



10 May 2021

District Plan - Resource Management Policy Team
Resource Management Policy Team
Waikato District Council

Attention: Lily Campbell

2-WLASS.CW

Technical Specialist Review, Geotechnical; Submissions 732.1 & 732.2, Terra Firma Resources Limited; Puketirini Block & Weavers Crossing, Huntly

1 Experience and Qualifications

My name is John Matthew Warrington.

I am currently employed as a Principal Geotechnical Engineer with WSP New Zealand Limited.

I hold the following qualifications:

- a) Bachelor of Science in Civil Engineering (2:1 Honours), 1980, from the University of Salford
- b) Master of Science in Civil Engineering, 1986, from the University of Salford, United Kingdom.

I hold the following Registrations and Memberships:

- a) Registered Chartered Professional Engineer (CPEng) with Engineering New Zealand. Registration No. 1030020
- b) Chartered Member of Engineering New Zealand (CMEngNZ)
- c) Member of the New Zealand Geotechnical Society.
- d) Chartered Engineer with the Engineering Council (CEng) (UK)
- e) Member of the Institution of Civil Engineers (MICE) (UK)

I have 41 years experience in total, 25 years spent in geotechnical and civil engineering consultancy, 13 years in operational management with a Public Corporation and 3 years undertaking university research. I have spent the last 10 years in New Zealand specialising in geotechnical work with the previous 31 years in the UK. My experience in geotechnical consulting has included projects involving sites impacted by coal mining activities primarily within the UK (North-West England, North-East England and the English Central and East Midlands).

2 Purpose of Report

I have been engaged by Waikato District Council to provide a Technical Specialist Review of information submitted as evidence in support of an application by Terra Firma Resources with respect to the re-zoning of areas within the Proposed Waikato District Council District Plan Review. The submission covers two land areas in the vicinity of Lake Puketirini referred to as Weavers Crossing, seeking village zone, and the Puketirini Block, seeking residential zone. The Puketirini Block is part of the site of the former Solid Energy Mine (previously named Weavers Opencast Mine);

The review will include an assessment of the following:

- Whether sufficient and appropriate information has been included in the evidence;
- Whether the assumptions, methods and conclusions are sound and reasonable;
- Whether any proposed solutions are technically feasible and realistic;
- Advice on any potential or actual issues that the Planner and Hearings Panel may need to be made aware of.

3 Source Information

I have reviewed the reports prepared by Raglan Geotech. In undertaking this review, I have used the information provided therein and drawn on my general experience with relation to work involving sub-division developments and coal mining areas. I have not undertaken further investigations or visited the specific areas involved in the re-zoning submissions.

The documents I have reviewed are:

Statement of Evidence of Michael Carter, Raglan Geotech, 10 February 2021 including:

- Preliminary Geotechnical Assessment, Lot 1 DPS 61669, Weavers Crossing, Huntly, January 2021
- Preliminary Geotechnical Investigation, Pt Lot 2, Lot 1 DPS 61669, Pt Sec 1 SO 58281 & All Lot 9C SO 4206, November 2020

4 Principal Observations

4.1 Weavers Crossing

The applicant is seeking the re-zoning of a Section of Rural Zone land to either Village Zone or Residential Zone.

The area under consideration is a sloping site with a road within cutting (Weavers Crossing Road) located at the site's eastern boundary.

The submitter has carried out a ground investigation and geotechnical assessment within the area to identify major constraints as they would relate to building foundation bearing capacity, environmental impact and hazards that could have the potential to influence the prospect of the site being developed as a residential sub-division.

The submitter has advised that they consider the site to be suitable for residential construction with soils presenting mostly as 'Good Ground' (defined as ground with a minimum ultimate bearing capacity of 300 kPa in accordance with NZS3604:2011) and therefore unlikely to require Specific Engineer Designed (SED) foundations. Groundwater conditions have been reviewed and assessed as presenting no impact on any proposed development.

An evaluation of the stability of the cut slope to the east of the site has been undertaken and assessed as being stable for the seismic design load case. However, due to surface erosion it is considered the slope could retreat westwards across the Section boundary over time.

All the above matters are considered to be relevant to any proposed development within the area and have an appropriate assessment methodology.

4.2 Puketirini Block

The applicant is seeking the re-zoning of a Section of Rural land to mixed Residential and Business Zones.

The area under consideration is described as a generally undulating and sloping gently down at an angle of 4° towards Lake Puketirini to the North. The soil materials are described as being comprised almost entirely of open-cast coal mine excavation debris containing materials ranging from "hard rock clasts to very soft saturated clays". The mine waste has been placed within the excavation of a previously worked area and is stated as ranging from meters to tens of metres in thickness.

The submitter has carried out a limited ground investigation and geotechnical assessment within the area to identify major constraints as they would relate to building foundation bearing capacity, environmental impact and hazards that could have the potential to influence the prospect of the site being developed as a mixed Residential and Business subdivision.

Ground investigations undertaken comprised a total of twelve Vane Penetrometer and Scala Penetrometer tests to depths ranging from 0.3m bgl to 2.8m bgl.

The Geotechnical Assessment report refers to groundwater being encountered at three locations at depths ranging from 1.5m bgl to 2.8m bgl (test location nos. 5, 10 and 11) with soft saturated soils located towards the bottom of the remaining test locations.

The submitters geotechnical assessment describes the presence of a number of surface water drainage zones which are considered to be seasonal in nature. It has not been established whether groundwater is contributing to flows within these features.

As a consequence of the identification of an area considered to be a 'softer zone' of soils over the western half of the site, the applicant has revised their submission for re-zoning of the Puketirini Block to cover just the eastern half of the area.

Consolidation and settlement of soils is mentioned as having occurred within the 'mine debris of mixed properties including fully saturated silt and clay' subsequent to placement of the mine waste materials.

Within the discussion section of the report, it is suggested that the mine waste materials may have been placed at different locations across the site according to their properties. It has been postulated that the eastern half of the site incorporates a "significant presence of

the Hinuera Formation/ Tauranga Group type soils”, these being derived from higher level geological units within the excavated area. It is also stated that greywacke gravel and cobble sized rocks (sourced from an underlying geological unit) have also been observed within the same areas of fill. On this basis, it has been inferred that materials sourced from different stratigraphic units have become mixed consequential to the excavation and filling methods used during the period of active open cast mine working.

Reference is made to the random distribution of low permeability clays within the fill. This again may be expected given the excavation and filling methods that will have been used.

The report concludes that based on an interpretation of the available data, further ground investigation is recommended as part of a detailed geotechnical assessment for a full subdivision development. The installation of settlement and groundwater monitoring is also recommended.

All the above matters are considered to be relevant to any proposed development within the area and have an appropriate assessment methodology.

5 Technical Assessment

5.1 Weavers Crossing

The submitted information relating to the ground conditions present across the site and geotechnical assessment are considered to be acceptable for this stage of planning for the development.

The ground investigation undertaken was limited in scope comprising six shallow (up to 1.5m bgl) and two deep (up to 4.0m bgl) Scala Penetrometer and Vane Penetrometer tests with minor sampling. These have identified that the near surface soils comprise generally stiff to very stiff cohesive materials. This indicates that standard shallow foundations may be located within these soils, in accordance with NZS3604:2011, and that the requirement for SED foundations would be low.

Surface water run-off from the site towards the east is likely a significant contributor to the erosion of the exposed cutting along Weavers Crossing Road. Future development of the site should therefore include measures for the management of surface water run-off across the site and stabilisation/ protection of the exposed cut slope.

Future development of the area will require a full ground investigation with laboratory testing and geotechnical assessment to identify potential geotechnical issues relating to the site and how these may affect the type of development and impact on foundation design.

5.2 Puketirini Block

The submitted ground investigation and geotechnical assessment report provides a clear indication of the variability of the soil materials present at shallow depth within the site area, this being as a result of the coal extraction methodology, unsystematic deposition and uncontrolled compaction of placed fill materials. This is considered evidential that the mine waste appears to have been placed ‘as found’ from the mine excavations and stockpiles and not in a selective and controlled manner. Consequently, the material can therefore be classified as a ‘non-engineered fill’ having a variable matrix of constituents and properties.

The ground investigation comprised a total of twelve Vane Penetrometer and Scala Penetrometer tests to depths ranging from 0.3m bgl to 2.8m bgl (eleven up to 1.8m bgl and one to 2.8mbgl). Of these it is assessed that half identified the presence of 'Good Ground' in accordance with NZS 3604:2011. Additionally, four of the Scala Penetrometer tests refused at depths of less than 1.0m bgl being recorded as 'rock' on the ground investigation logs. Given the origin of the materials comprising the fill and the probable nature of the excavation and filling methods used, it may be considered that refusal at these test locations will most likely be due to the presence of larger cobbles and boulders within the fill matrix. It can therefore be inferred that this is indicative of the random make-up of the fill materials present.

Review of the vane penetrometer and shear vane test results indicates that areas of softer ground similar to that experienced within the western area are also present within the eastern half of the site. The limited scope of testing undertaken is insufficient to be able to quantify the extent of these areas which would require further ground investigation. This is taken as further evidence of the significant variability of the near surface soils present beneath the site.

It should be noted that where softer soils are present, differential settlement of structures could potentially occur due to variations in the type and strength of soil materials present within any one location. These may however be mitigated by the adoption of appropriately designed SED foundations.

It has been stated that the excavated depth and profile of the mine is unknown and that the thickness of the mine waste fill may extend from meters up to tens of meters. The depth of the fill has not been determined by deeper ground investigations. Given the depth and variable nature of the observed materials on the site, it can be considered that underlying fills will be similar in nature. Further, the presence of groundwater at depth may also have an influence on the constituency and strength of the fill materials. There is therefore the potential for ongoing subsidence across the site that may be dependent upon any applied surface loading.

The mine waste fill beneath the site will slope northwards into Lake Puketirini. The thickness of fill beneath the site has been stated as being from meters up to tens of metres due to the depth of quarrying activities that have been undertaken. Consequently, the height and length of the slope beneath the lake supporting the filled area will be significant. It is noted in the evidence provided by Craig Smith that the maximum depth of the lake is 64m. The assessment of the stability of this slope is therefore fundamental to the safety of any proposed development above. If the zoning of the site is to be changed from Rural to mixed Residential and Business, this will impact on the stability assessment of the slope with respect to seismic actions due to an increase in seismic Importance Level in accordance with AS/NZS 1170.5. Consequently, an assessment of the stability of the slope should be undertaken to evaluate the suitability of the site for re-zoning. This will necessitate a ground investigation to determine the current nature and properties of the soil materials and groundwater conditions present beneath the site.

Development would require significant earthworks which could include benching and retaining walls. The variability of soils will present some difficulties in undertaking this work but are not insurmountable with available engineering techniques. The installation of driven piles for foundations and retaining walls may be more problematic given the presence of large cobbles and boulders within the soil matrix.

Foundation construction or ground improvement works would involve the excavation and replacement of the mine waste materials which will require appropriate management. Given the source of the materials it is possible that clasts of coal, heavy metal minerals and other contaminants may be present within the mine waste. Offsite disposal would be of high cost and consequently will likely need to be managed within the confines of the site. This would require further consideration for any development including for the obtaining of Resource and Building Consents. A contaminated land assessment covering these specific aspects is therefore advisable.

In accordance with the recommendation provided within the submitted geotechnical assessment, it is agreed that further ground investigation will be a pre-requisite for the consideration of future development of the site.

6 Conclusions

6.1 Weavers Crossing

The submitted information relating to the Weavers Crossing area has considered all key aspects considered as being relevant to the assessment of geotechnical issues and risks pertaining to the potential development of the area under review...

Consideration will be required with regard to the stabilisation and prevention of erosion of the cutting for the Weavers Crossing Road present to the east side of the site beyond the site boundary.

6.2 Puketirini Block

The submitted information relating to the Puketirini Block area has been reviewed and it is considered that additional investigations and assessment are needed in order to support the re-zoning of the area from Rural to mixed Residential and Business Zones

The ground investigation and geotechnical assessment undertaken provides a clear indication of the variability of the soil materials present within the site area, this being as a result of the coal extraction methodology and random deposition of fill materials.

Review of the Vane Penetrometer and Scala Penetrometer test results indicates that softer ground also appears to be present within the eastern half of the site. The limited scope of testing undertaken is insufficient to be able to quantify the extent of these areas.

An assessment of the overall stability of the slope extending beneath Lake Puketirini should be undertaken to evaluate the suitability of the site for re-zoning. This will necessitate a ground investigation to determine the current nature and properties of the soil materials and groundwater conditions present beneath the site

Earthworks across the site will generate surplus materials which will require further management. The preferred method for this would be for their use as general fill in other areas of the site. However, given the source of the materials it is possible that clasts of coal, heavy metal minerals and other contaminants may be present within the mine waste which could be released into the environment. A contaminated land assessment covering these specific aspects is therefore advisable.

7 Limitations

This report has been prepared by WSP New Zealand Limited exclusively for Waikato District Council in relation to a Technical Specialist Review of information submitted as evidence in support of an application by Terra Firma Resources Limited with respect to the re-zoning of areas within the Proposed Waikato District Council District Plan Review and in accordance with the Framework Agreement (the "Agreement") dated 1 August 2019 between Waikato District Council and WSP New Zealand Ltd., and incorporates the terms and conditions set out in Schedule 2 of the Agreement. WSP accepts no liability whatsoever for any use or reliance on this Report, in whole or in part, for any purpose other than the Purpose or for any use or reliance on this Report by any third party.

For and on behalf of WSP New Zealand

Prepared by:



John Warrington CPEng, CMEngNZ

Principal Geotechnical Engineer