage facility or a stock holding area; (d) organic waste or leachate from storage of organic material; and	The proposed discharge is for construction phase stormwater water only which will not be directly discharged to surface or groundwater. The works will remove a previously consented discharge of solid waste to land which may be affecting groundwater. The activity is considered to be consistent with this policy.

Table 16: Canterbury Land and Water Regional Plan – Strategic Policies

Strategic Policies		**Comment**
	(e) untreated industrial or trade waste.	
4.13	For other discharges of contaminants into or onto land where it may enter water or to surface water bodies or groundwater (excluding those passive discharges to which Policy 4.26 applies), the effects of any discharge are minimised by the use of measures that: (a) first, avoid the production of the contaminant; (b) secondly, reuse, recovers or recycles the contaminant; (c) thirdly, minimise the volume or amount of the discharge; or (d) finally, wherever practical utilise land-based treatment, a wetland constructed to treat contaminants or a designed treatment system prior to discharge; and (e) in the case of surface water, results in a discharge that after reasonable mixing meets the receiving water standards in Schedule 5 or does not result in any further degradation in water quality in any receiving surface	An ESCP and SMP will be in place to minimise the potential discharge of sediment entrained in stormwater. Contaminated soil will be managed appropriately on site in accordance with the RAP.

Table 16: Canterbury Land and Water Regional Plan – Strategic Policies

Strategic Policies		Comment
	waterbody that does not meet the water quality standards in Schedule 5 or any applicable water conservation order.	
4.14	Any discharge of a contaminant into or onto land where it may enter groundwater (excluding those passive discharges to which Policy 4.26 applies): (a) will not exceed the natural capacity of the soil to treat or remove the contaminant; and (b) will not exceed available water storage capacity of the soil; and (c) where meeting (a) and (b) is not practicable, the discharge will: (i). meet any nutrient limits in Schedule 8 or Sections 6 to 15 of this Plan; and (ii). utilise the best practicable option to ensure the size of any contaminant plume is as small as is reasonably practicable; and (iii). ensure there is sufficient distance between the point of discharge, any other discharge and drinking-water supplies to allow for the natural decay or	A RAP will be in place to minimise the potential discharge of sediment entrained in stormwater. Contaminated soil will also be managed appropriately on site in accordance with the RAP. It is expected that Schedule 5 standards will not be breached as a result of the discharge. The proposal is considered to be consistent with this policy.

Table 16: Canterbury Land and Water Regional Plan – Strategic Policies

Strategic Policies		**Comment**
	attenuation of pathogenic micro-organisms in the contaminant plume; and (iv). not result in the accumulation of pathogens, or a persistent or toxic contaminant that would render the land unsuitable for agriculture, commercial, domestic, cultural or recreational use or water unsuitable as a source of potable water or for agriculture; and (v). not raise groundwater levels so that land drainage is impeded.	
4.14B	Have regard to Ngāi Tahu values, and in particular those expressed within an iwi management plan, when considering applications for discharges which may adversely affect statutory acknowledgement areas, nohoanga sites, surface waterbodies, silent file areas, culturally significant sites, Heritage New Zealand sites, any listed archaeological sites, and cultural landscapes, identified in this Plan, any relevant district plan, or in any iwi management plan.	Regard has been had to these matters.

Table 16: Canterbury Land and Water Regional Plan – Strategic Policies

Strategic Policies		**Comment**
Stormwater and Community Wastewater Systems		
4.17	Stormwater run-off volumes and peak flows are managed so that they do not cause or exacerbate the risk of inundation, erosion or damage to property or infrastructure downstream or risks to human safety.	Stormwater will be retained on site and discharged to ground via soakage. It is considered that the proposal is consistent with this policy.
Earthworks, Land Excavation and Deposition of Material into Land over Aquifers		
4.18	The loss or discharge of sediment or sediment-laden water and other contaminants to surface water from earthworks, including roading, works in the bed of a river or lake, land development or construction, is avoided, and if this is not achievable, the best practicable option is used to minimise the loss or discharge to water.	An ESCP will be implemented during construction, which will help minimise the potential discharge of sediment laden water. It is considered that the proposal is consistent with this policy.
4.19	The discharge of contaminants to groundwater from earthworks, excavation, waste collection or disposal sites and contaminated land is avoided or minimised by ensuring that: (a) activities are sited, designed and managed to avoid the contamination of groundwater; (b) existing or closed landfills and contaminated land are managed and monitored where	The prepared ESCP and SMP will minimise the potential discharge of contaminants to underlying groundwater. Contaminated material will be excavated from the site in accordance with the RAP. The site is located over a semi-confined or unconfined aquifer estimated to be a 12m below the surface. It is considered that the proposal is consistent with this policy.

Table 16: Canterbury Land and Water Regional Plan – Strategic Policies

Strategic Policies		**Comment**
	appropriate to minimise any contamination of groundwater; and (c) there is sufficient thickness of undisturbed sediment in the confining layer over the Coastal Confined Aquifer System to prevent the entry of contaminants into the aquifer or an upward hydraulic gradient is present which would prevent aquifer contamination.	
Hazardous Substances and Hazardous Activities		
4.26	Any discharges of hazardous substances from contaminated land, including existing and closed landfills, are managed to ensure that adverse effects beyond the site boundary on people's health or safety, on human or stock water supplies, or on surface water are avoided.	As noted in Section 5, earthworks and the discharge of construction phase stormwater water to land are designed to avoid water entering the landfill and its contents as much as possible during their removal.

Table 17: Canterbury Regional Air Plan

Objective		**Comment**
5.5	Air quality is managed in a way that provides for the cultural values and traditions of Ngāi Tahu.	The views and values of Te Rūnanga o Arowhenua are incorporated into this proposal and it is considered that the proposal is consistent with these objectives.
5.6	Amenity values of the receiving environment are maintained.	
Policy		
6.8	Offensive and objectionable effects are unacceptable and actively managed by plan provisions and the implementation of management plans.	A draft Dust Management Plan in accordance with Schedule 2 is attached to this report and will be finalised once contractors have been selected.

Table 18: Timaru District Plan – Relevant objectives and policies

Objective/Policy		Comment
1. Land Resources Objective 1	Achieve the sustainability of the District's land resource by: ⁘ maintaining the life-supporting capacity of soils ⁘ preventing induced land degradation ⁘ restoring degraded land ⁘ managing the stock of versatile land for the greatest benefit to present and future generations ⁘ maintaining a representative range of natural ecosystems	The proposal retains the soils on the site, protects them from contamination and restores degraded land. The replanting with indigenous species supports natural ecosystems. The proposal is fully in accordance with this objective.
Land Resources Policy 2	To promote the restoration of degraded lands and to prevent the degradation of further areas.	The removal of the landfill prevents further degradation and will assist in restoring degraded land.
2. Natural Environment Objective 2	Protect and enhance the natural character and functioning and habitat values of the coastal environment and wetlands, streams, rivers and their margins.	The proposal is in full accordance with this objective.

Table 18: Timaru District Plan – Relevant objectives and policies

Objective/Policy		**Comment**
Natural Environment Policy 3	To promote the enhancement of areas of indigenous vegetation and habitats of indigenous fauna. Where areas with important ecological values exist in a degraded state, enhancement should be promoted particularly where it will achieve long term improvement and: i) Contribute to the indigenous biodiversity of the area, particularly for ecosystem types that are threatened or under-represented in protected areas; or ii) Improve the life supporting capacity of the indigenous ecosystems; or iii) Improve or establish connections between habitats and create corridors for wildlife dispersal.	The proposal is in full accordance with this objective.
11(a). Amenity values – Amenity planting Objective 3	Increased areas of local native species.	The proposal is in full accordance with this objective.

Table 18: Timaru District Plan – Relevant objectives and policies

Objective/Policy		**Comment**
Amenity Planting Policy 4	To encourage the replanting of indigenous vegetation with eco-sourced indigenous local species. (Eco-sourced means that plants are grown from seeds sourced from the planting site or nearby to minimise genetic pollution and the loss of local biodiversity.)	The proposal is in full accordance with this objective.
12. Noise Objective 1	Minimise the situations where there is conflict between noise emissions from land use activities and other more sensitive land uses.	The proposal is in full accordance with this objective.

Table 19: Proposed Timaru District Plan

Objectives		Comment
SASM-O1	**Decision making**	
	Kāti Huirapa are actively involved in decision making that affects the values of the identified Sites and Areas of Significance to Kāti Huirapa.	Kāti Huirapa through Aoraki Environmental have been instrumental in the proposal including writing Section 8.12 of the AEE. Drafts of all the investigation reports and the RAP have been shared with Aoraki Environmental.
SASM-O2	**Access and use**	
	Kāti Huirapa are able to access, maintain and use resources and areas of cultural value within identified Sites and Areas of Significance to Kāti Huirapa.	Whilst long term access to the Rangitata from the landfill area is not part of the proposal, access for the purposes of planting is anticipated. Furthermore the plants to be placed in the rehabilitation of the site are being raised by Te Rūnanga o Arowhenua..
SASM-O3	**Protection of Sites and Areas of Significance**	
	The values of identified areas and sites of significance to Kāti Huirapa are recognised and protected from inappropriate subdivision, use and development.	The purpose of the proposal is to remove inappropriate material (waste) from an area of significance (riverbank and river) and prevent further degradation of the environment.

Table 19: Proposed Timaru District Plan

Objectives		Comment
Policies		
SASM-P2	**Consultation and engagement with Kāti Huirapa**	
	Encourage and facilitate consultation and engagement between landowners and applicants with Kāti Huirapa, prior to applying for consent and/or undertaking activities within or adjacent to the identified sites and areas listed in SCHED6 – Schedule of Sites and Areas of Significance to Kāti Huirapa, as being the most appropriate way to obtain understanding of the potential impact of any activity on the site or area.	Consultation with iwi has taken place since the flooding incidents and throughout the subsequent investigations and proposal through to this AEE. The consent process has been facilitated primarily with Aoraki Environmental.
SASM-P5	**Protection of values of Sites and Areas of Significance to Kāti Huirapa**	
	Protect the identified values of the sites and areas listed in SCHED6 – Schedule of Sites and Areas of Significance to Kāti Huirapa through: 1. retention of connections to whakapapa, history and cultural tradition; and 2. protection of mauri and intangible values; and	The proposal supports the protection of site integrity and the sustainability of ecosystems, particularly the river by preventing refuse entering the river directly and removing the source of potentially contaminated leachate.

Table 19: Proposed Timaru District Plan

Objectives		**Comment**
	3. maintenance or enhancement of access by whānau for customary use and cultural purposes; and 4. protection of site integrity; and 5. ensuring sustainability of ecosystems supporting taoka species and mahika kai resources.	
SASM-P8	**Protection of wāhi taoka, wāhi tapu, wai taoka and wai tapu sites and areas**	
	Where an activity is proposed within any of the wāhi taoka sites, wāhi tapu sites, wai taoka areas and wai tapu areas listed in SCHED6 – Schedule of Sites and Areas of Significance to Kāti Huirapa, ensure that: 1. there is engagement with Te Rūnanga o Arowhenua to understand the effects of the activity on the identified values of the site or area, including the connections of Kāti Huirapa to the site or area, the mauri of the site or area, site integrity,	There has been engagement with Te Rūnanga o Arowhenua throughout the development of this AEE primarily through Aoraki Environmental. An accidental discovery protocol forms part of the Remedial Action Plan. It is acknowledged that there could be some adverse effects of the proposal related to the earthworks but these are characterised and controlled by both proposed conditions and effect specific management plans. The anticipated level of adverse effect is low and temporary. The loss of values created by the landfill will be remediated and the mauri of the site restored as much as possible.

Table 19: Proposed Timaru District Plan

Objectives		Comment
	and the ability of the site or area to support taoka species and mahika kai; and 2. an accidental discovery protocol is prepared and adopted for any earthworks; and 3. any adverse effects on identified values are avoided unless it can be demonstrated that: a. due to the functional needs of the activity, it is not possible to avoid all adverse effects; and b. any residual effects that cannot be practicably avoided are mitigated, as far as possible, in a way that protects, maintains or enhances the overall values of the site or area; and c. where any historical loss of values can be remediated.	