

EXPERT WITNESS CONFERENCE

Case: Levin landfill consent review S128 Permit number 6011

Topic: Whakawatea Forum Questions

Date: 11.00 am 10 August 2016, 11:30 am 11 August 2016

Venue: Phone conference

Witnesses present:

Name	For
Doug Body (DB)	MWH for HDC
Deborah Ryan (DR)	Jacobs for Horizons Regional Council
Louise Wickham (LW)	Emission Impossible Ltd for CNLG

Facilitator:

none

Environment Court Practice Note:

It is confirmed that all present:

- Have read the Environment Court Practice Note 2014 Code of Conduct and in particular
 - Have read the Environment Court Practice Note 2014 in respect of Appendix 3 – Protocol for Expert Witness Conferencing and agree to abide by it.

Joint Witness statement:

- **Identification of Issues** – see Table 1 Items 1 to 19 relate to questions from the Whakawatea Forum

Materials comprising primary data, including published studies or reports

- a) *Notice of Review*, Greg Bevin, Horizons Regulatory Manger, 30 October 2015 (Attachment A) footnote – refer to hearing folder. It is noted that LW did not have this document.
- b) *Levin Landfill – Response to Notice of Review*, Prepared for the Horowhenua District Council, November 2015
- c) *Levin Landfill Objectionable Odour Beyond the Property Boundary Non-Compliance Report*, Letter from Mr Stuart Standen, Horizons Regional Council, to Mr Arron Cox, Horowhenua District Council, dated 9 February 2015

- d) *Odour Diary* prepared by Mr and Mrs Grange dated 13 February 2014 – 5 August 2016, email to Stuart Standen
- e) *Pre-Hearing Meeting* document prepared by prepared by Christine Foster, Independent Facilitator on HDC Consent Review and s127 Application for HRC Consents 6009, 6010, 6011, 7289 and 102259 dated Wed 6 Apr 2016
- f) *Whakawatea Forum Minutes* of 26.07.16 Meeting and 8.08.16 Meeting prepared by Christine Foster, Independent Facilitator
- g) *Levin Landfill Management Plan* dated November 2010. It is noted that LW did not review this document due to time constraints.
- h) *Levin Landfill Odour Assessment* dated February 2015 prepared by MWH (Report Reference R001c) for Horowhenua District Council
- i) *Continuous Ambient Air Quality Monitoring for Hydrogen Sulphide September 2015—Levin Landfill*, Letter from Dr Doug Boddy, MWH New Zealand Limited, to Mr Gerry O’Neill, Horowhenua District Council, dated 10 July 2015, Reference ‘**L001**’
- j) *Continuous Ambient Air Quality Monitoring for Hydrogen Sulphide September 2015—Levin Landfill*, Letter from Dr Doug Boddy, MWH New Zealand Limited, to Mr Gerry O’Neill, Horowhenua District Council, dated 14 October 2015, Reference ‘**L002**’
- k) *Levin Landfill Discharge Permit 6011—Proposed Conditions*, Letter from Dr Doug Boddy, MWH New Zealand Limited, to Mr Warwick Meyer, Horowhenua District Council, dated 10 June 2016, Reference ‘**L003**’
- l) *Levin Landfill Biofilter Technical Review*, Letter from Dr Doug Boddy, MWH New Zealand Limited, to Mr Paul Gaydon, Horowhenua District Council, dated 19 July 2016, Reference ‘**L004**’
- m) *Levin Landfill Discharge Permit 6011—Proposed Conditions*, Letter from Dr Doug Boddy, MWH New Zealand Limited, to Ms Deborah Ryan, Jacobs New Zealand Limited, dated 4 August 2016, Reference ‘**L005**’

Key facts and assumptions

The scope of this caucusing is set out in the questions from the Whakawatea Forum. We note this is wider than the scope of issues in the HRC’s notified review of permit number 6011. To address the questions of the Forum, some elements of our response refer to matters regulated by other permits held by HDC for the landfill. We have not considered these other permits in any detail at this point.

Relevant standards/guidelines referred to

[Technical Guidelines for Disposal to Land](#), WasteMINZ, April 2016.

[Landfill Guidelines, Towards Sustainable Waste Management in New Zealand](#), Centre for Advanced Engineering (CAE), University of Canterbury, Christchurch, April 2000.

[Environmental Guidelines Solid Waste Landfill](#), Second edition 2016, NSW EPA, Sydney, Australia.

[Siting, design, operation and rehabilitation of landfills](#), Best practice environmental management, EPA Victoria, August 2015.

- Agreed; those issues which area agreed between the experts - see Table 1
- Disagreement; those issues not agreed and the reasons in each case - see Table 1

Signed:

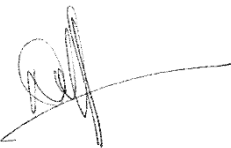
Witness	Signature	Date
Doug Body (DB)		12 August 2016
Deborah Ryan (DR)		12 August 2016
Louise Wickham (LW)		12 August 2016

Table 1 Air quality Issues Summary – Levin Landfill Air Permit Caucusing

Whakawatea Forum Questions	Discussion	Agree or Disagree
<p>1. What are the actual and potential sources of odour at the Levin landfill?</p>	<p>Deborah</p> <p>Key odour sources are:</p> <ul style="list-style-type: none"> • Inadequate/lack of gas collection and/or LFG flaring • A lack of or inadequate daily and intermediate cover • LFG emissions from the leachate collection sump • The leachate storage pond, inflow is exposed to air (likely to be anaerobic) • Leaks in the capping/cover material generally inadequate capping/cover associated with parts of the landfill not being actively filled • Working face and odorous waste loads. <p>Note: A separate consent is held for discharges from the LFG flare but there is no condition in either consent that requires collection and treatment of the LFG.</p> <p>Also note final cover/capping is not addressed in the air consent.</p> <p>Doug</p> <p>Based on my odour assessment report dated February 2015¹, the principal odour emission sources at the landfill are as follows:</p> <ul style="list-style-type: none"> • The leachate collection manhole; and, • Stage 2 – inactive landfill cell with intermediate (temporary) cover (emission “hotspots”). 	<p>All agree that landfill gas (LFG) is likely to be the main source contributing to offsite odour.</p> <p>This is arising from both Stage 2 and Stage 3 of the landfill because LFG has been uncontrolled with no collection and flaring since the previous flare broke down.</p>

¹ Levin Landfill Odour Assessment, report prepared for Horowhenua District Council by MWH New Zealand Limited, February, 2015.

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<p>The following locations are also considered to be potential sources of odour at the landfill:</p> <ul style="list-style-type: none"> • Delivery and handling of waste: there is the potential for high odour emissions to occur at the landfill during the delivery and handling of refuse at the working (tipping) face, particularly waste with high intensity odours; and, • The leachate pond (open storage). <p>Doug notes that odour emissions at the above sources have always been relatively minor during his site visits, compared with the principal sources (areas with intermediate cover and at the leachate collection sump).</p> <p>Louise</p> <p>Louise notes Deborah & Doug’s view that the old, unlined landfill is not likely to be the source of odour complaint but reserves caveat given its closer proximity to Granges.</p> <p>Composting operation located near site office was not a source of odours on day of Louise’s visit. Doug similarly notes no odours during his (repeated) site visits.</p> <p>Notes views of Mr W Meyer & Mrs G Grange that leachate pond and active face (as typified by normal rubbish smell) are not the source of odour complaint.</p>	
2. Based on the monitoring information available, does the	<p>Deborah:</p> <p>There are two separate air discharge permits for the landfill. The one under review is permit number 6011. One of the stated reasons for the review by HRC</p>	Deborah and Louise consider the landfill is non-compliant with Condition 3.

Whakawatea Forum Questions	Discussion	Agree or Disagree
<p>landfill operation achieve compliance with the relevant consent conditions?</p>	<p>is the ongoing odour issues, which reflects the HRC's view that there has been non-compliance with the odour condition (see below issue 3).</p> <p>Also the existing condition 5 states:</p> <p style="padding-left: 40px;"><i>5) The Permit Holder shall take all practicable steps to avoid, remedy or mitigate significant adverse effects of the discharge of landfill gas to air.</i></p> <p>My view is that this condition is not being complied with due to LFG significantly contributing to offsite odour.</p> <p>Doug</p> <p>Potentially no. He acknowledged the non-compliance letter from Stuart Standen (HRC) dated 9 February 2015, however, none of the odour complaints referred to in the letter have been verified by Stuart and another HRC officer, and the 3-month H₂S monitoring data (refer Letter L002 dated 14 October 2015) and is not definitive with respect to the sources of H₂S in the vicinity of the landfill.</p> <p>Agrees with Deborah that Condition 5 (requiring all practicable steps to be undertaken to avoid, remedy, etc.) has not been complied with.</p> <p>Louise</p> <p>No. Considers that non-compliance is well established through:</p> <ul style="list-style-type: none"> • Officers report concluding significant non-compliance (Letter prepared by Stuart Standen, Horizons Regional Council to Arron Cox, Horowhenua District Council dated 9 February 2015) • Multiple exceedances of national ambient air quality guideline for hydrogen sulphide (set primarily to protect against odour nuisance) 	<p>Doug considers there is potential non-compliance with Condition 3.</p> <p>All agree that Condition 5 has not been complied with.</p>

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<p>measured at Grange's property (Letter prepared by Doug Boddy, MWH NZ Ltd to Gerry O'Neill, HDC dated 10 July 2015)</p> <ul style="list-style-type: none"> Odour diary prepared by Mr and Mrs Grange commencing 13 February 2014 through to 5 August 2016 (email from Mrs Grange to Mr Standen dated 5 August 2016) <p>Concurs with Deborah and Doug on non-compliance with Condition 5 re practicable steps.</p>	
<p>3. How does the record of complaints made by the Granges reconcile with the experts' assessments of compliance?</p>	<p>Deborah In my view the complaints are likely to have validity based on the lack of LFG control at the site, my experience of odour at the site entrance (weigh station) and previous experience of odour from landfills without gas collection and flaring.</p> <p>Doug noted he had perceived a slight, transient LFG odour whilst visiting the Grange's property during the 3-month H₂S monitoring study, however, it was not offensive or objectionable at the time of the visit</p> <p>Louise considers Grange's complaints to be valid, particularly in light of extensive diary record.</p>	<p>All agree there is no inconsistency, i.e. Grange's experience consistent with current odour sources at landfill.</p> <p>All agree the odour complaints are credible.</p>
<p>4. Where should odour monitoring occur within and beyond the Levin landfill site? And, should that monitoring</p>	<p>Deborah Monthly LFG surface monitoring, weekly walk over and site/boundary observations of odour are proposed as part of the new consent conditions under the review.</p>	<p>All agree following proposed monitoring is appropriate:</p> <ul style="list-style-type: none"> Monthly surface monitoring for methane

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<p>be by way of ‘grab’ sampling (intermittent) or permanent in situ equipment monitoring?</p>	<p>An annual audit of the proposed biofilter and routine monitoring of the biofilter condition are also proposed.</p> <p>In my view the key is improved control, particularly of LFG including improved gas collection and cover. Provided improvements are made along with improved management, the above proposed monitoring for odour is considered adequate, being typical of good practice monitoring at similar operations.</p> <p>Doug</p> <p>Under HRC’s proposed Condition 6E (refer Horizon Regional Council’s (HRC) document entitled ‘Review of Conditions of Discharge Permits 6009, 6010, 6011, 7289 and 102259 for the Levin Landfill—Schedule of Proposed Conditions’ dated 30 October 2015), MWH recommends changing the word “survey” to “site inspection”. In my opinion, the condition intends to refer to a visual check (or walkover site inspection) as opposed to the use of landfill gas monitoring equipment or odour emissions monitoring for analysis by DDO, hence the suggestion to replace the word “survey” with “inspection”.</p> <p>However, landfill gas monitoring equipment could be used (as required in Condition 3E), if possible and practicable, as it certainly would assist in the identification of any emission hotspot locations, where there may be evidence of landfill gas leaks, odour, cracks in the landfill surface where capping has been applied, gas bubbles, leaks in the gas extraction system or vegetation damage. It is reasonable to assume that the “check for odour” (refer Condition 6E) would involve HDC or site staff undertaking a sniff test and an assessment of odour intensity, rather than a detailed field-odour investigation (modified VDI 3940)</p>	<ul style="list-style-type: none"> • Monthly boundary monitoring for odour using amended VDI method • Biofilter monitoring <p>Refer Attachment A for additional detail that should be incorporated into OMP and referenced in consent conditions.</p> <p>Louise (only) also recommends continuous monitoring for H₂S at Grange’s property to demonstrate improvement once recommendations re capping, LFG extraction & flaring and biofilter are implemented.</p> <p>Louise’s point of clarification:</p> <p>Monitoring is for purpose of compliance (i.e. demonstrating no objectionable or offensive odours beyond boundary of site).</p>

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<p>or odour emissions monitoring using sampling equipment (e.g. flux hood) and analysis by dilution olfactometry (using an odour panel).</p> <p>Louise Agree with proposed surface monitoring for methane, proposed boundary monitoring for odour (suggest using updated GPG method) and proposed biofilter monitoring (in letter from Doug to Deborah dated 4 August 2016). However, also considers there is merit in monitoring for H₂S at the Granges as we should see a reduction in this if all our recommendations are implemented (i.e. improved landfill management, capping, LFG extraction & flaring, biofilter commissioning). Notes NSW Landfill guidance has useful detail on surface methane monitoring (put into Attachment A for consideration).</p>	
<p>5. Are the proposed Horizons RC and Horowhenua DC conditions of consent sufficient to effect appropriate monitoring of odour?</p>	<p>All agree that Condition 3f needs a lower trigger level for surface monitoring of methane (this is taken from NES which is not about odour). 5,000 ppm is too high for preventative measure for odour. Shouldn't be any methane on the surface of the landfill.</p> <p>Doug proposes Vic EPA guidelines for methane trigger levels:</p> <ul style="list-style-type: none"> • 100 ppm for 'final cap' areas; • 200 ppm for 'intermediate cover' areas; and, • 5,000 ppm for onsite buildings and structures. <p>Deborah / Louise concur with these trigger levels.</p>	<p>Doug/Deborah – yes Louise – yes but would also like continuous H₂S monitoring. All agree on need for lower trigger levels for methane to be incorporated as conditions of consent. Refer Attachment A for suggested condition of consent (refer new proposed Condition 3F of consent number 6011).</p>

Whakawatea Forum Questions	Discussion	Agree or Disagree
	All agree that the OMP/LMP should be updated to contain these trigger levels.	
6. What methods do the experts recommend for monitoring, detecting and verifying the presence of odour beyond the boundary of the landfill site and, specifically, at the Grange property?	<p>All agree that applying VDI 3940² (German method) in full is not practicable and the method is generally adapted in NZ (and Australia).</p> <p>Deborah suggests in addition to monthly monitoring, a weekly site walk over would assist with preventative odour management, as required by the proposed consent conditions.</p> <p>Louise concurs.</p> <p>All agree odour complaint response and recording, remains an important element for odour monitoring and compliance and is consistent with national and international practice.</p> <p>Louise notes importance of 'being nice to neighbours' now written into updated GPG. It is not enough to be <i>considerate</i>, dischargers to air should be <i>nice</i> to those living with their discharges (i.e. prompt, courteous and helpful in resolving odour complaints).</p> <p>Doug recommends pro-active liaison through NLG (Deborah & Louise concur).</p>	<p>All agree odour monitoring with amended VDI method using one or two people (Louise suggests independent assessor(s), Doug/Deborah suggest HDC and HRC personnel).</p> <p>All agree odour assessors must be trained in odour assessment. Doug willing to help HDC with this.</p> <p>All agree odour monitoring to be undertaken at multiple locations (including met station on Granges boundary) upwind and downwind of landfill.</p> <p>All agree method should be documented in the OMP and adopted into revised LMP.</p> <p>Louise (only) recommends continuous H₂S monitoring, even if</p>

² VDI 3940 Part 2 – Measurement of Odour Impact by field inspection – Measurement of the Impact Frequency of Recognizable Odours Plume Measurement

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<p>Louise notes NSW Landfill Guidelines (updated 2016) have specific requirements for surface gas emissions monitoring that should be incorporated into the OMP. Refer Attachment A.</p>	<p>only on campaign basis, to demonstrate improvement.</p>
<p>7. What will be the effect and effectiveness of the proposed Horizons RC and Horowhenua DC conditions of consent?</p>	<p>All agree that under the proposed new consent conditions improvement in odour will occur from:</p> <ul style="list-style-type: none"> • Improved daily, intermediate and final cover; and • Extraction of leachate sump gas to a biofilter <p>Louise does not agree with proposal to use sand as daily cover.</p> <p>Deborah</p> <p>Consider gas capture and flaring is the most critical improvement for odour reduction. While it is understood HDC is proceeding with capture and flaring of the gas, this aspect is not currently within the scope of proposed conditions and is not required by either consent.</p>	<p>All agree the consent conditions for Permit 6011 are not comprehensive:</p> <ul style="list-style-type: none"> • No OMP proposed • Nothing about final capping • Nothing about LFG extraction • Flaring not required as condition of consent • No waste acceptance procedures (e.g. special wastes) <p>Note: some of these provisions may be in other permits for the landfill we have not reviewed</p>

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<p data-bbox="555 339 1480 440">It should also be noted that parts of the landfill have not been fitted with any gas collection infrastructure and retrofit may be needed to ensure effective control of LFG from the site.</p> <p data-bbox="555 496 640 520">Louise</p> <p data-bbox="555 576 1496 676">Concurs with Deborah's concerns and notes there are further no requirements to inspect the status of the existing infrastructure (e.g. cctv inspection of pipes to ensure not all blocked).</p> <p data-bbox="555 732 629 756">Doug</p> <p data-bbox="555 772 1458 836">Odour control measures that should be implemented at the landfill include, which could be incorporated into the proposed consent conditions:</p> <ul data-bbox="613 852 1480 1230" style="list-style-type: none"> <li data-bbox="613 852 1429 916">• Implement an Odour Management Plan (OMP) and incorporate amendments suggested in this Joint Witness statement; <li data-bbox="613 924 1480 1019">• Application of effective capping (e.g. clay layer) across intermediate cover areas (e.g. Stage 2 and 3) and installation of effective gas collection and flaring; <li data-bbox="613 1027 1397 1123">• Extract odorous air from the leachate collection manhole for treatment (e.g. by biofiltration). This is required by proposed condition 3H; <li data-bbox="613 1131 1480 1230">• Control odour at the leachate pond (e.g. by reducing residence time, avoiding certain wind conditions for planned maintenance, use of mechanical aeration as required); and, 	

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<ul style="list-style-type: none"> Control odour at the working face (e.g. keep an adequate supply of daily cover, inspect cover integrity, rapid and deep burial of malodorous waste). 	
<p>8. Proposed Condition 3(c): What is an appropriate material for covering daily landfill operations in order to suppress odour?</p>	<p>Deborah Notes CAE Guidelines state:</p> <p><i>Daily cover typically consists of a minimum of 150 mm thick earthen layer or an alternative material such as: geosynthetic blankets; shredded green waste; sawdust; spray on foam; contaminated soil (that complies with waste acceptance criteria); ash (that complies with waste acceptance criteria); stabilised sludge; paper pulp; composted material; small weave netting; and heavy duty reusable plastic sheets or tarpaulins.</i></p> <p>Because active face not source of odours at Granges, prepared to compromise on daily cover including some sand as long as mulch added. Depth is ok. New wording brings in performance element which is good. More concerned about intermediate cover. As per CAE, the purpose of intermediate cover is to:</p> <ul style="list-style-type: none"> minimise water ingress; reduce air intrusion; manage windblown litter, odour, vermin and birds; manage storm water; improve aesthetics. 	<p>All agree that intermediate cover should have a compacted soil layer, and that an effective (clay) cap is required above the intermediate cover layer.</p> <p>All agree Doug's proposed condition requiring keeping adequate supply of daily cover material.</p>

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<p>The CAE Landfill Guidelines are specific about intermediate cover in stating that Intermediate cover typically consists of a compacted soil layer.</p> <p>Doug Keen to retain the minimum depth of 150 mm of daily cover specified in proposed consent condition 3C. In particular, HDC should keep an adequate supply of daily cover material onsite (sand, soil and mulched woody material or MWM) in order to ensure that the depth (at least 150 mm at the end of each working day) and type of cover material is effective in controlling odour and other matters which could cause nuisance, such as litter. Doug notes the importance of implementing the odour mitigation measures stated in answer to question 7 above.</p> <p>Louise Louise noted rubbish poking through 'intermediate' cover on Stage 3. MWH work to date shows how big an impact on odour protrusions such as pipes can have (and how ineffective the existing intermediate cover is for odour control). Not supportive of using sand for daily cover but prepared to compromise. Agrees with Deborah intermediate cover is the bigger issue. Concurs with Deborah's views on requirements for intermediate cover being in accordance with CAE /WasteMINZ guidelines.</p>	
9. Related to the above, is sand an appropriate material for	All agree sand not appropriate on its own.	All agree that improvements are required to be made to reduce LFG

Whakawatea Forum Questions	Discussion	Agree or Disagree
<p>suppressing odour? If sand is an appropriate material for covering landfill operations for the suppression of odour, what depth should be applied?</p>	<p>All agree on proposed consent condition:</p> <p><i>“From the commencement date of the decision of the 2015 review of conditions, the Consent Holder must place daily cover over the entire operational fill area to a depth of at least 150 millimetres by the end of each operating day. Daily cover material may comprise of sand, soil or mulched woody material and should be applied to ensure effective odour control.</i></p> <p>All agree intermediate cover is more critical than daily cover because this is when landfill gas is starting to generate, and is considerably more odorous than the working face. The focus for getting an improved material for intermediate cover should take precedence.</p> <p>All note lack of design detail. Intermediate capping seems to be in place for significant periods of time. The temporary cap applied above the intermediate cover layer should be removed to avoid impermeable layers and perched leachate.</p> <p>All agree the LMP should be updated with regards to the staging of the landfill and the design and use of daily cover, intermediate cover and partial-capping (temporary) and final capping. The LMP update should also include details regarding the gas collection system and collection efficiency, projected gas volumes and quality, and the size, type and destruction efficiency of the new flare.</p>	<p>and odour emissions across the intermediate cover areas.</p> <p>All agree that the existing intermediate cover is not effective in controlling odour and LFG emissions.</p>

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	<p>Doug</p> <p>The intermediate cover, as per industry best practice, is effectively a thicker layer of daily cover where tipping will not occur for approximately seven days or more, and is distinct from both the partially final-capped area on the intermediate cover areas located at Stage 2 (or at Stage 3) and the permanently (final) capped areas (such as the old unlined landfill and Stage 1a).</p> <p>Where possible and practicable, the use of an effective capping layer should be applied across parts of Stage 2 (and possibly Stage 3) in order to reduce air infiltration, leachate, and fugitive odour and LFG emissions from the surface, and also increase the efficiency of the landfill gas collection system. However, it is noted that it will not be possible or appropriate to cap the entire intermediate cover area, as this areas may be part of or close to the active filling operation. In these locations, it will be important to monitor the effectiveness of the intermediate cover and to ensure that odour emissions are kept to a practicable minimum. The use of intermediate cover and capping will also improve the aesthetics of the landfill.</p> <p>I suggest the following amendments to the wording of Condition 3D:</p> <p><i>“From the commencement date of the decision of the 2015 review of conditions, the Consent Holder must ensure that intermediate cover is placed over daily cover to close-off a fill area that will not receive additional lifts of waste or final cover for more than three months.</i></p>	

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	<p><i>The combined depth of cover, including daily cover, over the waste shall be a minimum of 300 millimetres. Intermediate cover material should be applied to ensure effective odour control and should comprise of uncontaminated soil and mulched woody material, and include a clay layer on top of the intermediate cover. It is noted that this is likely to result in both partially-capped (temporary cap) and permanently-capped (final cap) areas. Intermediate cover shall be stabilised within 20 working days of completion.”</i></p> <p>The above condition, as amended, refers to partially-capped (temporary) and permanently capped areas. It is acknowledged that the partially-capped clay layers may need to be removed before filling re-commences on parts of the landfill (Stage 2 or 3), in order to avoid impermeable layers and/or perched leachate within the body of the landfill. Providing the intermediate cover mix of sand, soil or mulched woody material is applied to a sufficient depth (at least 300 mm, but it could be greater on occasion) in the areas where it is not possible or practicable to apply a clay cap on top of the intermediate cover, and is regularly monitored to determine its effectiveness for odour control, the odour emissions should be kept to a practicable minimum.</p> <p>Deborah</p> <p>So a partial cap comprises a 300 mm of sand/mulch as intermediate cover, with an unspecified clay cap (temporary) where an area will not be filled for more than 3 months? This 3 month period would correlate with LFG starting to form, so this is probably ok. Although the clay depth requires specification.</p>	

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	<p>It would be useful if we could include some maps/plans with areas that currently have the poorly covered mulch/sand areas with some time frames for when these areas would have the full 300 mm plus temporary cap.</p> <p>I still think some clear definitions of intermediate/temp and final would be useful.</p>	
<p>10. What are the actual and potential effects of long-term exposure to landfill odour (for example, as experienced at the Grange property)?</p>	<p>Deborah: In general terms long term effects are annoyance and stress thus affecting wellbeing.</p> <p>Research as to the actual health effects in communities of an area affected by landfill gas has not shown any likelihood of health effects, based on health risk assessments (which cover long term exposure) nor evidence of other health consequences based on observations in literature and HRAs done for other landfills in NZ. The Levin landfill is relatively smaller than other landfills and does not accept hazardous wastes, so that the conclusion in the literature can be expected to apply to Levin. These findings are supported by a recent paper published at the CASANZ Melbourne Conference³ (2015).</p>	<p>All agree overall exposure likely to be low (and significantly reduced should recommended mitigation measures be implemented).</p>

³ Porter, N et al., *A review of the literature on the identity and risk of odours associated with landfill*, CASANZ2015 Conference, Melbourne, September 2015.

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<p>Doug: Odour is perceived by our brains in response to one or more chemicals present in the air we breathe, and is the effect that those chemicals have upon us. Humans can detect odour even when chemicals are present in very low ambient concentrations (usually far less than the concentration that could cause adverse effects on the physical health of humans or impacts on any other part of the environment).</p> <p>Most odours are a mixture of many chemicals that interact to produce what we detect as an odour, and odour from a landfill is no different. Fresh air is usually perceived as being air that contains no chemicals or contaminants that could cause harm, or air that smells “clean” (i.e. neutral, rather like cork). Fresh air may contain some odour, but these odours will usually be pleasant in character (e.g. rose, strawberry or bakery-type odours) or below the odour detection limit (ODT) of the chemical.</p> <p>Different life experiences and natural variation in the population can result in different sensations and emotional responses by individuals to the same odorous compounds. Because the response to odour is synthesised in our brains, other senses such as sight and taste, and even our upbringing, can influence our perception of odour and whether we find it acceptable, objectionable or offensive.</p> <p>The difficulty when assessing odours is the fact that the same odour has the potential to cause an effect that may be considered “acceptable”, “objectionable” or “offensive” depending on the context, the sensitivity of the</p>	

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	<p>receiving environment and the person carrying out the assessment. An “objectionable” or “offensive” effect may occur where an odorous compound is present in a sample of air in very low concentrations and, as mentioned above, usually far less than the concentration that could cause adverse effects on the physical health of humans or impacts on any other part of the environment.</p> <p>Louise LFG contains carbon dioxide, methane, volatile organic compounds (VOCs), hazardous air pollutants (HAPs), and odorous compounds (US EPA, 2016).⁴ However, the potential health effects from long-term exposures to low levels of landfill gases released to ambient air are not easy to evaluate, largely because exposure data are often lacking (Agency for Toxic Substances and Disease Registry, 2001).⁵</p> <p>Odour producing chemicals (i.e., hydrogen sulphide, dimethyl sulphide, ammonia) are not likely to produce long-term adverse health effects at the levels typically associated with landfill emissions. However, the odours associated with these chemicals can cause acute (short-term) effects, such as nausea and headaches. Acute effects are usually transient (i.e. resolved when the odour or exposure ends).</p> <p>The Agency for Toxic Substances and Disease Registry reports (ATSDR, 2016): <i>The handful of studies looking at possible long-term adverse health effects (e.g., cancer) associated with low-level and multi-chemical</i></p>	

⁴ <https://www3.epa.gov/lmop/faq/public.htm> Accessed 10 Aug 2016

⁵ ATSDR (2001). *Landfill Gas Primer – An Overview for Environmental Health Professionals*. Atlanta. GA. USA. November 2001. Accessed 10 Aug 2016.

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<p><i>exposures associated with living near landfills have been largely inconclusive...</i></p> <p><i>In each study, the researchers noted the lack of data both about specific landfill gas emissions and about the effects of confounding factors such as lifestyle choices that may affect the health of individuals exposed to landfill gas emissions. Investigators noted that a study of a single landfill and the surrounding community is unlikely to answer the question of whether landfill gases are adversely affecting the health of community members. In all cases, the investigators cited the need for additional studies.</i></p> <p>The Grange's odour diary provides some measure of assurance that overall exposure is low relative to total potential exposure (i.e. high intensity odours are typically of short duration).</p> <p>Landfill gas data can help rule out problems (i.e., if landfill gas readings are below screening levels, concentrations in ambient air will be even lower). If the NLG is concerned about long-term exposure to LFG then I would recommend gas composition analysis as a starting point.</p>	
<p>11. What odour-reduction performance is anticipated from the leachate-trap biofilters and within what time</p>	<p>All agree need to monitor pH to ensure H₂S doesn't kill all the bugs (which is covered in HRC proposed conditions).</p> <p>Doug advised there will be 5% shells in the media and that regular pH monitoring will be undertaken</p>	<p>All agree a well-designed and operated biofilter should achieve a removal efficiency of at least 95% for hydrogen sulphide (H₂S), organo-sulphur and organo-nitrogen compounds.</p>

Whakawatea Forum Questions	Discussion	Agree or Disagree
<p>frame should a result be expected?</p>	<p>All agree with Doug’s proposed monitoring conditions for moisture, pH, temperature, etc.</p> <p>Louise suggested undertaking odour monitoring within 1 year of the commissioning date of the biofilter to determine the destruction efficiency meets is at least 95% and that there is no short-circuiting (by using smoke testing). Doug and Deborah do not believe that it is necessary to undertake these tests in addition to the performance monitoring tests required in proposed conditions 3I, 3J and 3K.</p>	<p>All agree it takes around six months for a biofilter to establish peak operational performance (i.e. stable bug population and operational efficiency).</p>
<p>12.What odour-reduction performance is anticipated from the flare proposed for the Levin landfill and within what time frame should a result be expected?</p>	<p>We have no details on the flare.</p> <p>All agree on a need to establish the status of existing infrastructure before we can have any assurance on future LFG extraction. Similarly query LFG generation calculations – we haven’t seen these so cannot comment on effectiveness (or otherwise) of flare. Details should be provided in the LMP.</p> <p>However, we caution that the overall effectiveness of the flare depends on the overall efficiency of the gas collection system, which as discussed elsewhere depends on the capping/cover and pipework design, including possible retrofit of old areas.</p>	<p>All agree the flare should perform in accordance with the standards under the NESAQ.</p> <p>The overall effectiveness of the flare in reducing odour will depend on the effectiveness of the gas collection.</p>
<p>13.Can the anticipated performance outcomes for the biofilters and flare be expressed as</p>	<p><u>Flare</u> Yes – The permit for the flare specifies performance criteria and monitoring requirements, which we consider are appropriate and if complied with will have a typical destruction efficiency of 98% or greater.</p>	

Whakawatea Forum Questions	Discussion	Agree or Disagree
<p>environmental outcomes or standards for the purposes of conditions?</p>	<p>Refer to above concerns over missing conditions in response to question 7.</p> <p><u>Biofilter</u> Doug satisfied with proposed design for biofilter as has reviewed calculations in detail.</p> <p>Deborah comfortable with proposed design for biofilter.</p> <p>Louise has not reviewed calculations in any detail but happy to accept Doug and Deborah's peer review. Notes that consent conditions could state 95% efficiency for odour removal in biofilter.</p>	
<p>14. Do the current proposed Horizons RC and Horowhenua DC conditions of consent appropriately express the expected outcomes for the biofilters and flare? What adjustments to wording would be required to achieve that?</p>	<p><u>Biofilter</u></p> <p>Refer letter from Doug to Deborah dated 4 August 2016.</p> <p>Proposed Condition 3(H): <i>"Within six months of the commencement date of the decision of the 2015 review of conditions, the leachate collection chamber must be vented to a biofilter. The biofilter must be designed by a suitably qualified and experienced person."</i></p>	

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<p>All agree first sentence likely to be redundant but this and remainder are suitable.</p> <p>Proposed Condition 3(I): <i>“The Consent Holder must employ an appropriately qualified person to undertake a comprehensive assessment of the biofilter performance on an annual basis. The assessment shall include, but not be limited to, an evaluation of the media size distribution and composition and effectiveness in removing contaminants.”</i></p> <p>All agree annual review appropriate.</p> <p>We recommend the following revised Proposed Condition 3(J): <i>The Consent Holder shall maintain the biofilter, measure and record the following parameters:</i></p> <ul style="list-style-type: none"> • <i>Daily visual inspection of the state of the biofilter bed, particularly for signs of any short-circuiting, clogging of the bed, compaction and weed growth.</i> • <i>Daily inspection of the inlet gas fan and ductwork and any maintenance;</i> • <i>Continuous display of differential pressure for the biofilter;</i> • <i>Weekly recording of pressure across the biofilter bed;</i> • <i>Weekly inspection to check for odour at the biofilter (i.e. assessment of odour intensity in accordance with the most up to date good practice guidance for assessing and managing odour).</i> 	

Whakawatea Forum Questions	Discussion	Agree or Disagree
	<ul style="list-style-type: none"> • <i>Weekly monitoring and recording of the biofilter media moisture content;</i> • <i>Monthly monitoring and recording of the pH of the biofilter media;</i> • <i>Quarterly raking and loosening of the biofilter media, or as otherwise required, to reduce the potential for short-circuiting, clogging of the bed, compaction and weed growth.</i> <p>We recommend the following revised Proposed Condition 3(K): <i>The Consent Holder must ensure that the biofilter and bed complies with the following limits at all times:</i></p> <ul style="list-style-type: none"> • <i>Pressure drop across the biofilter shall be less than 100 mm water gauge;</i> • <i>Biofilter media moisture content shall be between 40-60% moisture content;</i> • <i>The air flow rate shall not exceed 100 cubic metres per hour per square metre of biofilter media;</i> • <i>The pH of the filter material shall be between 6 and 8 pH units;</i> • <i>An even distribution of gas flow through the filter bed; and</i> • <i>There shall be no short circuits of untreated air through and filter bed.</i> <p>Louise (only) recommends testing the destruction efficiency and doing smoke testing to ensure no short-circuiting within the biofilter media bed within a year (takes six months to establish peak bug population).</p>	

Whakawatea Forum Questions	Discussion	Agree or Disagree
<p>15.How should the following odour-mitigation equipment be operated and maintained so as to ensure achievement of the intended environmental outcome (described in 11 and 12 above):</p> <p>a) The biofilters? b) The flare? c) The landfill capping (daily capping of current landfill)?</p>	<p>a) The biofilters? All agree that provided conditions of consent adhered to (as suggested above) this should be sufficient.</p> <p>b) The flare? Due to a lack of information we have only answered question 12 in general performance terms Doug – as long as it’s designed and run properly it should achieve a good destruction Deborah notes lack of back-up flare which could be an issue if outages are frequent (flare consent does require details to be kept of flare outages)</p> <p>c) The landfill capping (daily/intermediate/final* capping of current landfill)? All agree that if proper daily and intermediate cover and capping is employed, and the gas extraction and flare system operated properly there should be a significant reduction in LFG and odour emissions from the intermediate cover areas.</p> <p>*added in by us</p>	
<p>16.Re complaints procedure: Is the</p>	<p>The proposed conditions of consent are fairly standard.</p>	<p>All agree</p>

Whakawatea Forum Questions	Discussion	Agree or Disagree
<p>proposed condition addressing complaints best practice? And, what is a best practice process for addressing odour complaints?</p>	<p>Deborah considers the OMP is a bit vague regards complaint procedures, for example, a 24 hour contact number should be made available; the overall procedure could be improved.</p> <p>All agree that a more pro-active approach to communication is needed. The NLG could play a larger role in reviewing odour complaints and investigations.</p> <p>Doug notes that conditions 32, 33 and 34 refer to the NLG and it may be possible to amend one of these conditions to incorporate a feed-back loop regarding any odour complaints received by HDC. For example, any complaints received by HDC could be reported and discussed with the NLG at the monthly meetings, including a summary of the corrective measures undertaken to control odour. The HDC representatives should be local to the landfill and be available to respond quickly to any odour complaints received.</p> <p>All agree that the Granges are to be commended for their odour diary (this information has proved very useful). It would be very helpful if the Granges continued with the odour diary as it would provide valuable information on the on-going performance of the landfill in terms of odour control, particularly after the implementation of the odour control measures (biofilter at the leachate collection sump, effective capping across the intermediate cover, gas collection and flaring, improvements in handling malodorous waste at the working face etc.).</p>	
<p>17. Is the flare Horowhenua DC</p>	<p>We don't have details of the flare. We understand the flare will be located where the old flare is on the south eastern corner.</p>	<p>All agree the location is appropriate as it is as far as possible from the</p>

Whakawatea Forum Questions	Discussion	Agree or Disagree
proposes, in the location proposed, appropriate for this site?		Granges, on elevated land with clear surrounds and connects to existing pipework.
18.What best practice measures are adopted at other NZ landfills that could be implemented at Levin to achieve compliance with the 'no offensive or objectionable odour' condition?	<p>All agree the following measures will help reduce odour to achieve compliance:</p> <ul style="list-style-type: none"> a. Improved practice in daily and intermediate cover and final capping. b. Collection and flaring of landfill gas. c. Adherence to an improved landfill management plan that includes <ul style="list-style-type: none"> a. general waste acceptance procedures (e.g. gypsum, highly odorous putrescible waste) b. special waste acceptance procedures (e.g. sewage sludge, dead animals) c. inspections and audits d. Routine monitoring as proposed in review conditions. <p>All strongly caution against use of masking agents.</p>	All agree
19.Are there particular types of waste that should be specifically identified, separated and disposed of separately within the landfill? And, does the	<p>All agree that a standard requirement is that potentially odorous loads be booked in advanced of receipt and that special handling procedures, including immediate burial for odorous loads be applied.</p> <p>Deborah The proposed consent conditions do not currently reflect the need for OMP and or require compliance with such a Plan.</p>	All agree

Whakawatea Forum Questions	Discussion	Agree or Disagree
<p>Levin Landfill Management Plan adequately address this issue?</p>	<p>The MWH draft OMP does identify handling waste with high intensity odours as an issue ie as a potential odour source at the site, and recommends:</p> <ul style="list-style-type: none"> a. burial (with daily cover), b. non-acceptance or c. tipping only under specified meteorological conditions as mitigation. <p>The OMP also recommends tipping of odorous waste only within the hours of 7 am and 4 pm to avoid material being dumped at times when it may not be immediately covered. My view is that immediate burial of odorous loads with a suitable cover, not raw sand is needed to minimise the potential effect of odour.</p> <p>Doug The procedures for handling special wastes at the landfill, which include offal, dead animals and sludge from the Levin wastewater treatment plant, are detailed in the Landfill Management Plan. I recommend any malodourous waste received onsite should be buried quickly and deeply and that there should be an adequate supply of daily cover material and regular inspections of cover integrity, such that odour emissions at the working face are kept at the minimum practicable level.</p> <p>Louise I have not reviewed the LMP and cannot comment. Concur with Doug and Deborah on standard procedures for handling special wastes.</p>	

Whakawatea Forum Questions	Discussion	Agree or Disagree
	Surprised at lack of any documentation of sewage sludge waste or other special waste (e.g. dead animal carcasses) – this is routine on well-run landfills and detailed procedures are documented in WasteMINZ guidelines for landfills.	

Attachment A Surface monitoring for methane⁶

A surface gas monitoring programme should be established to detect any emissions through the cover/capping material and fugitive emissions from any gas extraction system present.

The LFG monitoring should include, as a minimum, the following locations:

- *the landfill's surface*
- *subsurface geology*
- *subsurface services on and adjacent to the site*
- *buildings/structures on and adjacent to the site*
- *landfill gas treatment/management equipment (such as flares and engines).*

In some cases, it may be appropriate to also monitor landfill gas present in groundwater and leachate.

The landfill gas surface emissions monitoring program should be conducted in the following way:

- *Methane should be tested in the atmosphere 5 centimetres above the landfill surface in areas with intermediate or final cover/capping. Testing should be conducted in a grid pattern across the landfill surface at 25 metre spacings. Depressions in the cover material, areas of distress vegetation and/or surface fissures away from the sampling grid, should also be investigated. The monitoring should be performed on calm days (winds below 10 kilometres/hour) and preferably during periods of relatively low and stable atmospheric pressure (e.g. less than 101.3 kPa).*
- *The monitoring should not be undertaken during or immediately after a prolonged period of heavy rainfall.*
- *The landfill gas monitoring device should be capable of detecting methane gas in sufficiently low concentrations to ensure confidence in the results. For surface gas monitoring, this level is 20 parts per million. The device should be properly zeroed and calibrated according to the manufacturer's instructions before any measurements are made. A flame ionisation detector is usually used for this purpose.*

The threshold level for further investigation and corrective action are in Table 1.

⁶ Adapted from NSW, (2016) and Vic EPA (2015).

Table 1 Landfill gas action levels

Location	Parameter(s)	Action level and unit
Landfill surface final cap	Methane concentration in air*	100 ppm
Within 50mm of penetrations through the final cap	Methane concentration in air**	100 ppm
Landfill surface intermediate cover areas***	Methane concentration in air*	200 ppm
Within 50mm of penetrations through the intermediate cover	Methane concentration in air**	1000 ppm
Subsurface geology at the landfill boundary	Methane and Carbon Dioxide concentrations	1% v/v Methane or 1.5% v/v Carbon Dioxide above background
Subsurface services on and adjacent to the landfill site	Methane concentration	10,000 ppm
Building/structures on and adjacent to the landfill site	Methane concentration in air	5,000 ppm
Landfill gas flares	Methane and Volatile Organic Compounds	98% Destruction efficiency

* Point of measurement is 50mm above the landfill surface.

** Point of measurement is 50mm from the point of discharge.

*** Intermediate cover areas are those that do not have an engineered landfill cap and are not scheduled to receive waste during the next three months.

If methane is detected at or above trigger levels, investigation and corrective actions can include:

- *repair or replacement of the cover material*
- *flux (emissions) monitoring to quantify emission rates and help identify the extent of gas loss (surface scans give a concentration, not a flow rate)*
- *installation of sub-surface monitoring wells (if not already installed) to gauge the extent of any lateral migration of gas*
- *adjustment or installation of landfill gas controls to extract and treat gas.*