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Omarunui Landfill Area B Consent Application – Technical Review

Hawke's Bay Regional Council

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Omarunui Landfill Area B Consent Application - Technical Review

Prepared for

Hawke's Bay Regional Council

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

Tel +64 3 **345 7100** Fax +64 3 **345 7101**
Website **http://www.pdp.co.nz**
Auckland Tauranga Wellington **Christchurch**

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Prepared by

SIGNATURE

Hilary Lough

Reviewed and approved by

SIGNATURE

Alan Pattle

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1.0 Introduction

1.1 Background

Hastings District Council (HDC) and Napier City Council (NCC) (jointly the Applicant) have applied to Hawke's Bay Regional Council (HBRC) for resource consents to construct and operate a new area of landfill (Area B) at the operational municipal landfill, the Omarunui Landfill. The application will be publicly notified, at the request of the applicant.

Pattle Delamore Partners Limited (PDP) has been engaged by Hawke's Bay Regional Council (HBRC) to provide a technical review of the consent application for the following matters:

- Geotechnics
- Landfill design
- Leachate management and irrigation
- Stormwater, hydrology and drainage design
- Air quality
- Surface water quality and aquatic ecology
- Groundwater
- Proposed operation and monitoring
- Waste acceptance criteria

This report provides an overview of the proposed activities, the existing relevant consents held and consents being sought, the receiving environment and summarises the reviews of the matters above and the additional information considered to be required for the application. Reviews of the individual matters above are included in the appendices to this report.

Omarunui Landfill is located approximately 12 km to the northwest of Hastings and is jointly owned by HDC and NCC. It receives residual solid waste collected from both Napier City and Hastings District.

The Assessment of Environment Effects (AEE) prepared by Tonkin & Taylor Limited (T+T) describes how the landfill site comprises four separate valleys identified for landfilling activities, referred to as Area A, Area B, Area C and Area D. Area D is the current landfill area on the site. Area D of Omarunui Landfill commenced operation in 2006, following closure of Area A. Area D has an expected closure date between 2025 and 2026 although T+T note that recent increases in waste volumes delivered to the landfill suggest Area D may be full

earlier than these predictions. The two undeveloped valleys are known as Area B and Area C.

HDC and NCC propose to develop Area B as the next area to accept waste and are therefore seeking resource consents from HBRC.

A number of activities are considered to be permitted activities. HDC and NCC are seeking resource consents for the following activities:

- Discharges of contaminants to air (odour, landfill gas, dust and the products of combustion of landfill gas)
- Discharges of contaminants to land and water (from the landfill operation)
- Diversion and discharge of stormwater
- Diversion and discharge of drainage water (from a pumped system)

2.0 Existing consents and consents sought

The applicant holds a number of existing consents for the operation of the Omarunui Landfill. Two of these consents are proposed to be amended to allow for the Area B activities, while new consents are being sought for other activities, as outlined in Table 9.3 of the AEE.

2.1 Air discharge consent

The applicant holds consent DP040122Ab, which authorises the discharge of the following contaminants into the air from Areas A and D of the Omarunui Landfill:

i) odour and landfill gas derived from the decomposition of refuse,

ii) dust, and

iii) the products of controlled combustion of landfill gas

The AEE refers to consent DP040122Aa as being the current consent, although conditions 1 and 3 of the consent were changed in 2018 to reflect the increased footprint and air space of Area D, resulting in the new consent number DP040122Ab.

The applicant is seeking to change the conditions of the current air discharge consent to exclude discharges from landfill gas (LFG) combustion. This is because the LFG from Area B will be collected and reticulated to the same flare and LFG to energy facility used for Areas A and D. They are therefore seeking a new separate consent to allow for the discharge of the products of controlled combustion of landfill gas from Areas A, D and B.

A separate consent is also being sought for discharges to air from waste disposal in Area B, including odour, LFG and dust.

In summary, a variation is being sought to the current air discharge consent to exclude LFG combustion with two new consents being sought to allow:

- Discharges to air including odour, landfill gas, and dust, from Area B (classified in the AEE as a *discretionary* activity)
- Discharges to air of the products of combustion of landfill gas from Areas A, B, and D (classified in the AEE as a *discretionary* activity)

2.2 Leachate discharge consent (leachate irrigation)

The applicant holds consent DP160044L, which according to the AEE authorises the discharge of leachate from a landfill operation into and onto land, in circumstances that may result in contaminants entering water (HBRC's online record for this consent does not include an activity description).

The applicant is seeking to change the conditions of this current consent to include the discharge of leachate from and onto Area B.

It is proposed that leachate will continue to be irrigated on capped surfaces of the landfill as areas become available. Initially, once Area B is operating and Area D is capped, the surface of Area A and D will be available for irrigation. As filling in Area B progresses, additional capped areas of Area B will progressively become available.

This change of conditions is classified in the AEE as a *discretionary* activity.

2.3 Waste and leachate discharge consent

The applicant holds consent DP040120Lc, which authorises the discharge of leachate and general municipal and industrial waste from a landfill operation into and onto land, in circumstances that may result in contaminants entering groundwater.

The application refers to consent DP040120Lb as being the current consent, although conditions 1, 2, 4, 15, 16, 18 and 22 were changed and condition 3 was deleted in 2018 to reflect the increased footprint and air space of Area D, resulting in the new consent number DP040120Lc.

The applicant is not seeking to change the conditions of this consent and instead is seeking a separate consent for Area B to allow:

- Discharges of contaminants to land and water from operating landfill Area B (classified in the AEE as a *discretionary* activity)

2.4 Stormwater discharge consent

The applicant holds consent DP040121Wb, which authorises the diversion of stormwater from a municipal landfill and discharge of treated stormwater to water via stormwater treatment ponds.

The application refers to consent DP040121Wa as being the current consent, although condition 1 was changed in 2018 to reflect the increased footprint and air space of Area D, resulting in the new consent number DP040121Wb.

The applicant is not seeking to change the conditions of this consent and instead is seeking authorisation for:

- Diversion and discharge of stormwater from Area B (classified in the AEE as a *controlled* activity)

2.5 Water take consent

The applicant holds consent WP040123T, which authorises the taking of groundwater from a 200 mm bore (No. 2354) for general use at the Omarunui Landfill, including filling a reservoir of approximately 2500 m^3 for the purpose of firefighting.

The applicant is not seeking to change the conditions of this consent or for a new bore for water supply, although they have noted additional water will be available in the Area B stormwater pond and is currently available in the Area D stormwater pond.

2.6 Diversion and discharge of drainage water (dewatering)

The applicant does not currently hold a consent related to drainage water at the site. However, dewatering is anticipated to be required during the removal of the alluvium in the gully in the centre of the site and replacement with appropriate fill as part of construction of the landfill, based on the typically encountered depth to groundwater of 3 to 4 m. The dewatering discharges will be directly to the stormwater system to provide for sediment removal prior to entering Upokohino Stream, or discharged directly if sufficiently clean.

They are therefore seeking authorisation for:

- Diversion and discharge of drainage water (pumped dewatering) (classified in the AEE as a *controlled* activity)

2.7 Soil disturbance

The soil disturbance that will be required for the development of Area B has been classified in the AEE as a permitted activity, given the sediment control and dust management measures that will be put in place together with the measures to minimise soil loss.

2.8 Diversion and discharge of drainage water

Some subsoil drainage is required and this has been classified in the AEE as a permitted activity. Drains will be installed from any observed seeps to the main subsoil drain at the base of the landfill. These will discharge via the stormwater

system and the AEE states that the discharge will meet the permitted activity conditions related to downstream flooding on other proprieties, scouring and erosion, wetland effects, temperature changes and the discharge occurring in the same catchment.

3.0 Receiving environment

3.1 Site location

As outlined in Section 5.1 of the AEE, the landfill site is located at 329 Omarunui Rd and comprises four separate valleys identified for landfilling activities, referred to as Area A, Area B, Area C and Area D. Area D is the current landfill area on the site. Area A closed in 2006. The two undeveloped valleys are known as Area B and Area C. Area B covers an area of approximately 23 hectares. Clean filling operations are authorised to occur in a separate area, Area E.

The general site location is shown in Figure 5.1 of the AEE and the details of the different areas are shown in Figure 5.2, both of which are reproduced below. The Tūtaekurī River can be seen to the east of the site.

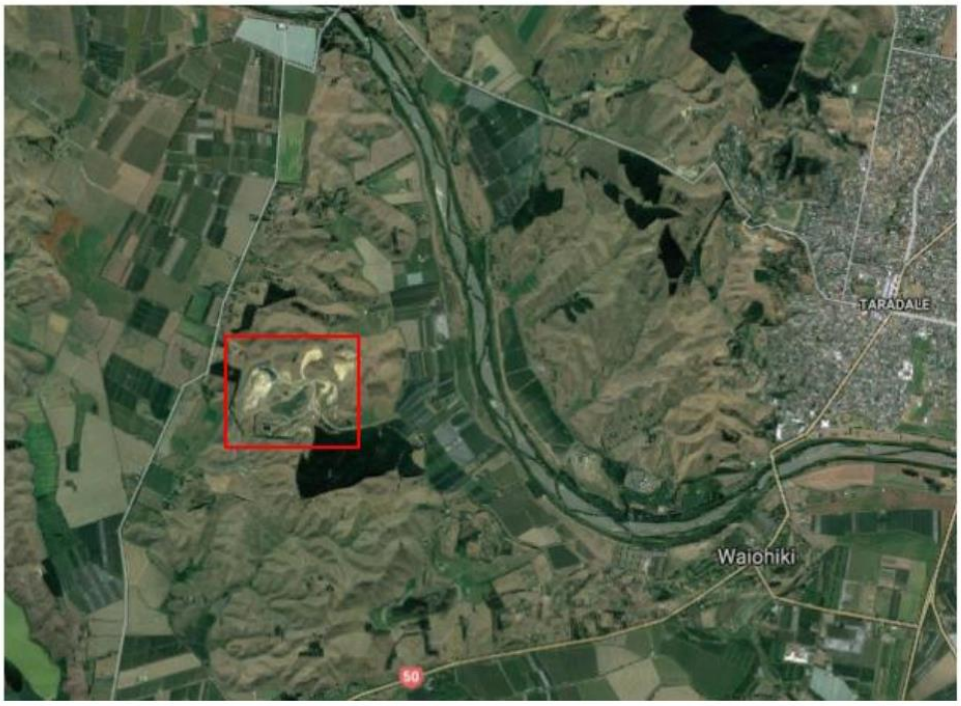

Figure 1: Figure 5.1 of the AEE showing site location

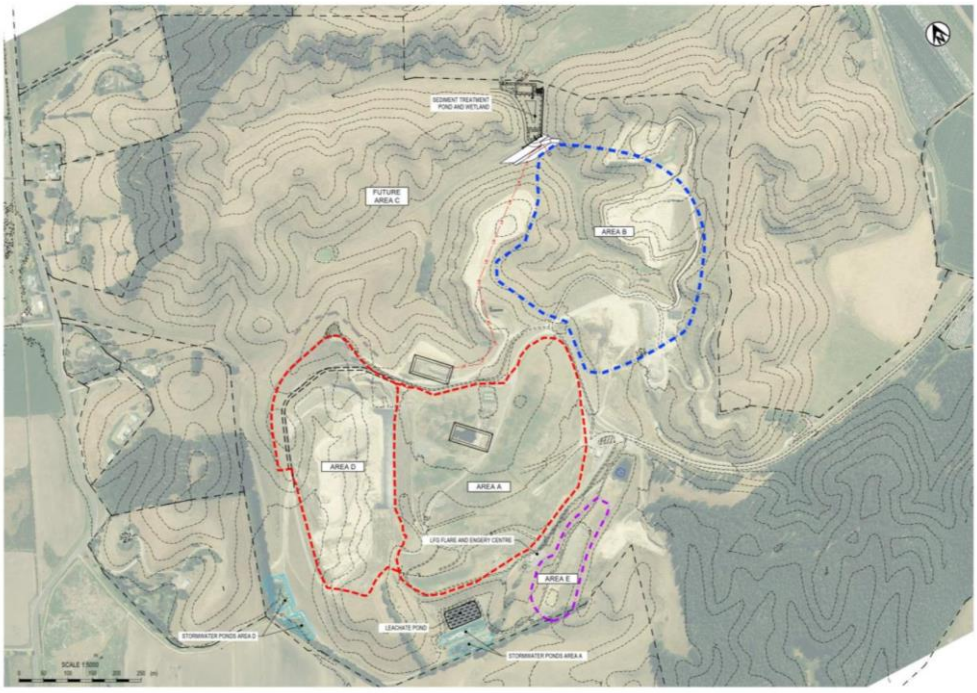

Figure 2: Figure 5.2 of the AEE showing landfill areas

3.2 Summary of natural environment

Section 5.2.1 of the AEE presents information on the natural environment and this is also provided in supporting reports. This information is summarised here.

3.2.1 Topography

The topography in Area B is described as series of steep narrow gullies amongst a larger broad valley, that is surrounded by ridgelines on the western, southern and eastern portions of the site. The southern and central portions are described as level plateaus which have been modified as a result of their use as borrow and fill areas.

3.2.2 Geology

Geological investigations have been interpreted to show that the higher topography within Area B consists of rock comprising interbedded and interfingering limestone (LST), siltstone and sandstone (SST) beds. The valley floor consists of alluvium and is indicated to be up to 9 m in thickness, comprising sandy organic silts and silty sands. Near the base of the gully slopes is a layer of colluvium comprising reworked weathered sandstone and loess with minor boulder-sized limestone blocks.

It is noted that the faults mapped at the site are not recorded on the GNS database of active faults and that the nearest known active fault is the Napier Fault, approximately 6 to 10 km east of the site.

A number of geotechnical investigations have been undertaken at the site including mapping, logged machine boreholes with packer testing and slug testing, test pitting and laboratory sampling including particle size distribution tests and permeability testing.

3.2.3 Climate

The climate is described as temperate with the nearest weather station indicating an average rainfall of 866 mm/year. The nearest weather station is noted to be on the Heretaunga Plains, which will not reflect the topographical variation present in the area of the landfill. However, this indicates that regionally the prevailing wind is from the south-west, with north-east winds also frequently occurring.

3.2.4 Groundwater

The surrounding flat land within the Moteo Valley to the west and the Tūtaekurī River to the east are described as containing a shallow aquifer system comprising unconfined and semi-confined to confined aquifer conditions, at times with flowing artesian pressures, occurring within the layered deposition of historical river deposits. Groundwater contours from previous reporting by HBRC indicate regional groundwater flow in the area is typically from north-west to south-east.

Locally around Area B, groundwater is interpreted to generally flow from east to west. To the west of Area B, groundwater is inferred to potentially flow both south and north and it is suggested that it may be controlled by a groundwater divide. A potentially perched area of groundwater is inferred to be present near to the sediment pond.

Groundwater quality sampling has been undertaken within the monitoring wells located around Area B. Exceedances of the guideline values were observed at some of the sampled locations.

3.2.5 Surface water

The AEE describes how the Upokohino Stream, which is a tributary of the Tūtaekurī River, is located to the east of the site.

A large portion of Area B surface water and groundwater drains north east towards the Upokohino Stream. The southern extent of Area B also currently drains to the south and enters an existing sediment treatment pond, which discharges via a drain to the Upokohino Stream.

The average flow from the Upokohino Stream is unknown, although landfill operations staff have described it as having a stable flow most of the year with little fluctuation. The flow observed during the February 2018 site visit was low, with no observable flow velocity. It was noted that the stream was dry immediately upstream from the landfill access road.

3.2.6 Vegetation

Area B is described as predominantly grass covered, with a small number of trees on the site. The wider designated site is also predominately grassed, with some native vegetation having been planted to provide screening of Area D.

3.3 Summary of human environment

Section 5.2.2 of the AEE presents information on the human environment and this is also provided in supporting reports. Relevant sections of this are summarised here. The AEE also includes information on access to the site from Omarunui Rd, traffic, landscape and archaeology.

3.3.1 Land use at the site/Previous and current landfill activities

The AEE describes how Area A of the landfill commenced operation in 1987 and stopped accepting refuse on a regular basis at the end of 2006. The landfill was constructed with a clay liner system. Leachate collected on the Area A liner flows by gravity to the leachate pond at the toe of Area A. Since closure, work has been undertaken to complete the final capping layer on Area A and to install a landfill gas collection and flaring system and, more recently, a landfill gas to energy plant. An open pit remains on the upper surface of Area A for recirculating leachate into the landfill. Leachate is currently pumped from the storage pond to the pit through a fixed piping system which also feeds the leachate irrigation system, irrigating leachate to the landfill surface.

The AEE describes how Area D opened to receive refuse in January 2006. Filling is currently occurring in Stage 3 of Area D. Area D has a composite geomembrane/clay liner system and leachate is pumped from the base of the Area D landfill to the leachate pond located at the toe of the Area A landfill.

The AEE describes how the southern section of Area B was used as a 'quarry' for obtaining liner materials for Area A. This has since been filled with non-engineered fill from surplus material from the excavation for Area D. Excavations have been occurring within Area B, including to find clay material for lining Area D and for some off-site use of clean fill.

Other activities on the wider site include borrow areas for obtaining soils for the clay component of the landfill liner, for daily and intermediate cover and for the final capping layer.

3.3.2 Adjacent land use

The AEE describes how the Omarunui Landfill site is bound primarily by rural land uses including farming (primarily grazing), horticulture, and some small pine plantations. A number of lifestyle properties are also located in the vicinity of the site to the west of the site in the Moteo Valley along Swamp Road and to the southeast along Breckenridge Road, with each property typically featuring a single dwelling.

3.3.3 Ambient air quality and sensitivity to air discharges

The AEE concludes that, due to both low population density and the background of rural odours that may be expected from the agricultural activities in the area, the surrounding rural area is relatively insensitive to odour and other air pollutants emitted from the proposed activities. However, the AEE notes that sensitivity to odour will be elevated at the rural dwellings, where consistent human occupation is likely, and expectations of amenity will be higher and that expectation of amenity may also be high in garden and yard areas within the immediate curtilage of the dwelling.

3.3.4 Groundwater users

The AEE describes that a review of the consented wells and consented water takes presented on the HBRC online GIS system indicates that there are 120 wells and 27 consented water takes within an approximate 2 km radius of the site. This appears to have been measured from a location near the centre of the site.

4.0 Overview of the proposed activities

4.1 Landfill overview

As outlined in Section 6 of the AEE, Area B has a design capacity of approximately 3.3 Mm^3 of airspace to provide for the disposal of municipal solid waste, and ancillary infrastructure. Based on 85,000 tonnes/annum of waste, the projected operational period is 32 years.

As described in the AEE, the works will include the following.

- Earthworks to construct the required shape.
- Construction of toe and intermediate stability bunds.
- Construction of a lining system to help prevent leachate seepage into the surrounding environment.
- Construction of a leachate collection system above the lining system. A leachate management system comprising leachate transfer, storage and irrigation, with irrigation both onto the closed Areas A and D of the landfill and to capped parts of Area B.

- Stormwater control around the constructed landfill and treatment of stormwater to remove sediment before it leaves the site.
- A landfill gas (LFG) collection system to collect LFG from the placed waste. LFG treatment by the existing flare and existing LFG to energy plant.
- Cover and capping consisting of daily cover (minimum thickness of 100-150 mm), intermediate cover (minimum thickness of 300 mm) and final landfill cap.

The lining system proposed for Area B is:

- For base areas, flatter than 1V:4H:
  - 300 mm drainage aggregate leachate collection layer;
  - Protection geotextile;
  - 1.5 mm HDPE geomembrane;
  - GCL ($k \leq 3 \times 10^{-11}$ m/s); and
  - Selected compacted soil layer, 600 mm thickness, selected to be mostly silt soils, and avoiding particularly sandy soils, but with no specified maximum permeability (k likely to be in the range of $1 \times 10^{-6} < k < 1 \times 10^{-8}$ m/s).
- For side slope areas, steeper than 1V:4H;
  - 300 mm drainage aggregate leachate collection layer;
  - Protection geotextile;
  - 1.5 mm HDPE geomembrane;
  - GCL, ($k \leq 3 \times 10^{-11}$ m/s); and
  - Selected compacted soil layer, 300 mm thickness, selected to be mostly silt soils, and avoiding particularly sandy soils, but with no specified maximum permeability (k likely to be in the range of $1 \times 10^{-6} < k < 1 \times 10^{-8}$ m/s).

4.2 Proposed waste acceptance

As with the existing areas, the landfill will be a Class 1 landfill, in accordance with the WasteMINZ Technical Guidelines for Disposal to Land (2018). A Class 1 landfill accepts municipal solid waste (which includes residential and commercial waste), construction and demolition waste, some industrial wastes (that meet waste acceptance criteria) and contaminated soils. As described in Section 6.4 of the AEE, these items will be accepted provided they meet Omarunui Landfill's waste acceptance criteria. These waste acceptance criteria are provided in

Appendix Q of the AEE and there is also a section on waste control (Section 21) included in the Operations and Maintenance Manual in Appendix P. WasteMINZ (2018) describe how it is recognised that municipal solid waste is likely to contain a small proportion of hazardous waste from households and small commercial premises that standard waste screening procedures will not detect. However, this quantity should not generally exceed 200 ml/tonne or 200 g/tonne.

The AEE describes how the waste acceptance process is administered at the point of entry allowing only permitted waste into the facility. Drivers must make contact with the kiosk operator before commencing onto site. Spot checks and analysis of materials deposited at the landfill may be carried out at the weighbridge and/or the working face to confirm that waste meets the acceptance criteria.

Omarunui Landfill's waste acceptance criteria include restrictions on potentially hazardous wastes, including requirements for medical wastes to be sterilised prior to acceptance, acidic or alkaline wastes to be neutralised, containment of asbestos contaminated materials, and testing of contaminant concentrations to show that the appropriate guidelines have been met. Potentially hazardous waste can be accepted where testing shows that contaminant concentrations are such that the potential leaching of contaminants will be less than the USEPA TCLP leaching limits and the Ministry for the Environment Class A landfill limits.

4.2.1 Prohibited wastes

A number of prohibited waste types will not be accepted under the waste acceptance criteria at Omarunui Landfill included in Appendix Q of the AEE. These are:

- bulk liquid waste
- radioactive waste (unless they meet specific regulations)
- lead acid batteries
- used oils
- explosive, flammable, oxidising or corrosive substances
- refrigerators or freezers unless they have been degassed
- PCB wastes
- drummed wastes and fadges (wool packs)
- wastes with a pH < 4 or > 10

4.2.2 Waste subject to approval

There are a number of wastes which can be disposed at the landfill subject to application to and approval from HDC's Solid Waste Engineer under the waste

acceptance criteria at Omarunui Landfill included in Appendix Q of the AEE. A hazardous waste manifest form needs to be completed. All applications for disposal of these substances must be accompanied by a chemical analysis of the material and technical data if available. These wastes are:

- Any dangerous goods or other hazardous material not defined above or in the list of prohibited wastes
- Any scheduled poisons or other hazardous chemicals
- Asbestos
- Others materials under the following conditions:
  - Acidic wastes are neutralised
  - Alkaline wastes are neutralised
  - Chemicals which react violently with water or ignite on exposure to air are treated to a non-reactive state.
  - Cyanide compounds are de-toxified and packaged separately.
  - Mercury compounds are converted to mercuric sulphide and packaged separately.
  - Oxidising agents are reduced
  - Reducing agents are oxidised

All chemicals and hazardous substance must be suitably packaged in containers with detailed labels showing contents, date, and quantity. Spot checks and analysis of materials deposited at the landfill may be carried out on all substances in this category to certify that these are within acceptable limits.

4.2.3 Special wastes

A number of wastes are defined as requiring special disposal procedures at the Landfill under the waste acceptance criteria at Omarunui Landfill included in Appendix Q of the AEE. Approval is required for each load of the material. A date and time is to be specified for the delivery of such loads in order to prepare the tipping area. Approval for the disposal of such wastes must be obtained from the Solid Waste Engineer. These wastes are:

- Bulk Construction / Demolition Material
- Dust-type wastes
- Hospital / medical wastes
- Intractable Materials / items (e.g. concrete, steel, rubble etc)

- Putrescible and odorous wastes (offal / animal waste / vegetable and fruit processing by-products)
- Very large items

5.0 Proposed monitoring

Section 6.8.11 of the AEE outlines how an environmental monitoring programme will be established for the new area to monitor any potential effects on the environment so that identified effects can be controlled. The monitoring programme will involve the following focus areas:

- Stormwater;
- Landfill Gas;
- Groundwater;
- Surface water;
- Ecology.

T+T state that the environmental monitoring and reporting requirements are expected to be confirmed in resource consent conditions on regional consents issued by HBRC. They proposed that monitoring be based on the monitoring programme currently undertaken for Area D. Table 1 below summarises the proposed monitoring.

Table 1: Proposed environmental monitoring (as outlined in Table 6.1 of the AEE)

Matter	Purpose	Control
Groundwater	To assess liner performance, effectiveness of pollution prevention measures, resource consent conditions, landfill effects on groundwater	There is an existing network of observation boreholes that is proposed to be used for continuous monitoring of groundwater levels and to facilitate screening for the presence of leachate in groundwater beyond the boundary of the site. Typical indicator contaminants for leachate will be monitored quarterly (electrical conductivity, ammoniacal nitrogen, total organic carbon, biological oxygen demand, chemical oxygen demand, and chloride). A full suite of contaminants will be monitored six monthly.
Surface water quality and in stream ecology	To identify any adverse effects on the quality of surface water and in stream ecology	The following monitoring is proposed: ⁘ Baseline water quality monitoring of the Upokohino Stream prior to construction commencing, at the sites sampled in the Ecological assessment (Appendix L), comprising of three sampling rounds during wet weather and three in dry weather with samples analysed for TSS and turbidity. ⁘ Initial site establishment and construction phase monitoring of the Upokohino Stream comprising turbidity based water quality sampling at the three sites sampled in the Ecological assessment (Appendix L). Samples analysed for TSS and turbidity at quarterly intervals when discharge occurs from the sediment pond. ⁘ Operational monitoring of the Upokohino Stream, comprising water quality monitoring at approximately quarterly intervals when discharges occur from the sediment pond. Monitoring should be undertaken at the three sites sampled in the Ecological Assessment (Appendix L), with samples analysed for TSS, turbidity and parameters to detect accidental leachate contamination. In-stream sediment quality and macroinvertebrate monitoring undertaken annually, to monitor that the stormwater pond and wetland are operating as intended and to detect any accidental contamination of stormwater from leachate or refuse.
Stormwater	To identify any	Monitoring of the existing sediment ponds will

Table 1: Proposed environmental monitoring (as outlined in Table 6.1 of the AEE)

Matter	Purpose	Control
	adverse effects on the quality of the stormwater discharge	continue as per Conditions 13 and 14 of Permit DP040121Wa. Consistent with the existing consent, the new sediment pond for Area B will be monitored for water clarity, field pH and conductivity at a point entering the pond and at the discharge outlet on a six monthly basis and a more extensive suite on a yearly basis. In addition, regular visual checks of the landfill surface will be undertaken, to check for any leachate breakouts.
Landfill gas	To provide assurance that excessive LFG migration and/or emissions are not occurring, to test the efficacy of the existing LFG control system, to ensure equipment is operational	Gas production, composition and flare operation will be monitored by automated equipment – readings will be captured by telemetry. Physical observation of flare will be undertaken daily to ensure flare is operational.
Landfill liner	To provide reliability that the lining system has been installed with no manufacturing or construction defects that may result in subsequent leakage	As described in Section 6.6.2, a construction quality assurance (CQA) process is proposed. The CQA process comprises an oversight of the testing undertaken by the contractor, regular or continuous observation of lining system placement and testing, a final inspection prior to covering and a review of all quality control documentation produced by the supplier and contractor.
Odour	To record odour complaints that may result from landfill activities	The landfill operator will log all odour complaints received and report these to HBRC.

6.0 Review summary and additional information required

Detailed reviews are provided in the appendices to this report. This section of the report includes the summaries from each review and the recommended additional information to be requested from the applicant.

6.1 Geotechnics and landfill design

The AEE and engineering reports provide details of the conceptual design of the extension of the Omarunui Landfill into Area B. Specific areas of the design that are addressed by other review reports include stormwater, leachate irrigation, air quality including odour, groundwater and aquatic ecology.

Clarification regarding the engineering report should be sought from the applicant in regard to the following:

1. Reasons for not complying with the WasteMINZ guidelines on permeability criteria for the capping layer should be given.
2. Excavation of the gully alluvium – clarification is required around the removal of this material especially in relation to the effect on the liner levels which if excavated as shown on drawing 1000647.1000-22 would suggest that the alluvial material is not all removed. In addition, clarification on the removal of the limestone should also be provided.
3. Subsoil drainage – clarification is sought on the details of how and where the groundwater would discharge to should seepage zones be encountered during the earthworks construction phase. In particular, given that previous stages of the landfill may have already been constructed prior to encountering seepage zones. Further detail is required to ensure that the perched groundwater is dealt with and there are no effects on the liner system resulting in the loss of containment.
4. Fill compaction - the report indicates that the engineered fill areas are to be compacted however it should refer to the compaction specification contained within the geotechnical report
5. Liner leakage – the report documents the assumption of 3 manufacturing and 3 installation per hectare however the HELP modelling uses 2 manufacturing and 2 installation defects per hectare. The sensitivity of the HELP model should be checked regarding the difference in terms of seepage flow rates through the liner.
6. Leachate collection and irrigation system
    a. Leachate design flows are calculated from the HELP modelling. The HELP modelling scenarios all assume final capped conditions with only 10 m of waste. The engineering report notes however that the maximum depth of waste would be 50 m. The sensitivity

of the depth of waste on leachate generation rates should be carried out. In addition, the layout of the leachate collection system shows the collection pipelines following single contours without an indication of the expected gradients of the collection pipelines. Clarification is sought on these aspects.

b. Details regarding the redundancy of the leachate sump and pumping system are required to evaluate the potential effect of spillage from the leachate sump in the event of pump failure.

c. Details and calculations regarding the system capacity and leachate water balance are sought to confirm the excess leachate volumes compared with available storage volume to confirm the concept design required leachate storage volumes.

7. New leachate pond on top of Area A – issues around formalising the existing pit on top of Area A into a new HDPE lined pond are not discussed. Formalising the existing pit into a lined leachate pond will require the excavation of the closed landfill and breaching of the existing cap and the potential effects of this are not discussed. Clarification on the design and how this work is to be carried out is sought so that the potential effects (odour, stability, LFG, etc.) are able to be adequately assessed.

8. Intermediate bund location – the engineering report notes that the location and size of the intermediate bund will be determined at the detailed design stage. However, given that the stability assessment given in the geotechnical report has recommended the incorporation of an intermediate bund for stability reasons this should be considered part of the conceptual design. The location of the edge of Stage 1 is known and if the intermediate bund is to located at this edge then the stability model should be re-run with the intermediate bund in the correct location to determine if the FoS remains the same as calculated in the geotechnical report. The stability analysis of this scenario is sought to confirm the results given in the geotechnical report.

6.2 Operation and monitoring and waste acceptance criteria

The review of the Operational and Monitoring Aspects of the proposal for landfilling in Area B, including a review of the proposed waste acceptance criteria has generally found the proposed measures are appropriate and consistent with current best practice in New Zealand.

However, further information is sought from the applicant to help clarify some aspects of the information provided. These are:

- Provide further information on the sources, tonnages and makeup of industrial wastes accepted to the landfill and the waste acceptance principles applied to these wastes to assist in assessing the environmental risks that attach to disposal of these substances to the landfill.
- Provide commentary on the previous performance of the landfill operator at the site, including provision of previous monitoring reports that discuss compliance against the consents, to assist in understanding how well the landfill operations have been undertaken in practice. From this further refinement of the O & M Manual may be required to address deficiencies that will need to be remedied for activities in Area B.
- It is requested that proposed policies and procedures and ongoing review for dealing with WAC for emerging contaminants be provided by the applicant.
- It is requested that the applicant provide an updated list of prohibited substances that will apply to wastes disposed of to Area B.

6.3 Air quality

PDP considers that while the effects assessment methods used in the air quality assessment generally align with accepted practice in the MfE good practice guides for odour, dust and industrial emissions, there are gaps in the assessment and the level of detail recommended for monitoring and mitigation.

In terms of overall effects on air quality, the air quality assessment indicates that abnormal emissions such as flare outages, odorous loads and opening up old areas are the likely cause of adverse effects from odour, with minimisation of such events identified as the proposed mitigation. However, little or no detail or reference is made to what actions will be taken to "minimise" events such as these i.e. how this will be implemented in practice is unclear. In particular, there is inadequate information in relation to an odour management plan, contingency procedures, process controls and design, emission controls and engineering risk for system failures (Table 5, MfE GPG for Odour).

In our view the air quality assessment needs to be aligned with other, more detailed, information relating to specific design, monitoring, management and mitigation rather than providing generic statements about minimisation.

In our experience, during the early phases of filling before LFG capture can be fully established, LFG releases have high potential to result in odour effects off-site, particularly under katabatic drainage conditions. Other than mitigation being identified as that the gas collection system should be installed progressively with the fill, there is essentially no assessment of the effects of LFG

during the establishment phase of the Area B i.e. what is the risk of elevated odour having an adverse effect offsite during the establishment phase?

Some specific matters the need to be addressed are as set out below. We reiterate that because the air quality report on the whole does not align with, or reference, the detailed measures where they are described elsewhere in the documentation e.g. O&M Manual, it is very difficult to understand what monitoring and mitigation is being proposed for the current suite of consents. The following is not intended to be a complete list of the matters that we consider need to be addressed at this stage, but provide examples of gaps in the air quality assessment:

1. Surface monitoring of methane is not described in the air discharge assessment, but is an important control for odour in our view, and should be included. We would recommend monitoring for temporary and final cover is needed to identify hot spots and using trigger thresholds set for odour management to identify where remedial action required.
2. The standard of the flare (specifications) and monitoring and maintenance details are not referred to in the air quality assessment, which are important for ensuring good operations and minimising HAPs and should be included.
3. The AEE/air quality assessment refers to minimisation of flare outages. How will flare outages be minimised? e.g. what testing or maintenance to ensure flare efficiency and reliability?
4. How will the NESAQ flare standards be complied with (Regulation 27)?
5. It appears that the flare will burn the majority of the gas i.e. there is not enough generator capacity to handle the gas flow. Since gas flow is permanently going to the flare, Regulation 27(5) requires that a back-up flare be provided, please confirm/clarify the provision for a back-up flare.
6. While there is a section on fires included in the O&M manual, there is no mention of fires in the air quality assessment or management of fire risk, please discuss (or at least reference and confirm how fire risk will be mitigated for Area B and what the contingency is for fire).
7. What is meant by "judicious use" of odour masking or deodorant sprays?
8. The assessment that the working face size should be minimised appears at odds with the proposal to increase the working face area compared to the current consent. What is best practice for working face size?

Please provide details in relation to the aspects as they relate to the air quality assessment and/or references to where this information is held. By preference, these aspects should be directly addressed as part of the air quality assessment.

Again, we acknowledge that some matters may be addressed elsewhere in the documentation, but in our view the air quality assessment needs to at least cross reference the detail if available in other parts of the documentation to provide more certainty in relation to the proposal and the overall assessment.

6.4 Stormwater, hydrology and leachate irrigation

The AEE and Engineering Report provide details of the proposed stormwater treatment approach, which consists of directing runoff that has not come into contact with refuse to a new sediment pond and wetland. The proposed treatment approach targets sediment suspended in stormwater runoff. The Application states that the sediment pond has been sized in accordance with Hawke's Bay Waterway Guidelines: Erosion and Sediment Control, however these guidelines are targeted to temporary construction activities. The sediment pond would be operational throughout the staging of Area B (30 + years). The Application does not specify what sediment load (entrained in stormwater) is expected to be discharged to the receiving waterway, and further information is required to assess the potential effect on the receiving environment.

Stormwater that has come into contact with refuse will be treated as leachate and directed to the leachate collection and recovery system. The system will provide 8,300 m^3 of storage, comprised of the existing 3,500 m^3 pond and a proposed 4,800 m^3 leachate storage pond. Stored leachate will be irrigated to capped surfaces of the landfill, and when required, excess leachate will be trucked to the Hastings Sewage Treatment Plant for treatment and disposal. It is proposed to irrigate leachate (from Stages A, B and D) to the capped surfaces of the landfill at an overall average irrigation rate not exceeding 3 mm/day. A separation distance of 10 m between the spray zone and stormwater drains is proposed. The application does not include details of soil moisture deficit modelling, which is required to assess the potential of leachate irrigation activity generating runoff or becoming entrained in runoff, which could lead to an adverse effect on the water quality of the sediment pond, wetland and receiving waterway. It is recommended that further information be requested in order to assess the suitability of the proposed leachate irrigation rate and separation distance.

The T&T Engineering Report includes a hydrological assessment which assesses the change in the peak runoff, calculated via the rational method. The assessment states that the peak flow will increase to a maximum of approximately 17% (compared to the existing scenario) during the intermediate/operational phase of Area B, then start reducing back to the existing conditions at the landfill, with the developed (capped) stage being unchanged compared to the existing scenario. Clarification is sought from the Applicant regarding the runoff coefficients used for calculating the peak runoff for the developed (capped) phase, in particular why the runoff coefficient from

the developed (capped) Area B was not adjusted for slope, which could impact the peak runoff rates post development.

To better understand the proposed stormwater treatment system, potential changes to peak runoff rates, the potential for leachate to enter the stormwater system, and the potential effects on the receiving environment, it is recommended that the following information is requested in a Section 92 request:

Hydrological assessment:

- The Appendix D – Stormwater Calculations of the Engineering Report provides a comparison of peak runoff rates, calculated using the rational method, for three scenarios. The assessment states that "*design rainfall intensities were sourced from NIWA's High Intensity Rainfall Design (HIRDs) version 4*", however the rainfall intensities values are not specified. Please specify the rainfall intensities used for the peak flow calculations (Table 3.1). Furthermore, please advise how climate change was accounted for.
- Table 2.1 of the Stormwater Calculations states that the slope of Area B in the 'Developed – capped Stage 5' scenario is 21%. The runoff coefficient (0.3) does not appear to have been adjusted for the slope. Table 6-1b of the Hawke's Bay Waterway Guidelines Stormwater Management specifies slope corrections for runoff coefficients. Please revise the assessment or otherwise advise why a slope correction is not necessary.
- Table 2.1 of the Stormwater Calculations states that the time of concentrations (t_c) for the various sub-catchments for the three scenarios range from 10 to 12 minutes. Given the size of the sub-catchments, the values for t_c appear to be low. Please confirm the t_c values and any changes to the peak flow, if necessary.
- Please provide an assessment of the capacity of the farm drain (to which the proposed Stage B sediment pond/wetland would discharge to) with reference to the above assessment, in particular with respect to any potential increases in peak runoff as a result of the proposal.
- Section 6.6.6 of the AEE states that the southern extent of Area B currently drains to the south, and that this southern portion of Area B will become incorporated into the landfill. Please advise whether the incorporation of the southern portion of Area B has been included in the peak flow calculation (Table 3.1 of the Appendix D – Stormwater Calculations).

Stormwater system:

- The Application states that all short-term drains will be designed for a 10-year ARI event, and all permanent drains for a 100-year ARI event. Based on the information provided in Section 3.5, the expected lifespan of the landfill is approximately 30 years, with 10+ years between Stage 4 and 5. To better understand the proposed drains, and how long the drains would be operational for,
  - Please clarify what constitutes a "short-term" drain – how long would a "short-term" drain be operational for (e.g. up to x number of years). Similarly, please confirm what constitutes a "permanent" drain (e.g. operational for more than x number of years).
  - Please provide further details on the (conceptual) design and dimensions of the stormwater drains.
- The Application states that only runoff that has not come into contact with waste will enter the stormwater system. Please clarify what measures are proposed to ensure only clean stormwater is able to enter the stormwater system.
- The Application states that the Stage B sediment pond will be designed to meet or exceed the requirements of the Hawke's Bay Waterway Guidelines – Erosion and Sediment Control 2009 ("the guidelines"). The guidelines provide sizing criteria for sediment retention ponds, which were used to size the proposed Area B pond as described in the AEE. The guidelines refer to sediment retention ponds as temporary ponds, and states that where they are used for more than two years, *"further measures to ensure stability and effectiveness are likely to be needed*". The Application states that the proposed Area B pond will form the basis for sediment treatment for all works within Area B. Area B is expected to provide approximately 30 years of landfill capacity, which suggests the pond will be operating for at least 30 odd years. To understand the operation of the pond and the potential effect on the receiving environment, please specify
  - What is the expected treatment efficiency of the Area B pond and wetland;
  - What ARI storm event the sediment pond is able to accommodate;
  - An indication of the likely performance of the sediment pond during storm events greater than the design storm, and/or how these peak flows will be managed and /or if they will mobilise contaminants in the sediment pond and/or wetland;

- How the potential risk of spills, for example from machinery and vehicles operating during the construction and operation of the landfill will be managed;
- How the potential risk of run-off or additional leachate generation will be managed in the event of landfill fires, with consideration of the potential contaminants contained in this. There is some information on this in the O&M manual but specific information for Area B is required;
- The expected sediment load of treated stormwater discharged to the unnamed farm drain. How much sediment is expected to deposit in the unnamed farm drain and the Upokohino Stream;
- Please provide details of when/if accumulated sediment would be removed from the proposed sediment pond and wetland;
- Does the proposed geometry of the Area B sediment pond (i.e. the non-rectangular shape) affect the expected treatment efficiency of the pond;
- Appendix D – Stormwater Calculations of the Engineering Report notes that the sediment pond and wetland would provide additional storage capacity and could cause a further lag in the stormwater runoff and potentially reduce the peak flow rate for smaller storm events. Please advise whether the pond and wetland are expected to attenuate flows, and what impact, if any, this may have on the ability of farm drain and the Upokohino Stream to flush accumulated sediments.

- Section 6.6.6 of the Application states that the proposed Area B sediment pond will block the outlet from the Area C Valley, and that it is proposed to install a pipeline within the pond bund to by-pass the Area B sediment pond and discharge to the farm drain downstream of the pond. Please provide details on the proposed bypass pipeline, in particular what the design capacity will be and what the implications would be if the pipeline failed or the capacity was exceeded (e.g. potential for flooding, potential for washing out the sediment pond or wetland).

Monitoring:

- The Application states that visual checks of the landfill surface on a regular basis to check for any potential leachate breakouts. Please specify the proposed frequency of the visual inspections.
- Please advise if and what type of regular inspections are proposed for monitoring the stormwater system (stormwater drains, sediment pond, etc.).

- The proposed stormwater monitoring (Table 6.1 of the AEE) specifies stormwater monitoring at six monthly intervals for water clarity, pH and conductivity. If the stormwater system were to be impacted by leachate, the proposed sampling would only detect such impacts after potentially six months. Please clarify why more frequent sampling was not considered appropriate, or potentially continuous monitoring of pH and conductivity, which could detect leachate impacts more quickly and allow a more rapid response.
- The proposed stormwater monitoring (Table 6.1 of the AEE) specifies that "*a more extensive suite*" will be analysed on a yearly basis. Please advise which parameters are proposed to be included in the "more extensive suite".
- Section 10.6.2.2 of the Application proposes to "*monitor spray drift under different weather conditions for the potential to enter stormwater drains to the extent that this may cause contamination*". Please provide further details of what spray drift monitoring is proposed, and how this will be undertaken to avoid spray drift from potentially entering any temporary or permanent stormwater drains.
- Section 6.6.6 of the Application states that it is proposed to divert run-off water from Area C around the Area B sediment pond, and that clean water diverted from the Area B site will also be diverted to this by-pass where possible. Please advise how it will be determined whether runoff can be diverted to this by-pass, and whether any further ongoing monitoring is proposed to monitor the quality of water diverted by this by-pass.
- The Operations and Maintenance Manual (Appendix P) specifies leachate monitoring of the existing leachate collection pond, in accordance with the existing consent DP040120Lb. The proposed environmental monitoring (Table 6.1 of the AEE) does not include leachate monitoring from the proposed new 4,800 m^3 pond. Please confirm whether it is proposed to monitor leachate from the new 4,800 m^3 leachate pond, and what parameters would be included, or otherwise clarify why this is not considered necessary.

Leachate management and irrigation

- The Application proposes a 10 m separation distance between the spray zone and stormwater drains. To better understand the proposal and potential effects, please advise:
  - Whether the 10 m separation distance applies to permanent stormwater drains only, or whether this applies to all drains (including temporary stormwater drains). It is noted that existing condition 4 of DP160044L does specific 10 m from any

stormwater drain, overland flow paths or other surface water body.

- Why a 10 m separation distance is considered sufficient, taking into account slopes of the areas proposed to be irrigated in Area B and the potential for contaminants to be entrained in the runoff (as shown in Drawing 1000647.1000-31).

- Please advise whether the potential for leachate impacted water to enter stormwater drains via interflow through the growth layer of the capping layer has been considered, and how this potential risk has been mitigated or avoided.
- The Application proposes a maximum leachate irrigation rate of 3 mm/day. Section 5.5.3 of the Engineering Report includes the results of an irrigation capacity versus leachate storage volume assessment, and Section 5.2 provides reductions in leachate irrigation capacity during wetter months which are reported to have been back calculated from the existing leachate irrigation activity. In order to better understand the potential risk of leachate generating runoff or becoming entrained in stormwater runoff, please provide details of soil moisture deficit modelling to justify why the proposed irrigation rates are suitable, how irrigation rates will be managed in consideration of potential lower permeability cap rates, and how the risk of leachate being entrained in stormwater runoff will be mitigated or avoided.
- The irrigation of leachate has the potential to lead to an accumulation of sodium in soils in the proposed irrigation areas. Please provide an assessment of the potential for sodium accumulation in the within the proposed irrigation areas soils, and any potential increase in the exchangeable sodium percentage (ESP) and any potential effect on surface soil permeability and generation of runoff. Proposed sodium mitigation measures are also requested.
- The irrigation of leachate furthermore has the potential to lead to the accumulation of heavy metals in soils within the proposed irrigation areas. Please provide an assessment for the potential of heavy metal accumulation, and whether this may have an effect on vegetative cover of landfill cap or on the quality of stormwater and the receiving environment, associated with runoff.
- Please provide information on the risk of other contaminants including emerging contaminants, accumulating in soils, being entrained in run-off or being discharged from the underdrainage system, in line with PDP's review memorandum of the waste acceptance criteria.
- The Engineering Report specifies that the average leachate generation rate, as modelled in HELP, is expected to be 105 m^3/day during Stage 5

of the landfill (estimated filling period of 2043 to 2060). Please provide further details on the design of the leachate system, in particular with reference to the risk of leachate spilling and whether this could enter the stormwater system should the design capacity of the system be exceeded (for a year with greater than average rainfall), or in the event of a leachate pump failure.

- Please provide details of a refined irrigation area to optimise the proposed leachate irrigation area, but minimise irrigation of steep slopes.
- In line with the geotechnical review further information request, please provide details on the calculations regarding the system capacity and leachate water balance to confirm the excess leachate volumes in a year with greater than average rainfall compared with available storage volume to confirm the concept design required leachate storage volumes. The highest year on record rainfall needs to be included in this calculation with allowance for climate change.
- Also, in line with the geotechnical review further information request, please provide details on the design of the proposed new leachate storage lagoon and how the potential for differential settlement will be managed, particularly in relation to the storage lagoon liner integrity.

6.5 Surface water quality and ecology

The T+T ecological assessment provides a good baseline overview of the Upokohino Stream, detailing its existing condition and the proposed effects from stormwater. However, this assessment is completed only once, and in summer low flow conditions with dry reaches downstream. This is the correct procedure for ecological surveys, as the system is at its most stressed; however, it is not when stormwater contribution is expected. Higher water flows are likely to be present when stormwater run-off is occurring and therefore an assessment of the potential effects over a wider time period, with discussion on downstream transport and cumulative effects to downstream receptors is required.

It is recommended that the following information is requested:

- An assessment of effects is needed to determine the risk of contaminant transport from landfill activities (leachate, spills etc.) and additional proposed controls to mitigate risk to receiving waterways.
- Please provide details of the management/response plan if contaminants are discovered in surface water samples. What are the trigger levels for turbidity/TSS in the stream to warrant action?

- An assessment of effects needs to be completed for the Tūtaekurī River and Lake Te Rotokare, including cumulative effects, with controls developed to ensure no effects are caused from the proposed activities.
- There is no reference of Figure 4.2 in the report, what is the importance/context of this figure and the spring systems to the application?
- Results indicate that the current and historic landfill activities may already be having an impact on Upokohino Stream, with elevated levels of multiple parameters, including ammoniacal-N at 11.6 g/m^3 (background levels at < 0.010 g/m^3) in water quality samples collected in February 2018. Given these potentially toxic levels and the dead eels observed, further investigation into whether the landfill is currently having an adverse effect on aquatic life is required. Please provide an assessment of the cumulative effects of the proposed discharge on the already stressed environment in Upokohino Stream.
- Please provide an assessment of effects of the potential adverse effects of the treatment pond and wetland, including effects of wildlife using these habitats and proposed maintenance of the pond and wetland (and its effects) for sediment accumulation removal. This should include an assessment of nutrient accumulation in the pond which could lead to nuisance algal blooms.
- Section 6.1 states that high water temperatures recorded are due to lack of riparian shade, however no mitigation methods are proposed to increase riparian planting along the affected section of Upokohino Stream. Please provide plans for any mitigation or restoration activities planned.

6.6 Groundwater

The proposal to establish a landfill at Area B has a number of potential effects on groundwater quality and quantity, although the risk of these occurring can be minimised through appropriate design, management and monitoring.

It is recommended that the following additional information should be sought from the applicant:

- Details of the calculations (for example a spreadsheet print-out) for auditing purposes of the leachate dilution modelling.
- There is a potential pathway from the irrigation of leachate on the landfill cap, should runoff or underflow occur outside the landfill footprint, resulting in leaching to groundwater. This should be further considered based on the runoff and underflow issues raised in PDP's

review memorandum of the stormwater, drainage and leachate irrigation.

- Comparison of water quality sampling with the NZDWS, 2018 and ANZG, 2018 and explanation of the choice of the 95% protection values. The long-term groundwater record provided with the application is relatively short and there appears to be some uncertainty regarding the existing groundwater divide and the groundwater flow directions. Bores located further away from Area B should also be included in any groundwater level monitoring/piezometric surveys to determine groundwater flow directions in the wider area. Any existing water level information should be considered together with the levels recorded in the bores around Area B to help refine and understand the groundwater flow directions. A longer groundwater level record would also be useful to determine how groundwater levels change seasonally and if seasonal fluctuations result in any changes in flow direction or groundwater divides. It is recommended the applicant commence this as soon as possible, or provide information on why this is not considered to be required at this stage.
- Groundwater quality data suggests some localised contamination has occurred in the groundwater system beneath the proposed Area B landfill from localised landuse potentially not associated with adjacent landfill activities, although leachate contamination from adjacent landfill activities cannot be ruled out. A review of historic landuse information would be useful to confirm if any elevated concentrations are related to historic landuse. Comparison with water quality monitoring data for all bores around the landfill and beyond would be useful to help establish whether the elevated concentrations could be due to existing landfill impacts.
- Groundwater sampling over a longer time period (ideally at least one year) would be useful to determine if there are any seasonal trends in contaminant concentrations. It is recommended the Applicant commence this as soon as possible, or provide information on why this is not considered to be required at this stage. Bores located within a wider radius from the boundary of the Area B landfill should also be included during any groundwater level monitoring and groundwater sampling to provide additional background water level and quality information.

7.0 Summary

This report and the memorandums included in the appendices have detailed PDP's technical review of the consent application lodged with HBRC by HDC and NCC for resource consents to construct and operate a new area of landfill (Area B) at the operational municipal landfill, the Omarunui Landfill. The application will be publicly notified, at the request of the applicant.

The comprehensive Assessment of Environment Effects (AEE) report prepared by Tonkin & Taylor Limited (T+T) together with the reports provided in the appendices to this have been reviewed.

Following the review of this information, it is recommended that HBRC should request some additional information from the applicant, as identified in this report.

Appendix A

Geotechnics and landfill design review

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

Tel +64 3 **345 7100** Fax +64 3 **345 7101**
Web **www.pdp.co.nz**
Auckland Tauranga Wellington **Christchurch**

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memorandum

TO	Greg Shirras	FROM	Gerald Strayton
	Hawke's Bay Regional Council	DATE	31 March 2020
RE	Omarunui Landfill Area B Consent Review – Geotechnics and Landfill Design		

1.0 Introduction

Hastings District Council (HDC) and Napier City Council (NCC) (jointly the Applicant) have applied to Hawke's Bay Regional Council (HBRC) for resource consents to construct and operate a new area of landfill (Area B) at the Omarunui Landfill. The Assessment of Environment Effects (AEE) has been prepared by Tonkin & Taylor Limited (T+T).

A number of activities are considered to be permitted activities. HDC and NCC are seeking resource consents for the following activities:

- Discharges of contaminants to air (odour, landfill gas, dust and the products of combustion of landfill gas)
- Discharges of contaminants to land and water (from the landfill operation)
- Diversion and discharge of stormwater
- Diversion and discharge of drainage water (from a pumped system)

The applicant is seeking to change conditions associated with the existing air discharge and leachate discharge permits to provide for the Area B extension and is seeking new consents for the other activities.

Pattle Delamore Partners Limited (PDP) has been engaged by Hawke's Bay Regional Council (HBRC) to provide a technical review of the consent application for the following matters:

- Geotechnics
- Landfill design
- Leachate management and irrigation
- Stormwater, hydrology and drainage design
- Air quality
- Surface water quality and aquatic ecology
- Groundwater
- Proposed operation and monitoring
- Waste acceptance criteria

This memorandum details PDP's review of the landfill design and geotechnical matters related to the proposed activities. The Geotechnical Report (Appendix J of the AEE) and the Engineering Report (Appendix I of the AEE) have been reviewed together with relevant aspects of the AEE and other reports. The review considers suitability of the landfill design, comparison with best practice guidelines, assessment and investigation methods, proposed management and interpretation and further investigations and monitoring.

2.0 Overview of geotechnical and landfill design aspects of the proposal

The AEE has a section on Waste in the Hawke's Bay Region which documents waste sources and pathways, the role of landfills in the waste cycle and the Waste Future project. The Waste Future project identified Option A as the way forward following an evaluation of four short listed options in terms of their economic, social, cultural and environmental impacts. Option A involves:

- Optimising the collection system to maximise the diversion of materials from the landfill.
- Working towards development of additional landfill capacity at Omarunui Landfill.

In Section 6 of the AEE the landfill design and operation is discussed. In summary the extension of the landfill into Area B will provide an additional 3.3 Mm^3 of airspace for future landfilling operations which at the current rate of deposition of between 85,000 – 95,000 tonnes/annum could give Area B a life in excess of 30 years. The AEE notes that the conceptual details of the engineering design of the landfill is given in the Engineering Report.

The AEE highlights the key design features of the concept landfill design and comments on:

- The lining system – designed in accordance with the Technical Guidelines for Disposal to Land (WasteMINZ, 2018) but noting that with the lack of suitable low permeability soils available the liner system will comprise a composite design involving a geomembrane and a geosynthetic clay liner.
- The leachate collection and recovery system (LCRS) – designed to collect and remove leachate from the base of the landfill to store and irrigate the leachate onto the closed areas of the landfill where it is lost via evapotranspiration or seeps back into the closed landfill areas. Excess leachate will be removed to the Hastings Sewage Treatment Plant for treatment by tanker trucks when required. Additional storage ponds are able to be constructed in the area north of Area A or Area C.
- The cover and capping system – material for the daily, intermediate and final capping of the site will be provided from soils excavated and stockpiled during the staged construction of Area B.
- The Landfill Gas (LFG) system – designed to extract LFG and flare the gas as well as use the gas to generate electricity (existing Waukesha generator – 0.9 MW). The LFG extraction wells and pipework to be installed progressively as part of the operation of the landfill.
- The stormwater system and erosion and sediment controls – designed to keep leachate and stormwater separate. Any rainwater coming into contact with the waste is regarded as leachate and is not discharged to the stormwater system. Stormwater treatment is aimed at removal of sediment only prior to discharge. Short term stormwater drains are designed for the 10 year ARI event and permanent drains for the 100 year ARI event.
- Landfill operations – this section of the AEE covers operation aspects of the day to day operation of the landfill which is covered by the Landfill Operations and Maintenance Manual. The staged development of Area B is summarised with Area B being developed in 5 stages. The implementation of the cover and capping design is described along with the placement and

compaction of the incoming waste. It also addresses operational hours, wind-blown debris, pest management, dust, noise, traffic, landscaping and monitoring.

Section 7 of the AEE deals with the initial construction of Area B and discusses the implementation of the conceptual design in terms of earthworks, subgrade preparation, engineered fill placement, stockpiling, dewatering, subsoil drainage and construction traffic.

Section 8 of the AEE covers the closure and aftercare of Area B. This discusses the final landform, the final cap and the required rehabilitation and aftercare requirements.

Section 10 deals with the assessment of effects and effects relevant to the landfill design and geotechnical matters are discussed in Section 5 of this technical memorandum.

Aspects related to the concept design are discussed in Section 4 of this technical memorandum.

3.0 Receiving environment

The site is located at 329 Omarunui Road, south-west of Taradale and has been designated in the proposed Hastings District Plan for the purposes of landfilling. The AEE describes the site as comprising *"four separate valleys described as Area A, Area B, Area C and Area D. Clean filling operations are authorised to occur in Area E. Area D is the current landfill area on the site. Area B is located to the north east of the existing landfill areas A and D. Area B covers an area of approximately 23 hectares."*

Section 5 of the AEE describes the existing environment and covers the natural and human environment.

The topography in Area B is described as series of steep narrow gullies amongst a larger broad valley, that is surrounded by ridgelines on the western, southern and eastern portions of the site. The southern and central portions are described as level plateaus which have been modified as a result of their use as borrow and fill areas.

A large portion of Area B surface water and groundwater drains north east towards the Upokohino Stream. The southern extent of Area B also currently drains to the south and enters an existing sediment treatment pond, which discharges via a drain to the Upokohino Stream. Groundwater is generally expected to be below the base of the landfill, but within parts of the valley alluvium to be removed.

The geological investigations have been interpreted to show that the higher topography within Area B consists of rock comprising interbedded and interfingering limestone (LST), siltstone and sandstone (SST) beds. The valley floor consists of alluvium and is indicated to be up to 9 m in thickness, comprising sandy organic silts and silty sands. Near the base of the gully slopes is a layer of colluvium comprising reworked weathered sandstone and loess with minor boulder-sized limestone blocks.

4.0 Discussion on Engineering, Geotechnical and Operations and Maintenance Manual Reports

The focus of this technical memorandum is related to the landfill concept design and the geotechnical information.

4.1 Engineering Report

The engineering report details the concept design elements for the extension of the Omarunui Landfill into Area B. This concept design will form the basis of the detailed design for the principal elements of the landfill. The report draws on information from the geotechnical report as it relates to the design of various elements of the landfill extension.

The report provides a suitable level of detail to establish the fact that Area B is able to be designed and developed as an extension to the current landfill operations. The stability of the cut and fill slopes is assessed as part of the geotechnical report.

Overall, the engineering report clearly details the conceptual design covering all aspects of design at a level considered suitable for resource consent purposes. The report acknowledges that further detailed design is necessary prior to construction. There are a couple of design elements that are described but require further explanation. There are:

1. Excavation of the gully alluvium – the report seems to indicate that up to 9 m of this material will be removed as part of the construction of the landfill, but this is not shown on plan or in the sections provided. In addition, the sections used as part of the stability assessment do not show the overall removal of this material but only show the presence of two shear keys. In addition, the limestone is identified to be highly variable in terms of both strength and permeability across the site in Section 3.2.3. and 5.2.2 of the geotechnical report. Section 3.2.1 of the engineering report and Section 5.4.2 of the geotechnical report indicate removal of some limestone will occur, but it is not clear how this process/decision making will be carried out to ensure stability issues do not arise.

2. Subsoil drainage – the concept design notes that as a precautionary measure subsoil drains should be installed below the liner in the lower cells but these are not shown on the plan and details of how and where the groundwater would discharge to are not contained in the report, although the AEE notes that this will discharge to stormwater.

3. Fill compaction – the report indicates that the engineered fill areas are to be compacted however it should refer to the compaction specification contained within the geotechnical report.

4. Liner leakage – the report documents the assumption of 3 manufacturing and 3 installation per hectare however the HELP modelling uses 2 manufacturing and 2 installation defects per hectare. The sensitivity of the HELP model should be checked regarding the difference in terms of seepage flow rates through the liner.

5. Liner Design – the drawings show that the soil layer beneath the GCL/HDPE lining system have a permeability range between 10^{-6} and 10^{-8} m/s. The WasteMINZ guidelines indicate that a maximum permeability of 10^{-8} m/s is required for this layer in conjunction with a GCL/HDPE liner system. Section 4.3 of the engineering report notes that "*in addition to the above material requirements, an Electrical Leak Location survey will be undertaken on all completed sections of lining system after placement of the drainage aggregate layer, and any leaks found from this survey will be repaired*" and "*In addition to the above lining system, the consents should also allow for both a Type 1 or Type 2 lining system as defined in the Technical Guidelines for Disposal to Land and as described above. This will allow for the possibility of locating sufficient low permeability soils on site, or locating a source of suitable soils from off-site*". On the basis of reducing the number of leakage points the design assumes that the range of permeabilities indicated of between 10^{-6} and 10^{-8} m/s will be suitable. In this case provided that the ELL survey is stipulated then the maximum permeability of 10^{-6} m/s should be included.

6. Leachate collection system – leachate design flows are calculated from the HELP modelling. The HELP modelling scenarios all assume final capped conditions with only 10 m of waste. The engineering report notes however that the maximum depth of waste would be 50 m. The sensitivity of the depth of waste on leachate generation rates should be carried out. In addition, the layout of the leachate collection system shows the collection pipelines following single contours without an indication of the expected gradients of the collection pipelines.

7. New leachate pond on top of Area A – issues around formalising the existing pit on top of Area A into a new HDPE lined pond are not discussed. Formalising the existing pit into a lined leachate pond will require the excavation of the closed landfill and breaching of the existing cap and the effects of this are not discussed.
8. Intermediate bund location – the engineering report notes that the location and size of the intermediate bund will be determined at the detailed design stage. However, given that the stability assessment given in the geotechnical report has recommended the incorporation of an intermediate bund for stability reasons this should be considered part of the conceptual design.
9. Final cap design – the engineering report notes that the final cover will include a compacted soil layer with a permeability range between 10^{-6} and 10^{-8} m/s. The WasteMINZ guidelines indicate that a maximum permeability of 10^{-7} m/s is required for this layer. References are provided for a range of 10^{-6} to 10^{-7} m/s in Section 6.2 of the report, but the differences to the WasteMINZ guidelines are not explained.

4.2 Geotechnical Report

The geotechnical report covers the geotechnical investigations carried out at the Omarunui Landfill in relation to Area B. The report considers the results of the investigation and evaluates the ground conditions to assess the feasibility of using the site for the purposes of landfilling.

The report provides the required information based on the results of the current (2018) investigation and reviews the applicable results of two previous investigations of the area from 1983 and 2001. The subsurface conditions are described and geological profiles defined. The report covers the stratigraphy of the site and the geological units encountered together with groundwater data collected in 2009 and 2018.

Given the location of the landfill within a seismically active area of New Zealand, the seismic hazard is assessed and design earthquake loads for the serviceability limit state (SLS) and ultimate limit state (ULS) are determined. The importance level of the landfill is not given and should be stated in the report. The report assumes that the alluvial soils will be removed as part of the earthworks for the development of the Area B landfill extension and does state that should not all alluvial soils be removed then a detailed liquefaction assessment should be carried out prior to detailed design. The issue regarding the removal of the alluvial soils is raised in the engineering report but the extent and details on the removal of these soils is not given.

The slope stability modelling is limited to the two critical sections, viz. the eastern highwall excavated slope and the permanent toe bund at the base of the landfill. The stability models were based on the geological models determined from the results of the investigation information with strength parameters determined from laboratory testing and published and unpublished values for similar materials. The stability modelling assessed overall slope stability but not intermediate slopes. The calculated Factors of Safety (FoS) for static and elevated groundwater conditions exceed the defined target FoS. The eastern highwall exceeds the target FoS under the ULS conditions however the permanent toe bund does not, even when the toe bund height is raised from 7 m to 10 m.

The geotechnical report recommends that an intermediate bund be constructed upslope of the permanent toe bund to increase shear resistance across the lower liner surface. The location of this intermediate bund is not given in either the geotechnical report or the engineering report.

As in the engineering report the geotechnical report notes the potential for groundwater seepage or springs which will need to be controlled but does not detail how and to where the seepage drains are to be constructed, although the AEE suggests this drainage will be to stormwater.

The issue of the quarry in the southern portion of Area B backfilled with non-engineered fill is addressed and, based on the CPT testing data, settlements are estimated. Based on these estimates, mitigation measures are proposed together with monitoring.

The testing of the soils encountered on site has shown that it is feasible to construct the necessary earthworks and liner elements of the Area B landfill with the materials excavated on site if treated and compacted in line with the recommendations of the geotechnical report. However, the extent of the source materials will need to be further clarified as part of the detailed design.

Non-significant aspects identified during the review include incorrect labelling of contours on drawings 1000647.1000-22, 1000647.1000-24, 1000647.1000-26 and 1000647.1000-29.

4.3 Operations and Maintenance Manual

In order for the design of the landfill to be effective the landfill also needs to be operated in accordance with the design assumptions and requirements. Therefore, the Omarunui Landfill Operations and Maintenance Manual has also been reviewed in relation to its applicability to the landfill design components covered in the engineering report.

The manual has a management review process in place to address any relevant issue that may arise as part of ongoing operations. This would include aspects related to the landfill design or changes to landfill operations.

Monitoring systems are described that cover the following aspects covered by the design:

- Landfill status
- Site integrity
- Integrity of final cover
- Refuse quantities and type
- Groundwater quality
- Surface water quality
- Stormwater discharge quality
- Landfill gas production and gas flare
- Landfill gas composition
- Leachate analysis
- Leachate production
- Leachate pond inspection
- Liner monitoring pipes
- Liner material suitability
- Liner density and permeability
- Weather data

Other aspects are also monitored such as noise, odour, etc. but which do not impact on the landfill design.

Operational procedures and controls that relate to the design elements contained in the manual include:

- Daily cover
- Pest control
- Managing the working face
- Waste compaction
- Landfill fires
- Natural disasters
- Stormwater and sediment control
- Waste control
- Leachate control
- Odour control
- Landfill gas management

Aspects of the landfill design particular for Area B would be able to be addressed within this manual as part of a revision to the manual.

5.0 Potential effects

Brief comments on some of the potential effects resulting from the landfill design are covered in the following sections. These potential effects and others are covered in more detail in the separate review memorandums.

5.1 Dust

Dust would be generated through the ongoing operation of the landfill facility and from construction activities. This aspect is addressed in more detail under the air quality review. The engineering report does note that during construction earthwork areas are to be watered to mitigate against dust generation, which can assist in mitigating effects. As described in air quality review, further information on the specific implementation of the mitigation would be helpful. Landfill Gas

Landfill gas will be generated during the life of the facility. The landfill design includes a LFG collection and destruction system which is a suitable management method for this type of proposed facility and the operation and maintenance manual documents the procedures to be followed during the operation to minimise the effect of LFG. As per the air quality review, there is some ambiguity on the monitoring to be undertaken between the different documents provided in the application. Clarity on this and further information on the specific implementation of the mitigation would be helpful, as described in the air quality review. Odour effects as a result of LFG are discussed as part of the air quality review.

5.2 Leachate

Leachate will be generated as a result of the operation of the landfill. The landfill design provides for systems to help isolate the leachate from the surrounding environment through the liner system. Leachate is to be collected through drainage layers and systems within the area contained by the liner system and directed to lined ponds. Leachate is then to be pumped from the ponds to be irrigated on top of the areas of landfill that have been finally capped. Leachate is lost to the system by evapotranspiration and returned to the system through seepage back into the waste body.

Overall, the concept landfill design of liner system and leachate drainage and collection system is sound, although as per the matters discussed in the other review memorandums, further information is required to evaluate the potential effects of leachate and other matters. The permeability range of the compacted soil layer beneath the GCL/HDPE liner system and the capping layer do not conform to the WasteMINZ guidelines, however the proposed additional ELL survey will reduce the potential of leakage through the liner. Reasons for not complying with the WasteMINZ guidelines on permeability criteria for the capping layer should be given.

6.0 Proposed monitoring

The proposed monitoring in the AEE refers to the operation and maintenance manual which as noted above is considered suitable to accommodate the design aspects for the Area B landfill design, with appropriate updates.

Based on the information provided to date within the AEE and supporting reports, no further monitoring related to the implementation of the landfill design is suggested at present, over and above that suggested in the other reviews.

7.0 Summary and recommendations for additional information

The AEE and engineering reports provide details of the conceptual design of the extension of the Omarunui Landfill into Area B. Specific areas of the design that are addressed by other review reports include stormwater, leachate irrigation, air quality including odour, groundwater and aquatic ecology.

Clarification regarding the engineering report should be sought from the applicant in regard to the following:

1. Reasons for not complying with the WasteMINZ guidelines on permeability criteria for the capping layer should be given.
2. Excavation of the gully alluvium – clarification is required around the removal of this material especially in relation to the effect on the liner levels which if excavated as shown on drawing 1000647.1000-22 would suggest that the alluvial material is not all removed. In addition, clarification on the removal of the limestone should also be provided.
3. Subsoil drainage – clarification is sought on the details of how and where the groundwater would discharge to should seepage zones be encountered during the earthworks construction phase. In particular, given that previous stages of the landfill may have already been constructed prior to encountering seepage zones. Further detail is required to ensure that the perched groundwater is dealt with and there are no effects on the liner system resulting in the loss of containment.
4. Fill compaction - the report indicates that the engineered fill areas are to be compacted however it should refer to the compaction specification contained within the geotechnical report
5. Liner leakage – the report documents the assumption of 3 manufacturing and 3 installation per hectare however the HELP modelling uses 2 manufacturing and 2 installation defects per hectare. The sensitivity of the HELP model should be checked regarding the difference in terms of seepage flow rates through the liner.
6. Leachate collection and irrigation system
    a. Leachate design flows are calculated from the HELP modelling. The HELP modelling scenarios all assume final capped conditions with only 10 m of waste. The engineering report notes however that the maximum depth of waste would be 50 m. The sensitivity of the depth of waste on leachate generation rates should be carried out. In addition, the

layout of the leachate collection system shows the collection pipelines following single contours without an indication of the expected gradients of the collection pipelines. Clarification is sought on these aspects.

b. Details regarding the redundancy of the leachate sump and pumping system are required to evaluate the potential effect of spillage from the leachate sump in the event of pump failure.

c. Details and calculations regarding the system capacity and leachate water balance are sought to confirm the excess leachate volumes compared with available storage volume to confirm the concept design required leachate storage volumes.

7. New leachate pond on top of Area A – issues around formalising the existing pit on top of Area A into a new HDPE lined pond are not discussed. Formalising the existing pit into a lined leachate pond will require the excavation of the closed landfill and breaching of the existing cap and the potential effects of this are not discussed. Clarification on the design and how this work is to be carried out is sought so that the potential effects (odour, stability, LFG, etc.) are able to be adequately assessed.

8. Intermediate bund location – the engineering report notes that the location and size of the intermediate bund will be determined at the detailed design stage. However, given that the stability assessment given in the geotechnical report has recommended the incorporation of an intermediate bund for stability reasons this should be considered part of the conceptual design. The location of the edge of Stage 1 is known and if the intermediate bund is to located at this edge then the stability model should be re-run with the intermediate bund in the correct location to determine if the FoS remains the same as calculated in the geotechnical report. The stability analysis of this scenario is sought to confirm the results given in the geotechnical report.

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This memorandum has been prepared by PDP on the specific instructions of Hawke's Bay Regional Council for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum 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.

Prepared by	Reviewed by	Approved by
Gerald Strayton	**Alan Pattle**	**Hilary Lough**
Technical Director - Geotechnics	Technical Director	Technical Director Resources

Appendix B

Operation and monitoring and waste acceptance criteria review

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

Tel +64 3 **345 7100** Fax +64 3 **345 7101**
Web **www.pdp.co.nz**
Auckland Tauranga Wellington **Christchurch**

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memorandum

TO	Greg Shirras	FROM	Alan Pattle
	Hawke's Bay Regional Council	DATE	31 March 2020
RE	Omarunui Landfill Area B Consent Review – O & M and Waste Acceptance		

1.0 Introduction

Hastings District Council (HDC) and Napier City Council (NCC) (jointly the Applicant) have applied to Hawke's Bay Regional Council (HBRC) for resource consents to construct and operate a new area of landfill (Area B) at the Omarunui Landfill. The Assessment of Environment Effects (AEE) has been prepared by Tonkin & Taylor Limited (T+T).

A number of activities are considered to be permitted activities. HDC and NCC are seeking resource consents for the following activities:

- Discharges of contaminants to air (odour, landfill gas, dust and the products of combustion of landfill gas)
- Discharges of contaminants to land and water (from the landfill operation)
- Diversion and discharge of stormwater
- Diversion and discharge of drainage water (from a pumped system)

The applicant is seeking to change conditions associated with the existing air discharge and leachate discharge permits to provide for the Area B extension and is seeking new consents for the other activities.

Pattle Delamore Partners Limited (PDP) has been engaged by Hawke's Bay Regional Council (HBRC) to provide a technical review of the consent application for the following matters:

- Geotechnics
- Landfill design
- Leachate management and irrigation
- Stormwater, hydrology and drainage design
- Air quality
- Surface water quality and aquatic ecology
- Groundwater
- Proposed operation and monitoring
- Waste acceptance criteria

This memorandum details PDP's review of the O and M manual (Appendix P of the AEE) and the waste acceptance criteria (Appendix Q of the AEE) and relevant aspects of other reports. The review considers the suitability and adequacy of the proposed management of operations and monitoring and the waste acceptance criteria. Relevant aspects of the O and M manual and monitoring are also covered in our review of other aspects of the landfill activities. This review considers matters within the O and M manual not already raised in the other reviews.

2.0 Overview of operation and monitoring aspects of the proposal

Operations will be undertaken in accordance with the conditions in the Omarunui Landfill Management Plan (OLMP) in Appendix 24 of the Proposed Hastings District Plan and generally in accordance with the Omarunui Landfill Operations and Maintenance Manual. Operation and monitoring activities for the existing Stages A and D are managed under the O and M Manual, which is a live working document controlled by the Waste Services Department, Hastings District Council. The OLMP is a very brief document that sets out the general requirements for operation of the landfill while the Manual provides detailed description of policies, and procedures for the landfill operation activities.

It is expected that activities that service Area B will fall under the requirements of the Manual updated to reflect the particular features of that stage.

The manual is set out under the following main headings

1. Preamble
2. The Purpose of this Operations and Maintenance Manual
3. Site Access, Security and Sign-in
4. Emergency Contact Information
5. Governance and Communication
6. Management Review
7. Continuous Improvement Request System
8. Overview of this Site
9. Site Roads
10. The Use of Daily Cover
11. Bird Control
12. Wheel Cleaning
13. Litter Control
14. Pest Control
15. Weeds and Noxious Plants
16. Managing the Working Face
17. Waste Compaction
18. Landfill Fires
19. Natural Disasters
20. Stormwater and Sediment Control

21. Waste Control at Landfills
22. Leachate Control
23. Odour Control
24. Landfill Gas Management
25. Guideline for Site Safety and Security
26. Forms

The Manual is designed for use by multiple groups although primarily as a reference point for the site operator but also for reference by external parties and stakeholders to confirm the objectives, policies and procedures that the site operator is bound by. The Omarunui Joint Refuse Landfill Committee oversees the operation of the landfill and holds quarterly meetings, for the most part open to the public, for this purpose.

Landfilling standards have evolved considerably over the period of operation of the landfill which, based on comparison with current best practice appear to be well reflected in the current manual.

3.0 Overview of waste acceptance aspects of the proposal

Landfilling at the site has been occurring for over 30 years with the current landfill stage, Area D, accepting municipal waste since 2006. Municipal solid waste can typically be categorised into residential, commercial and industrial, construction and demolition, and special wastes.

In the Landfill Guidelines municipal solid waste is defined as:

Any non-hazardous, solid waste from household, commercial and/or industrial sources. It includes putrescible waste, garden waste, biosolids, and clinical and related waste sterilised to a standard acceptable to the Ministry of Health…..

It is recognised that municipal solid waste is likely to contain a small proportion of hazardous waste from households and small commercial premises that standard waste screening procedures will not detect. However, this quantity should not generally exceed 200 ml/tonne or 200 g/tonne.

Analysis of waste currently going to Omarunui Landfill shows that 49.1% is commonly recyclable and/or compostable material. The remaining 50.9% includes a significant amount of potentially divertible material such as electronic waste, wood waste, plaster board, and scrap metal.

The landfill also accepts stabilised or treated industrial wastes, sterilised medical wastes, neutralised acidic or alkaline wastes, asbestos contaminated materials and contaminated soils.

Controls are applied to waste materials entering the Omarunui Landfill site. This requires the use of specified pre-determined Waste Acceptance Criteria (WAC) suited to Class 1 landfills to permit particular waste loads. A number of prohibited waste types will not be accepted, including bulk liquid waste, radioactive waste, and explosive, flammable, oxidising or corrosive substances.

The AEE does not provide further breakdown of the sources of waste accepted by the landfill but given the presence of a range of industries in the region, it would be expected that these would supply a significant portion of the overall waste stream to the landfill, some of which will likely be hazardous, presumably pre-treated to meet waste acceptance criteria. Further, some of these wastes are likely to be specific to industries of the region rather than generic, in terms of their quantity and makeup. Further information on the sources, tonnages and makeup of industrial wastes accepted to the landfill and the waste acceptance principles applied to these wastes will assist in assessing the environmental risks that attach to disposal of these substances to the landfill.

4.0 Receiving environment

A description of the receiving environment is provided in the PDP report, Omarunui Landfill Area B Consent Application - Technical Review (the PDP report) and the other technical review memorandums.

Of relevance to this assessment is the sensitivity of the surrounding environment to adverse effects from fugitive discharges from the wastes accepted into the landfill. Such discharges are intended to be avoided, minimised or mitigated through the policies and procedures set out in the OLMP and the O and M Manual but the risks from fugitive discharges are related to the sensitivity of the environment to those discharges. Key aspects of the receiving environment most at risk are groundwater, surface water, ecology and air. The AEE discusses the sensitivity of each of these parts of the environment, as summarised below.

4.1 Groundwater

The site is underlain by an unconfined aquifer comprised of bedrock (sandstone/limestone) and is overlain by alluvium and colluvium within the base of the valley within Area B. Exceedances in water quality guideline values have been observed at some of the sampled locations inferred to be due to influences outside of the landfill site, such as nearby farming/ horticultural activities and naturally occurring conditions.

A review of the consented wells and consented water takes presented on the HBRC online GIS system indicates that there are 120 wells and 27 consented water takes within an approximate 2 km radius of the site.

4.2 Surface Water Quality and Ecology

The main surface water receiving environment is the Upokohino Stream which is a tributary of the Tūtaekurī River. The ecological assessment found the stream to be characterised by poor water and habitat quality and this was reflected in the low diversity macroinvertebrate and fish populations encountered. The assessment concluded that Upokohino Stream is of low ecological value and has low sensitivity as a receiving environment in its current condition.

4.3 Air

In general, due to both low population density and the background of rural odours that may be expected from the agricultural activities in the area, the surrounding rural area is relatively insensitive to odour and other air pollutants emitted from the proposed activities. However, sensitivity to odour will be elevated at the rural dwellings, where consistent human occupation is likely and expectations of amenity will be higher. Expectation of amenity may also be high in garden and yard areas within the immediate curtilage of the dwelling.

5.0 Potential effects on the environment from proposed O&M policies

The AEE states that Area B landfill will be designed in line with modern best practice for landfills, and in accordance with the WasteMINZ Technical Guidelines for Disposal to Land (2018). As the WasteMINZ Guidelines reflect current best practice for landfill management in New Zealand, the potential effects on the environment should be expected to duly reflect the tight management controls that are embodied in the Guidelines.

It must be recognised however, that the performance of the landfill against the environmental objectives of the OLMP and the Manual depend on how well the operator is able to comply with the plan requirements. While good design of measures that control discharges such as leachate collection systems, landfill liner, landfill gas management and stormwater management help to facilitate the operational effort required to minimise offsite effects, such as are proposed for Area B, the experience, diligence and

application of the landfill operator are key factors in how well the landfill performs against the objectives. To this end, the provision of previous monitoring reports that discuss compliance against the consents would provide evidence of how well the landfill operations have been undertaken in practice. From this further refinement of the Manual may be required to address deficiencies that will need to be remedied for activities in Area B. It is noted in the Consultation Report (Appendix H of the AEE) that feedback has been received from neighbours and issues such as windblown litter on neighbouring properties have been raised.

6.0 Potential effects on the environment from proposed waste acceptance criteria

Waste acceptance criteria are designed to help ensure that materials placed within a landfill will not cause unacceptable adverse effects on the environment or human health (both in the short term (i.e. operational period of the landfill) and in the long term (i.e. post closure period)). The approach used by the landfill to date for toxic substances in the waste has been to follow the WAC set out in the WasteMINZ Guidelines which rely on limits for leachability characteristics, mainly developed by USEPA. These criteria (limits) in turn are developed from assessing the effects of the leachable fraction in the environment against environmental standards such as drinking water (in the main) and aquatic criteria for receiving waters. Although there are differences in drinking water limits between New Zealand and the USA, the WasteMINZ Guidelines consider that more stringent landfill liner design used in NZ offsets those instances where the environmental limits in the US are tighter than here.

Hence, it is accepted by this reviewer that the use of the WAC as set out in the WasteMINZ Guidelines represents best practice in NZ. Further, as discussed in section 4 above, the receiving environment for fugitive discharges from the landfill is not highly sensitive, thus generally reducing the risks below the thresholds assumed for the guidelines. However, as discussed below, this view excludes emerging contaminants which have yet to be fully assessed by regulatory and other authorities.

A key issue that arises for WAC is the often rapid development and use of new chemical substances (emerging contaminants) for which environmental guideline values have yet to be developed. Further, some of these substances and some legacy chemicals; e.g. persistent organic pollutants or POPs, are almost intractable and have very long lives in the environment (hundreds of years) without breaking down. Likely routes for significant quantities of these chemicals to be accepted to the landfill are through biosolids from wastewater treatment plants and through contaminated soils. Chemicals of concern include:

- perfluorinated chemicals (PFOS, PFOA);
- polychlorinated alkanes (PCAs), polychlorinated naphthalene (PCNs);
- organotins (OTs), polybrominated diphenyl ethers (PBDEs), triclosan (TCS), triclocarban (TCC);
- benzothiazoles;
- pharmaceutical products;
- isphenol A, quaternary ammonium compounds (QACs), steroids;
- phthalate acid esters (PAEs) and polydimethylsiloxanes (PDMSs).

It is recommended that HBRC request that proposed policies and procedures and ongoing review for dealing with WAC for emerging contaminants be provided by the applicant.

There are some chemicals used in NZ which have been banned overseas. These include organophosphate pesticides and N-methyl Carbamates which are banned in the European Union and are also currently under review due to toxicity concerns and potential impacts on endangered species in the United States.

Due to their persistence and current use, residues of these compounds are likely to be within biosolids and soils that may be deposited into the landfill. Therefore, it is recommended that WAC be developed for these compounds as has been done by other Class 1 landfills in New Zealand including North Waikato Landfill at Hampton Downs and the Canterbury Regional Landfill at Kate Valley.

The list of prohibited substances given in the O & M Manual is less comprehensive than the list in the WasteMINZ Guidelines. This may be because some of these substances are not known to be present in the region and therefore unlikely to be presented for disposal. It would be advisable to expand this list of prohibited items to include:

- Lithium-ion batteries (due to environmental toxicity concerns around cobalt and the potential for lithium-ion batteries to cause landfill fires).
- Mercury-containing batteries, mercury lamps and elemental mercury-containing wastes.
- Used Tyres (as they contain elevated concentrations of a number of hazardous and persistent toxic compounds and the Ministry for the Environment is funding a number of initiatives for end of life use of used tyres).
- Bis (2-ethylhexyl) phthalate (DEHP) and Bis(tributyltin) oxide (TBTO) have been identified being commonly present in Redvale leachate above drinking water criteria, and both are listed as substances of very high concern by the European Union.

It is requested that the applicant provide an updated list of prohibited substances that will apply to wastes disposed of to Area B.

7.0 Proposed monitoring

The current waste discharge consent (DP040120Lc) for Areas A and D requires:

- Random inspections of incoming loads for the presence of hazardous waste on a frequency of not less than 1 in 50 loads, in accordance with the WasteMINZ guidelines.
- A record of each load of material accepted at the landfill including date and time, quantity and description of the material.

It is presumed this is also proposed for Area B, given it is also required under the O&M manual.

8.0 Summary and recommendations for additional information

This review of the Operational and Monitoring Aspects of the proposal for landfilling in Area B, including a review of the proposed waste acceptance criteria has generally found the proposed measures are appropriate and consistent with current best practice in New Zealand.

However, further information is sought from the applicant to help clarify some aspects of the information provided. These are:

- Provide further information on the sources, tonnages and makeup of industrial wastes accepted to the landfill and the waste acceptance principles applied to these wastes to assist in assessing the environmental risks that attach to disposal of these substances to the landfill.
- Provide commentary on the previous performance of the landfill operator at the site, including provision of previous monitoring reports that discuss compliance against the consents, to assist in understanding how well the landfill operations have been undertaken in practice. From this further refinement of the O & M Manual may be required to address deficiencies that will need to be remedied for activities in Area B.

- It is requested that proposed policies and procedures and ongoing review for dealing with WAC for emerging contaminants be provided by the applicant.
- It is requested that the applicant provide an updated list of prohibited substances that will apply to wastes disposed of to Area B.

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Prepared by

Alan Pattle

Technical Director

Reviewed and approved by

Hilary Lough

Technical Director – Water Resources

Appendix C

Air quality review

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

Tel +64 3 **345 7100** Fax +64 3 **345 7101**
Web **www.pdp.co.nz**
Auckland Tauranga Wellington **Christchurch**

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memorandum

TO	Greg Shirras	FROM	Deborah Ryan
	Hawke's Bay Regional Council	DATE	30 March 2020
RE	Omarunui Landfill Area B Consent Review – Air quality		

1.0 Introduction

Hastings District Council (HDC) and Napier City Council (NCC) (jointly the Applicant) have applied to Hawke's Bay Regional Council (HBRC) for resource consents to construct and operate a new area of landfill (Area B) at the Omarunui Landfill. The Assessment of Environment Effects (AEE) has been prepared by Tonkin & Taylor Limited (T+T).

A number of activities are considered to be permitted activities. HDC and NCC are seeking resource consents for the following activities:

- Discharges of contaminants to air (odour, landfill gas (LFG), dust and the products of combustion of landfill gas)
- Discharges of contaminants to land and water (from the landfill operation)
- Diversion and discharge of stormwater
- Diversion and discharge of drainage water (from a pumped system)

The applicant is seeking to change conditions of the existing air discharge and leachate discharge permits to provide for the Area B extension and is seeking new consents for the other activities. The existing air discharge permit is reference number DP040122Ab, which expires on 31 May 2039.

Pattle Delamore Partners Limited (PDP) has been engaged by Hawke's Bay Regional Council (HBRC) to provide a technical review of the consent application for the following matters:

- Geotechnics
- Landfill design
- Leachate management and irrigation
- Stormwater, hydrology and drainage design
- Air quality
- Surface water quality and aquatic ecology
- Groundwater
- Proposed operation and monitoring
- Waste acceptance criteria

This memorandum details PDP's review of the potential effects of the proposed activities on air quality. The Area B Air Quality Impact Assessment (Appendix M of the AEE) has been principally reviewed together with the relevant section of the AEE. Various other documents are provided in the application, specifically and Operations & Maintenance (O&M) Manual, and an engineering report. However, relevant details are not cross-referenced or specified in the air discharge assessment, therefore, it is difficult to understand which details relate to the proposals for the new air consents.

PDP's review considers if the assessment methods used align with accepted good practice as detailed in the relevant Ministry for the Environment Good Practice Guides, whether the assessment conclusions are robust and if the proposed monitoring and mitigation methods are best practice and will ensure that the impacts of the discharges from the site will be minimised.

2.0 Overview of proposal relevant to air quality

The current consent for discharges to air from the landfill is number DP040122Ab. Conditions 1 and 3 of the consent were changed under Section 127 of the RMA in 2018 to reflect the increased landfill footprint incorporating Area D.

A new separate consent is being sought to allow for the discharge of the products of combustion of landfill gas (LFG) from Areas A, D and B. LFG from Area B will be collected and reticulated to the same flare and energy facility as used for Areas A and D. The applicant is then seeking to change the conditions of the current consent to exclude the discharges to air from (LFG) combustion, with the new consent providing for this.

A further separate consent is also being sought for discharges to air from waste disposal in Area B, including odour, LFG and dust.

In summary, the scope of the applications for air discharges relate to:

- A change to conditions to the current air discharge consent to exclude LFG combustion discharges as described in Section 9.1.2.1 of the AEE.
- A discharge to air consent including odour, landfill gas, and dust from Area B (as a *discretionary* activity).
- A discharge to air consent for the products of combustion of landfill gas from Areas A, B, and D (as a *discretionary* activity).

3.0 Receiving environment

The site location is as described in Section 3.0 of the PDP report, Omarunui Landfill Area B Consent Application - Technical Review (the PDP report). The site is predominantly surrounded by rural land, with some lifestyle properties to the west along Swamp Road and Breckenridge Road. Area B is to the east of the site, and is northeast of Areas A and D, inland 3.5 km to the west of Taradale.

Section 5.2.1.3 of the AEE provides a description of the climate and a windrose for a weather station at Whakatu, which is to the southeast of the site on the Heretaunga Plains. T+T note that the wind rose is indicative of regional wind patterns but will differ from the localised wind at the site. The prevailing winds are in the south-westerly and north-easterly directions.

Section 5.2.2.6 of the AEE identifies that the location has a low population density so generally is expected to have low sensitivity to odour, although individual dwelling and outdoor spaces are identified as places where higher amenity would likely be expected.

Section 10.3.1.1 of the AEE, identifies that Area B is further away from sensitive receptors than the current fill Area D. Currently there are four dwellings in the Swamp Road area within 500 m of Area D. For Area B, one dwelling at 419 Omarunui Road lies within 500 m of the fill extent. The AEE identifies that this dwelling lies at the base of the valley in which Area B is located, at 475 m distance.

The AEE identifies that katabatic drainage air flows occurring in calm, stable overnight wind conditions (e.g. during temperature inversions) are likely to "gently direct" air from the landfill towards this dwelling. We also note that the prevailing winds flow in this direction. There are other dwellings along Omarunui Road downwind of the prevailing wind at 471, 395 and 367 and these appear to be less than 1 km from the landfill Area B extent.

4.0 Potential effects on air quality

4.1 Airborne contaminants

The contaminant discharges considered in the air discharge assessment relevant to the consent applications for the landfill expansion are:

- Odour from leachate storage, management and disposal;
- Odour and contaminants from fugitive LFG;
- Odour and dust from the working face associated with Area B;
- Odour from trucks bringing in rubbish;
- Odour from neutralising sprays around the fill area;
- Odour from excavation into older areas of waste to bury loads or install LFG or other infrastructure;
- Dust from construction and operation of Area B, including dusty loads; and
- Products of LFG combustion from Area A, B and D.

PDP staff have reviewed the potential impacts associated with spray irrigation of leachate in the memorandum on stormwater and leachate.

4.2 Dust

Dust may arise from mechanical disturbance, filling activities or wind erosion. Earthworks associated with construction, operation and eventual closure, and material stockpiles have the potential to discharge dust.

Strong winds and dry conditions are those that have the potential to generate significant dust. Given the separation distance to the nearest dwelling is nearly 500 m, we agree that dust nuisance at neighbouring properties is an unlikely consequence of the landfill operation, however, good practice management should still be adhered to, including to minimise the risk of dust being blown over to and entering surface waterways.

The access roads, weighbridge and wheel wash that are proposed to be used for Area B remain as per the current landfill operation. The current controls of a sealed accessway, road sweeping and wheel wash facilities are expected to remain in place. A new internal access perimeter road for Area B is also proposed to be located for the long-term along the perimeter of the fill area, which will turn off the main access road from the existing facilities. The perimeter road is proposed to be developed in stages and is proposed to be unsealed all weather access, with additional metalled services roads. We note that, comments are made in the O&M Manual that there are advantages to sealing long-term internal roads.

Waste acceptance procedures are described in Section 4.2 of the PDP report. Particularly dusty wastes are treated as special wastes, requiring pre-approval prior to acceptance.

4.3 Odour

Leachate is to be collected and stored as per leachate from the current fill area, in the existing leachate pond, which is at the toe of Area A. A pond collects leachate at Area D, which is pumped to the Area A pond. A further storage pond is proposed to manage the additional leachate from Area B and is proposed to be constructed in the same area as the existing leachate pond. Leachate irrigation is proposed to continue over Area A, with extension to Areas D and B as capping is completed. If storage and balancing systems are at capacity HDC can tanker excess leachate to the Hastings Sewage Treatment Plant. T+T states that leachate aeration will be considered but that the current leachate system does not result in adverse odour effects. It appears from the O&M Manual, however, that dissolved oxygen monitoring and aeration is provided for the current leachate pond. Clarification is needed as to how the leachate will be managed to minimise the risk of odour.

Waste acceptance procedures are described in Section 4.2 of the PDP report. Putrescible and particularly odorous wastes are treated as special wastes, requiring pre-approval prior to acceptance so that the potential for odours off site is minimised. The O&M Manual also discusses using alternate working faces and considering the times of day special wastes are accepted as possible mitigations, however, this is not referred to in the air quality assessment.

Excavation in old areas of refuse is identified for infrastructure maintenance and disposal of some special wastes. The T+T report indicates that excavation should be minimised through planning any works and pre-approval for odourous loads.

Odour also arises from fugitive LFG emissions across the landfill area because not all LFG is able to be captured in LFG collection systems. Fugitive LFG emissions will occur, particularly, during the early stages of filling prior to the establishment of the LFG collection system in Area B.

There is either a lack of or limited LFG capture in the early stages of filling, which in our view has the potential for adverse effects due to offensive or objectionable odour. T+T describes that LFG will tend to pool and travel downhill with the katabatic drainage flows but has not specifically assessed the potential of LFG during this phase to impact on amenity at the dwelling at 419 Omarunui Road or further downwind. In Table 3.3 of the air quality assessment T+T assesses that the passive venting of LFG through intermediate and final covers is generally low and mitigated by LFG extraction (which they note is increased if extraction is not in operation). In our view, the frequency and duration of the events whereby gas collection will be either inefficient or not operating requires further assessment as to the odour impacts.

In our experience, LFG plumes have a pungent odour and can travel significant distances downwind, therefore it is likely that those residences will experience odours particularly in the initial phases.

We agree with T+T, that once capped, surface methane emission measurements at a well-run landfill facility show that there is typically no detectable methane at the surface of the final cap. We understand that surface monitoring of methane may be proposed to detect cracks or defects in the capping layer so that remediation can be undertaken as required, but this is not referenced in the air quality assessment. The only monitoring proposed in the air quality assessment is by odour complaint.

4.4 LFG collection and products of combustion

Information on the LFG collection and treatment systems is addressed in Appendix I, Section 9 of the engineering report attached to the AEE. Section 6.6.5 of the AEE also describes LFG management. Up to

0.9 MW of electricity is generated using the existing Waukesha generator and residual LFG is combusted in an enclosed flare.

The existing LFG management system is proposed to be used to manage the gas collected from Area B, as well as the gas from Area A and Area D. An LFG collection system will be progressively installed in Area B of the landfill and collection and combustion will continue post closure.

There is a lack of integration of the information relating to LFG combustion in the air quality assessment. The flare is not well described in the air quality assessment, for example, in terms of compliance with the National Environmental Standards for Air Quality (NESAQ). In our view, this should be addressed within the air quality assessment.

The products of gas combustion are detailed in Section 3.4 of the air quality assessment. The use of emission factors from UC Davis does not appear to be justified, is there relevant NZ data or a more reputable emission factor source that could be used? There is no detail supporting the mass emission calculations for the generator.

Section 10.3.2.1. of the AEE states that for the flare and LFG generator, the nearest dwelling is at 500 Swamp Road, which is located 700 m distant from the combustion sources. Given the separation distance and the scale and nature of the discharges from LFG combustion, we agree that the discharges of products of combustion are unlikely to result in adverse effects on human health or the environment.

We also agree that adverse effects on health due to exposure to trace contaminants are unlikely based on previous experience and studies around landfills.

Flare outages are also identified as a source of untreated LFG with the potential to have effects from odour beyond the boundary. Monitoring and maintenance of the flare is not well covered in the air quality report, nor is the provision for a back-up flare in order to comply with the NESAQ.

5.0 Mitigation

The air assessment indicates active tipping and abnormal emissions are the main sources of odour. Accordingly, the AEE identifies that active odour management measures are likely to be needed to avoid potential for odour nuisance from the Area B operations on the dwelling at 419 Omarunui Road. The air assessment proposes:

- Minimising the size of the active tip area to 1,200 m^2 compared with 600 m^2 in the O&M Manual
- Covering the landfill with daily, intermediate and final cover. Daily cover with soil is proposed with a minimum thickness of 100 to 150 mm. Alternative daily covers may also include foam products, geosynthetics or spray applied products. We are unsure of the effectiveness of some of the alternative daily covers in terms of odour control effectiveness, and in our view the appropriateness of these for odour control should be assessed in the air quality report.
- Intermediate cover will comprise at least 300 mm of compacted soil which will be placed over areas that will not receive any more fill for three or more months. Intermediate cover areas will be grassed to minimise dust generation.
- Minimising opening up old areas of fill by special waste procedures for accepting and handling odorous loads and minimising the duration of excavation in old areas. Measures identified as rigorous implementation of odorous load identification and burial procedures, and planning of works needed for infrastructure installation.
- Installing LFG collection as early as practicable
- Odour neutralising sprays used judiciously

- Minimisation of downtime of the LFG extraction system for maintenance purposes
- A water cart is proposed to be used to manage dust from internal unsealed roads in dry weather, if necessary.
- Acceptance of waste is identified as being only on weekday working hours as a mitigation, but elsewhere opening on Saturday is referred to.

Minimal to no detail is referenced or provided about what the above mitigations mean in practice, for example, management and maintenance of the LFG and flare and/or generator is not well described or otherwise referenced in the air assessment. Therefore, we consider there is a great deal of uncertainty associated with the overall assessment and the recommended mitigation measures.

Leachate collection and management is not well described in the air report. The air report identifies that there are no odour issues currently associated with leachate, and that aeration is not undertaken. The O&M Manual, however, indicates that dissolved oxygen monitoring and aeration are in place. In our experience leachate can be a major source of odour if it is inappropriately stored, and this issue should be clearly addressed in the odour assessment and management and mitigation measures, including appropriate consideration of effects resulting from leachate irrigation.

6.0 Proposed monitoring

As described in Section 5 of the PDP report the proposed monitoring programme includes LFG production, composition and flare operation. LFG production and composition data is intended to provide information to the efficacy of the gas collection.

The air assessment proposes to monitor odour through a complaint log, which in our view is not adequate on its own for managing odour effects.

Overall, the monitoring proposals in the air quality assessment are very lacking in our view. For example, weather monitoring or surface monitoring of methane, even though the existing consent (condition 13) requires monitoring of surface methane for existing fill areas.

7.0 Summary and recommendations for additional information

PDP considers that while the effects assessment methods used in the air quality assessment generally align with accepted practice in the MfE good practice guides for odour, dust and industrial emissions, there are gaps in the assessment and the level of detail recommended for monitoring and mitigation.

In terms of overall effects on air quality, the air quality assessment indicates that abnormal emissions such as flare outages, odorous loads and opening up old areas are the likely cause of adverse effects from odour, with minimisation of such events identified as the proposed mitigation. However, little or no detail or reference is made to what actions will be taken to “minimise” events such as these i.e. how this will be implemented in practice is unclear. In particular, there is inadequate information in relation to an odour management plan, contingency procedures, process controls and design, emission controls and engineering risk for system failures (Table 5, MfE GPG for Odour).

In our view the air quality assessment needs to be aligned with other, more detailed, information relating to specific design, monitoring, management and mitigation rather than providing generic statements about minimisation.

In our experience, during the early phases of filling before LFG capture can be fully established, LFG releases have high potential to result in odour effects off-site, particularly under katabatic drainage conditions. Other than mitigation being identified as that the gas collection system should be installed progressively with the fill, there is essentially no assessment of the effects of LFG during the establishment

phase of the Area B i.e. what is the risk of elevated odour having an adverse effect offsite during the establishment phase?

Some specific matters the need to be addressed are as set out below. We reiterate that because the air quality report on the whole does not align with, or reference, the detailed measures where they are described elsewhere in the documentation e.g. O&M Manual, it is very difficult to understand what monitoring and mitigation is being proposed for the current suite of consents. The following is not intended to be a complete list of the matters that we consider need to be addressed at this stage, but provide examples of gaps in the air quality assessment:

1. Surface monitoring of methane is not described in the air discharge assessment, but is an important control for odour in our view, and should be included. We would recommend monitoring for temporary and final cover is needed to identify hot spots and using trigger thresholds set for odour management to identify where remedial action required.
2. The standard of the flare (specifications) and monitoring and maintenance details are not referred to in the air quality assessment, which are important for ensuring good operations and minimising HAPs and should be included.
3. The AEE/air quality assessment refers to minimisation of flare outages. How will flare outages be minimised? e.g. what testing or maintenance to ensure flare efficiency and reliability?
4. How will the NESAQ flare standards be complied with (Regulation 27)?
5. It appears that the flare will burn the majority of the gas i.e. there is not enough generator capacity to handle the gas flow. Since gas flow is permanently going to the flare, Regulation 27(5) requires that a back-up flare be provided, please confirm/clarify the provision for a back-up flare.
6. While there is a section on fires included in the O&M manual, there is no mention of fires in the air quality assessment or management of fire risk, please discuss (or at least reference and confirm how fire risk will be mitigated for Area B and what the contingency is for fire).
7. What is meant by “judicious use” of odour masking or deodorant sprays?
8. The assessment that the working face size should be minimised appears at odds with the proposal to increase the working face area compared to the current consent. What is best practice for working face size?

Please provide details in relation to the aspects as they relate to the air quality assessment and/or references to where this information is held. By preference, these aspects should be directly addressed as part of the air quality assessment.

Again, we acknowledge that some matters may be addressed elsewhere in the documentation, but in our view the air quality assessment needs to at least cross reference the detail if available in other parts of the documentation to provide more certainty in relation to the proposal and the overall assessment.

8.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Hawke’s Bay Regional Council and others (not directly contracted by PDP for the work), including Tonkin & Taylor Ltd. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This memorandum has been prepared by PDP on the specific instructions of Hawke's Bay Regional Council for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum 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.

Prepared by

Deborah Ryan
Technical Director – Air Quality

Reviewed and approved by

Hilary Lough

Technical Director – Water Resources

Appendix D

Stormwater, hydrology and leachate irrigation review

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

Tel +64 3 **345 7100** Fax +64 3 **345 7101**
Web **www.pdp.co.nz**
Auckland Tauranga Wellington **Christchurch**

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memorandum

TO	Greg Shirras	FROM	Sebastian Küng, Mark Ellis and Daryl Irvine
	Hawke's Bay Regional Council	DATE	30 March 2020
RE	Omarunui Landfill Area B Consent Review – Stormwater, Hydrology and Leachate Irrigation		

1.0 Introduction

Hastings District Council (HDC) and Napier City Council (NCC) (jointly the Applicant) have applied to Hawke's Bay Regional Council (HBRC) for resource consents to construct and operate a new area of landfill (Area B) at the Omarunui Landfill. The Assessment of Environment Effects (AEE) has been prepared by Tonkin & Taylor Limited (T+T).

A number of activities are considered to be permitted activities. HDC and NCC are seeking resource consents for the following activities:

- Discharges of contaminants to air (odour, landfill gas, dust and the products of combustion of landfill gas);
- Discharges of contaminants to land and water (from the landfill operation);
- Diversion and discharge of stormwater;
- Diversion and discharge of drainage water (from a pumped system).

The Applicant is seeking to change conditions associated with the existing air discharge and leachate discharge permits to provide for the Area B extension and is seeking new consents for the other activities.

Pattle Delamore Partners Limited (PDP) has been engaged by Hawke's Bay Regional Council (HBRC) to provide a technical review of the consent Application for the following matters:

- Geotechnics;
- Landfill design;
- Leachate management and irrigation;
- Stormwater, hydrology and drainage design;
- Air quality;
- Surface water quality and aquatic ecology;
- Groundwater;
- Proposed operation and monitoring; and
- Waste acceptance criteria.

This memorandum details PDP's review of the management of:

- Construction-phase and ongoing stormwater and drainage and the basis of design of the erosion and sediment control infrastructure. The Engineering Report (Appendix I of the AEE) has been reviewed together with relevant aspects of the AEE and other reports including the O and M manual. The review considers the suitability of the proposed stormwater controls over a longer period and associated effects of large events on downstream waterways, risk of leachate ingress, comparison with best practice guidelines, assessment methods and interpretation including climate change allowance and the adequacy of the proposed monitoring.
- The proposed leachate management systems, including irrigation. The Engineering Report (Appendix I of the AEE) has been reviewed together with relevant aspects of the AEE and other reports. The review considers suitability of the proposed leachate management and irrigation, potential effects associated with the proposed management and irrigation, comparison with best practice guidelines, assessment methods and interpretation and further investigations and monitoring.

2.0 Overview of stormwater, drainage, and leachate management aspects of the proposal

2.1 Stormwater and drainage

The Applicant states that all stormwater discharged from Area B will be treated for sediment removal, with treatment systems designed to meet or exceed the requirements of the Hawke's Bay Waterway Guidelines: Erosion and Sediment Control (2009). The Applicant proposes to construct a sediment retention pond and stormwater wetland adjacent to the north-western corner of Area B, as shown in Figure 5.2 of the AEE. The Area B sediment pond would block the outlet from the Area C Valley. The Applicant therefore proposes to install a pipeline within the Area B sediment pond bund to direct flow from Area C to by-pass the sediment pond and discharge to the farm drain downstream of the pond. The alignment of this pipeline is shown in drawing 1000647.1000-30, however no further details are provided (e.g. pipe size, or level of service provided by the pipe).

The AEE states that the southern portion of Area B currently drains to an existing sediment pond located by the main landfill access road. The Applicant proposes to let this area continue to drain to the existing sediment pond in order to reduce the catchment size of the new Area B sediment pond. The Applicant notes that once this southern portion of Area B is incorporated into the landfill, that at this stage there would be areas along the western portion of Area B that will be fully vegetated that could be diverted to the Area C clean water by-pass.

The Application states the Area B sediment pond will be designed to "*meet the overall treatment requirements for sediment removal*", and notes that the pond would also provide removal of suspended contaminants including heavy metals. Treated stormwater discharged from the Area B sediment pond will flow into the wetland, which will provide additional treatment to polish stormwater discharges up to a 2 year ARI event. The sedimentation pond and wetland form the basis of sediment treatment for all works within Area B over the operating life of Area B. The Application states the wetland may also provide some additional treatment for organic chemicals and dissolved heavy metals should there be any accidental/unintended seeps of contaminants into the stormwater system.

The Application proposes a main stormwater drain around the perimeter of each stage, and ultimately around the perimeter of Area B. This drain would intercept runoff from upstream portions of the catchment (clean water) and water diverted from earthworks and waste fill surfaces covered with intermediate or final cover.

It is proposed to divert run-off water from Area C around the Area B sediment pond. Furthermore, the Application states that where possible, clean water diverted from the Area B site will be diverted to this by-pass where possible.

In addition, the application proposes the installation of a groundwater drain beneath the landfill liner, to provide drainage of areas of high or perched groundwater, and which will discharge to the stormwater system. For further details and an assessment of the underdrainage system, please refer to the groundwater memorandum.

The Application states that only stormwater that has **not** come into contact with refuse will be diverted to the stormwater treatment system. Runoff that comes into contact with refuse will be diverted to the leachate system.

2.2 Leachate management and irrigation

The proposed leachate collection and recovery system (LCRS) is designed to collect leachate from the base of Area B, which will be pumped to a new 4,800 m^3 geomembrane lined leachate storage pond on the top of Area A. The Application seeks to expand the existing leachate irrigation activity to allow for the spray irrigation of leachate generated from Area B. Initially, once Area B is operational and Area D is capped, spray irrigation would occur on the surface of Areas A and D. As Area B progresses, additional capped portions of Area B would become available for spray irrigation. The extent of the potential spray irrigation area is shown in Drawing 1000647.1000-31 of the Engineering Report.

Excess leachate will be removed to the Hastings Sewage Treatment Plant for treatment by tanker trucks when required. If further storage is required, the Application states there is the opportunity to construct an additional leachate storage pond on the land directly north of Area A (as depicted in drawing 1000647.1000-2a).

3.0 Receiving environment

3.1 Hydrology

The Application includes a high-level hydrological assessment as Appendix D of the Engineering Report (Appendix I of the AEE). The assessment notes that there is a low point adjacent to the north-eastern boundary of the landfill land parcel. Runoff from Area B combines with runoff from Area C as well as an unnamed valley to the north of the landfill site, and the combined runoff discharges at the aforementioned low point, as illustrated in Figure 1.2 of the hydrological assessment. The assessment states there is no formed channel from any of the three contributing valleys, with runoff flowing via overland flow.

A farm drain is located along the property boundary, which connects to the Upokohino Stream. The Upokohino Stream flows to the Tūtaekurī River. Stormwater treated by the proposed Area B sediment pond and wetland will discharge to the farm drain.

The catchment area of the low point is reported to be 60.73 ha. The Applicant has calculated the peak flow for the existing catchment, calculated via the rational method, to be 1.41 m^3 for the 2 year ARI event, 2.43 m^3/s for the 10 year ARI event, and 4.23 m^3/s for the 100 year ARI event.

3.2 Leachate management

Currently, leachate from Area A drains to a 3,500 m^3 HDPE lined pond at the toe of Area A. Leachate from Area D is pumped to the same 3,500 m^3 pond at the toe of Area A. The existing leachate storage pond provides temporary storage, to balance leachate flows until leachate is able to be irrigated. During the wetter winter months, some excess leachate is stored in a temporary pond on the top of Area A to prevent the primary (3,500 m^3) storage pond from overflowing. When the system is at capacity, HDC use tankers

to truck excess leachate to the Hastings Sewage Treatment Plant for treatment and disposal. The applicant proposes to construct an additional 4,800 m^3 leachate storage lagoon on top of Area A in 2020.

Leachate is irrigated via K-line irrigation system, by pumping leachate from the 3,500 m^3 HDPE lined leachate pond. K-lines have 4 to 5 pods, spaced at a distance of 15-20 m, which are connected to a buried leachate rising main (via quick release coupling). Leachate is currently spray irrigated onto the existing closed portion of the landfill (Area A), where the irrigated leachate is to the atmosphere via evapotranspiration or alternatively soaking into the underlying refuse. Leachate is irrigated at a maximum rate of 3 mm/day.

4.0 Potential effects on surface water quality and hydrology

4.1 Stormwater and water quality

The Application states that only stormwater that has **not** come into contact with refuse will be diverted to the stormwater treatment system; any runoff that comes into contact with refuse will be diverted to the leachate system. However, the Application notes that there is the potential for accidental discharges from refuse or leachate entering the stormwater system from the operation of Area B. Furthermore, potential spray drift and/or overland flow from the leachate irrigation system could enter into the stormwater system if the irrigation system is not well managed. To mitigate these risks, the Applicant proposes monitoring, including regular inspections of the landfill surface to check for potential leachate seeps. The Application states that potential contamination of surface drains by leachate irrigation will be mitigated and/or avoided by:

- Limiting the leachate irrigation rate so as to prevent runoff. We agree that leachate irrigation should be limited to allow leachate to soak into the landfill cap, rather than generating overland flow or interflow that could daylight downgradient of the irrigation field.

  The Engineering Report specifies an overall average irrigation rate of ≤ 3 mm/day. The report further specifies that leachate irrigation will not occur during significant rainfall or after a period of heavy rain, and that typically it is expected that irrigation will not occur when 20 mm of rainfall or more has occurred over the previous 24 hours. It however notes that a judgement decision will be required on each day as to whether conditions are suitable for leachate irrigation. The report states that an assessment of the irrigation capacity and leachate storage was undertaken, which takes into account the reductions in capacity due to wet weather in the winter months. The results are presented as Figure 5.1 in the Engineering Report, which depicts excess leachate storage capacity over time. The report does not include details of soil moisture deficit modelling, which would help assess the risk of irrigated leachate being entrained in stormwater runoff. We therefore recommend that the results of soil moisture deficit modelling are requested that would help demonstrate the proposed controls / limitation on irrigation would mitigate the risk of leachate being entrained in the stormwater runoff.

- Providing a 10 m separation distance between the spray zone and any surface stormwater drain. The Application states that this is to avoid direct discharge into stormwater drains, and furthermore in the case of overland flow, to provide opportunity to soak into ground prior to reaching the stormwater drain. The Engineering Report notes that if significant overland flow from the irrigation area be observed during irrigation, then irrigation of that area will cease. The report states that minor overland flow, in the order of 1-2 m from the spray zone, may be expected from time to time. The Applicant proposes a 10 m separation distance, however, does not demonstrate how the 10 m was determined and why the distance is sufficient to mitigate the risk of spray drift and/or contaminating stormwater runoff. Whilst we agree that a separation distance should be provided between leachate irrigation spray zones and any

stormwater drains, we recommend that further information be requested from the Applicant to demonstrate why the 10 m buffer is considered to be sufficient.

- Monitoring spray drift under different weather conditions for the potential to enter stormwater drains. The Engineering Report specifies that during windy conditions, the irrigation pods "will be located so that any spray drift does not impact any surface water" and that if that cannot be achieved with the irrigation areas, then irrigation will cease. Spray drift monitoring is inherently problematic; we recommend that further information be requested to support the qualitative assessment presented in the Application. It is anticipated that the spray drift under a variety of likely wind speeds could travel further that the proposed 10 m buffer, which may inform an increase in the separation distance between the irrigation and any stormwater drains or clean stormwater catchments.

In addition, it is proposed to regularly monitor stormwater quality in the stormwater pond, monitoring water quality and macroinvertebrates in the Upokohino Stream. The Applicant's proposed monitoring is discussed in Section 5.0 of this memorandum.

The Applicant has not assessed the potential for interflow, specifically the potential for the interflow of irrigated leachate through the growth layer of the final cap and whether this could potentially enter any of the stormwater drains downgradient of the irrigation field. Hence a specific question has been raised to address this risk.

The proposed irrigation of leachate could lead to an accumulation of sodium in soils. An increase in the ESP (exchangeable sodium percentage) levels could lead to clay dispersion, which could result in a reduction in soil permeability. If a reduction in the permeability occurred in the near surface soils, this could lead to a greater risk of runoff during rainfall events or during irrigation. The Application has not included an assessment of the potential sodium accumulation and associated mitigation measures, and hence it is recommended that an assessment be requested.

Furthermore, the proposed leachate irrigation could lead to an accumulation of heavy metals in soils, which could potentially impact vegetative cover of the landfill cap, or migration of heavy metals via the stormwater pathway. An assessment of heavy metal accumulation has not been provided in the application, and it is recommended that an assessment be requested.

In addition, there is the potential risk of leachate spills should the capacity of the leachate system (e.g. leachate pump station) be exceeded. The Engineering Report has calculated an average leachate generation rate of 105 m^3/day during Stage 5 of the landfill (estimated filling period of 2043 to 2060). Further information is required to assess the potential of leachate spill should the capacity of the system be exceeded (such as in a year with greater than average rainfall), or in the event of a leachate pump failure.

The proposed landfill cap material will have a permeability of $1x10^{-6}$ m/s to $1x10^{-8}$ m/s (equivalent to 86 mm/d to 0.9 mm/d at saturated). It is noted that, the proposed irrigation rate exceeds the lower permeability range of the proposed cap materials (although it is acknowledged that there is a growth layer over this). It is recommended that further information be requested regarding the proposed irrigation rates in consideration of potential lower permeability cap rates.

In our assessment, we have considered the following guidelines:

- The Waste Management Institute New Zealand (WasteMINZ) Technical Guidelines for Disposal to Land August 2018;
- Centre for Advanced Engineering (CAE) Landfill Guidelines 2000; and

- Aqualinc 2017, Guidelines for reasonable irrigation water requirements in Otago Region, prepared for Otago Regional Council (while this is in a different region, the general principles of good irrigation practice apply).

We note that the CAE Landfill Guidelines (2000) state that Department of Health guidelines recommend that for waste irrigation, only pre-treated effluent be irrigated, and subject to site-specific requirements, oxidation ponds with a minimum detention of 30 days, or alternatively two-stage aerated lagoons with a minimum total detention of 10 days, may be appropriate. The application does not appear to propose pre-treatment of effluent, however the O&M manual suggests that some aeration is occurring (Section 22.6.7). Under normal operating conditions, leachate will be managed within the landfill area, and when/if required excess leachate will be trucked to the Hastings Sewage Treatment Plan for treatment and disposal.

We also note that the proposal to irrigate slopes in the order of 20% is considered marginal with steeper slopes having greater susceptibility to runoff, as described in the ORC guidelines.

4.2 Hydrology

The hydrological assessment calculated peak discharge rates using the rational method. The assessment calculates the peak runoff rate for three scenarios: existing, intermediate – operational, and developed – capped scenarios. We agree that the three scenarios considered are appropriate.

The Applicant has sourced rainfall intensities from NIWA's High Intensity Rainfall Design (HIRDs) version 4, however has not stated in the assessment what the value for the rainfall intensities are. The assessment also does not state whether climate change has been accounted for.

The assessment has used a time of concentration for each sub-catchment of minimum of 10 minutes (ranging from 10 to 12 minutes), which appears to be quite low given the size of the sub-catchments modelled. A runoff coefficient of 0.3 was used for good grass cover surfaces, and a runoff coefficient of 0.6 was used for bare surfaces included in the 'intermediate – operational' scenario. We agree that these runoff coefficients are appropriate. However, in the third scenario ('developed – capped') a runoff coefficient of 0.3 was used for the capped area of Area B. The slope for the capped Area B area is reported to be 21%, and as such a slope correction should be applied to the runoff coefficient in accordance with Table 6-1b of the Hawke's Bay Waterway Guidelines Stormwater Management (2009).

The assessment has calculated an increase in peak flow of 17% for the 'intermediate – operational' scenario (compared to the existing scenario), and no increase for the 'developed – capped scenario'. We are unable to confirm if the latter statement (i.e. no increase in peak runoff for the developed – capped scenario) is correct. Given that the capped Area B slope is reported to be 21%, the runoff coefficient should be adjusted for slope, which would lead to a higher runoff rate to be calculated via the rational method. The Application states that the Area B sediment pond and wetland would provide some attenuation and potentially reduce the peak flow rate for smaller storm events. While we agree that the peak flow rate could potentially remain unchanged (or be reduced) for smaller storm events via attenuation, further information would be required to verify this. For larger storm events, peak runoff rates could increase for the 'developed – capped scenario' given the steepness of the capped Area B, and further information is required.

We have recommended further clarification be sought around the selection of the time of concentration and confirmation of the likely changes in the hydrological environment. This includes, but is not limited to, an assessment of the existing farm drain's capacity.

As outlined in the Application, it is proposed to install a diversion drain for Area C, in the embankment of the Area B sedimentation pond. Further clarification should be sought on the basis of the design of the drain (level of service) and what the implications would be if the hydraulic capacity of the drain is exceeded, including any potential adverse effects on the sedimentation pond.

The applicant has outlined in the AEE that the required irrigation area is in the order of 14.1 ha, once Areas A, D and B are included. Drawing 1000647.1000-31 outlines the proposed irrigation areas, which includes steeper slopes of the final landfill (assumed to be in the order of 21%). The risk of runoff increases with grade and irrigating slopes in the order of 20% is not advised if it can be avoided. Clarification is sought from the applicant to optimise the proposed leachate irrigation area, to maximise spread but minimise irrigation of steep slopes.

5.0 Proposed monitoring

Table 6.1 in Section 6.8.11 of the AEE states that it is proposed to:

- Continue monitoring the existing sediment ponds as prescribed by Conditions 13 and 14 of DP040121Wa (now DP040121Wb).
- At 6-monthly intervals monitor the Area B sediment pond for water clarity, field pH and conductivity at a point entering the pond and at the discharge outlet, and "a more extensive suite on a yearly basis". It is not specified which parameters would be included in the more extensive suite, although the intention may be for this to be the same as for Condition 14 of DP040121Wb.
- Visual checks of the landfill surface on a regular basis to check for any potential leachate breakouts. The frequency of the proposed visual checks is not specified.
- Monitoring spray drift under different weather conditions for the potential to enter stormwater drains.

The Applicant also proposes to monitor the Upokohino Stream:

- Baseline water quality sampling (prior to construction commencing): three wet weather and three dry weather sampling rounds with samples analysed for TSS and turbidity, at the three sites sampled in the Ecological Assessment.
- Initial site establishment and construction phase monitoring: quarterly sampling for TSS and turbidity, when discharge occurs from the sediment pond, at the three sites sampled in the Ecological Assessment.
- Operational monitoring: water quality sampling to be undertaken quarterly when a discharge occurs from the sediment pond. Sampling to include TSS, turbidity and "parameters to detect accident leachate contamination". Annual sampling of instream sediment quality and macroinvertebrate monitoring.

In addition, as outlined in Section 9.1.2.2 of the AEE, the existing monitoring conditions of the leachate irrigation discharge consent DP160044L are not proposed to be altered, other than allowing for irrigation to occur on Area B. The current consent requires a leachate irrigation monitoring and record keeping plan, which must include monitoring of rainfall, leachate volumes and irrigated areas, together with visual inspections for overland flow and the leachate irrigation system.

6.0 Summary and recommendations for additional information

The AEE and Engineering Report provide details of the proposed stormwater treatment approach, which consists of directing runoff that has not come into contact with refuse to a new sediment pond and wetland. The proposed treatment approach targets sediment suspended in stormwater runoff. The Application states that the sediment pond has been sized in accordance with Hawke's Bay Waterway Guidelines: Erosion and Sediment Control, however these guidelines are targeted to temporary construction activities. The sediment pond would be operational throughout the staging of Area B (30 + years). The Application does not specify what sediment load (entrained in stormwater) is expected

to be discharged to the receiving waterway, and further information is required to assess the potential effect on the receiving environment.

Stormwater that has come into contact with refuse will be treated as leachate and directed to the leachate collection and recovery system. The system will provide 8,300 m^3 of storage, comprised of the existing 3,500 m^3 pond and a proposed 4,800 m^3 leachate storage pond. Stored leachate will be irrigated to capped surfaces of the landfill, and when required, excess leachate will be trucked to the Hastings Sewage Treatment Plant for treatment and disposal. It is proposed to irrigate leachate (from Stages A, B and D) to the capped surfaces of the landfill at an overall average irrigation rate not exceeding 3 mm/day. A separation distance of 10 m between the spray zone and stormwater drains is proposed. The application does not include details of soil moisture deficit modelling, which is required to assess the potential of leachate irrigation activity generating runoff or becoming entrained in runoff, which could lead to an adverse effect on the water quality of the sediment pond, wetland and receiving waterway. It is recommended that further information be requested in order to assess the suitability of the proposed leachate irrigation rate and separation distance.

The T&T Engineering Report includes a hydrological assessment which assesses the change in the peak runoff, calculated via the rational method. The assessment states that the peak flow will increase to a maximum of approximately 17% (compared to the existing scenario) during the intermediate/operational phase of Area B, then start reducing back to the existing conditions at the landfill, with the developed (capped) stage being unchanged compared to the existing scenario. Clarification is sought from the Applicant regarding the runoff coefficients used for calculating the peak runoff for the developed (capped) phase, in particular why the runoff coefficient from the developed (capped) Area B was not adjusted for slope, which could impact the peak runoff rates post development.

To better understand the proposed stormwater treatment system, potential changes to peak runoff rates, the potential for leachate to enter the stormwater system, and the potential effects on the receiving environment, it is recommended that the following information is requested in a Section 92 request:

Hydrological assessment:

- The Appendix D – Stormwater Calculations of the Engineering Report provides a comparison of peak runoff rates, calculated using the rational method, for three scenarios. The assessment states that "*design rainfall intensities were sourced from NIWA's High Intensity Rainfall Design (HIRDs) version 4"*, however the rainfall intensities values are not specified. Please specify the rainfall intensities used for the peak flow calculations (Table 3.1). Furthermore, please advise how climate change was accounted for.
- Table 2.1 of the Stormwater Calculations states that the slope of Area B in the 'Developed – capped Stage 5' scenario is 21%. The runoff coefficient (0.3) does not appear to have been adjusted for the slope. Table 6-1b of the Hawke's Bay Waterway Guidelines Stormwater Management specifies slope corrections for runoff coefficients. Please revise the assessment or otherwise advise why a slope correction is not necessary.
- Table 2.1 of the Stormwater Calculations states that the time of concentrations (t_c) for the various sub-catchments for the three scenarios range from 10 to 12 minutes. Given the size of the sub-catchments, the values for t_c appear to be low. Please confirm the t_c values and any changes to the peak flow, if necessary.
- Please provide an assessment of the capacity of the farm drain (to which the proposed Stage B sediment pond/wetland would discharge to) with reference to the above assessment, in particular with respect to any potential increases in peak runoff as a result of the proposal.
- Section 6.6.6 of the AEE states that the southern extent of Area B currently drains to the south, and that this southern portion of Area B will become incorporated into the landfill. Please

advise whether the incorporation of the southern portion of Area B has been included in the peak flow calculation (Table 3.1 of the Appendix D – Stormwater Calculations).

Stormwater system:

- The Application states that all short-term drains will be designed for a 10-year ARI event, and all permanent drains for a 100-year ARI event. Based on the information provided in Section 3.5, the expected lifespan of the landfill is approximately 30 years, with 10+ years between Stage 4 and 5. To better understand the proposed drains, and how long the drains would be operational for,
  - Please clarify what constitutes a "short-term" drain – how long would a "short-term" drain be operational for (e.g. up to x number of years). Similarly, please confirm what constitutes a "permanent" drain (e.g. operational for more than x number of years).
  - Please provide further details on the (conceptual) design and dimensions of the stormwater drains.
- The Application states that only runoff that has not come into contact with waste will enter the stormwater system. Please clarify what measures are proposed to ensure only clean stormwater is able to enter the stormwater system.
- The Application states that the Stage B sediment pond will be designed to meet or exceed the requirements of the Hawke's Bay Waterway Guidelines – Erosion and Sediment Control 2009 ("the guidelines"). The guidelines provide sizing criteria for sediment retention ponds, which were used to size the proposed Area B pond as described in the AEE. The guidelines refer to sediment retention ponds as temporary ponds, and states that where they are used for more than two years, *"further measures to ensure stability and effectiveness are likely to be needed*". The Application states that the proposed Area B pond will form the basis for sediment treatment for all works within Area B. Area B is expected to provide approximately 30 years of landfill capacity, which suggests the pond will be operating for at least 30 odd years. To understand the operation of the pond and the potential effect on the receiving environment, please specify
  - What is the expected treatment efficiency of the Area B pond and wetland;
  - What ARI storm event the sediment pond is able to accommodate;
  - An indication of the likely performance of the sediment pond during storm events greater than the design storm, and/or how these peak flows will be managed and /or if they will mobilise contaminants in the sediment pond and/or wetland;
  - How the potential risk of spills, for example from machinery and vehicles operating during the construction and operation of the landfill will be managed;
  - How the potential risk of run-off or additional leachate generation will be managed in the event of landfill fires, with consideration of the potential contaminants contained in this. There is some information on this in the O&M manual but specific information for Area B is required; The expected sediment load of treated stormwater discharged to the unnamed farm drain. How much sediment is expected to deposit in the unnamed farm drain and the Upokohino Stream;
  - Please provide details of when/if accumulated sediment would be removed from the proposed sediment pond and wetland;
  - Does the proposed geometry of the Area B sediment pond (i.e. the non-rectangular shape) affect the expected treatment efficiency of the pond;

- Appendix D – Stormwater Calculations of the Engineering Report notes that the sediment pond and wetland would provide additional storage capacity and could cause a further lag in the stormwater runoff and potentially reduce the peak flow rate for smaller storm events. Please advise whether the pond and wetland are expected to attenuate flows, and what impact, if any, this may have on the ability of farm drain and the Upokohino Stream to flush accumulated sediments.

- Section 6.6.6 of the Application states that the proposed Area B sediment pond will block the outlet from the Area C Valley, and that it is proposed to install a pipeline within the pond bund to by-pass the Area B sediment pond and discharge to the farm drain downstream of the pond. Please provide details on the proposed bypass pipeline, in particular what the design capacity will be and what the implications would be if the pipeline failed or the capacity was exceeded (e.g. potential for flooding, potential for washing out the sediment pond or wetland).

Monitoring:

- The Application states that visual checks of the landfill surface on a regular basis to check for any potential leachate breakouts. Please specify the proposed frequency of the visual inspections.
- Please advise if and what type of regular inspections are proposed for monitoring the stormwater system (stormwater drains, sediment pond, etc.).
- The proposed stormwater monitoring (Table 6.1 of the AEE) specifies stormwater monitoring at six monthly intervals for water clarity, pH and conductivity. If the stormwater system were to be impacted by leachate, the proposed sampling would only detect such impacts after potentially six months. Please clarify why more frequent sampling was not considered appropriate, or potentially continuous monitoring of pH and conductivity, which could detect leachate impacts more quickly and allow a more rapid response.
- The proposed stormwater monitoring (Table 6.1 of the AEE) specifies that "*a more extensive suite"* will be analysed on a yearly basis. Please advise which parameters are proposed to be included in the "more extensive suite".
- Section 10.6.2.2 of the Application proposes to "*monitor spray drift under different weather conditions for the potential to enter stormwater drains to the extent that this may cause contamination*". Please provide further details of what spray drift monitoring is proposed, and how this will be undertaken to avoid spray drift from potentially entering any temporary or permanent stormwater drains.
- Section 6.6.6 of the Application states that it is proposed to divert run-off water from Area C around the Area B sediment pond, and that clean water diverted from the Area B site will also be diverted to this by-pass where possible. Please advise how it will be determined whether runoff can be diverted to this by-pass, and whether any further ongoing monitoring is proposed to monitor the quality of water diverted by this by-pass.
- The Operations and Maintenance Manual (Appendix P) specifies leachate monitoring of the existing leachate collection pond, in accordance with the existing consent DP040120Lb. The proposed environmental monitoring (Table 6.1 of the AEE) does not include leachate monitoring from the proposed new 4,800 m^3 pond. Please confirm whether it is proposed to monitor leachate from the new 4,800 m^3 leachate pond, and what parameters would be included, or otherwise clarify why this is not considered necessary.

Leachate management and irrigation

- The Application proposes a 10 m separation distance between the spray zone and stormwater drains. To better understand the proposal and potential effects, please advise:
  - Whether the 10 m separation distance applies to permanent stormwater drains only, or whether this applies to all drains (including temporary stormwater drains). It is noted that existing condition 4 of DP160044L does specific 10 m from any stormwater drain, overland flow paths or other surface water body.
  - Why a 10 m separation distance is considered sufficient, taking into account slopes of the areas proposed to be irrigated in Area B and the potential for contaminants to be entrained in the runoff (as shown in Drawing 1000647.1000-31).
- Please advise whether the potential for leachate impacted water to enter stormwater drains via interflow through the growth layer of the capping layer has been considered, and how this potential risk has been mitigated or avoided.
- The Application proposes a maximum leachate irrigation rate of 3 mm/day. Section 5.5.3 of the Engineering Report includes the results of an irrigation capacity versus leachate storage volume assessment, and Section 5.2 provides reductions in leachate irrigation capacity during wetter months which are reported to have been back calculated from the existing leachate irrigation activity. In order to better understand the potential risk of leachate generating runoff or becoming entrained in stormwater runoff, please provide details of soil moisture deficit modelling to justify why the proposed irrigation rates are suitable, how irrigation rates will be managed in consideration of potential lower permeability cap rates, and how the risk of leachate being entrained in stormwater runoff will be mitigated or avoided.
- The irrigation of leachate has the potential to lead to an accumulation of sodium in soils in the proposed irrigation areas. Please provide an assessment of the potential for sodium accumulation in the within the proposed irrigation areas soils, and any potential increase in the exchangeable sodium percentage (ESP) and any potential effect on surface soil permeability and generation of runoff. Proposed sodium mitigation measures are also requested.
- The irrigation of leachate furthermore has the potential to lead to the accumulation of heavy metals in soils within the proposed irrigation areas. Please provide an assessment for the potential of heavy metal accumulation, and whether this may have an effect on vegetative cover of landfill cap or on the quality of stormwater and the receiving environment, associated with runoff.
- Please provide information on the risk of other contaminants including emerging contaminants, accumulating in soils, being entrained in run-off or being discharged from the underdrainage system, in line with PDP's review memorandum of the waste acceptance criteria.
- The Engineering Report specifies that the average leachate generation rate, as modelled in HELP, is expected to be 105 m^3/day during Stage 5 of the landfill (estimated filling period of 2043 to 2060). Please provide further details on the design of the leachate system, in particular with reference to the risk of leachate spilling and whether this could enter the stormwater system should the design capacity of the system be exceeded (for a year with greater than average rainfall), or in the event of a leachate pump failure.
- Please provide details of a refined irrigation area to optimise the proposed leachate irrigation area but minimise irrigation of steep slopes.
- In line with the geotechnical review further information request, please provide details on the calculations regarding the system capacity and leachate water balance to confirm the excess

leachate volumes in a year with greater than average rainfall compared with available storage volume to confirm the concept design required leachate storage volumes. The highest year on record rainfall needs to be included in this calculation with allowance for climate change.

- Also, in line with the geotechnical review further information request, please provide details on the design of the proposed new leachate storage lagoon and how the potential for differential settlement will be managed, particularly in relation to the storage lagoon liner integrity.

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Hawke's Bay Regional Council and others (not directly contracted by PDP for the work), including Tonkin & Taylor Ltd. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This memorandum has been prepared by PDP on the specific instructions of Hawke's Bay Regional Council for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum 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.

Prepared by

Sebastian Küng

Environmental Engineer

Reviewed by

Dr Mark Ellis

Senior Water Services

Reviewed by

Daryl Irvine

Technical Director – Water Infrastructure

Approved by

Hilary Lough

Technical Director – Water Resources

Appendix E

Surface water quality and ecology review

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

Tel +64 3 **345 7100** Fax +64 3 **345 7101**
Web **www.pdp.co.nz**
Auckland Tauranga Wellington **Christchurch**

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memorandum

TO	Greg Shirras	FROM	Laura Drummond
	Hawke's Bay Regional Council	DATE	30 March 2020
RE	Omarunui Landfill Area B Consent Review – Surface water quality and ecology		

1.0 Introduction

Hastings District Council (HDC) and Napier City Council (NCC) (jointly the Applicant) have applied to Hawke's Bay Regional Council (HBRC) for resource consents to construct and operate a new area of landfill (Area B) at the Omarunui Landfill. The Assessment of Environment Effects (AEE) has been prepared by Tonkin & Taylor Limited (T+T).

A number of activities are considered to be permitted activities. HDC and NCC are seeking resource consents for the following activities:

- Discharges of contaminants to air (odour, landfill gas, dust and the products of combustion of landfill gas)
- Discharges of contaminants to land and water (from the landfill operation)
- Diversion and discharge of stormwater
- Diversion and discharge of drainage water (from a pumped system)

The applicant is seeking to change conditions associated with the existing air discharge and leachate discharge permits to provide for the Area B extension and is seeking new consents for the other activities.

Pattle Delamore Partners Limited (PDP) has been engaged by Hawke's Bay Regional Council (HBRC) to provide a technical review of the consent application for the following matters:

- Geotechnics
- Landfill design
- Leachate management and irrigation
- Stormwater, hydrology and drainage design
- Air quality
- Surface water quality and aquatic ecology
- Groundwater
- Proposed operation and monitoring
- Waste acceptance criteria

This memorandum details PDP's review of the potential effects of the proposed activities on surface water quality and ecology. The Ecology Report (Appendix L of the AEE) report has been reviewed together with relevant aspects of the AEE and other reports. The review considers if the baseline ecological assessment adequately assesses the condition of the waterbodies which have the potential to be affected by the proposed activities, if assessment methodology and conclusions are robust and if proposed construction and operational monitoring parameters, locations, and sampling frequency are sufficient to determine potential effects.

2.0 Overview of proposal relevant to surface water quality and aquatic ecology

The proposal has the potential to impact water quality and ecology in nearby waterways through the transport of contaminants from the site. An assessment of ecological effects (AEE) was completed by T+T (Appendix L of the AEE). The T+T report states that it only covers the potential effects of the proposed stormwater discharge from the new landfill (Area B) on the ecology of the Upokohino Stream receiving environment and therefore does not assess the potential effects of the proposed landfill operations, including construction activities, on receiving surface waterways.

Currently, the southern portion of Area B drains to a sediment pond, then through on-site drains to Upokohino Stream. The proposed system will construct an additional 'treatment pond' which is proposed to be sized for the catchment area it drains. Water will then flow into a polishing wetland before being discharged into a farm drain that runs along the northern boundary of the property. The treatment pond has been designed to remove suspended sediment, which has been determined as the contaminant of concern from the landfill operations. The treatment pond and wetland has not been designed to treat other potential contaminants associated with the landfill, including those associated with potential leachate ingress to the stormwater system.

3.0 Receiving environment

Once water flows through the treatment pond and wetland it will be directed into a farm drain that runs along the northern boundary of the landfill property. This farm drain flows for approximately 600 m before discharging into the Upokohino Stream, which has been assessed by T+T as the primary receiving environment.

The Upokohino Stream flows into the Tūtaekurī River approximately 4 km downstream of the eastern boundary of the site, with flows infrequently diverted into Lake Te Rotokare when lake levels are low.

4.0 Discussion on ecological assessment

An ecological assessment of Upokohino Stream (Appendix L of the AEE) was completed by T+T during one site visit on 26 February 2018, during low flow conditions. The assessment follows the Ecological Impact Assessment guidelines (EcIA) produced by the Environment Institute of Australia and New Zealand (EIANZ, 2018), which provide a transparent method of assessing effects.

The assessment determined that the Upokohino Stream is of 'low' ecological value, with low sensitivity as a receiving environment in its current condition. The assessment concluded that the proposed activity would have 'negligible' effects and the overall effect would be 'very low'. The existing condition of the farm drain, the ability of the drain to transport high flows and the potential ecological effects to this drain has not been assessed.

Substrate comprised of a deep layer of mud and decomposing macrophytes. There was no flow velocity at the time of the survey and the stream was dry downstream of the landfill. Limited shading of the channel was present, and high water temperatures were recorded. Dead eels were observed at the downstream 2 site, likely a result of toxic levels of ammoniacal-nitrogen (11.6 g/m^3).

An assessment of effects to the Tūtaekurī River has not been completed. A brief assessment on the potential effect for Te Rotokare has been completed, stating that there is a *"low probability for the landfill stormwater discharge to have a measurable adverse effect on the water quality of the lake".* An assessment through the EcIA guidelines categorises Te Rotokare as having 'high' ecological value, but because of the distance from the lake to the site and low occurrence of discharges to the lake resulted in the report stating the effects would be 'negligible' (section 6.3: Appendix L).

5.0 Potential effects on surface water quality and aquatic ecology

The primary contaminant of concern, suspended and deposited sediment, can cause negative impacts to aquatic values. At elevated levels, suspended sediment can have direct and indirect ecological effects. Reduced light penetration can lower periphyton and macrophyte abundance and increase invertebrate drift, which can impact fish populations by reducing feeding success. Fish can also be directly affected through abrasion and clogging of the gills. When deposited, sediment can clog interstitial spaces and reduce habitat available for macroinvertebrates and fish.

There are also additional contaminants that could migrate into the stormwater drains, including from spills from landfill vehicles and equipment as well as leachate runoff or spray drift from leachate irrigation, leachate ingress via the underdrainage system or groundwater inflows. Potential run-off in the event of a landfill fire also poses a contaminant risk as does direct entry of windblown litter.

While the receiving environment is already in a degraded state, the proposed activities should not add to that degradation. Therefore, the removal of **all** potential contaminants to appropriate levels must be achieved. The following sections discuss potential effects that are not considered to be covered to a satisfactory level in the ecological report.

5.1 Contaminants entrained in surface run-off

Stormwater will be directed around the landfill areas and led to the main diversion drains which will flow into a treatment pond and wetland to remove sediments. As set out in Table 6.1 of the AEE, monitoring of the stormwater is proposed to occur above and below the pond at 6-monthly intervals for water clarity, field pH and conductivity, and '*a more extensive suite on a yearly basis'*. Upokohino Stream will only be monitored for turbidity and suspended sediments, quarterly when discharge from the pond occurs, until the operational stage, when quarterly monitoring for some leachate contaminants will begin when discharge from the pond occurs.

Section 3.2.1 of the Ecology Report states that *'stormwater treatment at a landfill site is therefore aimed at removing sediment and is not intended to provide treatment for other contaminants'.* This is a 'best case' scenario where no contamination occurs from the waste or leachate and with activities such as the leachate spray irrigation occurring there is a risk of other contaminants entering the stormwater. No information on controls to detect leachate contamination in the stormwater network (drains, treatment pond and wetland) other than six monthly sampling of the stormwater have been provided.

No information on the maintenance of the treatment pond and wetland and the potential adverse effects that these habitats could have on downstream receiving environments have been provided. There is potential for algal blooms and wildlife activity which could lead to increased nutrient and *E. coli* levels.

Temporary stormwater drains are designed for a 10-year ARI while others are designed for 100-year ARI. There is no rationale provided for this, therefore the risk of contaminated water entering the stormwater network is uncertain. No information is provided for the buffer distance for temporary drains or how temporary drains will be managed.

A 10 m buffer distance of leachate spray irrigation from stormwater surface drains is proposed in the AEE. While this is applied to Areas A and D, this distance does not seem sufficient considering the landfill areas

are not flat and stormwater run-off following irrigation could entrain leachate contaminants. The Engineering Report specifies that leachate irrigation will not occur during significant rainfall or after a period of heavy rain, and that typically it is expected that irrigation will not occur when 20 mm of rainfall or more has occurred over the previous 24 hours. It however notes that a judgement decision will be required on each day as to whether conditions are suitable for leachate irrigation. There is also risk of spray drift being transported to surface drains during wind events. Further information should be provided on the sufficiency of the separation distance.

Further consideration of other contaminants as indicated in PDP's stormwater and leachate review memorandum is also required.

5.2 Airborne contaminants

Section 3.2.1 states that "landfill operations require ongoing movement of soils…" Area B is located in close proximity to Upokohino Stream, but there are no clear controls proposed to prevent windblown dispersal of leachate spray dust and other landfill contaminants entering the drains or other surface waterways. It is also noted in the Consultation Report (Appendix H of the AEE) that feedback has been received from neighbours and issues such as windblown litter on neighbouring properties have been raised. It will important that appropriate controls are in place in Area B to prevent windblown litter entering the surface waterways.

5.3 Cumulative effects downstream

Section 6.1 states that adverse effects from the proposed activity are very unlikely to extend to the Tūtaekurī River and no assessment is made into the cumulative effects to this already impacted system. A brief assessment was made on Lake Te Rotokare, in which a 'negligible' affect is expected due to the distance between the sites and the low frequency of lake openings.

In my opinion a more detailed assessment of the cumulative effects to the Tūtaekurī River is required. An assessment on the risks to the health of Lake Te Rotokare, potential triggers for lake openings and a cultural impact assessment (CIA) are also required.

5.4 Contaminants within groundwater

Surface water quality could be impacted by groundwater inflows to the stream, if groundwater is impacted by the landfill activities. This is discussed in PDP's groundwater review memorandum.

6.0 Proposed monitoring

The ecological report sets out a range of proposed surface water monitoring in the Upokohino Stream which will include monitoring at the three sites sampled in the T+T ecological assessment:

- Baseline monitoring of TSS and turbidity
  - Three wet weather replicates
  - Three dry weather replicates
- Construction monitoring quarterly for TSS and turbidity, when discharge occurs from the pond
- Operational monitoring quarterly for TSS and turbidity, ammoniacal – n, heavy metals and BOD, when discharge occurs from the pond
- Instream sediment and macroinvertebrate sampling annually

Justification is required as to why quarterly sampling during and post construction is sufficient, as opposed to monthly sampling. Justification is also required for not sampling for other potential leachate indicators. It is considered that existing effects of the landfill may be occurring downstream in the Upokohino Stream

(based on the monitoring data in the ecological report in Appendix L) so further investigation of potential causes of the water quality change and proposed monitoring is recommended.

7.0 Summary and recommendations for additional information

The T+T ecological assessment provides a good baseline overview of the Upokohino Stream, detailing its existing condition and the proposed effects from stormwater. However, this assessment is completed only once, and in summer low flow conditions with dry reaches downstream. This is the correct procedure for ecological surveys, as the system is at its most stressed; however, it is not when stormwater contribution is expected. Higher water flows are likely to be present when stormwater run-off is occurring and therefore an assessment of the potential effects over a wider time period, with discussion on downstream transport and cumulative effects to downstream receptors is required.

It is recommended that the following information is requested:

- An assessment of effects is needed to determine the risk of contaminant transport from landfill activities (leachate, spills etc.) and additional proposed controls to mitigate risk to receiving waterways.
- Please provide details of the management/response plan if contaminants are discovered in surface water samples. What are the trigger levels for turbidity/TSS in the stream to warrant action?
- An assessment of effects needs to be completed for the Tūtaekurī River and Lake Te Rotokare, including cumulative effects, with controls developed to ensure no effects are caused from the proposed activities.
- There is no reference of Figure 4.2 in the report, what is the importance/context of this figure and the spring systems to the application?
- Results indicate that the current and historic landfill activities may already be having an impact on Upokohino Stream, with elevated levels of multiple parameters, including ammoniacal-N at 11.6 g/m^3 (background levels at < 0.010 g/m^3) in water quality samples collected in February 2018. Given these potentially toxic levels and the dead eels observed, further investigation into whether the landfill is currently having an adverse effect on aquatic life is required. Please provide an assessment of the cumulative effects of the proposed discharge on the already stressed environment in Upokohino Stream.
- Please provide an assessment of effects of the potential adverse effects of the treatment pond and wetland, including effects of wildlife using these habitats and proposed maintenance of the pond and wetland (and its effects) for sediment accumulation removal. This should include an assessment of nutrient accumulation in the pond which could lead to nuisance algal blooms.
- Section 6.1 states that high water temperatures recorded are due to lack of riparian shade, however no mitigation methods are proposed to increase riparian planting along the affected section of Upokohino Stream. Please provide plans for any mitigation or restoration activities planned.

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Prepared by	Reviewed by
Laura Drummond	**Hilary Lough**
Senior Ecologist	Technical Director – Water Resources

Appendix F

Groundwater review

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

Tel +64 3 **345 7100** Fax +64 3 **345 7101**
Web **www.pdp.co.nz**
Auckland Tauranga Wellington **Christchurch**

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memorandum

TO	Greg Shirras	FROM	Ryan Nicol
	Hawke's Bay Regional Council	DATE	30 March 2020
RE	Omarunui Landfill Area B Consent Review – Groundwater		

1.0 Introduction

Hastings District Council (HDC) and Napier City Council (NCC) (jointly the Applicant) have applied to Hawke's Bay Regional Council (HBRC) for resource consents to construct and operate a new area of landfill (Area B) at the Omarunui Landfill. The Assessment of Environment Effects (AEE) has been prepared by Tonkin & Taylor Limited (T+T).

A number of activities are considered to be permitted activities. HDC and NCC are seeking resource consents for the following activities:

- Discharges of contaminants to air (odour, landfill gas, dust and the products of combustion of landfill gas)
- Discharges of contaminants to land and water (from the landfill operation)
- Diversion and discharge of stormwater
- Diversion and discharge of drainage water (from a pumped system)

The applicant is seeking to change conditions associated with the existing air discharge and leachate discharge permits to provide for the Area B extension and is seeking new consents for the other activities.

Pattle Delamore Partners Limited (PDP) has been engaged by Hawke's Bay Regional Council (HBRC) to provide a technical review of the consent application for the following matters:

- Geotechnics
- Landfill design
- Leachate management and irrigation
- Stormwater, hydrology and drainage design
- Air quality
- Surface water quality and aquatic ecology
- Groundwater
- Proposed operation and monitoring
- Waste acceptance criteria

This memorandum details PDP's review of the potential effects of the proposed activities on groundwater. The Hydrogeology Report (Appendix K of the AEE) has been reviewed together with relevant aspects of the AEE and other reports. The review considers the groundwater characterisation, groundwater-surface water interaction, the assessment methods, suitability of current investigations to extrapolate longer term site conditions and the adequacy of the proposed monitoring.

2.0 Overview of proposal relevant to groundwater

The application indicates that the proposed "Area B" Landfill involves establishing the following components:

- Developing a base grade and underdrainage system below the existing ground levels.
- Development of toe bund near the northern end of the Area B valley.
- Lining of the landfill using a composite geosynthetic liner system to capture leachate generated within the landfill at Area B.
- Establishing a leachate and landfill gas collection system.
- Infilling of Area B with refuse up to a level of approximately RL80 m at the crest of Area B.
- Final soil capping of the landfill.

Landfilling can result in the generation of leachate which can potentially enter downgradient groundwater and surface water systems, causing a deterioration in water quality. Effects of leachate seepage to groundwater can be mitigated by lining the landfill and collecting and containing any leachate generated in the landfill. However, installing a liner to capture leachate and also capping the landfill to reduce rainfall infiltration through deposited refuse material can result in a reduction of rainfall recharge to any groundwater systems beneath the landfill, which can cause a local reduction in the groundwater table and possibly a change in groundwater flow directions.

Based on the applicant's proposal to establish a landfill at Area B, there is potential for groundwater effects to occur relating to both:

- Groundwater quality.
- Groundwater quantity.

3.0 Receiving environment

The Area B Landfill comprises an area of approximately 23 hectares and the topography consists of a series of relatively steep narrow gullies/valleys surrounded by ridgelines on the western, southern and eastern portions of the sites. Part of the southern ridgeline is described by the Applicant as being a plateau as a result of modification from borrow and fill activities. The gullies and valleys open into a larger valley to the north which slopes toward the east and the Tūtaekurī River Plain. Based on the topography of Area B, any surface water flows are expected to be towards an easterly direction toward Upokohino Stream and Tūtaekurī River located to the east of the site. The information provided in the AEE indicates that local groundwater flow directions are less certain.

The information provided indicates that the potential receiving groundwater related environments from effects associated with the proposed landfill are expected to be;

- Shallow groundwater/aquifer systems beneath and downgradient of the proposed landfill.
- Springs and surface waterways connected to groundwater located downgradient of the proposed landfill (i.e. Upokohino Stream)

4.0 Discussion of hydrogeological investigation

The application indicates that there are 120 groundwater bores and 27 groundwater take consents (including stream depleting groundwater takes) located within 2 km of Area B. It is noted that the bore and groundwater take consent searches appear to be based around an arbitrary location near the centre of Area B and not the boundaries of the proposed landfill. Therefore, there may be additional bores and groundwater consents within 2 km of the boundaries of Area B to those provided in the application.

The underlying geology beneath and immediately adjacent to Area B is described as consisting of interbedded and interfingered marine sediments including limestone, siltstone and sandstone deposits. A veneer of colluvial and alluvial material overlies the marine sediments at the base of the gullies/valleys and is described in the application as being up to 9 m thick.

Regional groundwater is understood to flow from north west to south east within the shallow alluvial groundwater systems associated with the Tūtaekurī River to the east of the site and the Moteo Valley to the west of Area B.

Continuous groundwater level information beneath Area B provided in the application is provided for six bores for the period between 6 June 2018 and 30 August 2018 with manual groundwater level measurements recorded on 29 and 30 August in nine bores. The manual groundwater level measurements recorded on 29/30 August have been used to generate a piezometric contour map showing groundwater flow directions beneath the landfill. The piezometric contours generated from this groundwater level data indicate relatively complex groundwater flow patterns with a relatively steep groundwater gradient and flow direction from east to west beneath the majority of Area B. Conversely, further to the west, there appears to be a less steep groundwater gradient and flow direction from west to east from near the northern extent of Area D. The two opposing groundwater flow directions appear to meet at a “plateau” with groundwater interpreted to flow both south and north depending on groundwater levels. The western extent of the Area B footprint appears to be located beneath this groundwater plateau.

A bore with high groundwater levels (BC7A) located within the Area B footprint was disregarded by the Applicant when the piezometric contours were generated as it was interpreted to be an anomaly by the Applicant. Including the water level measured in this bore would give a significantly different groundwater flow direction and pattern of groundwater divides.

The continuous groundwater level data indicates that groundwater levels during the monitored period appear to be relatively stable with very minor fluctuations, although it is noted that the monitoring period is very short (around 3 months) so will not show any seasonal fluctuations.

Based on the relative complexity of groundwater flow directions and the relatively short continuous groundwater level monitoring period, it is likely that the pattern of groundwater level fluctuations and flow directions beneath Area B are not fully understood. Therefore, additional groundwater level monitoring data is recommended, including groundwater level measurements in the existing bores as well as bores located further away from Area B (including additional bores located to the north and east of Area B). A longer term record of continuous groundwater level measurements to help determine seasonal fluctuations both beneath and around the site would also be recommended.

The application indicates that seven bores at Area B were sampled for groundwater quality on 26/27 April/6 June 2018 and 29/30 August 2018. The sampling methodology provided in the application indicates that multiple methods were used during each sampling round. It is generally considered best practice to use a single sampling methodology to collect all groundwater samples at a site where possible.

The groundwater quality data provided with the application indicates that an adequate range of leachate indicator parameters were sampled to establish baseline groundwater quality.

The application compares the groundwater quality results against the Australian-New Zealand Environment Conservation Council (2000) (ANZECC 2000) 95% trigger values for the protection of aquatic species. It would be helpful for the applicant to provide reasoning for why the groundwater quality results were compared against the 95% trigger values in the application.

The groundwater quality results were also compared against the New Zealand Drinking-water Standards 2000 (Revised 2008) (NZDWS 2008). It is noted that between the initial preparation and the final version of the report, both the NZDWS 2008 and the ANZECC 2000 documents were replaced by more recent revisions (i.e. NZDWS, 2018 and ANZG, 2018 respectively). It is recommended that the new guidelines be used to compare the groundwater sampling results to the relevant guideline/trigger values.

The groundwater sampling results indicated elevated conductivity and concentrations of some parameters exceeding the NZDWS values in four of the bores monitored at the site, including:

- Arsenic
- Iron
- Nitrate-N
- Manganese
- pH (below the range)

In addition, one bore also had concentrations above the detection limit for the following parameters:

- Volatile fatty acids
- Xylene
- Methylphenol
- Toluene
- Carbon disulphide

The Applicant interpreted the elevated concentrations to be a result of surrounding landuse (i.e. horticulture/agriculture activities). It was noted that the types of parameters with elevated concentrations are generally consistent with typical leachate indicator parameters and given the proximity to the closed landfill Area A and the active landfill Area D as well as the complexity and potential uncertainty in regards to the groundwater flow directions beneath the site, it is difficult to rule out leachate contamination from the nearby landfill areas as a cause of the elevated concentrations. Additional groundwater sampling from a wider array of bores further from the existing landfill areas and Area B would be useful in determining background water quality for the wider groundwater system. Furthermore, a summary of historic landuse could be useful in confirming if localised landuse is the cause of the elevated concentrations in some of the bores.

The application indicates that an underdrainage system will be installed beneath the Area B landfill to reduce groundwater pore pressures beneath the landfill liner. It is understood that groundwater intercepted by the underdrainage system will discharge water into the onsite stormwater system which will discharge into Upokohino Stream.

If any leaks in the liner were to occur, there is potential that the underdrainage system will intercept contaminated groundwater and discharge it into the stormwater system. Based on this, it would be useful to continuously monitor the discharges from the underdrainage system where they enter the stormwater system for basic leachate parameters (pH, Conductivity etc) to detect any leachate contamination as quickly as possible.

5.0 Potential effects on groundwater

There are potential effects on both groundwater quality and quantity as a result of the proposed landfill at Area B.

5.1 Groundwater quality

Any leakage through the landfill liner could potentially result in a loss of leachate into the shallow groundwater system beneath the landfill at Area B, and therefore potentially release contaminants into the groundwater system beneath and downgradient of the landfill, which could potentially impact groundwater on the surrounding Tūtaekurī River Plain where a number of groundwater bores are located. In addition, there is likely to be potential for water quality effects within Upokohino Stream also located downgradient of the Area B landfill, either via groundwater inputs into the stream or groundwater from the drainage system into the stormwater system. T+T have assessed the potential impacts of this, although details of the calculations (for example a spreadsheet print-out) would be useful for auditing purposes.

There is also a potential pathway from the irrigation of leachate on the landfill cap, should runoff or underflow occur outside the landfill footprint, resulting in leaching to groundwater. This should be further considered based on the runoff and underflow issues raised in PDP's review memorandum of the stormwater, drainage and leachate irrigation.

Monitoring for groundwater quality effects is very important for operating landfills to ensure significant impacts do not occur.

5.1 Groundwater quantity

Installation of an impermeable liner beneath Area B will likely reduce groundwater recharge into the shallow groundwater system and could result in potential lowering of the groundwater table beneath the site as well as a change in groundwater flow directions. A reduction of groundwater recharge could potentially result in a reduction of groundwater levels resulting in a reduction in available yields in downgradient bores and a reduction in any spring flows or groundwater connected streams (i.e. Upokohino Stream). It is noted that the information provided in the AEE suggests that Area D does not have a discernible impact on groundwater levels.

Short term effects may also occur during the proposed dewatering for the removal of the alluvium. It appears that T+T have conservatively assessed the effects of dewatering for the removal of the alluvium based on flow rates of up to 50 L/s. The conclusion that significant effects would not extend beyond 500 m seems reasonable based on a consideration of the change in levels required at the site and measured permeability values. In addition, the conclusion that net stream depletion would be inconsequential given the discharge of water to the stormwater system is also valid.

Dewatering of shallow groundwater beneath the Area B landfill via the underdrainage system also has potential to cause a change in groundwater flow directions and levels. Overall, the long term drainage rates would be expected to be less than for the short term dewatering. It would however be useful if the applicant could provide information on any underdrainage systems for Areas A and D and typical flows from this either presently or historically.

Given the distance from the coast and the elevation of the proposed landfill Area B, T+T's conclusion that saline intrusion effects are not expected to occur as a result of the development of the site for use as a landfill is valid.

6.0 Proposed monitoring

As outlined in Table 6.1 of the AEE, the applicant is proposing to continue to monitor groundwater levels in an existing network of observation bores, which were installed as part of the Area B investigation, and to screen for the presence of leachate in groundwater beyond the boundary of the site. It is proposed that typical indicator contaminants for leachate will be monitored quarterly (electrical conductivity, ammoniacal nitrogen, total organic carbon, biological oxygen demand, chemical oxygen demand, and chloride). A full suite of contaminants will be monitored six monthly and Attachment 3 to the Hydrogeology Report indicates some additional parameters will be tested annually. This is in line with the current consent for Area A and D (DP010120Lc). Overall, the indicator contaminants proposed for sampling seem reasonable.

From our review of the application with respect to potential effects on groundwater, the following monitoring is recommended in addition to the monitoring proposed in the application:

- Inclusion of additional bores for groundwater level and groundwater quality monitoring within a wider radius from the boundary of Area B.
- Collection of groundwater level data over a longer period (ideally at least 1 year of monitoring) to establish seasonal fluctuations and potential for groundwater flow direction variations. It is acknowledged that this, together with water quality sampling, is proposed at least one year prior to receiving the waste, as set out in Section 6 of the Hydrogeology Report, but it is recommended that this should commence as soon as possible to help identify seasonal patterns and flow directions.
- Establishing continuous water quality monitoring of basic leachate indicator parameters immediately downstream of the underdrainage discharge point to monitor for potential leachate discharges to groundwater.
- Annual reporting of groundwater level and groundwater quality monitoring to identify any potential changes in groundwater flow and adverse impacts on groundwater quality, as per the consent for Area A and D (DP010120Lc).
- A review of groundwater levels every five years to discuss any observed changes in groundwater levels, changes in groundwater divide and changes in groundwater flow directions. This review should also provide a discussion of how any changes in groundwater levels/flow directions may affect the downgradient receiving environment and any groundwater users.

7.0 Summary and recommendations for additional information

The proposal to establish a landfill at Area B has a number of potential effects on groundwater quality and quantity, although the risk of these occurring can be minimised through appropriate design, management and monitoring.

It is recommended that the following additional information should be sought from the applicant:

- Details of the calculations (for example a spreadsheet print-out) for auditing purposes of the leachate dilution modelling.
- There is a potential pathway from the irrigation of leachate on the landfill cap, should runoff or underflow occur outside the landfill footprint, resulting in leaching to groundwater. This should be further considered based on the runoff and underflow issues raised in PDP's review memorandum of the stormwater, drainage and leachate irrigation.
- Comparison of water quality sampling with the NZDWS, 2018 and ANZG, 2018 and explanation of the choice of the 95% protection values. The long-term groundwater record provided with the application is relatively short and there appears to be some uncertainty regarding the existing

groundwater divide and the groundwater flow directions. Bores located further away from Area B should also be included in any groundwater level monitoring/piezometric surveys to determine groundwater flow directions in the wider area. Any existing water level information should be considered together with the levels recorded in the bores around Area B to help refine and understand the groundwater flow directions. A longer groundwater level record would also be useful to determine how groundwater levels change seasonally and if seasonal fluctuations result in any changes in flow direction or groundwater divides. It is recommended the applicant commence this as soon as possible, or provide information on why this is not considered to be required at this stage.

- Groundwater quality data suggests some localised contamination has occurred in the groundwater system beneath the proposed Area B landfill from localised landuse potentially not associated with adjacent landfill activities, although leachate contamination from adjacent landfill activities cannot be ruled out. A review of historic landuse information would be useful to confirm if any elevated concentrations are related to historic landuse. Comparison with water quality monitoring data for all bores around the landfill and beyond would be useful to help establish whether the elevated concentrations could be due to existing landfill impacts.
- Groundwater sampling over a longer time period (ideally at least one year) would be useful to determine if there are any seasonal trends in contaminant concentrations. It is recommended the Applicant commence this as soon as possible, or provide information on why this is not considered to be required at this stage. Bores located within a wider radius from the boundary of the Area B landfill should also be included during any groundwater level monitoring and groundwater sampling to provide additional background water level and quality information.

8.0 Limitations

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Prepared by	Reviewed by
Ryan Nicol	**Hilary Lough**
Senior Hydrogeologist	Technical Director – Water Resources