



31 March 2020

Hilary Samuel
Taupo District Council
46 Horomatangi Street
Taupo
3330

Proposed Plan Change 36 - Whareroa North - Initial Geotechnical Review

2-37780.00

Dear Hilary

WSP New Zealand (WSP) have been engaged by Taupō District Council (TDC) to review geotechnical elements relating to the private plan change application titled '*Whareroa North Residential*', submitted by Proprietors of Hauhungaroa No. 6 (applicant).

The plan change application seeks to rezone approximately 14.63 hectares on the western edge of Lake Taupō adjoining the existing Whareroa Settlement from Rural Environment to Residential Environment. Our review of the various documents has focused on whether the information presented provides sufficient certainty that residential development is appropriate on this landform.

WSP are in receipt of the following documents relating to geotechnical matters:

- 19 October 2006, Site Assessment and Supplementary Geotechnical Engineering Appraisal Proposed Whareroa North Residential Subdivision, Hauhungaroa No. 6, Whareroa Road North, West Lake Taupō.
- 18 October 2018, Whareroa North Subdivision: Verification of Geotechnical Constraints for Residential Development, (Cheal, 2018).
- 26 September 2019, Whareroa North Preliminary Stormwater Assessment, Rev 4, (Cheal, 2019).
- 20 December 2019, Waikato Regional Council Submission to Proposed Private Plan Change 36 to the Taupō District Plan, (WRC, 2019).

An initial review of the documents outlined above has been undertaken, and three key geotechnical concerns specific to this site that loosely link together are:

- Lack of deep geotechnical investigation;
- Insufficient detail relating to the formation of the 'bowl-shaped' area and no consideration given to the potential for ongoing subsidence or land instability. This also links into there being no commentary around the sites propensity for seismic effects;
- The effect of concentrated stormwater on the steep land surrounding the escarpment.

1. Deep Geotechnical Investigation

The 2006 Mitchell report tables the issue of land instability and compressible soils, particularly in relation to the bowl feature. These two issues are significant geohazards. This report touches on mitigation measures for these risks.

The more recent geotechnical assessments of the site appear to have been based on desktop studies, site walkovers and shallow investigation techniques. Deep geotechnical investigation such as Cone Penetrometer Tests (CPTs) or machine drilled boreholes, are recommended to support proposed plan change applications as per New Zealand Geotechnical Society (NZGS) and Ministry of Business, Innovation and Employment (MBIE) Earthquake Geotechnical Engineering Practice guidelines.

We note that the guidelines are draft, and it is not mandatory to follow the guidelines, however they are becoming widely accepted as 'best practice' in the geotechnical engineering industry. We refer to Table 2.1 in Module 2 of the guidelines, which recommends a minimum of five deep site investigation locations at the plan change stage, for a site with an area greater than 1.0 hectare. We would expect to see geotechnical investigation extending to at least the depth of the Whareroa Stream invert.

The application is currently lacking a ground model, which would show a clear understanding of the ground and groundwater conditions pertaining to the site. Ground and groundwater conditions have an impact on the ability to develop the site for residential housing, and therefore a ground model is a crucial piece of information at this stage of the project.

The application makes no mention of the risk of seismic hazards such as liquefaction or lateral spread. We consider that there is potential for liquefaction and lateral spread at the site due to the presence of loose, granular soils (tabled as alluvial) and underground water (tabled as perched) flow. These hazards should be appropriately investigated and either discounted or defined with enough detail to have confidence that the risks can be mitigated through subdivision and ultimately building consent conditions.

With the tabled geohazards being global stability, compressible soils, and the sites likely seismic response, significantly more understanding is required to determine that the land is suitable for residential development. A deep investigation is required to inform much of the work that is required.

2. Potential for Ongoing Subsidence

The 2006 Mitchell report presented tables the issue of land instability and compressible soils, particularly in relation to the bowl feature. These issues are critical to understand as they affect the viability of the land for residential development. This initial piece of work tables that the bowl is a river meander with air fall deposits draping it. This initial piece of work explores the issues with bulk filling and the risks associated with settlement. Settlement and global instability are both issues that need to be resolved to determine that the land is suitable for residential development. This remains valid whether the applicant choose to simply place houses within/in close proximity to the bowl feature on natural soils, or whether they choose to undertake bulk earthworks of the same feature (cut/bench/fill for example).

The later Cheal work makes the assumption that the 'bowl-shaped' areas of land within the proposed plan change area and to the west are '*ancient meanders of the Whareroa Stream created when the level of Lake Taupō was at a higher level than present (Cheal, 2018)*'. This aligns with the 2006 Mitchell report. The deep geotechnical investigation should include a component of petrographic analysis to confirm the soils origin and thus most likely genesis of the bowl feature.

Although this is a possible explanation for the geomorphic features, investigation into the genesis of the 'bowl-shaped' area is brief, and there is no consideration given to the

possibility that there is potential for ongoing subsidence or land instability as was tabled in the 2006 Mitchell report as a function of the alluvial deposits (typically loose non-cohesive soils) or the 'compressible' air fall ash draping the site.

Subsidence is a type of ground settlement closely related to changes in the groundwater regime and/or loss of soil structure in a material such as a compressible ash. The potential for an underground water source is mentioned in the Cheal 2018 report, in the context of flowing groundwater contributing to an erosional process. There has been no investigation into this possible underground water source. Deep geotechnical investigation, as discussed above, will help to identify the presence or lack of groundwater beneath the site.

Given the density of development allowed in a residential environment there would be a significant risk of differential settlement on future dwellings and underground utilities if the 'bowl-shaped' feature is in fact the result of settlement/subsidence. Further investigation is required to understand the subsurface conditions within the 'bowl-shaped' area, to determine if there is risk of ongoing subsidence and to quantify this risk.

3. Use of Soakholes for Stormwater Disposal

As per the Cheal 2019 Preliminary Stormwater Assessment, *'a low impact design is proposed which will utilise the site's natural soakage capabilities, whilst reducing existing erosion patterns above the Whareroa stream and preventing water quality degradation in the stream itself'*. The methods proposed for stormwater treatment, storage and disposal include soakholes and attenuation ponds.

Soakholes are widely used around Lake Taupō because of the relatively free draining characteristics of pumice sands and gravels. However, soakholes will concentrate stormwater to specific points within the proposed plan change area and will potentially increase the risk of underground erosion leading to subsidence at the surface, or discharge out of the steep sides of the escarpment. The Cheal report (2018) mentions that the ground water may be perched (which has thus contributed to the scour feature at the terminus of the 'bowl'). If this is the case, soakholes would be expected to increase the frequency of concentrated flows loading up the perched groundwater zone. Mitigation could potentially be achieved by soakholes only discharging to strata that is not expected to 'daylight' out the side the steep ground surrounding the potential development land.

Attenuation ponds are proposed to be lined, include slow release outlets and overtop to a spillway in events larger than the 1% AEP rainfall event. When Pond 1's spillway is activated, discharge will be via sheetflow onto the ground between the pond and the top of the escarpment which is shown to be approximately 50m from the pond. The risks associated with saturating the ground above the escarpment in extreme rainfall events requires greater consideration. The design life of the ponds will need to be agreed with TDC, such that they understand when the ponds will need refurbishment or replacement. Depending on the materials utilised, a finite life is assumed. The construction of the ponds would need to be very closely monitored and a maintenance and monitoring programme agreed with TDC, as any leakage or failure of the ponds would almost certainly result in catastrophic damage to the steep land adjoining the proposed development.

The feasibility of capturing and disposing stormwater run-off, from both road reserves and future dwellings, via a piped network which outlets to the Whareroa Stream should be explored as an alternative to disposal to ground.

Summary

We believe the applicant must address all geohazards that could conceivably influence the site and assess these hazards in sufficient detail to understand the impact they may have on future residential development. As a minimum, the following questions should be addressed:

- Are the soils compressible, and if so, how are they to be treated in the context of residential development;
- What is the genesis of the bowl - is it alluvial or a function of subsidence. This should also cover global stability around the bowl and margins of the steep land around the escarpment;
- Are seismic effects a concern for future residential development;
- Will stormwater generated from residential development adversely affect the sub surface strata, and if so, how could the effects be mitigated;
- What is the groundwater regime, and how does groundwater affect the site when combined with the presence of compressible soils (to be confirmed), alluvial soils (to be confirmed) and seismic effects (to be confirmed).

Limitations

The purpose of this letter is to highlight to Taupō District Council that the applicant's submission does not adequately address several key geohazards related to the proposed plan change. This initial review has been expediated, rather than as a comprehensive preparation of evidence, as it is expected that further work will be required by the applicant to address these issues before progressing.

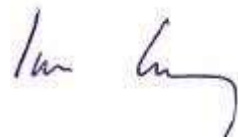
This letter is not a summary of WSP's future evidence preparation, other geotechnical issues/concerns/recommendations may arise during the evidence preparation process.

Regards



Maddison Phillips
Geotechnical Engineer

Reviewed by:



Ian Gray (Peng Geol)
Senior Engineering Geologist