	Question	Response Post Report Update
3	**Appendix 5 - Geotechnical Interpretive Report**	
3.1	**Introduction**	
	The Section 92 questions listed below, should be read in conjunction with those on the Geotechnical Factual Report, as set out in Section 4 below.	
3.2	**Section 1.3: Previous Reporting; Section 2.3.1: Taratu Formation; Section 3.2.6: Taratu Formation**	
	The Report notes that Taratu Formation has been assessed as more widespread than previously thought, (i.e. compared to published information).	GIR Sections 1.4 and 2.3.1 Reassessment of the Henley Breccia (HB) lithologies indicate that what was previously logged as Tarau Formation (TF) could be HB. The geotechnical behaviour of Tartatu Formation and Henley Breccia are sufficiently similar that all teh cire has been re-logged as HB.
a	How confident you are that all outcrops of Taratu Formation materials have been identified on the site, particularly within the proposed landfill footprint? What actions do you propose to confirm the unit's extent?	see above
b	Can the Taratu Formation and Henley Breccia materials be readily identified and distinguished in the field and investigations?	see above
c	If there are more extensive areas of Taratu Formation, please advise as to what potential effects that could have on the landfill's design and construction, in particular slope stability and materials reuse, and how would such issues be addressed.	see above
	Please also note the comments in Section 4.6 of this report.	
3.3	**Section 2.3.2: Henley Breccia Formation**	
	There appears to be the potential for discontinuity controlled instability along bedding planes and possible fractures/joints. In particular, Section 2.3.2 notes that "... the breccia units tended to be very weak at the contacts....", suggesting potentially low strengths associated with those bedding plane contacts.	GIR Section 7.4.1 HB is typically massive with very few discontinuities logged. Bedding is the most prevelent "defect". Slope modelling has focussed on bedding controlled slope failures.
a	What additional investigations are proposed to confirm the rock mass structure, i.e. bedding (and other discontinuity) orientations and strengths, and hence the potential for discontinuity controlled instability of in-situ and cut slopes?	Further investigation at detailed design. Slope models have confirmed where data could be useful to confirm bedding dip.
b	How would such potential instability be dealt with on site, should excavation reveal adversely dipping bedding planes or fractures?	Discontinuity/bedding controlled slope failure can be managed by cut slope angles and localised anchoring if adverse into slope.
3.4	**Section 2.3.2: Faults**	
	Refer to comments in Section 4.3 of this report.	
3.5	**Section 2.5: Natural Slope Instability; Section 3.2.2: Areas of Shallow Instability; Section 4.1: Shallow Slope Instability Failures; Appendix A: Instability Plan Figure A2**	
a	Do the currently identified slope failures only affect the Loess, or do they extend deeper into the underlying Henley Breccia?	GIR Section 4.1 field mapping to date indicates that these are all shallow seated sitting in surfical soils.
b	Please clarify the failure mechanism. Have any back-analyses been carried out to assess material properties for the affected materials?	No back analysis has been carried out because it is the intention to excavate all shallow instability.
c	How would such features be dealt with during construction? If that is to be by excavation and replacement, please advise how the location and extent of such features will be confirmed on site, so as to ensure their total removal and replacement.	During construction, all cut faces will be inspected by an Engineering Geologist to asssess stability
3.6	**Section 3.2.1: Fill**	
a	Will all existing Fill below the proposed landfill footprint be removed and replaced as part of construction?	GIR Sections 3.2.1 and 6.1 All uncontrolled fill identified on site during construction will be over-excavated
3.7	**Section 3.2.3: Buried Topsoil**	
a	The Report notes that buried topsoils were identified below the Loess in some boreholes. Such layers could potentially form low-strength shear planes. If the Loess is not entirely removed, how will the potential presence of such layers be identified and allowed for in design/construction?	GIR Sections 3.2.3 and 6.1 All topsoil and buried topsoil will be removed during construction
3.8	**Section 3.2.4: Alluvium**	
a	Will all existing Alluvium below the proposed landfill footprint be removed and replaced as part of construction?	GIR Sections 3.2.4 and 6.1 ditto above
3.9	**Section 3.2.5: Loess**	
a	Will all existing Loess below the proposed landfill footprint be removed and replaced as part of construction?	GIR Sections 3.2.5 and 6.1 All loess and loess derived colluvium soils will be stripped from within the landfill footprint In-situ loess may remain on the tops of the ridges above the landfill. These slopes will be managed as required with suitable permanent cuts
b	If the Loess is used for the low-permeability liner where would the materials be obtained from, e.g. from defined borrow areas or from local sources as the Loess is progressively stripped as part of ongoing cell construction?	Loess and loess derived soils will be progressively site won from within the landfill.
3.1	**Section 3.2.7: Henley Breccia**	
a	The Henley Breccia, as described, appears to be interlayered siltstone, sandstone and conglomerates. Is there any evidence of particular variation, or increased proportions, of particular lithologies or structural controls, (e.g. bedding, fracture spacing), across the site?	HB moderately weathered sandstone is the predominant lithology with sparse siltstone layers. The Breccia is the next dominant lithology. Bedding dominates the stucture

b	The siltstone is described as having a 10° to 15° dip. However, in Section 2.3, bedding dips are described as typically 15° to 30°. Please clarify.	15° to 30° is regional dipping and two outcrops marked on the map in the vicinity of the site record 16° and 18°. The orienation from the cores is less certain given the limited length of plane upon which it is measured. We have used the regional dip in the modelling
3.11	**Section 3.3: Groundwater**	
	Refer to Section 5 of this report regarding groundwater issues.	Refer to Groundwater report
3.12	**Section 3.5: Gaps in the Ground Model**	
	Please see the comments in Section 4.4 of this report.	
3.13	**Section 4.3: Groundwater seepage**	
a	The Report states that groundwater seepages were noted by GHD at a number of locations around the site. Their locations are not shown on the Reports' Drawings. Please provide further detail of such seepages, e.g. locations, flow rates and similar.	Refer to Groundwater report
b	Will further investigations and mapping be carried out to confirm the locations and extent of such seepages? How would they be dealt with during construction?	Refer to Groundwater report
	See also the Section 92 queries and comments in Section 5 of this report regarding groundwater issues.	Refer to Groundwater report
3.14	**Section 4.5: Site Seismicity; Section 7.4.4 Seismic Loading**	
a	The GHD Report assumes Importance Level 2 (IL2). Please provide further justification for that assigned IL2 rating, as it is more usual to assign an IL3 rating to the immediate post-construction phase, when the landfill contains significant leachate which could potentially be released as a result of a seismically induced breach of the containment system.	Agree, have revised to IL3. Change of IL changes pga but yield acceleration is very close to IL2 pga Edits included in GIR and Design Report Section 3.4.2
b	The final paragraph notes that "... a site specific probabilistic seismic hazard assessment could be completed...". Elsewhere you imply that such assessment will be carried out. Please confirm whether a site specific probabilistic seismic hazard assessment will indeed be carried out. If not, please provide justification as to why you consider that such an assessment may not be required.	GFR Section 2.2.3 and Design Report Section 3.4.2 At this stage there is no plan to undertake a site specific hazard assessment. The recent research is consistent with the fault database. The site does not have a liquefaction potential.
3.15	**Section 5.1: Preliminary Geotechnical Units**	
a	What further investigation and analyses are proposed to clarify the ground conditions and geotechnical design parameters for the various units?	Detailed design
3.16	**Section 5.2: Preliminary Geotechnical Design Parameters**	
a	Please provide further justification for the currently proposed design parameters in Table 2. In particular, how they have been derived and how they compare with design parameters used elsewhere for similar materials.	GIR Section 7.4.1 has been added
b	Currently a (relatively wide) range of geotechnical design parameter values are given for most of the defined geotechnical units. Please provide clarification as to what particular ground conditions, or geological units, such a range of parameters applies to, and the level of confidence in those values.	GIR Section 7.4.2 Table has limited the range We have commented on our level of confidence
c	The Henley Breccia comprises three distinct lithologies. Please clarify if you intend to provide a single set of design values for the Henley Breccia, or whether you consider the various lithologies require separately assigned design values.	GIR Section 7.4.2 Table has spilt into lithologies, the rare siltstone is assessed as weaker than the sandstone and breccia
d	Table 2 provides geotechnical design parameters for re-compacted Loess but not for in-situ Loess. Conversely geotechnical design parameters are provided for in-situ Henley Breccia, but not for compacted material, even though it is proposed to be used as bulk fill for the project, and will therefore be a critical parameter for assessing design aspects such as slope stability. Please provide geotechnical design parameters for a fuller, more representative, range of materials, both in-situ and recompacted. See also comments in Section 4.5 of this report.	GIR Section 7.4.2 Table
3.17	**Section 6.2.1: Liner and Capping Materials**	
	See also comments in Section 3.9 and Section 4.5 of this report.	
3.18	**Section 7.3.1: Landfill Liner**	
a	The bulk density of re-compacted Loess given in Table 3 contradicts the range of values given in Table 2. Please clarify and provide justification for the assessed density and strength values given in the Tables.	Recompacted loess density corrected to match test results
b	The proposed liner system is shown on Drg No. 51-12506381-01-C207/1. Slope stability failure mechanisms affecting such composite liner systems, i.e. liner systems with a combination of compacted clay and various geomembrane/geocomposite materials, often do not preferentially affect the compacted clay component. More commonly, critical failure mechanisms and surfaces typically involve sliding along the interfaces between the various components. Please therefore provide assessed design parameters for the various component interfaces, and your assessment of the likelihood of movement along those interfaces. See also comments in Section 3.21 of this report.	This will be covered at the Detail Design stage and will depend on the liner combination. This is not covered in the GIR
3.19	**Section 7.4.2: Engineered Slopes**	
a	Table 5 refers to "Engineered Fill". Will that only be reworked Henley Breccia materials? Please also see comments in Section 3.16 regarding geotechnical design parameters for the Henley Breccia.	At this stage the site won material for use as engineered fill will be site-won Henley Breccia GFR Appendix C lab results
b	The Report text (and drawings) indicate fill heights up to 16 m. Please provide details of the likely settlement behaviour of such fills, i.e. settlement magnitudes and settlement rates. Will your proposed liner design be able to cope with the possible settlement behaviour? Has an assessment been made of the resulting strains in the geosynthetic liner components?	Re-design now excludes significant thicknesses of engineered fill

3.2 Section 7.5.1: Concept Level Analyses

	Comment	Response
a	Please clarify assumed groundwater levels, in particular whether shallow, possibly perched, groundwater is present, as is inferred by the Report's comment that "….groundwater beneath the landfill will be managed …..by the placement of drainage material below the landfill liner……".	Refer to Groundwater report
b	The design drawings, in particular Drg No. 51-12506381-01-C208/1 and -C308/1, show only 4 No. relatively short sub-soil drains at the toe of the subgrade slopes, seemingly contradicting the statement in (a) above. Please clarify what groundwater conditions are expected under the liner during and post-construction, how any groundwater drains to the subsoil drains, and how groundwater has been modelled for the stability analyses, (see also Section 3.21 below).	Refer to Groundwater report
c	Please provide slope modelling analyses clearly identifying assumed groundwater conditions, for both temporary and long-term cases, including sensitivity analyses assuming elevated groundwater levels.	SlopeW outputs show groundwater below base of landfill and an assumed leachate level within the landfill

3.21 Section 7.5.2: Critical Cross Sections and Structures; Appendix C Slope Stability Modelling Results

	Comment	Response
a	Slope stability assessment has been carried out along three cross-sections through the site. However, as noted above, about 40% of the proposed landfill footprint has not been investigated. Please clarify the number and layout of additional cross-sections which you consider necessary to ensure that they adequately model the site, the proposed landfill layout, construction sequence and staging, and likely failure mechanisms.	GIR Section 7.5 - the slope analysis undertaken for the re-design covers all slopes, Assumptions have been made for the section of univestigated site based on the regional geology .
b	The slope stability analyses all appear to be relatively simplistic, and in particular they appear to only have assumed circular failure surfaces. Do you consider the shown critical failure surfaces (circles) are representative of realistic failure modes? Are analyses of non-circular surfaces, compared to the analysed circular surfaces, more appropriate? Please clarify your slope stability modelling philosophy and assumptions.	GIR Section 7.6.1 - we heve specified user-defined failures on new design
c	Have analyses been carried out assuming non-circular failure surfaces, for example along various unit interfaces such as refuse/liner; between the various liner component layers (as shown on Drg No. 51-12506381-01-C207/1); liner/fill; and fill/in-situ materials? In particular, the slope stability analyses do not model the potential for the refuse (MSW) to slide over the liner system, nor for sliding between the various composite liner components. The potential for such movements should be modelled both for when the landfill is partly filled, i.e. internal refuse slopes have been formed as part of construction staging, and also for the final completed landfill. The potential for such movements should be particularly assessed under seismic loading conditions. Please provide analyses and discussion of those potential failure mechanisms.	No inter-liner stability analysis included in the GIR Waste sliding over liner is a function of landfill staging
d	Has an assessment been carried out on the potential for discontinuity controlled slope failures, in particular along adversely dipping Henley Breccia bedding planes?	GIR Section 7 - have moved away from SlopeW analisis for all slopes and look qualitatively at the geological structure
e	There is no evidence of back-analysis of the observed on-site slope failures which would be helpful in refining the slope stability model and design parameters. Please provide details of such back-analyses, (see also Section 3.5 above).	All observed site instability confined to shallow surfical slips in materials that will be removed from site during construction. These slips do not add to the understanding of the Henley Breccia stability.
f	Most of the SLOPE/W plots show the critical slip circle as just skimming the ground surface. Whilst that may be the theoretical SLOPE/W analysis minimum FoS, are there other marginally higher FoS for deeper slope circles and which are more realistic of actual likely failure mechanisms? Please provide more detailed SLOPE/W plots showing the range of FoS for various slip surface geometries, with comment as to how representative you consider them of likely failure mechanisms.	GIR Section 7 , moved away from SlopeW models
g	The slope analyses indicate that the critical design input parameter is the assumed strengths of the in-situ Henley Breccia and of the engineered fill, assumed to derived from recompacted Henley Breccia. As per Sections 3.15 and 3.16 above, please provide justification for the geotechnical design parameters used for those two units.	Re-design no longer relies on significant thicknesses of re-compacted Henely Breccia GFR Appendix C
h	The design drawings, e.g. Drg No. 51-12506381-01-C204/1 and -C208/1, show temporary slopes formed at 1V:3H in the refuse. Please provide stability analyses demonstrating such temporary slopes are stable both for internal failure, and also for potential sliding over the liner component interfaces, (see also (i) below). After how long will such slopes cease being "temporary" and be categorised as "permanent" or long-term, with consequent changes in required target FoS?	Re-design has reduced need for waste slopes at 1V:3H

3.22 Section 7.6.4: Section D Toe Bund (Northern)

	Comment	Response
a	Please provide an assessment of the potential for a slope stability failure of the refuse mass under seismic loading to overtop the bund.	GIR Section 7.6.1 and Appendix C include Seismic analysis