IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of a submission in respect of the **PROPOSED WAIKATO DISTRICT PLAN** by **AMBURY PROPERTIES LIMITED** pursuant to Clause 6 of Schedule 1 of the Act to rezone 178ha of land at Ohinewai

STATEMENT OF REBUTTAL EVIDENCE OF NICHOLAS IAN SPEIGHT

1. INTRODUCTION

1.1 My name is Nicholas Ian Speight. I am a Senior Geotechnical Engineer and Director of Initia Ltd, a specialist geotechnical consultancy company. I have been in this role for two years. Prior to this, I was a Senior Geotechnical Engineer and Major Shareholder at Tonkin & Taylor Ltd, an environmental and engineering consultancy firm.

1.2 I have outlined my qualifications, experience and commitment to comply with the Environment Court Expert Witness Code of Conduct in my evidence in chief (**"**EIC**"**).

1.3 I have read Mr Dean Fergusson's statement of evidence for the Ralph Estates.

Purpose and scope of rebuttal evidence

1.4 The purpose of this rebuttal evidence is to address geotechnical issues relevant to Mr Fergusson's evidence. It does not restate matters addressed in my EIC.

1.5 Specifically, I address:

(a) Geotechnical effects associated with widespread dewatering (groundwater level reduction) which would inevitably occur from a deep open cast coal mine (Section 2);

(b) Estimated consolidation settlements from groundwater drawdown (Section 3);

(c) The likely effects of settlement (Section 4); and

(d) My brief conclusion (Section 5).

1.6 My evidence should be read alongside the rebuttal evidence of Mr David Stafford who addresses groundwater drawdown (dewatering) from an open cast coal mine which is the principal cause of geotechnical related effects, i.e. consolidated induced settlement.

2. GROUNDWATER DEWATERING

2.1 Mr Fergusson's evidence addresses groundwater issues associated with the pit wall stability of a deep open cast coal mine at Ohinewai. He notes that very gentle (10-12°) pit slope angles through the Tauranga Group sediments coupled with dewatering of the Tauranga Group soils – using groundwater drawdown wells[1] - could be employed to enable safe /stable excavation of the pit to significant depths. Whilst this is technically feasible, Mr Fergusson does not comment on the likely significant and widespread offsite effects of such works.

2.2 In Section 8.2 of his evidence, Mr Fergusson notes that that he has not considered the resource consents that would be required or the likelihood of being able to obtain the consents. In my experience, a proposed deep excavation, which effects groundwater levels, would require a very detailed assessment of the associated off-site effects of dewatering as part of a resource consent application.

2.3 A significant geotechnical issue associated with groundwater dewatering is consolidation settlement. This occurs due to an increase in stress in soil layers when groundwater, present in the pores between soil particles, is drained. This eliminates the "buoyancy" effect of groundwater which partially supports the weight of soil particles within a soil matrix. Draining of pore water therefore

[1] Statement of evidence of Dean Fergusson, paragraphs 11.17-18.

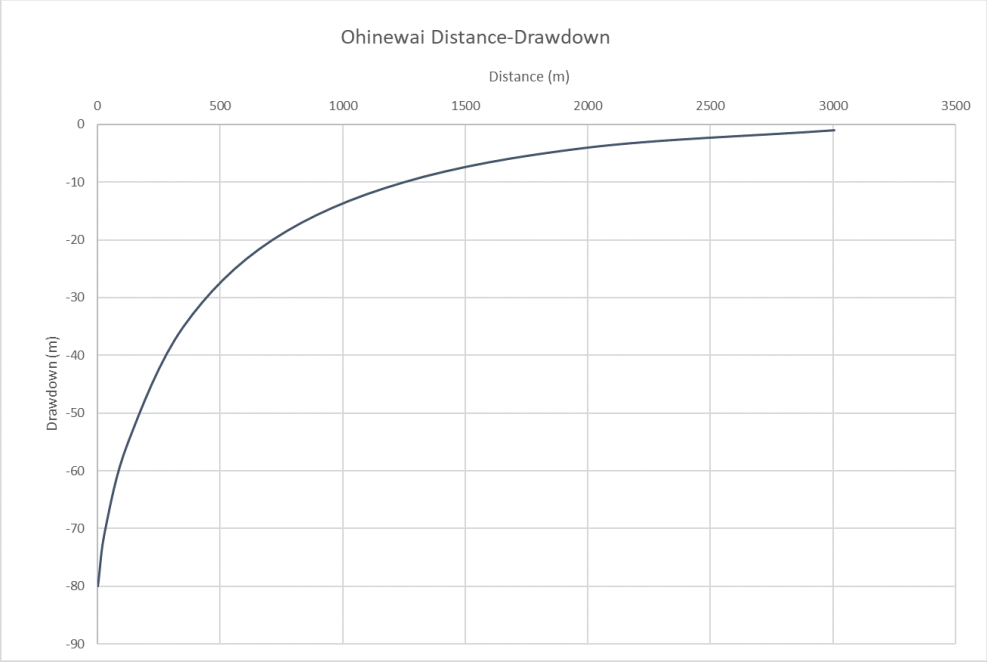
results in the densification of soil particles which ultimately causes settlement.

2.4 For every 1 m of groundwater drawdown within a soil layer, an additional vertical stress of approximately 10 kPa is introduced. This is approximately equivalent to placing a 0.5 m thick layer of soil on the ground surface, or the weight of a typical, single storey commercial building.

2.5 An excavation of the type proposed by Mr Fergusson for extraction of coal in Ohinewai, to depths of 70-100 m, could be expected to result in dewatering of all Tauranga Group soils which extend to a depth of about 80 m.

2.6 Mr Stafford has completed 2D numerical modelling - using the software package GeoStudio SEEP.W - to assess the groundwater effects of an open cast coal mine excavation extending to the base of the Tauranga Group unit (assumed 80 m below ground level). The assessed groundwater drawdown curve – showing the radius of groundwater drawdown away from the drawdown point (assumed to be a network of well/pump points installed around the pit perimeter) is presented as Figure 1 in Mr Stafford's evidence. This is copied below in my evidence for ease of reference.

Figure 1: Groundwater Drawdown Influence Curve Resulting from Dewatering to a depth of 80 m (Sourced from Mr David Stafford's Rebuttal Evidence)



3. ESTIMATES OF SETTLEMENT

3.1 To assess the magnitude of ground surface settlement that could occur from the predicted depth and extent of groundwater drawdown for an open cast coal mine of 80 m depth, I have completed a preliminary settlement analysis.

3.2 My analysis has been based on geotechnical (soil compressibility) data obtained from historical laboratory testing completed for historical coal mine studies in Ohinewai and from geotechnical investigations undertaken for the proposed APL development. I have also assumed a subsurface profile which reflects 'typical' conditions below the Ohinewai site, not 'worst-case' (i.e. most compressible) soil conditions.

3.3 A summary of the ground model and soil compressibility parameters assumed for analysis is presented in Table 1 below.

Table 1: Ground Model and Soil Compressibility Parameters for Settlement Analysis

Geological Unit	Layer Thickness (m)	Coefficient of Volume Compressibility Mv (m^2/MN)	Unit weight (kN/m^3)
Taupo Pumice Alluvium	5	Ignored (assumed no settlement)	18
Rotokawau Formation (including Peat)	5	1	17
Puketoka and Karapiro Formations	25	0.2	18
Whangamarino Formation	50	0.05	19

3.4 The estimated consolidation settlements which could occur due to groundwater drawdown to the base of the Tauranga Group units (approximately 80 m below ground level) range between 2.5 metres and 3.8 metres immediately adjacent to the pit perimeter (dewatering point) to between 0.3 metres and 0.5 metres some 2km away from the pit. Settlements from groundwater drawdown are

estimated to be minor only at a distance of approximately 3km away from the pit perimeter/dewatering location, where groundwater drawdown is negligible. Estimated settlements are presented in Table 2 below. Note that the estimated settlements in any given location will depend on the local underlying ground conditions.

Table 2: Estimated Consolidation Settlement Magnitudes at Increasing offset distance from the pit perimeter (dewatering point)

Horizontal offset from open pit perimeter (drawdown point)	Groundwater drawdown depth (m) from Figure 1 above	Estimated consolidation settlement due to groundwater drawdown (mm)
0	80	2,500 to 3,800
500 m	25	1,800 to 2,200
1,000 m	12	1,000 to 1,400
2,000 m	4	300 to 500
3,000 m	0	0

4. SETTLEMENT EFFECTS

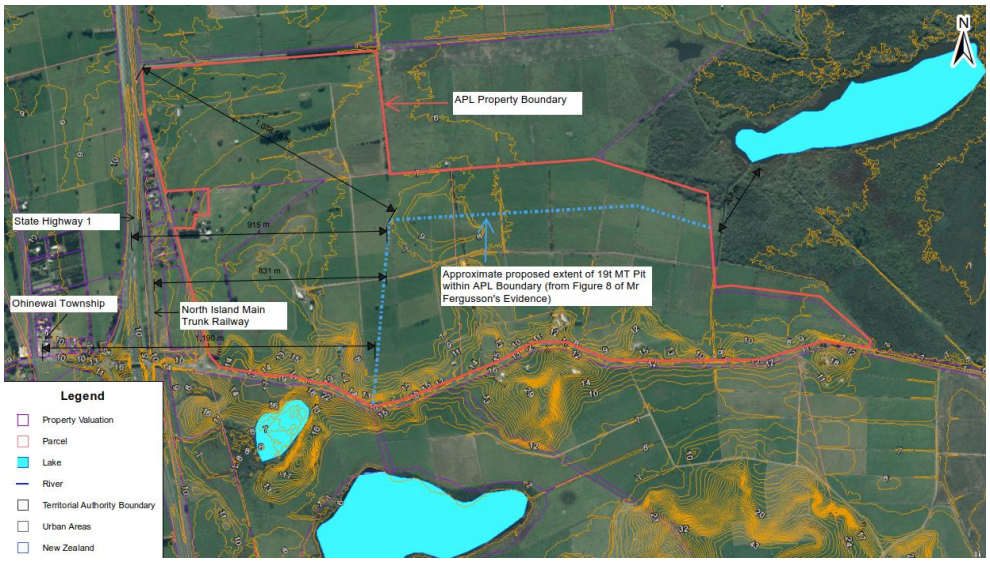
4.1 With reference to Table 2 above, it is readily apparent that the estimated consolidation settlements from groundwater drawdown are significant. The effects of such settlements could be expected to include the following:

(a) Increased vulnerability to flooding for large swathes of land within 2km of the pit perimeter. Potential long-term ponding of already low-lying land (currently at RL 8 m or lower) could also occur.

(b) Surface distortion (up to 1,400 mm of total settlement) of State Highway 1 and the North Island Main Trunk Railway Line which are offset just 915 m and 830 m respectively from the proposed western edge of the 19MT Pit presented in Mr Fergusson's evidence (refer Figure 2 below). Such settlements could cause damage to this infrastructure and a loss of functionality from flooding/inundation during storm events and sagging of below ground stormwater infrastructure.

(c) Damage to buildings and houses on surrounding rural properties within the Ohinewai Township area which is offset just 1.2 km from the crest of a possible 19MT pit (refer Figure 2 below). Whilst settlements may occur relatively uniformly, with gentle differential gradients, settlements of up to 1 metre at the Ohinewai Township would almost certainly result in some damage to structures in addition to a range of other issues such as increased flooding vulnerability, and damage to buried infrastructure that services the area (gravity drained pipes such as stormwater and sewer lines).

Figure 2: Western extent of possible 19MT open cast coal mine in Ohinewai within the APL Site



5. CONCLUSIONS

5.1 Whilst technically feasible, an open cast coal mine in Ohinewai would result in groundwater dewatering to the base of the Tauranga Group geological units, some 80 m or more below ground level.

5.2 The principal geotechnical effect of groundwater dewatering is consolidation settlement. For a 19MT pit in the location indicated in Mr Fergusson's evidence, ground surface settlements of up to 3,800 mm (3.8 metres) could occur directly adjacent to the pit perimeter with up to 1.4 metres of settlement occurring at State Highway 1 and the North Island Main Trunk Line. Settlements of up to 1 metre could occur at the Ohinewai Township.

5.3 The effects of such large magnitude settlements could be expected to result in widespread, increased flood risk vulnerability within 2 km of the pit perimeter and possible long term inundation (permanent ponding) in already low lying land (current ground level of RL 8 m or lower) in the eastern half of the APL site. Significant damage to buried infrastructure and housing/buildings within the Ohinewai Township and adjoining areas could also be expected.

5.4 It is my opinion that the significant and widespread effects of groundwater dewatering associated with an open cast coal mine in Ohinewai – namely ground surface settlement – would be extremely difficult to mitigate. On this basis, I consider that the adverse effects from an excavation such as that postulated by Mr Fergusson would be so severe that an applicant would be very unlikely to obtain a resource consent to authorise dewatering in the Ohinewai area.

Nicholas Speight

24 August 2020