RFI number	T+T Review Comments	ENGEO Response	T+T additional review comments	ENGEO Response
Site Investigation and Ground Model				
1	The number and spacing of intrusive investigation points appear insufficient to capture the anticipated variability in subsurface conditions across the site. The ground model should be supported by an appropriate level of intrusive investigation (e.g. boreholes and test pits) and laboratory testing to define soil and rock stratigraphy, groundwater conditions, areas of weak ground or uncontrolled fill, and any evidence of slope instability. As a guide, MBIE Module 2 Table 2.1 recommends a minimum number of investigation locations based on site area.	The geology of the site is not particularly variable, and we consider that the investigation undertaken are sufficient for this stage of the project. Module 2 recommends 166 investigation locations. We have completed 50 and completed a comprehensive site walkover to identify geological and geomorphological features. Given the topography there are many parts of the site that are inaccessible for borehole rigs and excavators. An appropriate level of supervision will be required during the earthworks stage to continually reference the ground conditions to the geological model.	Further clarification is required. The number, spacing, and depth of intrusive investigation points appear insufficient to capture the anticipated variability in subsurface conditions across the site. The majority of the completed investigations are between 2.4 and 4 m depth and 11 out of the 34 test pits (test pits 16 and 27, 30, 31, 32, 33 and 34 were not completed) terminated in soils (alluvium or loess) while the proposed cut might likely exceed the depth of investigations. Consequently, the thickness of the alluvial deposits and the nature of the underlying material remain poorly defined. There is a high degree of uncertainty regarding the extent of soft, weak, compressible, or potentially liquefiable soils that may influence the geotechnical performance of the proposed development	The main reason that the planned test pits could not be completed was because access was not possible. To complete additional investigations, extensive access tracks would be required to be constructed which is not practical at this stage of the development and would require extensive sediment control. The majority of the development is concentrated on the ridgelines where we have existing data suggesting that rock is near surface therefore the risk of soft, weak, compressible or potentially liquefiable soils in the areas where development is proposed is low. No buildings are proposed in gullies. Investigation in gullies suggests that rock is at a depth of between 1.4m and 6m (for example TP21 [depth to rock - DTR - 2.4m], TP13 [DTR 1.4m], BH05 [DTR 3.1m], BH01[DTR 6m]. All structures and earthworks (i.e. wetlands) in gullies will be founded in rock. This could be set as a consent condition. We understand that the developments to the immediate north (Muri Block) and South (Plimmerton Farm), were granted consent with a lower testing density than what has been undertaken at Mt Welcome.
2	In the material properties and slope stability analyses, loess and colluvium have been treated as a single unit. This assumption may not be appropriate, as it does not account for differences in soil structure and the collapsible behaviour of loess and its sensitivity nature to saturation and disturbance. Further justification or sensitivity assessment is required.	For this reason, we assumed very conservative parameters for the colluvium/loess unit and have used parameters for loess rather than colluvium. Limit equilibrium slope stability modelling software does not model differences in soil structure and collapsible behaviour. We have modelled the loess/colluvium unit in each slope model with a cohesion of 1 to reflect its sensitivity to saturation. Therefore, we do not consider that a sensitivity assessment is required.	Further clarification is required. Loess is highly susceptible to disturbance and saturation during earthworks. Its strength is reduced significantly when disturbed. We do not believe that the friction angle of 32 degrees reflects loess's sensitivity to both saturation and disturbance during construction. Please provide justification of the adopted parameters.	Geotechnical testing in this material indicates scala blows of between 4 to 8 blows per 100mm therefore we consider that a phi of 32 is suitably conservative. The majority of the cuts proposed are at the top of ridgelines to form building platforms and roads. All cuts along the ridgelines are expected to be through the loess and into Greywacke rock; if cut batters encounter loess within permanent cuts, this will be dealt with my engineering assessment and design at the time by chartered geo-professionals, likely to be grading back the slopes to an acceptable slope angle with erosion protection blanketing. Any loess remaining on building platforms will be tagged in the GCR as a SED zone requiring specific investigation and design.
Liquefaction and Seismic Hazards				

3	Liquefaction-prone soils are identified within low-lying gullies and valleys; however, the assessment appears to focus on building platforms and does not clearly address wetlands or embankments constructed from unsuitable materials. Please provide information on liquefaction risks and associated consequences for these features.	We have provided a plan showing the areas where there are gully areas containing possible liquefiable soils and the proposed locations of the wetlands and the unsuitable embankment. This shows that three of the five wetlands are not within areas expected to contain potentially liquefiable soil. The ground in the proposed location of the two wetlands in gullies may be liquefiable. The proposed location of the unsuitable embankment is partially within a gully with potentially liquefiable soil. At this stage, investigations in the base of the gullies is not possible due to restricted/difficult access. Where there is potentially liquefiable soil, any fill embankments will be founded on rock or keyed in below any liquefiable material and suitable drainage will be installed.	Further clarification is required. The response does not adequately describe the hazard, associated risks, and potential consequences as per Section 106 of the RMA. In addition, there is uncertainty of liquefaction assessment, as no geotechnical investigations were undertaken within the proposed wetlands and unsuitable embankment areas. Consequently, the depth, thickness, and extent of potentially liquefiable soils in these areas remain unknown. Due to lack of geotechnical investigation data, it is unclear whether undercutting and replacement liquefiable soils is a feasible or appropriate mitigation measure. Additional investigation and justification are required to support the proposed liquefaction mitigation strategy.	We consider that there is not a significant risk of liquefaction in the gullies in accordance with Section 106. The risk is not significant because the likelihood of liquefaction of natural ground in the gullies where damage resulting from the natural hazard could occur is low. This is because any structures within the gullies will be founded on rock. Therefore, the use of the land as a wetland/embankment will not accelerate, worsen or result in material damage. More detail is in the answer to question 5.
4	Liquefaction potential within the low-lying gully and the post-seismic stability of the embankment constructed from unsuitable material, including the potential for flow failure, do not appear to have been assessed and should be addressed.	The main gully is not being developed, apart from a wetland being constructed within it (see above). We have modelled the seismic stability of the unsuitable material in Appendix 9 of the report using conservative geotechnical parameters and conservative gradients. As stated above, any fill embankment will be founded on rock or keyed in below any liquefiable material and suitable drainage will be installed. Failure of the unsuitable embankment is expected in a ULS event. We have based our risk assessment on likelihood and consequence of failure and, because the likelihood of failure is low and consequence is low as there are no structures near or below the toe of the slope, the risk to life or injury in a ULS event is low.	Further clarification is required. Please provide a conceptual design to demonstrate that the proposed wetland embankment is feasible, and all associated geotechnical risks can be mitigated and meet relevant design guidelines and RMA requirements. Please specify the standards that the risk assessment was based on and provide definition on low likelihood and low consequences in accordance with the relevant standards.	Concept provided. The risk assessment is based on the National Policy Statement for Natural Hazards. Given that the consequence of embankment failure is negligible, with no loss of use, no building repairs required and no injuries, the risk is low for every likelihood level.
5	The estimated seismic-induced slope displacement ranges from 120 mm to 1400 mm. Please provide an assessment of the potential effects of these displacements on underground services.	The estimated slope displacements quoted are for ULS events. Underground services are not expected or required to remain operable after a ULS event. Underground services are, however, required to remain operable post SLS event. The majority of the services will be located beneath the roadways. Of the slopes we modelled where there may be small scale failures in a SLS event, these failures are expected either from slopes below building platforms or above building platforms where underground services are not expected to be located. All services will be located outside the potential failure zones where possible, or slope stabilisation measures will be put in place, such as, the use of geogrid.	Further clarification is required. Wellington Water Regional Standards for Water Services (Table 3-2) set out the required seismic performance criteria for critical and non-critical water services. Please confirm that the adopted performance objectives are consistent with Wellington Water's requirements for the WWL's assets or provide a written approval of Wellington Water's acceptance where a lower level of post-earthquake functionality is proposed.	Table 3-2 details the design criteria for new structures which exclude linear assets such as stormwater and wastewater pipes. Therefore, there is no requirement to comply with Table 3-2. Our original response still stands.
Slope Stability and Rock Behaviour				
6	The slope stability analyses do not appear to account for persistent defects or unfavourably oriented discontinuities within the rock mass. It is unclear how unfavourable defects would be managed if encountered, including any mitigation measures.	Due to the high density of fractures within Greywacke rock, it is not practical to assess continuous rock defects until the cuts are excavated. An engineering geologist will be onsite regularly during construction to identify any unfavourable or persistent defects. Slopes will be either modified if possible or suitable engineering solutions will be installed, such as, rock bolting or anchored mesh, or catch fences where suitable.	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.

7	Results of the slope stability analyses indicate that anticipated seismic displacements for the proposed fill batters are likely to be moderate to large. Mitigation measures will be required for these batters to reduce displacement risk under ULS earthquake loading. A feasibility-level design should be provided to demonstrate that suitable mitigation options are achievable.	In Section 8.2 we acknowledge that mitigation measures will be required for all fill batters due to the expected seismic displacement; mitigation will likely be either reducing the slope angles or geogrid reinforcement. We provide a slope model of the slope with the largest expected displacements (Section B) which includes the installation of geogrid beneath the building platforms. This indicates that it is possible to achieve a reduction in the expected displacement. With the geogrid as shown the displacement reduces from 340-440mm to 100-200mm in a ULS event. Note that this geogrid arrangement is not the final design.	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.
Drainage, Erosion and Fill Performance				
8	Please provide design details of subsoil drainage for fill slopes over gullies or within areas of significant fill depth, including discharge locations.	Slope specific subsoil drainage for fill slopes will be designed in consultation with the civil engineer. Typically, a subsoil drain will be placed up the centre of the gully at the beginning of the project. After this, lateral subsoil drains will be placed at the rear of the fill embankments at 1/3rd increments up the slope which tie into the central gully drainage trench. Additionally, during earthworks, if seepage is encountered during excavation of fill benches, this will be captured with drainage (wrapped novocoils) tied into the centre gully drainage trench.	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.
9	ENGEO recommends diverting free-flowing water away from fill slopes and applying hydroseeding. However, the erosion control approach is not clearly defined, including surface water interception, drainage pathways, and discharge locations. Further detail is required.	The 10-year event is contained within the piped network, with erosion protection detailed at each outlet and discharge locations shown on the stormwater design plans. Scour and erosion for stormwater outlets will be designed in accordance with the SMP (Section 6.14) and detailed at detailed design. Given the steep network, 100-year flows are largely contained within the network; where overland flow occurs, it runs down the batters at shallow depths and low velocities, with batters to be planted. The 100-year flow paths are shown in the Envelope Flood Risk Assessment and Flood Maps.	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.
10	If seepage is encountered in exposed cut faces, please comment on mitigation measures to manage slumping, muddy flows, and other associated instability.	If this occurs, drainage will be installed/drilled into the slopes to discharge to the base of slope.	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.
11	Please provide details of measures to manage surface water and groundwater infiltration.	Surface water is managed in accordance with the stormwater plans and SMP, with flows directed through the network to the designated management areas and devices	T&T note that they consider this response is sufficient and that it should be included as a consent condition.	The Applicant will discuss condition drafting with PCC.
12	In the slope stability analysis, please consider the potential for increased pore water pressure or saturation of fill embankments due to surface water infiltration, particularly where site-won materials contain a high proportion of fines.	In our slope models we have modelled each slope with raised groundwater as well as a saturated fill surface to consider the effects of surface water infiltration.	Further clarification is required. What are the types of structural fill are anticipated and do the adopted soil parameters adequately represent these materials in the slope stability modelling to account for increased pore water pressure or saturation of fill embankments due to surface water infiltration, particularly where site-won materials contain a high proportion of fines.	Structural fill will be blend of Greywacke rock with minor loess as is the industry standard within the area. The fines content is anticipated to be less than 25%; proctor and PSD testing will be undertaken during earthworks in line with an earthworks management plan. We consider that the parameters used in the slope stability modelling are representative of this type of fill.
13	Some fill embankments will disrupt existing natural drainage paths. Please outline mitigation measures to maintain overland flow continuity.	All existing flow paths have been designed with outlets to match the pre-development discharge. This has been informed by ecology and hydrology input to ensure existing hydrology and flow paths are respected	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.
14	Discharge locations of stormwater pipes are shown; however, outlet details are not provided. If discharging to gullies, please confirm whether erosion assessments have	Scour and erosion for stormwater outlets will be designed in accordance with the SMP (Section 6.14) and detailed at detailed design.	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.

	been undertaken and provide details of mitigation measures.			
15	For cut batters greater than 8 m where loess soils are present, please provide details of the proposed erosion design to mitigate the development of tunnel gullies.	Erosion controls will need to be slope-specific and will be completed at detailed design stage. Surface water will be directed away from the cut slopes with the use of cut-off drains at the crest of slopes and slopes will be planted to minimise erosion. SED zones will be detailed in the completion report if loess is present on building platforms.	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.
Materials, Settlement and Ground Conditions				
16	ENGEO considers the risk of collapsible soils to be very low; however, this is not clearly justified given the presence of loess.	Where there is loess soil beneath structures, the majority of the this will be removed therefore the risk is low. Where loess remains, drainage will be installed to direct water away. SED zones will be detailed in the completion report if loess is present on building platforms.	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.
17	Please comment on the erodibility of loess soils and the potential effects of sediment generation on stormwater systems, including proposed management measures.	Where stormwater flows over loess soil, erosion is possible. Overall sediment loss will be reduced with retirement from grazing, planting and stormwater diversion. Rain gardens have been designed in accordance with Wellington Water standards and will capture 90% of sediment from the reticulated stormwater system. The project ecologist has confirmed that there will be some natural load from undeveloped areas of the site into retention wetlands, but this will be less than is occurring at present and wetlands will be able to receive the sediment without needing to be cleaned out. Stormwater flow will not be concentrated within loess cuts or embankments.	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.
18	ENGEO notes potential differential settlement for buildings on mixed cut and fill ground; however, the feasibility of foundation solutions to address this has not been demonstrated and requires clarification.	Where this occurs, this will be clearly stated in the completion report as a specific engineer design zone and will need to be considered during house design - by a notice on the title if required	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.
19	Please identify contingency measures to address potential subgrade settlement.	If soft subgrade is encountered, this will be excavated and removed.	Further clarification is required. Please specify the likely extent and volume of soft subgrade excavation and if this is feasible for the proposed development	It is not possible to provide expected volumes of soft subgrade as this cannot be known prior to earthworks. The earthworks specification will be followed during earthworks to identify any subgrade that is unsuitable and this will be removed as cut to waste. Given that, as previously mentioned, all soil will be removed down to rock from anywhere that structures/batters are proposed within gullies, and that the majority of the development will be on the ridges which will be cut down into rock, the volume of potential soft soil is expected to be manageable, especially for a development of this scale.
20	Please outline remedial options for areas containing non-engineered fill, weak ground, or unsuitable materials where undercutting is not feasible (e.g. due to groundwater).	We do not anticipate any non-engineered fill in areas where it cannot be excavated. In the unlikely event that areas of weak ground or unsuitable material are encountered where structures are required, preloading of the ground may be utilised.	Further clarification is required. Please advise remedial options for areas where shallow groundwater is present and preloading is impractical due to site constraints.	As described above, investigations indicates that rock is present at 1.4 to 6mbgl. Any soft material will be removed prior to fill placement via bulk earthworks. If a higher water table exists, drainage and temporary works will be utilised to remove all soft material to foundation Greywacke rock.
Stormwater Wetlands and Embankments				

21	ENGEO proposes stormwater retention wetlands using site-won soils; however, ground conditions and associated geotechnical risks in these areas have not been clearly defined. Further clarification is required.	Evaluation of ground conditions and associated geotechnical risks have been assessed based on boreholes and test pits in the general areas as well as laboratory testing. Results are intended to be used to inform derivation of geotechnical parameters and assessment of the embankment geometry and configuration. ENGEO will complete a detailed design report (Overseen by a Recognised Dam Engineer (PIC/DSAP) concerning each of the wetlands which will include: - Determination of pre-development groundwater levels. - Determination of ground model (geological stratigraphy). - Derivation of geotechnical engineering parameters for soils used in modelling. - Computational slope stability and seepage analyses of stormwater embankments. We will complete iterative design of the embankments until acceptable FoS are achieved for all design cases to meet NZSOLD Dam Safety Guidelines (2024). - Consolidation / settlement analysis of embankments (using Settle 3). - Production of a Detailed Dam Design Report summarising laboratory test results and analyses for each of the stormwater embankments, including geotechnical recommendations for soil parameters, design slopes for the proposed stormwater embankments and conduit penetration recommendations. - Liaison with Civil Engineers and complete plan check on their drawings and advise on relevant earthworks specifications pertaining to the Wetland Embankments.	Further clarification is required. Please provide a conceptual design to demonstrate that the proposed wetland embankment is feasible, and all associated geotechnical risks can be mitigated and meet relevant design guidelines and RMA requirements.	Provided
Earthworks within covenant areas				
22	Covenant areas within the proposed development are protected by way of Conservation Covenants under section 77 of the Reserves Act 1977. Please clarify if proposed earthworks are likely to impact on the two covenant areas shown within Lot 1311.	The Lot 1311 covenant area does not currently exist and will be created through a conservation covenant being placed on the title when created through the subdivision process following the completion of earthworks, refer to proposed conditions of consent 101, 102 and 114 in Appendix 7 of the Substantive Application.	*T&T note that they consider this response is sufficient and that it should be included as a consent condition.*	The Applicant will discuss condition drafting with PCC.