**BEFORE AN INDEPENDENT HEARINGS PANEL**
**OF THE HAMILTON CITY COUNCIL**

**IN THE MATTER** of the Resource Management Act 1991 (**RMA**)

**AND**

**IN THE MATTER** of an application for resource consent for the redevelopment of the former Hamilton Hotel building at 170 Victoria Street, Hamilton CBD.

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# STATEMENT OF EVIDENCE OF DANIEL PAUL MILLS
# ON BEHALF OF THE APPLICANT

## GEOTECHNICAL
## 1 October 2019

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## 1. QUALIFICATIONS AND EXPERIENCE

**1.1** My full name is Daniel Paul Mills. I am a Senior Geotechnical Engineer at CMW Geosciences.

**1.2** I have a Bachelor of Engineering, BEng (Hons), in Engineering Geology and Geotechnics from the University of Portsmouth (UK) and am a current member of Engineering New Zealand and the New Zealand Geotechnical Society. I have ten years of experience in Geotechnical consulting practice and have worked on projects in the UK, Australia, and for the last 7 years in New Zealand (Christchurch, Hamilton, Tauranga).

**1.3** I have been involved in a number of relevant large scale infrastructure and commercial development projects including geotechnical design of the Waikato Freight Hub bridge crossing in Horotiu, a Nine Storey Transport Hub in Tauranga CBD, and feasbility work for a large multi-storey residential development to be constructed adjacent to historic coastal cliffs also in Tauranga CBD.

**1.4** I have been engaged by the applicant since November 2017 to oversee the geotechnical investigations and provide factual and interpretive reporting to assist with the structural design of the proposed development. I have personally been involved from the preparation of the initial proposal for geotechnical services in November 2017 through to the submission of the Geotechnical Interpretive Report (GIR) in June 2019.

## 2. CODE OF CONDUCT

**2.1** My qualifications as an expert are set out above. I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and have complied with it in preparing this evidence. I confirm that the issues addressed in this evidence are within my area of expertise and I have not omitted material facts known to me that might alter or detract from my evidence.

## 3. SUMMARY OF EVIDENCE

**3.1** I have been asked to provide evidence in relation to the geotechnical aspects of the project.

**3.2** In this statement of evidence, I do not repeat the project description and refer to the summary of the application in the evidence of Mr David Pugh on behalf of the Applicant.

**3.3** I prepared a Geotechnical Factual Report, dated 1 March 2018, and a Geotechnical Investigation Report, dated 24 June 2019, which were lodged with the resource consent application. I also provided a response to Section 92 queries on 2 July 2019.. I have read the submissions received on the application and the Council Report.

**3.4** Due to the size and extent of the proposed development in relation to the existing structures on the site, and construction of the proposed building proximal to the crest of the current riverbank escarpment, several significant geotechnical constraints are present.

**3.5** Although several geotechnical issues are present at the site, slope stability issues associated with the Waikato Riverbank provide a significant risk to the development, to be managed. The foundation system must therefore accommodate lateral loading from possible slope instability and address other less critical geotechnical risks for the site.

**3.6** In my opinion, the geotechnical risks can be reasonably and practically managed through suitably robust piled foundation systems, which should adequately mitigate the effects of slope instability. The proposed development is therefore considered suitable subject to the recommendations contained within the GIR and subsequent responses to queries.

**3.7** My evidence will address the following aspects of the resource consent, which are within my area of expertise:

a) Assessment of geotechnical hazards;

b) Section 92 Response;

c) Dewatering queries;

d) Consideration of submissions;

e) Consent Conditions; and

f) Conclusion.

## 4. RELEVANT FACTS AND CONTEXT

**4.1** I have relied on the topographical information based on site survey information gathered by Harrison Grierson Limited, and the proposed development drawings provided by Holmes Consulting as part of my assessment. The above referenced items are critical in assessing the geotechnical hazards at the site.

## 5. GEOTECHNICAL HAZARDS

### Current Landform

**5.1** The site is located at on a 0.6-hectare section on the former Hamilton Hotel site, at 170 to 206 Victoria Street, Hamilton City Centre.

**5.2** The subject site is located adjacent to the steep escarpments of the Waikato Riverbank. The current ground in the area of the proposed building platform slopes towards the east from RL 41.5m to RL 36.0m.

**5.3** The riverbank escarpments are approximately 24m high and have gradients on the upper slopes of between 38° and 40° to the horizontal and on the lower slopes (below existing pathway) of between 25° and 30° to the horizontal.

**5.4** The Waikato River water level generally sits at approximately RL 12m although is subject to seasonal fluctuations following periods of heavy rainfall and is in part controlled by upstream hydroelectric dams.

### Geological Setting

**5.5** The geological units underlying the project site typically comprise 15m of 20m of sand with discontinuous interbedded silt layers (Hinuera Formation), overlying 20m to 25m of fluvially reworked ignimbrite of the Walton Subgroup (silty clay, silts, and sands), which in-turn overly Older Ignimbrites of mid to late Pleistocene age to approximately 55m to

60m below current ground level. Groundwater generally lies at a depth of 12m to 24m below existing ground level, (29.5m to 24.0 m RL), with localised perched water levels on some of the silt beds.

**Seismic Hazard**

**5.6** Peak ground accelerations (PGAs) and earthquake magnitudes were calculated for the site to quantify the seismic hazard in accordance with industry practice and standards. Due to its nature the theatre is classed as an Importance Level 3 (IL3) structure. For an IL3 Structure, serviceability and ultimate limit states (SLS and ULS) PGAs were assessed to be 0.05g and 0.28g respectively. The above are relevant for an effective earthquake magnitude of 5.9.

**Liquefaction Hazard**

**5.7** Due to the predominantly low water table, medium dense to dense nature of the sands, thin and discontinuous nature of silt lenses, the “clay-like” behaviour of the upper silts, and the results of the CMW numerical analyses, the liquefaction hazard at the site is assessed to be very low.

**Static Slope Stability**

**5.8** Slope stability has been assessed using the design parameters detailed in CMW’s GIR and industry standard software.

**5.9** The results from the static global stability analysis indicate that the proposed theatre foundation slab is sufficiently set back (approximately 15m) from the riverbank crest to meet the requisite factors of safety for modelled prevailing and elevated groundwater cases where a Slope Stability Factor of Safety (**FoS**) of at least 1.5 and 1.3 is achieved for those two cases respectively. A FoS of greater than 1 is needed for a slope to be stable.

**5.10** However, the cantilevered concrete balcony that extends out from the eastern end of the main theatre foundation slab will extend to within approximately 4m of the riverbank crest. That part of the structure will be constructed over ground that does not meet the requisite long-term factors of safety, although these are generally above a FoS of 1.0. Therefore, in order to meet the relevant target FoS, this area will require deep foundations taken

below any potential slip surfaces. They will be designed to accommodate possible lateral loads imposed by movement on a slip surface which intercepts the structural foundation elements.

**Seismic Slope Stability**

**5.11** My observations of the Waikato Riverbank and gully profiles, which are consistent with the conclusions from previous geotechnical studies for the Cambridge Section of the Waikato Expressway, suggest that there is no evidence of historic large-scale lateral spreading of the Waikato Riverbanks or gullies near this site. It is therefore concluded that liquefaction and associated flow failure of the Riverbank during future similar seismic events is unlikely.

**5.12** Seismic stability analyses have been undertaken by applying a peak ground acceleration to the prevailing groundwater scenario.

**5.13** I have adopted a displacement-based approach for analysing the effect of a 1,000-year seismic event in order to satisfy building code requirements for the IL3 Theatre Slab Foundation and the proposed Concrete Theatre Balcony.

**5.14** By applying industry accepted Newmark Rigid Block displacement methods presented within the New Zealand Bridge Manual and MBIE Earthquake Geotechnical Engineering Practice Series (Module 3 – Identification, assessment and mitigation of liquefaction hazards), we have calculated likely deformations beneath the proposed structures to be accounted for in the pile design.

**Slab Foundations**

**5.15** Due to the proposed lowering of ground levels by depths of 3.0m and 5.2m across the building platform, slab foundations will be largely load compensated where the load form the slab will be less than or close to the weight of soil removed. The slab will be constructed on medium dense sand. Based on this, static settlement is considered to be negligible and the Ultimate Geotechnical Bearing Capacity of the raft should be sufficient to support the calculated building pressures with a suitable factor of safety.

**Pile Foundations**

**5.16** Large concentrated column loads will be supported on pile foundations. Geotechnical capacities were provided for 900mm and 1200mm diameter bored piles.

**5.17** In addition, “lateral spring constants” were provided for the pile/soil interaction. These enable the structural design and assessment of the piles to take into account lateral loading from the structure and possible slope instability and ensure adequate strength of the piles, and limit deformation/deflection to acceptable levels.

## 6. SECTION 92 RESPONSES

### Dewatering

**6.1** A shallow perched groundwater table is inferred to be between 5.0m and 6.0m below the existing ground level at approximately RL30m. As stated in the CMW revised GIR (Rev 1) we anticipate excavations will be above the perched water level.

**6.2** As such we would not anticipate that any dewatering operations would be necessary and consider that the risk of dewatering induced settlement to the neighbouring properties and infrastructure to be very low.

**6.3** Due to forming deep excavations in proximity to neighbouring infrastructure (roadway and services), we recommend the implementation of a settlement monitoring plan.

### Effects on Neighbouring Properties

**6.4** Where cuts of up to 5.2m are required close to neighbouring properties temporary (and permanent) retaining structures will be required to ensure stability of the cut and to protect both workers and the neighbouring properties. CMW have provided indicative geotechnical design parameters for retaining walls in the revised geotechnical report. The type of any temporary retaining wall (if required) will be subject to Contractor preference and construction methodology.

### Gully Hazard Zone

**6.5** As part of the proposed development, current ground levels will be lowered, which reduces the riverbank height and increases overall stability beneath the site. We have also carried out detailed stability analyses, which assess the effects of the proposed development with respect to the riverbank.

**6.6** Comments on the stability of the riverbank for both static and seismic conditions are presented in the GIR Rev1. Structures built into the gully hazard area, such as the proposed projector screens, will be supported on pile foundations and must be designed to accommodate lateral loads from possible future instability to achieve the requisite factors of safety.

**6.7** During construction, I anticipate that erosion and sediment controls will be implemented to protect the slope from surface water runoff to prevent excessive water ingress to the slope. I expect that this will be managed by the Contractor during construction. Once the theatre is completed, I anticipate a net decrease in rainfall volume entering the gully system as rainwater is attenuated by the roof and surface drains into stormwater reticulation.

**Lower Slopes**

**6.8** The proposed projector screen has been considered in terms of slope stability within the CMW GIR. Piles will support the screen and will be designed on the basis of the report recommendations.

## 7. DEWATERING QUERIES

**7.1** In July this year, the project Arborist, Mr Jon Redfern-Hardisty raised queries regarding dewatering effects on the two subject heritage trees. My response I provided to the query is set out below.

**7.2** Any dewatering required will likely be localised and only affect the western portion of the building where the proposed cuts may intercept the perched ground water table. Given the distance from the western edge of the building to the tree in question and considering that only shallow dewatering would be required, we consider the risk to the tree to be low. Without knowing the extent of the rootzone it is difficult to comment on how dewatering works will impact the tree and so I suggest that protection measures for the tree should be considered during construction where dewatering is required. In the permanent case it is acknowledged that any drainage behind the permanent basement walls may cut off a portion of the water supply to the tree. I also note that any surface water that drained towards the tree will be reduced and that direct rainfall to the tree roots

will be reduced by the deck area. I therefore consider a contingency for reduction in water to the tree is recommended for the permanent case.

## 8. CONSIDERATION OF SUBMISSIONS

**8.1** Responses to submission query numbers 008, 014, and 024 were provided to Tattico on 30 July 2019 via email. The concerns raised from the public were generally regarding slope stability of the neighbouring property to the north, 240 Victoria Street, the number of piles adopted for the design, and the effects of noise and vibration as a result of the pile installations. The submission responses are summarised below.

**Stability of 240 Victoria Street (#008)**

**8.2** Stability assessments of the Riverbank have been undertaken for the subject site based on the proposed development, which have been detailed within the CMW GIR. A visual assessment of the slopes below 240 Victoria Street has been undertaken by CMW. Bending at the base of trees and rotation of the timber access staircase piles suggest that surface soil creep is occurring across the steeper slope sections. Strips of bare land and fallen leaves aligned in a similar orientation suggest that concentrated surface water run-off is also occurring. The proposed works in the temporary and the permanent case must be managed to prevent any additional surface water run-off entering the adjacent land and will not adversely affect the adjacent slopes.

**Vibrations and noise effects from piling and earthworks (#008, 014, & 0024)**

**8.3** Effects of vibration from piling are not usually detailed within a geotechnical report. The nature and degree of vibration generated is dependant the piling method adopted during construction. I do however understand that bored and screw piles are the preferred options for the site. These methods generally produce significantly less vibration than driven piles.

**8.4** The use of vibratory rollers would be the most efficient means of compacting the sandy soils and result in a shorter timeframe for the ground improvement works with respect to the use of non-vibratory methods. Both methods should achieve the same degree of compaction.

**8.5** If it is identified that vibration effects may impact on the surrounding infrastructure, then compaction can be undertaken using non-vibratory processes.

**Numbers of piles for foundation design (#008)**

**8.6** The number of piles to be installed is not typically a geotechnical consideration. The distribution and magnitude of foundation loads is assessed by the structural engineer and the number and location of piles determined accordingly. The GIR provided soil strength parameters to assist with the design of piles (e.g. how long and wide they may need to be).

## 9. CONSENT CONDITIONS

**9.1** I acknowledge the conditions of consent provided by Hamilton City Council and provide the following responses to queries raised around some of these conditions.

**Neighbouring Retaining Walls**

**9.2** The drawings ref: "Theatre G7 Further Info Post Notification – Embassy Park Concept and Cross Sections" indicate that any temporary cuts associated with the formation of the permanent northern boundary wall of the Waikato Theatre will be undertaken at a horizontal distance of at least 12m from the neighbouring property (240 Victoria Street). As such, any temporary works to form the cuts as part of the Theatre development will likely have a negligible effect to the neighbouring properties to north. We also envisage that as temporary works will be required to form the cuts in the form of either temporary retaining walls or cut batter slopes, then local stability for the northern boundary will be managed through construction. The proposed permanent retaining walls within Embassy Park will be retaining soil from the theatre site and will not affect the stability of the neighbouring property to the north.

**Building Condition Survey**

**9.3** I recommend that a pre works survey is carried out to assess the condition of the neighbouring properties before the works commence. Ongoing visual assessments of the buildings should be undertaken at least weekly to check for vibration related effects during construction of the proposed piles and earthworks. The frequency may be reviewed following the results of initial surveys. I also note that bored or screw piles are

proposed which cause significantly less vibration than driven piles. Monitoring for any lateral movement behind any temporary retaining walls or cut slopes should also be undertaken at weekly intervals for at least the first month (following full excavation) to capture any movement of the ground adjacent to the works. It is usual then to review the frequency of monitoring on the basis of observed trends.

**9.4** In my opinion the conditions regarding the temporary stability of the site during construction are considered reasonable and can be managed through normal construction processes.

## 10. CONCLUSION

**10.1** The site is considered suitable for the proposed development provided that that the geotechnical limitations and risks are managed as per the recommendations presented within the GIR and as highlighted within this evidence.

Daniel Paul Mills
1 October 2019