

Memo

To:	Andrew Cumberbatch	Job No:	1008936
From:	John Brzeski	Date:	09 September 2019
Subject:	Waikato Regional Theatre Geotechnical Regulatory Review		

Please find below my regulatory review comments of the Geotechnical assessment for the proposed development of the Waikato Regional Theatre, Hamilton.

1 Introduction

The applicant is seeking resource consent to proceed with the Waikato Regional Theatre (WRT) Project at 170 Victoria Street, Hamilton. The proposal is to construct a 1,300 seat theatre over split levels on a terrace of the Waikato River in central Hamilton.

2 Review Scope

This regulatory review covers Hamilton City Operative District Plan (ODP) considerations with respect to the actual and potential effects of the proposal on geohazards and the actual and potential effects of geohazards on the proposal. This review has been guided by the following provisions of the ODP as well as section 3.24 of the Waikato Regional Policy Statement and the Regional Infrastructure Technical Specification.

- 21.2 Objectives and Policies: Waikato River Corridor and Gully Systems
- 22.2.1 Natural Hazards

This review is based the information relevant to geotechnical matters in the following documents:

- Assessment of Environmental Effects (AEE) – Waikato Regional Theatre. 170 Victoria Street, Hamilton.
- Waikato Regional Theatre, Geotechnical Factual Assessment. Prepared by CMW Geosciences (Appendix H to the AEE).
- Waikato Regional Theatre, Geotechnical Interpretative Report. Prepared by CMW Geosciences, dated 26 September 2018
- Theatre B3 Application - Civil Infrastructure Report - Waikato Theatre

This review is not to be considered as a design check peer review, as such I have not undertaken a detailed check of any calculations contained within the report.

3 Geotechnical investigation, assessment and reporting

CMW Geosciences (CMW) have been engaged by the Applicant to provide geotechnical advice for the theatre development.

The aim of the geotechnical investigation and assessment is to understand the ground model in relation to the proposed development. Once developed, the ground model is then used as a basis for the required assessments to determine the effect of geohazards on the development and the neighbouring properties from the perspective of a Resource Consent. Detailed design of the risk mitigation measures is outside the scope of a Resource Consent and should be submitted as part of a Building Consent.

A factual report detailing the encountered site conditions was provided with the AEE. An interpretive report was requested as part of a s92 request on the 18th January 2019. The interpretative report was issued on the 11th April 2019. The following sections are a combined review of both geotechnical reports.

3.1 Site Investigation

CMW have used a mixture of existing information and specific site investigation to develop the ground model. The placement of the investigation locations is such that it allows the general site to be characterised, however, due to the presence of existing buildings there are limited investigations under the proposed development. Investigations appear to have been targeted to understand the conditions at depth for the foundations and to understand the soil profile of the slope. A mixture of investigation techniques have been adopted to provide the data required for a slope stability assessment, liquefaction assessment and bearing capacity calculations. Cone Penetration Tests (CPT) have been undertaken next to Machine Boreholes (BH) in order to provide a correlation between the two methods, this is good practice.

The amount of investigation undertaken is deemed sufficient for a Resource Consent application, however, further information undertaken within the footprint of the building and for retaining structures will be required at detailed design stage.

3.2 Ground model

CMW have provided two geological cross sections through the site using the existing site contours and the investigation data. The cross sections show the distribution of the underlying soils and depths of ground water bodies. For the purposes of the model, CMW have identified the presence of five main geological units with sub-units based on lithology within the main unit. The encountered materials and the distribution shown on the cross sections are in agreement with nearby sites in my experience. It should be noted that the cross sections are based on limited ground investigations and very few from within the building footprint. The cross sections should be updated with additional site specific investigations at detailed design stage.

Groundwater monitoring has been undertaken on the site over a six month period as part of the investigation. This has shown that the likely standing groundwater surface dips from 30m in the west toward the Waikato River at approximately 15m RL in the east. In addition to this, perched water bodies are encountered within the top 5m in the Hinuera formation which present as seepages on the slope towards the river. In my experience, this groundwater regime is typical of sites on the Waikato River bank.

3.3 Geotechnical design parameters

Geotechnical design parameters for strength and density have been determined for each discrete geological unit and sub unit based upon laboratory testing, in-situ test data and back analysis of slip-

circles. The values for effective friction given for the Hinuera Formation appear high (non-conservative), however, laboratory data does provide justification for the use of these values. The laboratory tests on which these values are based are taken from an adjacent site and while it is reasonable to expect that the same conditions will prevail at the Theatre site, it is recommended that further justification for the correlation of strength parameters should be provided as part of the detailed design.

The seismic design parameters provided are in line with my experience in the area, the applicant has confirmed that the structure has a 50 year design life.

3.4 Liquefaction assessment

CPT and seismic CPT have been used to complete a qualitative assessment in general accordance with current Ministry of Business, Innovation and Employment guidelines for liquefaction assessments. CMW consider the liquefaction hazard at the site to be very low given the soil condition and depth to ground water. The conclusions made in the report are, in my opinion reasonable and in line with my experience in similar geological settings within Hamilton.

3.5 Slope stability assessment

In my opinion, CMW have undertaken sufficient slope stability assessments to demonstrate that the theatre development will not unduly be affected by or exacerbate the global slope stability hazard that is present on the eastern boundary. Numerical slope analyses have been undertaken taking the theatre main building into account to show that acceptable factors of safety are generally achievable. Where the desired factors of safety are not achieved, specific design of the structures will be required to ensure they are not affected by or exacerbate the hazard. This is to be provided at detailed design stage. A plan has been provided in an updated geotechnical report that indicates a Building Restriction Line (BRL), beyond which piles need to be designed to accommodate lateral loads imposed by possible slope instability/movement.

The numerical modelling undertaken by CMW indicates that seismic stability of the slopes is below the acceptable factor of safety. CMW point to Hamilton's history as having no recent evidence of large scale slope stability issues caused by earthquakes. In my opinion, this fact alone is not sufficient to justify adopting a lower factor of safety. In addition to this observation, CMW have adopted a deformation-based slope stability analysis to determine the approximate deformations in the Ultimate Limit State event. The deformations calculated should be accounted for in the detailed structural design.

While long term, global stability of the slope post construction of the main theatre building has been considered, CMW did not originally discuss the stability of the gully slope as a result of ongoing erosion and slumping especially with regards to temporary stability during construction of the main building and the external screen. A s92 response on this matter suggests that due to the net lowering (unloading) of the slope and a net reduction in rain entering the slope due to attenuation and reticulation, the overall resilience of the slope to erosion and continued slumping should be improved. This is a reasonable statement that I can agree with. CMW also state that surface water must be managed during construction to ensure that runoff is directed away from the slope face.

3.6 Structure foundations

CMW have provided preliminary foundation recommendations including expected settlements and bored pile design parameters. The information provided will need to be reviewed by CMW at detailed design stage once final plans are produced in order to confirm that the structural design is in accordance with the geotechnical requirements. Additional investigations underneath the footprint of the building should be undertaken to confirm the design parameters before proceeding

with the detailed design. Note that for the purposes of Resource Consent, a detailed review of geotechnical design parameters has not been undertaken. It is recommended that this is carried out at the time of Building Consent and a condition of consent is therefore recommended.

3.7 Earthworks

The Civil Infrastructure Report shows cuts of up to 5.4m are planned, and CMW anticipate these excavations to be undertaken above the perched water level and therefore only limited dewatering will be required in soils that have already experienced fluctuating water levels and as such they anticipate that any drawdown settlement that could occur would be minor. Stability in these excavations will still need to be monitored and managed carefully throughout construction to avoid collapse of any exposed faces with the potential to undermine any of the neighbouring properties. CMW state that permanent and temporary retaining structures will be required to manage stability in the cuts and to achieve the target depths. Temporary design is likely to be the responsibility of the constructor, it is important that the construction contractor engage a suitably qualified geo-professional to oversee their works and provide appropriate temporary works designs to ensure no adverse effects to neighbouring properties.

Only very limited filling is required for the development meaning that 15,000m³ will be required to be removed from site. The movement of trucks and trailers will need to be managed to limit the effect of neighbouring properties as well as traffic and pedestrians on Victoria Street. It is noted that the applicant is proposing a condition of consent requiring a Construction Traffic Management Plan.

The Civil Engineering Report suggests that a number of retaining walls including sheet pile walls along site boundaries will be required. These will all require specific investigation to determine retained soil parameters and embedment depth. Specific investigations for the design of retaining structures will need to be undertaken as part of the detailed design and a condition of consent is therefore recommended.

3.8 Effects on the gully

Given that the development includes earthworks and construction within the gully hazard, the District Plan requires a Site Management Plan (SMP). In geotechnical terms, CMW have provided the required components of an SMP, and a preliminary erosion and sediment control plan has been provided in the Civil Infrastructure Report.

In addition to this, the plans show an external screen and riverside embankment is to be constructed on the gully slope. CMW have stated that this will have piled foundations and these will be subject to specific engineer design supported by appropriate investigations and assessment at detailed design stage.

Control of stormwater and drainage of the site during construction is important to ensure that the slope stability risk is not exacerbated by surface runoff, CMW recognise this in their s92 response. Effective management of surface water should be closely monitored through implementation of an approved Site Management Plan as required by the District Plan.

CMW expect a net reduction in rainwater entering the gully system on account of attenuation by the proposed roof structure and subsequent reticulation as detailed in the Civil Infrastructure Report prepared by Holmes Consulting. This net reduction may result in overall improvement in the slumping observed on the gully slopes.

3.9 Effects on neighbouring properties

The risk to neighbouring properties from the geotechnical aspects of the development includes, but is not limited to; subsidence from ground movement associated with demolition and excavation,

drawdown settlement in relation to dewatering, vibration during piling of foundations or retaining walls and vibration during compaction. It is understood that Mr McGregor is providing comments on the vibration risks, this memorandum considers settlement and subsidence from ground movements.

CMW have stated that the risk of drawdown settlement effecting neighbouring property is low due to the limited dewatering expected and the soils having already experienced fluctuating water levels. As stated in the earthworks section of this memorandum, retaining structures (both permanent and temporary) will be required to ensure stability of the cut slopes at the property boundaries. The permanent retaining structures will be subject to specific engineer design, temporary works should be designed and overseen by a suitably experienced geoprofessional.

Due to the proximity of the neighbouring properties and the nature of the works proposed it is recommended that a monitoring plan is developed and that pre-condition surveys of the properties affected are undertaken prior to starting on site. CMW also recommend that pre-condition surveys are undertaken but this has not been taken forward to the suggested conditions of consent.

3.10 Proposed Conditions

Having read the Draft Conditions document (v4) the following additional conditions are proposed in order to capture the points raised in this memorandum.

Further to sections 3.5, 3.7 and 3.9 of this memorandum the following addition to the proposed consent condition is proposed.

28. The Construction Environment Management Plan (CEMP) shall include (but not be limited to) the following matters:

(b) Construction methodology, including:

(iv) Management of excavation stability for permanent and temporary works.

The following additional earthworks consent conditions are proposed:

- 1. The detailed design of the retaining walls and foundations are subject to additional geotechnical investigation.*
- 2. The detailed design of earthworks, retaining walls and foundations should be carried out or reviewed by a Chartered Professional Engineer practicing in geotechnical engineering or an experienced Engineering Geologist;*
- 3. All earthworks shall be managed to ensure that they do not lead to any uncontrolled instability or collapse either affecting the site or adversely affecting any neighbouring properties. In the event that such collapse or instability does occur, it shall immediately be rectified.*

Further to section 3.9 of this memorandum and the above condition 3 it is recommended that a condition is made to ensure pre-construction condition surveys of all at risk properties and assets is undertaken. At risk property and assets should be determined during detailed design.

3.11 Conclusion

The site appears to be suitable for the construction of the proposed development albeit with some geotechnical challenges that have been identified during the investigation works undertaken to date. The lack of investigations under the footprint of the building and for specific structures such as retaining walls and the external screen should be addressed as part of the detailed design.

Given the proximity of the neighbouring properties and the nature of the works, including deep excavations, a monitoring plan should be provided for acceptance at detailed design stage. The

monitoring plan should include provisions for undertaking pre-construction condition surveys prior to starting site works.

A number of conditions of consent are recommended to ensure the matters identified within this report are appropriately addressed.

3.12 Submissions

A number of submissions have been received. I have been asked to provide comments on a selection of them that have been deemed to contain geotechnical related matters. Submissions 3, 10, 14, 24 and 25 all raise concerns regarding effects on neighbouring properties specifically related to piling and roller vibration. Most of the submissions request pre-condition surveys to be completed and state a requirement for ongoing monitoring throughout and beyond demolition and construction. These comments are in line with my own and the applicant's geotechnical engineer for the reasons outlined above.

Additional concerns have been raised about slope stability in relation to the development. CMW have provided sufficient information at this stage to demonstrate that the works can feasibly be undertaken without detrimentally affecting the existing slopes. Additional investigations and assessments will need to be undertaken as part of detailed design to confirm that the designs meet the required factors of safety against slope stability.

Appendix A – Author’s Qualifications and Experience

<p>Masters of Science, Geohazard Assessment, University of Portsmouth, UK. 2000</p> <p>Bachelor of Science with Honours, Applied Geology, University of Kingston, London, UK, 1999</p>	<p>John Brzeski has 16 years’ experience in Engineering Geology and Geotechnical Engineering working on projects in the UK and more recently in New Zealand.</p> <p>He has extensive experience in geotechnical site investigations and interpretative reporting for a wide range projects including residential, commercial, industrial and municipal properties as well as for infrastructure projects.</p> <p>John has worked on a number of projects in the field of hazard and risk assessments including the identification and management of risk associated with soft soils, slope stability, liquefaction and expansive soils.</p> <p>John started his current employment with Tonkin + Taylor limited in January 2017, prior to this we has worked at CH2M Hill and Halcrow in the UK.</p> <p>A large part of John’s work portfolio in New Zealand involves Peer Review on behalf of Territorial Authorities throughout Waikato including review of resource and building consents.</p>
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