

IN THE MATTER of the Resource Management
Act 1991

AND

IN THE MATTER of the hearing (Stage 1) by the
Waikato District Council on the
Proposed Waikato District Plan

OPENING SUBMISSION BY CRAIG SMITH

Terra Firma Resources Limited

30 September 2019

1.0 Introduction

- 1.1 My name is Craig Lincoln Smith and I am a Director of Terra Firma Resources Ltd (TFR), a company set up in 2018 with my immediate family. I have been a Huntly resident for the past 20 years, and live on Rotowaro Rd with my wife. My three children and their families also live nearby, within Huntly and Ngaruawahia.
- 1.2 I am semi-retired, and work part time as a Mining Executive for Terra Firma Mining Ltd, a separate company owned by my son and daughter-in-law. My previous role was General Manager for Solid Energy NZ Ltd. When I left Solid Energy in 2013, I had had 41 years in the mining industry in New Zealand and Australia in both engineering and management roles.
- 1.3 TFR owns land around Lake Puketirini in Huntly, which was offered for public sale by tender by Solid Energy in 2017. The land is proposed to be zoned Rural under the Proposed Waikato District (PDP). TFR (Submitter 732) seeks that the land is rezoned instead to a residential zoning.
- 1.4 This site is a relatively new prospect for rezoning, but is significant in size, location and amenity. While TFR has a development concept in mind, the company is open to considering alternative scenarios. Accordingly, at this early stage in the hearing process, I believe the hearing panel would benefit from a general overview of development opportunities.

2.0 Background to Terra Firma Resources

- 2.1 TFR was established in order to purchase the Puketirini land from Solid Energy in 2018, with a view to developing it for residential purposes. My son Lincoln Smith is a co-director of TFR. We are both familiar with the site and its rehabilitation over the years, and have long considered it an ideal location for development.

2.2 During my time at Solid Energy, I was directly involved in establishing the walking and cycling networks and coordinating the extensive landscaping on what is now the Lake Puketirini Reserve. Over the years, I have undertaken voluntary track maintenance and maintain my interest with the reserve as a member of the Puketirini Management Committee. I was directly responsible for the transfer of the lake and land to the Waikato District Council and it has been personally and professionally satisfying to be directly involved in the transformation of the Weavers Opencast Mine to a popular recreational reserve.

2.3 TFR sees its land as being able to be developed into attractive residential properties compatible with, and further enhancing, the existing recreational reserve. TFR seeks to develop its own land from the current low-quality grazing land into desirable residential land, which we understand is much needed in Huntly.

3.0 Description of TFR Land

3.1 The subject land is in close proximity to the existing residential area of Huntly West and approximately 1.5 km from the main township, accessed over the Waikato River by the Tainui Bridge. A plan of the Huntly area is provided in **Attachment 1** to show the site in context.

3.2 The bulk of TFR's land is surrounded by Puketirini Recreational Reserve and is also zoned Recreational. The parcels total approximately 27 hectares, referred to as the "Puketirini Block" within this submission. This land is accessed via an easement across the Reserve from Rotowaro Road and is leased for drystock grazing. A two-hectare Rural Zone parcel is located at 63 Weavers Crossing Road.

3.3 Existing residential zones are located generally to the north and east of the Puketirini Block, and the Weavers Crossing residential area is located to the west. Industrial zones are situated on the south side of Rotowaro Road, and to the northeast and a business zone is to the east. Existing zonings in the area are shown in **Attachment 2**.

- 3.4 The Proposed District Plan seeks to rezone the Puketirini Block to Rural Zone, amongst other changes in the area (refer **Attachment 3**).
- 3.5 The Puketirini Block is generally north to north-west facing with extensive views over Lake Puketirini and Lake Waahi. The land gradient is gently sloping and undulating with relatively level areas to the south of the property, becoming steeper towards the lake, and then levelling out to swampy areas adjoining Puketirini Reserve to the north. There are no waterways on the land. Other than the reserve, the only immediately adjoining land is grazing land to the south west. Refer aerial photo in **Attachment 4** and photographs in **Attachment 5**.
- 3.6 At 54ha, Lake Puketirini is the largest post-mining lake in New Zealand and is the venue for on-water recreational activities including waka ama, yachting, water skiing, kayaking and swimming. Lake water quality is good and the high underwater visibility and depth make it an ideal for dive training. The surrounding network of walking and mountain biking trails within exotic and native species is popular with walkers, runners and cyclists.

4.0 Puketirini Block

- 4.1 TFR's Puketirini Block has a number of attributes that make it an attractive and viable option for residential development, as described below.
- 4.2 Firstly, the land is located on the fringe of the Huntly West residential zone and is a logical extension to this land use. TFR understands that Council is investigating measures to uplift Huntly West following completion of the SH1 bypass. The proposed rezoning and subsequent development is a step towards this goal.
- 4.3 The Puketirini Block has good connectedness to Huntly township via the Tainui Bridge, which is only 900m from the eastern edge of the block. The main Huntly shops are approximately 1.5 km away, and it is feasible that residents could walk or cycle to and from the town.

- 4.4 The recent news that Huntly is proposed as a station on the Hamilton-Auckland light rail network will further increase demand for local residences. The Puketirini Block is ideally suited to help meet this market and could be accessed by bus if Council extends its services to Huntly West.
- 4.5 Council sewerage and water supply reticulation infrastructure is located close to the subject site (**Attachment 6**). TFR understands the Council's existing wastewater infrastructure has sufficient capacity to accommodate residential development of the block, and also that that town water can be supplied via existing reticulation.
- 4.6 The block generally has a north-facing aspect and its elevation at the side of the lake allows for pleasant views of the lake and surrounds and beyond to rural land. The land has topographical separation from the Industrial Zone to the south. The minimum width of the buffer zone and road is approximately 120 m and the buffer zone is extensively planted.
- 4.7 Public access to, and use of, Puketirini Reserve will not be limited by residential development and will increase with new reserve connections from the subdivision. The proposed residential use alongside the reserve is anticipated to increase its local patronage and raise its profile as a destination within the District.

5.0 Terra Firma Resources' Vision

- 5.1 TFR's vision for the Puketirini Block is a variety of lot sizes and housing options to encourage a mix of purchasers and a diversity of residents, to create a stronger "community feel". TFR seeks that the land be rezoned to Village Zone and/or Residential Zone (plus two small Business Zones) (Refer **Attachment 7**). From discussions with Council staff, TFR understands that the preference is likely to be for higher density development. Accordingly, TFR is seeking that development in Village Zone ranges from a minimum of 1,000m² for serviced lots to 3,000m² for unserviced lots (as is the case for Tuakau and Pokeno).

- 5.2 As a greenfields site, the Puketirini Block offers design opportunities that will:
- a) Align with the surrounding landscape.
 - b) Provide links to Puketirini Reserve;
 - c) Help to foster a sense of community;
 - d) Embody energy efficiency principles
 - e) Encourage safer communities through location of houses, lighting etc;
 - f) Encourage residents to walk, cycle or use public transport; and
 - g) Improve the biodiversity of the area by planting appropriate species.
- 5.3 Subdivision design would provide for a mix of high-quality housing, appropriate to the lakeside setting, and include additional green space. TFR will consider covenants e.g. in relation to dwelling location, energy efficiency design, materials, features and colours.
- 5.4 TFR's indicative 120 lot concept plan for the Puketirini Block is provided in **Attachment 8**. This scenario combines Village and Residential Zones in an approximately 70:30 split. Village Zone lots are located on the premium north-facing land with reserve frontage and range from 1000 to 3000m², roughly equating to 50 properties. The Residential Zone is located nearer the access road and comprises approximately 70 properties, ranging from 450 to 1200m². This area includes a Business Zone and green space. A second Business Zone is proposed on the eastern fringe of the block, with a view to establishing a café for residents and lake visitors.
- 5.5 Currently, stormwater runs into two main wetlands before flowing into the lake. TFR envisages further development and expansion of these wetland areas as part of its stormwater management infrastructure.
- 5.6 While this concept is TFR's preferred scenario at this point, the company is open to considering other combinations and densities that may better suit the nature and timing of Huntly's development. Medium to high density development is possible on this block, providing higher traffic volumes can be accommodated.

- 5.7 A high level transportation assessment was commissioned from CKL Surveyors (**Attachment 9**), the key findings of which are:
- a) The proposed access from Rotowaro Road will be sufficient for development of the proposed 120 lot concept. This access will require widening of the easement across the reserve.
 - b) At a higher density e.g. 270 to 540 lots, a second access may be necessary.
 - c) Three options for a second access point are:
 - 1. Rotowaro Road, west of the existing access;
 - 2. Rotowaro Road, at the main reserve entrance; and
 - 3. Weavers Crossing Road.
 - d) All three options will require new easements across the reserve, and an alteration to the reserve. The Weavers Crossing Road access is unlikely to be feasible as it will require a bridge.

6.0 Staging

- 6.1 Following rezoning of all its land, TFR's priority is to develop the 2-hectare parcel at Weavers Crossing Road with up to six lots.
- 6.2 The timing and staging of development of the Puketirini Block will be influenced by the preferred density option and the potential requirement for a second access.

7.0 Geotechnical

- 7.1 The Puketirini Block is part of the former Weavers Opencast Mine site, which was mined by various state organisations until its closure by Solid Energy in 1993. The subsequent rehabilitation process included contouring and soil placement on the overburden dumps, riparian planting and filling of the final pit void to create the lake. In 2005, the lake reached its maximum depth of approximately 64m. Waikato District Council acquired the lake and surrounding land from Solid Energy in 2006.

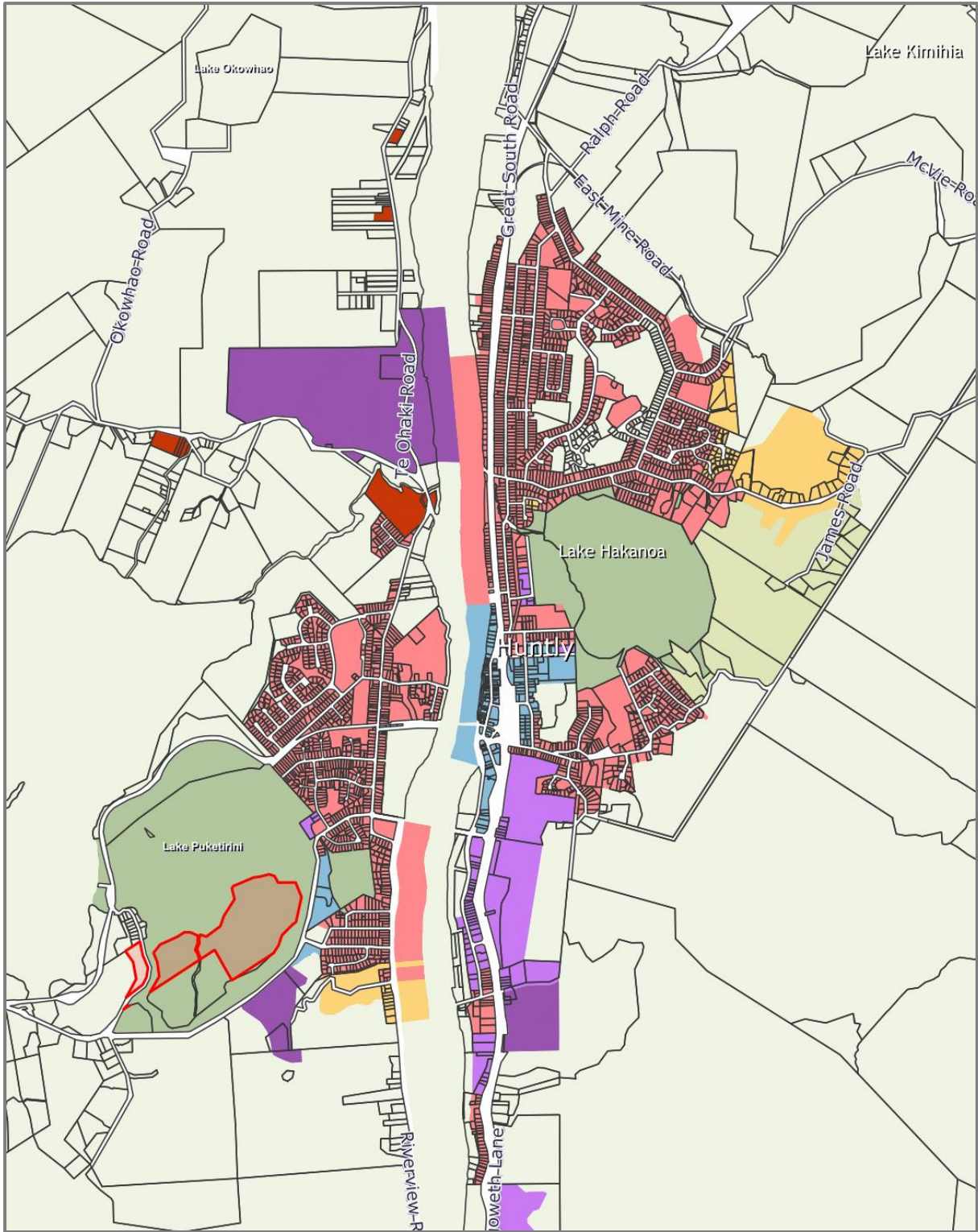
- 7.2 Uncertainty around the site's rehabilitated ground conditions has been a major hurdle to a residential rezoning in the past, due in part to a desktop assessment by GHD in 2017.
- 7.3 TFR has engaged Strata Control Technology Ltd, (SCT) to provide a more detailed geotechnical assessment of the subject land and its suitability for residential development. SCT is one of Australasia's most experienced geotechnical firms and has extensive geotechnical experience in Australia and New Zealand, particularly in mine subsidence. SCT staff were specialist advisers to Solid Energy and have been involved in the recovery works at Kaikoura post the 2016 earthquake.
- 7.4 SCT's geotechnical assessment (**Attachment 10**) is positive, concluding that there are no fatal flaws that would prevent residential development of the land. The fill material is the same as the foundations of the Huntly area and there has been sufficient time for consolidation over the past 26 years. Individual site investigations will determine proper foundation design and construction.

8.0 Conclusion

- 8.1 In summary, the proposed rezoning of the Puketirini block is a viable use of the land with many advantages. While the site is a relatively new prospect for rezoning, it is significant in size, location and amenity and can be developed to serve a variety of residential needs that will uplift the Huntly West area and help to meet the District's housing shortage.
- 8.2 There are no geotechnical barriers to the site's residential development.
- 8.3 A 120 lot development is proposed, combining Village Zone and Residential Zone, and providing a range of lot sizes and accommodation styles that attract a variety of residents. However, the company is open to other zoning and density scenarios, some of which may necessitate a second access point.

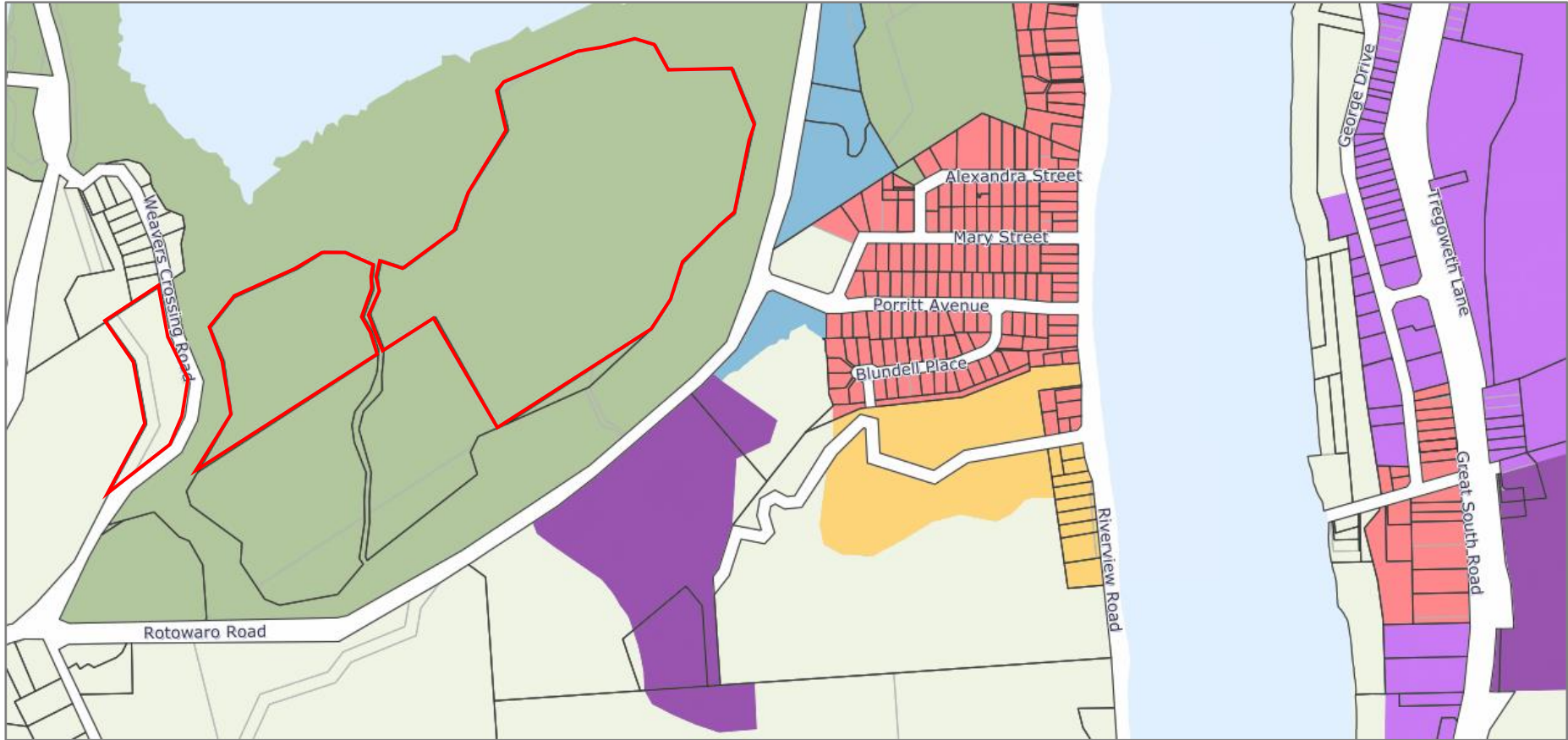
- 8.4 TFR is flexible on staging of the development, and seeks to initiate development as soon as possible following rezoning.
- 8.5 TFR wishes to work with Council to determine the best use of this land for the company and the Huntly housing market, and appreciates the opportunity to present this proposal to the panel at this stage.

Attachment 1
Location Plan - Huntly



Attachment 1: Huntly township (TFR land shown in red outline)

Attachment 2
Puketirini Area - Existing Zoning



Attachment 2: Existing zoning under Operative District Plan- Recreational Zone (green) and Rural Zone (grey). TFR land shown in red outline.

Attachment 3

Puketirini Area - Proposed Zoning



Attachment 3: Proposed zoning - Recreational Zone (green) and Rural Zone (grey). TFR land shown in red outline.

Attachment 4
Puketirini Area – Aerial Photograph



Attachment 4: General Puketirini area showing aerial photograph and TFR land holdings (outlined in red), with key features

Attachment 5
Site Photographs



North-western view from approximate southern boundary of Puketirini Block



Northern view from approximate southern boundary of Puketirini Block



North-eastern view from approximate southern boundary of Puketirini Block



Western view from approximate southern boundary of Puketirini Block



Southern view of Puketirini Block with reserve and lake in the foreground



Western view of part Puketirini Block and Weavers Crossing with lake in the foreground



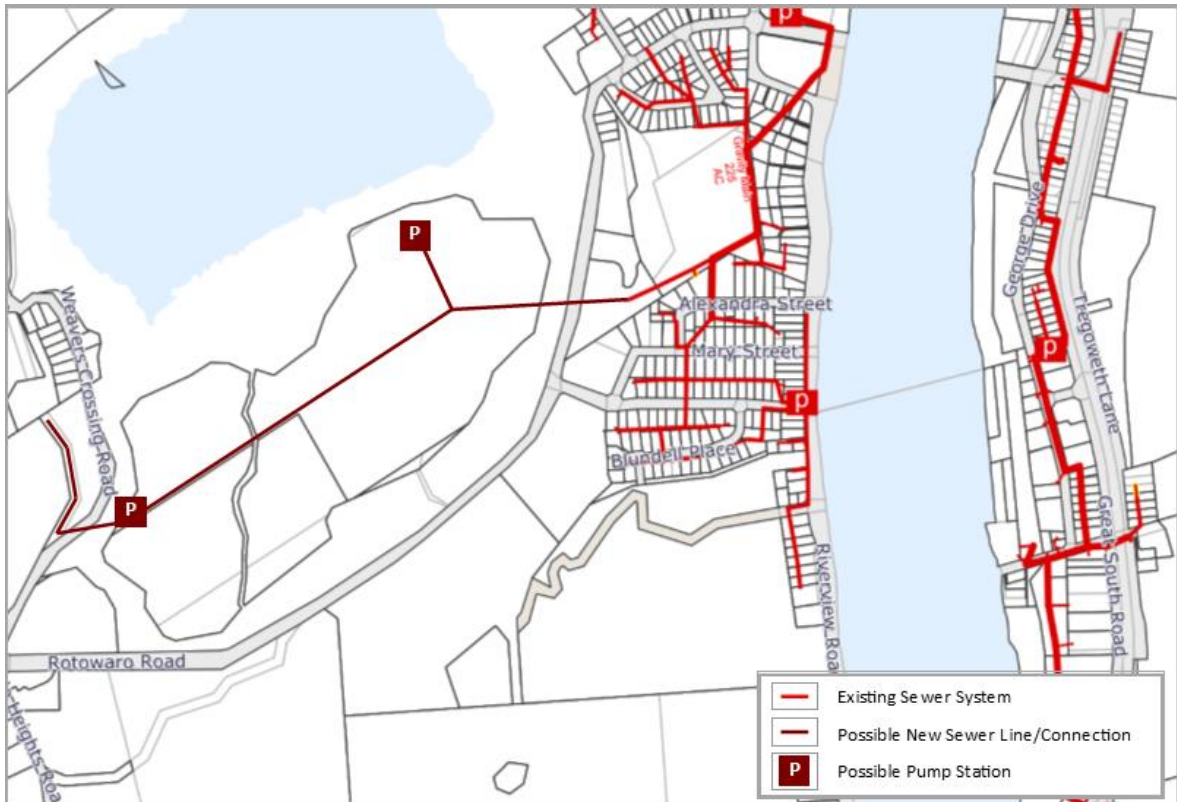
Southern view of Puketirini Block with lake and boat ramp in the foreground



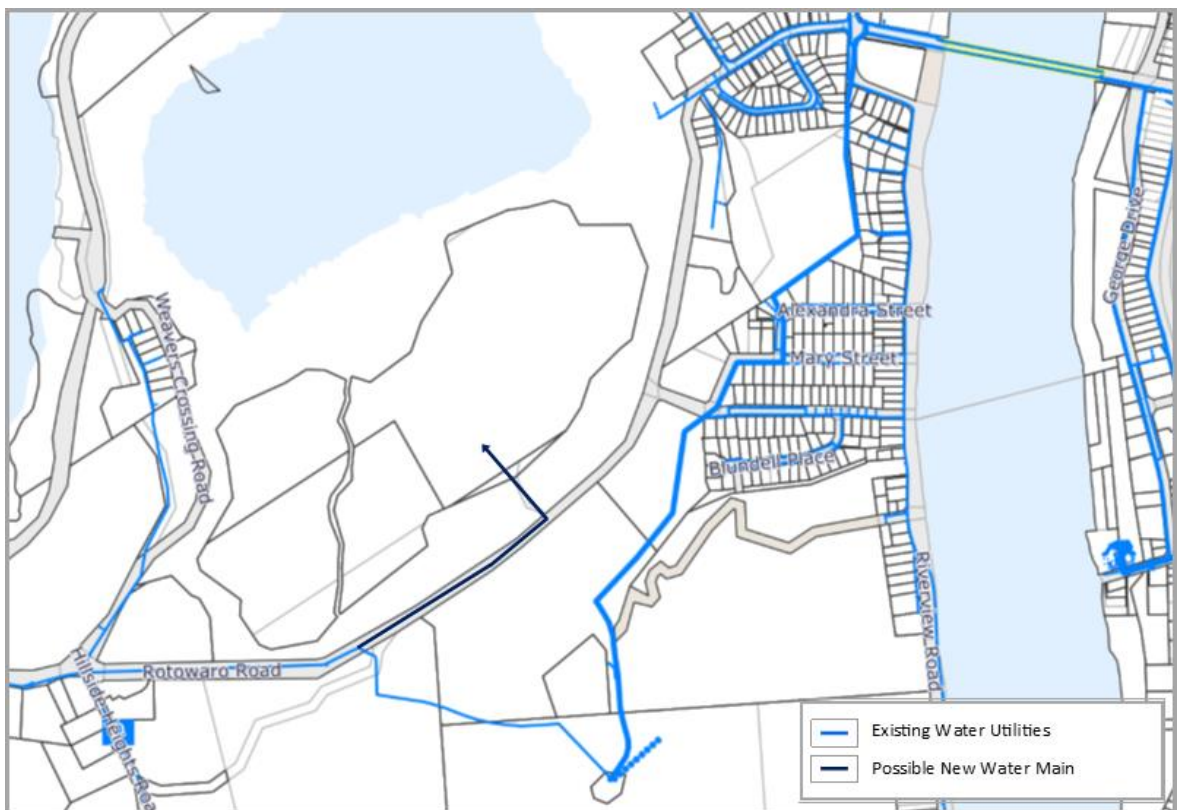
South-western view of part Puketirini Block with lake and wetland in the foreground

Attachment 6

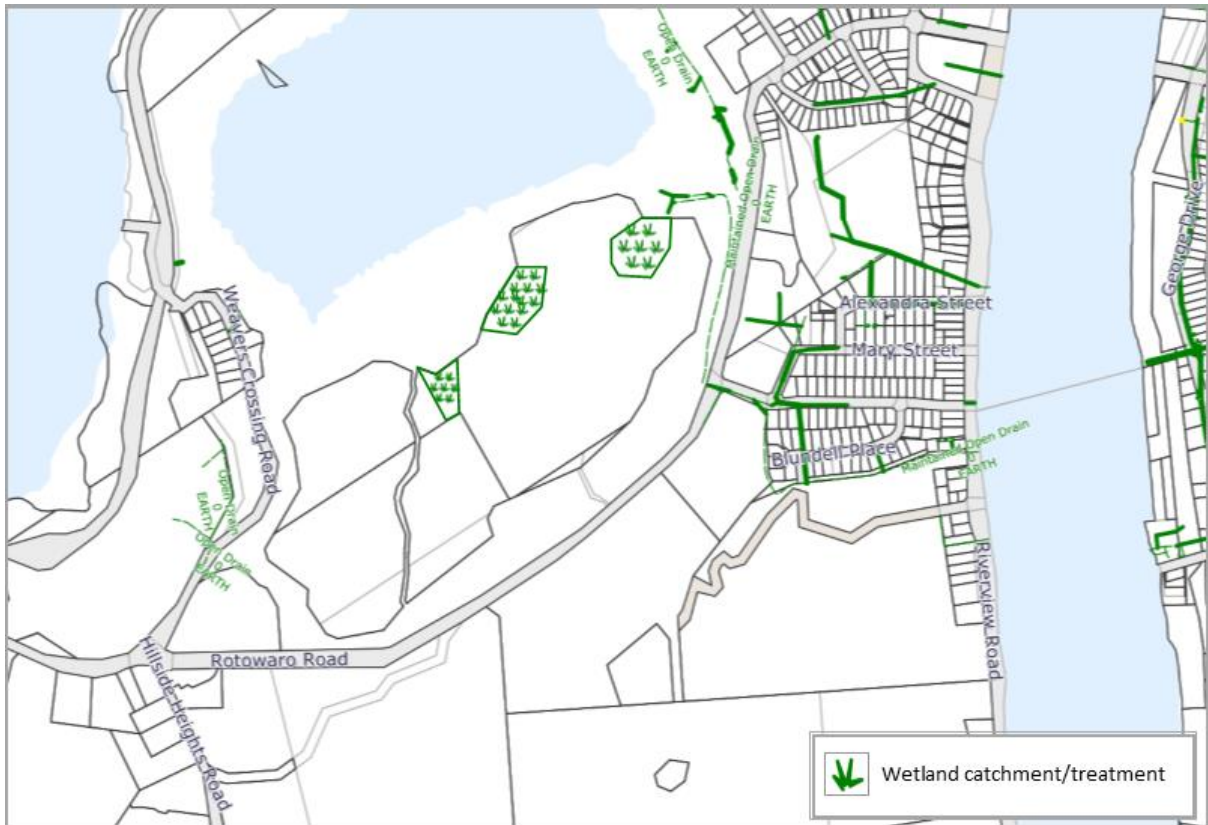
Location of Existing and Potential Services



Existing sewer system with potential wastewater servicing option



Existing water reticulation with potential water servicing option

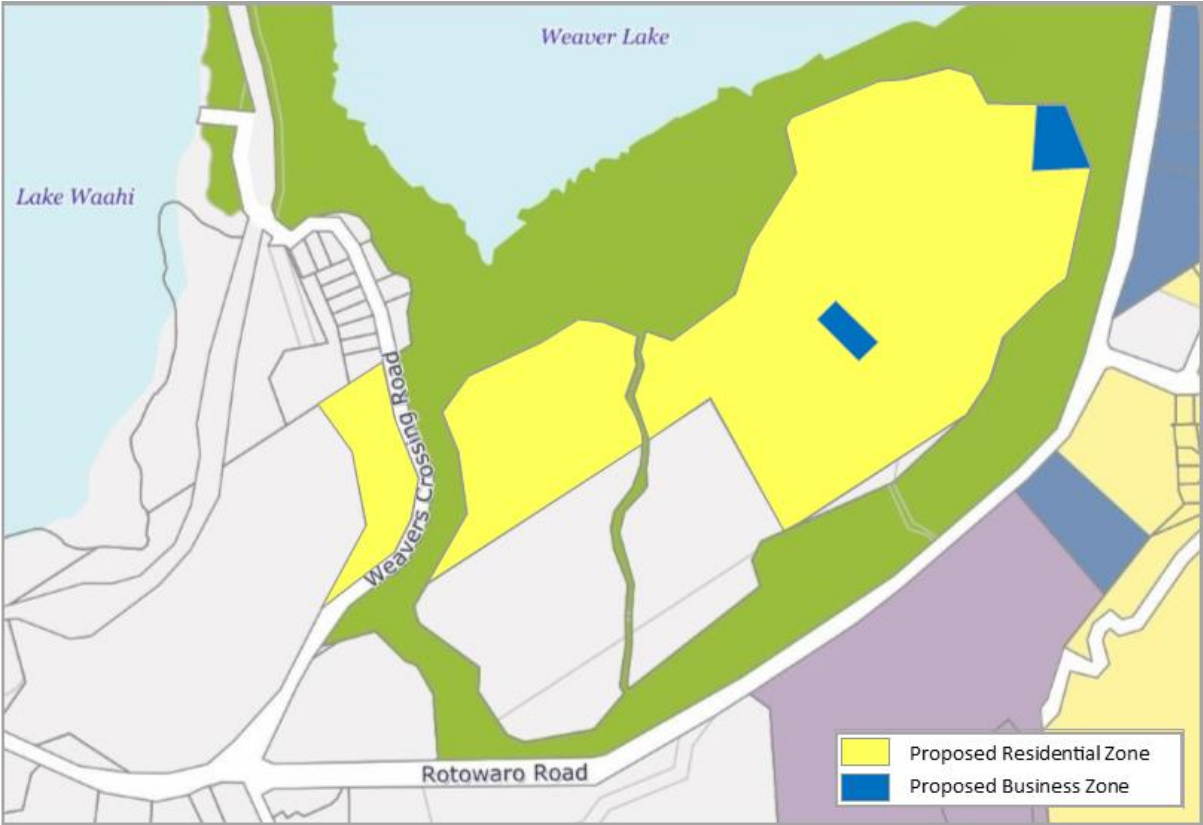


Existing stormwater reticulation, with potential location of stormwater wetlands/retention ponds on TFR land

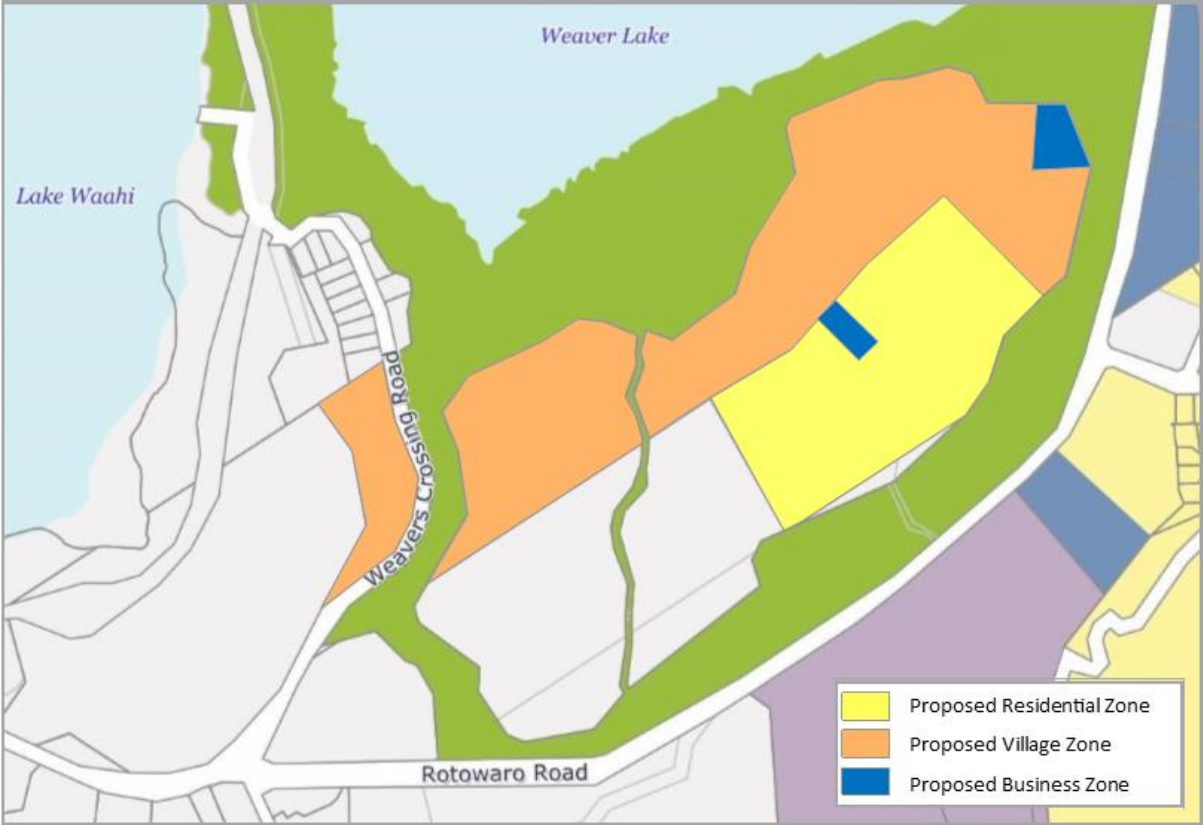
Attachment 7
Rezoning Options



Rezoning Option 1 - TFR land rezoned to Village Zone



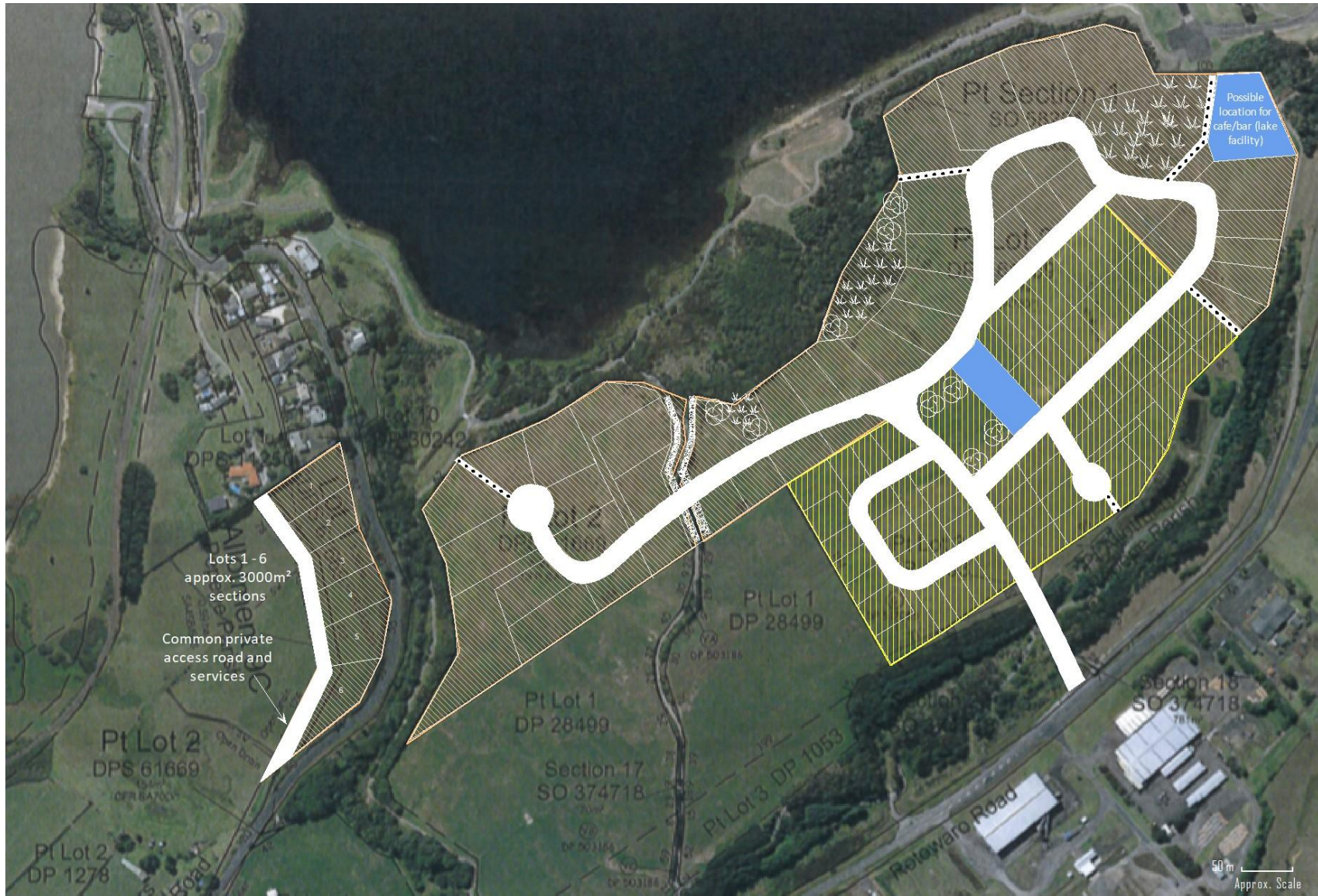
Rezoning Option 2 - TFR land rezoned to Residential Zone



Rezoning Option 3 -TFR land rezoned to Village and Residential Zones (Indicative Only)

Attachment 8

Puketirini Subdivision Concept Plan



Terra Firma Resources Ltd
 Puketirini and Weavers Crossing Subdivision Concept Plan
 Mix of Residential and Village Zoning

Drawn: Rachel Roberts Date: 27 September 2018

Legend

- Village Zone Lot sizes approx. 1000 - 3000m²
- Residential Zone Lot sizes approx. 450 - 1200m²
- Business Zone Indicative of size and location

- Rooding
- Wetland Planting/Ponding
- Boundary Planting/Walkway
- Community Green Space/Orchards
- Pedestrian Easement to Reserve

Attachment 8: Puketirini Subdivision Concept Plan

Attachment 9

Transportation Assessment by CKL Surveyors Ltd

Our Ref: B19134

26 September 2019

Lucy Smith
Terra Firma Mining Ltd
PO Box 67
Ngaruawahia 3742

Dear Lucy,

Lake Puketirini, Huntly – Proposed Residential Rezoning

We are pleased to provide the following initial review of transport and access matters associated with the proposed rezoning of approximately 27ha land around Lake Puketirini, Huntly.

Introduction

Currently, most of the area located south of Lake Puketirini is zoned as Recreational by Waikato's Operative District Plan (ODP). Waikato's Proposed District Plan (PDP) seeks to rezone this land to a Rural Zone. However, it is noted that Terra Firma Resources (TFR) opposes this provision and seeks to rezone the land to a Residential Zone for the provision of medium to high density housing.

Consideration has been given to potential yield for the rezoned land. An indicative concept plan has identified some 120 lots may be developed, however consideration has also been given to opportunities and constraints associated with higher density development in the area. Two options have therefore been considered:

- 10 lots per ha at a size of 600m², including the provision of roading network, green/recreational spaces and swale/wetland areas.
- 20 lots per ha with an average lot size of 350m² as per recent medium density residential development within Hamilton City.

These allow for a range of higher density development of between 270 – 540 lots.

The purpose of this letter is to provide a preliminary assessment of the transportation options to cater for a proposal of this size.

Existing Road Environment - Rotowaro Road

Access to the site is currently obtained from Rotowaro Road via an easement across the Puketirini Reserve, located on south-eastern boundary of the eastern lot. This section of Rotowaro Road is classified as a Rural Collector road in the ODP. Rotowaro Road is generally flat, straight and has a posted speed limit of 80km/h. Rotowaro Road has an estimated average daily traffic (ADT) count of 2,070 vehicles per day (vpd) estimated from Waikato District Council's RAMM roading database.

A search was undertaken on NZTA’s Crash Analysis System (CAS) for all reported crashes within a 200m radius of this easement and the intersection of the entrance located into the car park Lake Puketirini, between the years of 2014 and 2019.:

- The reported two crashes at the Lake Puketirini car park entrance happened in 2014 and 2018 and occurred as a result of drivers losing control. One of the crashes occurred as driver was chasing another driver which resulted in a minor injury. The other crash occurred due to a driver losing control around the bend in the road.
- The other two reported crashes near the easement also happened in 2014 and 2018. One crash occurred due to a motorbike driver losing control from speeding, resulting in minor injury. The other crash occurred as a result of a drunk driver abruptly undertaking a U-turn on Rotowaro Road without properly checking for oncoming cars.

These four crashes do not indicate that there is any existing issue with current layout of Rotowaro Road.

Proposed Access

The rezoning proposal includes providing a formalised roading access through the existing easement located off Rotowaro Road. The location of this access is shown below in Image 1.



Image 1: Rezoning Proposal

The location of this accessway provides approximately 150m sight distance looking east and 250m west on the road reserve. The standards set out in *Table 6 – Minimum Sight Distances* of the ODP

require at least 175m of clear sight distance for rural roads on an 80km/h road. To achieve this, some minor tree and grass trimming would be required on the Puketirini Reserve.

Additionally, to construct a satisfactory access, the following would probably be required:

- It is anticipated that the width of the road reserve would need to be 20m wide with a formed carriageway width of 6m. This road is likely to be classified as a Collector Road as it will have an ADT count exceeding 500vpd and serve multiple local roads within the subdivision. This would require widening of the easement as it is currently approximately 9m in width.
- Carriageway widening on Rotowaro Road to accommodate a right turn lane: As Rotowaro Road has an 80km/h speed limit it is recommended to ensure there is right turn lane to the development to ensure traffic flows on Rotowaro Road are not delayed and to provide a safe place for turning vehicles to wait.
- Adjust gradient: It was noted that the access drops away from the Rotowaro Road, then increases steeply towards the potential development site. The Regional Infrastructure Technical Specification (RITS) requires that the gradient of the road is not steeper than 1:12 and flattens out to 1:33 for the last 30m of the road toward the intersection with Rotowaro Road.
- Adequate cycle crossing: It was noted that the Puketirini Reserve cycle track is located perpendicular to this access. It is therefore recommended that a formal crossing point for cyclists is installed across the proposed road access, as well as some traffic calming devices installed on this road (e.g. raised table or different surfacing on the road).

Potential Second Access

A single point of access is considered a reasonable solution to serve the indicative development of 120 lots. However, if development at a higher density, potentially delivering 270 – 540 lots is to be pursued, it is recommended that a second access be provided. Although a second access would increase costs and would potentially reduce developable area, it is considered necessary to support higher density development as follows:

- It is less likely that congestion will occur at any site access intersection if demand can be spread across the network;
- It is easier for residents to travel to their desired destination within the wider residential zone and improves residential amenity as not all traffic is using a single point of access;
- It would better support transport policies and objectives, demonstrating the site has adequate roading infrastructure to support the scale of development;
- There would be less interaction between residential and existing traffic at nearby intersections, such as the entrance to the Huntly Coal Screening plant;
- There would be an overall improvement to driver safety as traffic is dispersed across two intersections; and
- There is better network resilience in the event of an emergency potentially blocking one or other access point.

Some potential options where a second access could be provided to support higher density development have been identified on Image 1.

Other opportunities for access options were also explored along the section of Rotowaro Road, between the Lake Puketirini car park main entrance and the proposed site access but it was

determined that due to the topography and limited sight distance available that providing a secondary access along this section of Rotowaro Road would be unlikely to be feasible.

Option 1 – Access Through Puketirini Reserve Main Entrance

This access opportunity identified was through the car park to Lake Puketirini, highlighted as the 'Main Entrance' on Image 1. This would require an additional easement and a road separating subdivision traffic from the car parking area. Some pros and cons are listed below.

Pros

- Good connection to Huntly town center which will be the predominant destination for residents;
- Good separation from the currently proposed access.
- Flatter area and easier to establish new road network;
- Speed limit is lower for this section of Rotowaro Road which will lower the risk of car crashes; and
- The ODP requires 80m of sight visibility for a 50km/h speed environment. This access has 87m visibility to the north and 120m south.

Cons

- Consent required to build adequate roading through Puketirini Reserve;
- The intersection from the car park onto Rotowaro Road is currently not in a satisfactory condition to accommodate additional vehicle movements. This will need to be upgraded;
- Traffic effects on amenity of the reserve;
- Estimated that this will be used by the majority of residents which will make the easement main access less utilized.

Option 2 – Access through Puketirini Reserve Southern Entrance

The next access opportunity was identified through the Southern Entrance shown in Image 1. This access will have similar constraints that were identified for the proposed access. The southern access is located approximately 245m away from the currently proposed access which complies with intersection separation distances required by the ODP.

Pros

- Estimated that this will evenly spread traffic between two accesses, reducing queuing and improving LOS;

Cons

- Closer to the 100km/h zone on Rotowaro Road which will increase the severity of injury or death if a crash was to occur;
- Sight distance is inadequate here with 180m east and 300m west. The ODP requires 250m of sight visibility for a rural road with a posted speed environment of 100km/h;
- Will also require a right turn lane to provide a safe area for drivers to wait; and
- Same constraints to build this access as the currently proposed access (e.g. gradient issues and will require more widening on Rotowaro Road to accommodate a right turn lane).

Option 3 – Connection to Weavers Crossing Road

Connection to Weavers Crossing Road has also been considered. This is located west of the Puketirini lots. However, there is a gully located through the site which would require the construction of a bridge to access Weavers Crossing Road.

Cons

- Construction of a bridge is unlikely to be a financially viable option for a development of this size;
- It is also noted that Weavers Crossing Road is not a road suitable for accommodating the traffic generated from 270 - 540 dwellings without substantial upgrading (such as resurfacing and widening) including an upgrade of the Weavers Crossing Road/Rotowaro Road intersection.

63 Weavers Crossing Road

It is noted that the proposal also includes rezoning a lot located at 63 Weavers Crossing Road as a Residential Zone. This lot is approximately 1.92ha with an existing common private access road and is planned for low density housing.

Weavers Crossing Road has an 100km/h speed limit. However, driver speeds are estimated to be in the order of 80km/h given the curvature and topography of Weavers Crossing Road. Weavers Crossing Road has an estimated ADT of 160 vpd estimated from Waikato District Council's RAMM roading database.

Sight distance from this existing private road was measured to be 115m to the north and 170m to the south. 175m of sight distance is required for a speed environment of 80km/h which means this proposed access does not comply with the required sight distance. There is limited opportunity to improve sight distance at this location given the curvature of the road. However, given the low traffic demands on Weavers Crossing Road, the effects of this non-compliance are likely to be less than minor.

Under these circumstances, it is recommended that no more than six dwellings are established on this lot to ensure minimal vehicle trips are added to this access. Six residential dwellings are estimated to generate an ADT count of 54 vpd which will provide a low probability of driver conflict occurring on Weavers Road Crossing Road.

A search was also undertaken on NZTA's CAS for all reported crashes within a 200m radius of this access, including the intersection with Rotowaro Road, between the years of 2014 and 2019. Two crashes occurred near the Weavers Crossing Road and Rotowaro Road intersection:

- The first crash occurred as a result of a driver evading police in stolen car and losing control near the intersection; and
- The second crash occurred as a result of a driver reversing out of a driveway on Hillside Heights Road onto an oncoming truck resulting in a moderate injury.

This CAS report suggests that there are no existing safety issues associated with Weavers Crossing Road. We do not recommend that additional roading changes are required to accommodate six additional units on this road.

Conclusions

In summary, it is concluded that:

- A single point of access is suitable to serve the indicative 120 lots currently under consideration
- The existing easement would benefit from being widened to allow for a collector road connection to serve the potential development;
- If development at higher density is to be pursued, a second access may be required, depending on overall lot yield and at that point, the options considered here, along with others, should be assessed in more detail.

In terms of next steps, it is recommended that:

- Desired residential density for the new zone be confirmed through discussions with Waikato DC.
- If higher density residential development is preferred, those discussions should include the location and form of a second means of access. Consideration should also be given to the process for ensuring that the existing easement can be varied to allow for a collector road connection into any new residential zone;
- Consideration be given to the staging of development and how this may link to road infrastructure provision;
- An Integrated Transportation Assessment considering the effects of traffic from the new residential zone on the key road network is likely to be required. At this stage, it is anticipated that analysis of the SH1 / Tainui Bridge Road, Tainui Bridge Road / George Drive and Tainui Bridge Road / Rotowaro Road intersections as these provide the key links to Huntly town centre and the strategic road network.

We trust the above provides all the information you require, but if you have any questions or if we can be of further assistance, please don't hesitate to contact us.

Yours sincerely

CKL Planning | Surveying | Engineering | Environmental



Judith Makinson
Transportation Engineering Manager

Attachment 10

Geotechnical Assessment by Strata Control Technology Ltd

24th September 2019



Craig Smith
Director
Terra Firma Resources
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New Zealand

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TFR5084

Dear Craig

HIGH LEVEL REVIEW OF GEOTECHNICAL ASPECTS RELATED TO LAND DEVELOPMENT PUKETIRINI

Thank you for the opportunity to submit the following high level geotechnical review of the proposed land development at the previous Weavers Open Cut mine (Puketirini).

Our review is based on extensive local experience related to geotechnical characterisation of the rocks and soils of the Huntly area associated with the Huntly East and Huntly West underground mines. Characterisation of the overburden sediments, including the more recent (geologically) Tauranga Group clays, silts and sands, has been integral to understanding surface ground movements in and about mining areas.

Figure 1 outlines a general location plan of the previous Weavers Open Cast mine (Google Earth imagery 2019) rehabilitated by Coal Corp NZ in the early to mid 1990's, with Lake Puketirini being formed in the northern deep area of the mine and the spoil emplacement area to the south being the proposed residential development area.

1. OBJECTIVES OF REVIEW

The objective of this high level study is to provide a geotechnical summary of the site characteristics, particularly relating to the nature of the spoil emplacement and related mine closure, and identify any geotechnical issues and forward work for the proposed residential re-development of the site.

2. DATA

A comprehensive datapack comprising site closure plans, technical drawings and registered mine plans has been provided by Terra Firma in digital format. The plans are technical drawings and registered mine plans from the former State Coal Mines NZ and date typically from the mid 1980's through to mine closure and rehabilitation in the early 1990's.



Figure 1: General Location Plan of Proposed Land Development - Puketirini

Specific technical drawings relating to the construction of the bund wall (No. 8 Bund) that replaces the spoil rehabilitation and separates Lake Puketirini from the old workings are also provided.

Additionally, the author has a range of district information relating to the geotechnical characteristics of the overburden sediments typical of this site, including work from Kelsey (1980's) and subsequent specific investigations at the Weavers Open Cast in the late 1980's from Wezenberg (Masters Thesis).

A walk over site inspection was conducted by the author on 27th February 2019.

Figure 2 provides a general scene of the proposed development area, which is currently subject to general farm grazing and pasture activities.



Figure 2: General images of development area taken February 2019, showing gently undulating pasture.

3. GENERAL SETTING

The proposed development site forms part of the old Weavers Open Cast coal mine. The open cast mine ran from 1958 until rehabilitation began in 1993 and was operated by State Coal Mines (and latterly Coal Corp NZ/Solid Energy).

The site is located immediately west of the township of Huntly, in a broader area of historic open cut coal mining. The main Rotowaro – Huntly coal mine alignment runs to the north of Lake Puketirini. The naturally formed Lake Waahi is to the west and north of the proposed area (as shown in Figure 1).

Weavers Open Cast mine targeted coal seams of the Waikato Coal Measures including the Lower Kupa Kupa Seam and overlying Renown Seam. It is noted that the mine plans reviewed here include limited old underground workings of the Taupiri West Mine, that are understood to have been recovered (in part) as part of the open cast workings (this is discussed further later in the report).

Figure 3 displays a photograph of open cast mine workings taken from Wezenberg’s thesis and show the in-pit crusher and mine highwall circa 1987.



Figure 3: Weavers Open Cast mine workings circa 1987, after Wezenberg (1988).

Figure 4 displays aerial photography of the Weavers Open Cast mine workings at 1985 showing the extensive mine operations across the site and the Huntly township to the immediate east of the operations.

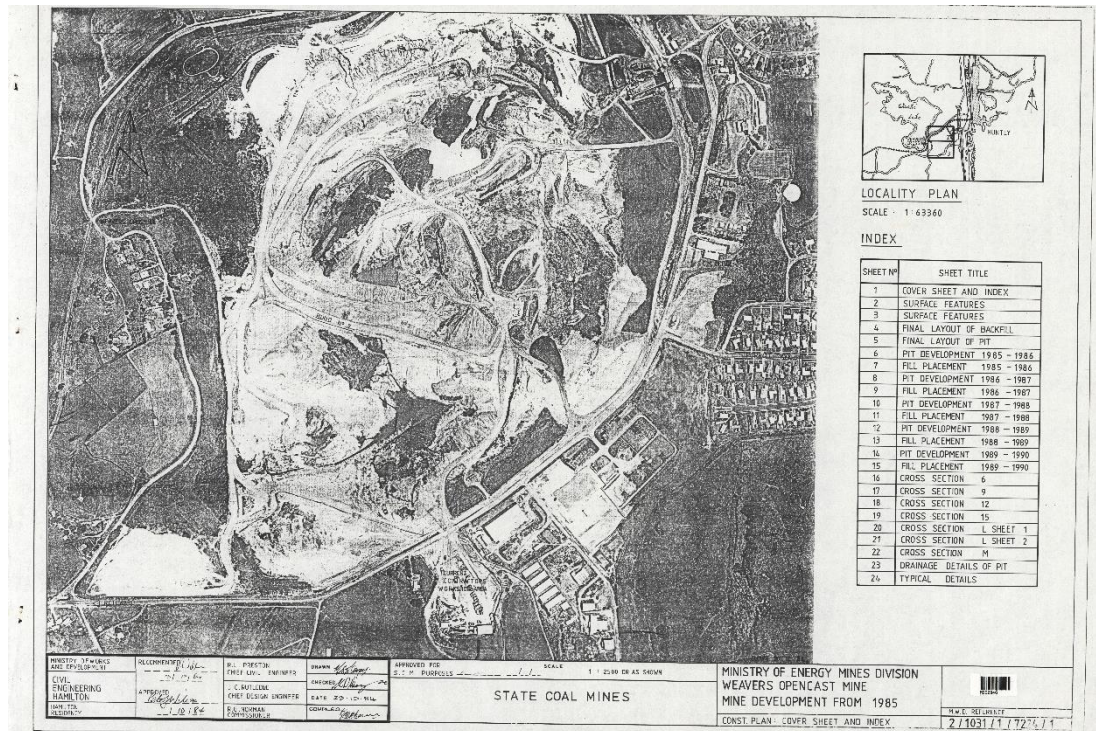


Figure 4: Weavers Open Cast Mine – Workings at 1985 including details of plans supplied.

The mine rehabilitation comprised the formation of a large retaining bund (No 8 Bund) in the central mining area, behind which successive periods and layers of overburden material from the site were deposited. The active working face continued down-dip to the north (winning coal) until mining and spoil placement was completed.

Contractor Doug Hood Mining finalised earthworks associated with mine rehabilitation with the resultant landforms being Lake Puketirini in the north and gently sloping farmland in the south (<https://www.doughood.co.nz/projects/open-cast-mining/weavers-opencast-coal-mine-huntly-coal-corporation/>).

4. GEOLOGICAL AND GEOTECHNICAL SETTING

The site comprises stratigraphy typical of the Huntly coalfield. The proximity to the Waikato River provides deposition of more recent Tauranga Group sediments that unconformably overly sedimentary rocks of the Te Kuiti Group. The Waikato Coal Measures form the basal unit of the Te Kuiti Group and unconformably overlying basement rocks of the Newcastle Group.

Figure 5, taken from Wezenberg's thesis, summarises the stratigraphic section of the site.

WEAVERS OPENCAST MINE
STRATIGRAPHIC COLUMN.

TABLE 2.1

		AGE	DESCRIPTION
TAURANGA GROUP	Undifferentiated Tauranga Group sediment (0-15m) Taupo Pumice Alluvium (0-8m)	HOLOCENE	swamp and lake sediments consisting of lightly compacted, organic rich, clayey silt, silty clay and peat. fluvialite, loose, whitish cream, current bedded, highly pumiceous, silts, sands and gravels, with common charcoal fragments.
	Hinuera Formation (0-10m)	PLEISTOCENE	fluvialite, loose, yellow brown to grayish green, pumice rich, silts sands and gravels, displaying current bedding and fining upward sequences. Interbedded with discontinuous lenses of sandy silty and silty clay.
	Kauroa-Hamilton Asm (0-5m)	PLEISTOCENE	ignimbritic paler reddish yellow and yellow brown sandy silts and halloysitic silty clay.
	Whangamurino Fm (0-65m)	PLIOCENE	fluvialite, stiff, bluish green, clayey silt with discontinuous bands of peat and wedge shaped lenses of silty sands and sandy silts. Basal unit. fluvialite highly compacted sequence of greywacke gravels in matrix of pumice and quartzose rich muddy sands and muddy gravels.
unconformity			
TE KUITI GROUP	Mangakotuku Siltstone (0-6m)	OLIGOCENE	Non calcareous, massive weak, greyish green mudstone.
	Pukemiro Sandstone (0-6m)	OLIGOCENE	Glaucanitic, massive, weak, greyish green fine sandstone.
	Glen Afton Claystone (0-15m)	OLIGOCENE	Non calcareous, massive, weak greyish green, silty claystone.
	Waikato Coal Measures (0-45m)	Eocene	moderately weak, dark grey to grey brown, slightly carbonaceous mudstone, interbedded with brownish black carbonaceous mudstone, basal coal seams and siderite concretions.
unconformity			
NEWCASTLE GROUP	Hakrimata Formation	UPPER TRIASSIC	Indurated silt stone and sandstone.

(based on Kear and Schofield 1978; Henderson 1983)

Figure 5: Stratigraphy of the Weavers Open Cast Mine, after Wezenberg 1988. Considered typical of the Huntly area.

The unconsolidated sediments of the Tauranga Group are quite well understood from a geotechnical perspective, and comprise much of the subsurface of the built landform in the Huntly district on the lower lying land. At Huntly East Mine, the Tauranga Group sediments were up to 70m in thickness and resided below residential and farmland to the east and west of the Waikato River that was actively undermined.

The Tauranga Group and Te Kuiti sediments were backfilled from the active mining areas of the Weavers Open Cast behind Bund No 8, which is discussed further in Section 5.

Wezenberg (1988) provides a useful summary of the geotechnical aspects of the Weavers Open Cast Mine. Issues around slope stability and geotechnical characterisation of the overburden sequence are captured. It is noted here that the emplacement of spoil as part of the rehabilitation process acts to provide active confinement and containment of old pit slope walls.

As discussed earlier, mine plans show old underground workings (nominally Taupiri West Mine as annotated with a stone drive to the Ralph Mine). The workings are located at/beneath Lake Puketirini and are understood to have been excavated as part of open cast operations, although definition of the status of old workings would form part of the forward work program. Figure 6 details the general arrangement of the old underground workings based on a 1985 State Coal Mines plan for 1989-1990 coal winning in the Weavers Pit.

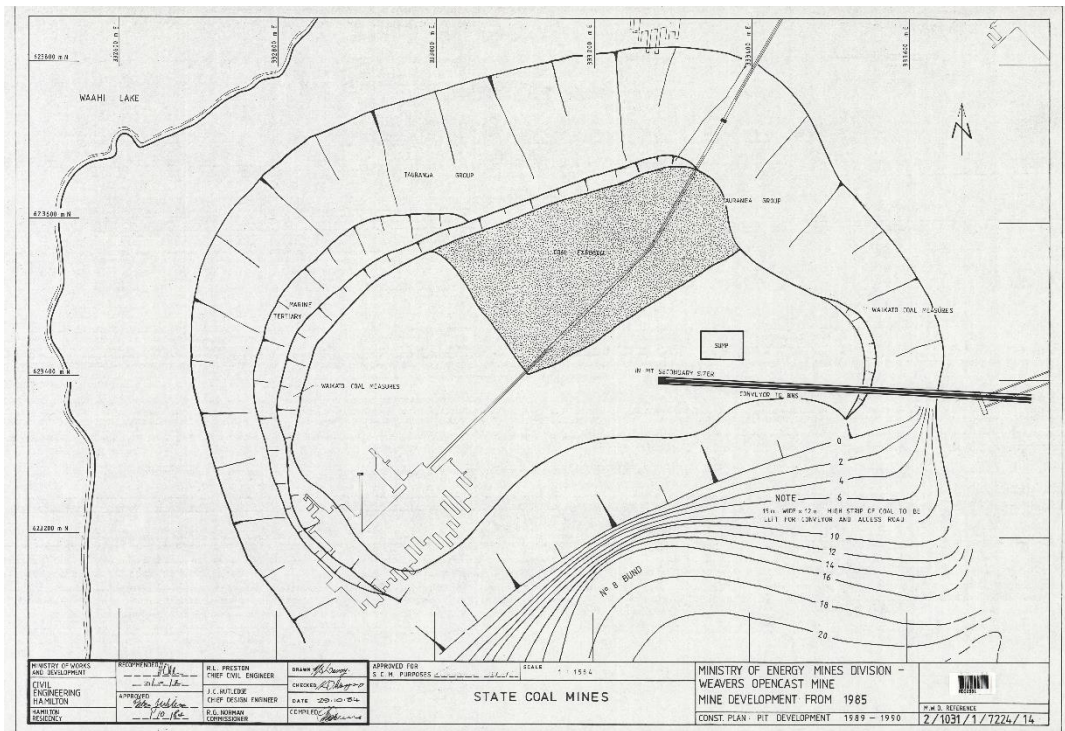


Figure 6: State Coal Mines plan for 1989-1990 coal development (circa 1985) showing extent of old Taupiri West underground workings and stone drive to the Ralph Mine. Note workings are north of No 8 Bund and nominally extracted.

5. REMEDIATION AND SPOIL EMPLACEMENT

The proposed development site was constructed by emplacement of mine spoil behind an engineered earth bund wall. Figure 7 provides a summary engineering drawing of the No 8 Bund Wall (that forms the southern wall of Lake Puketirini).

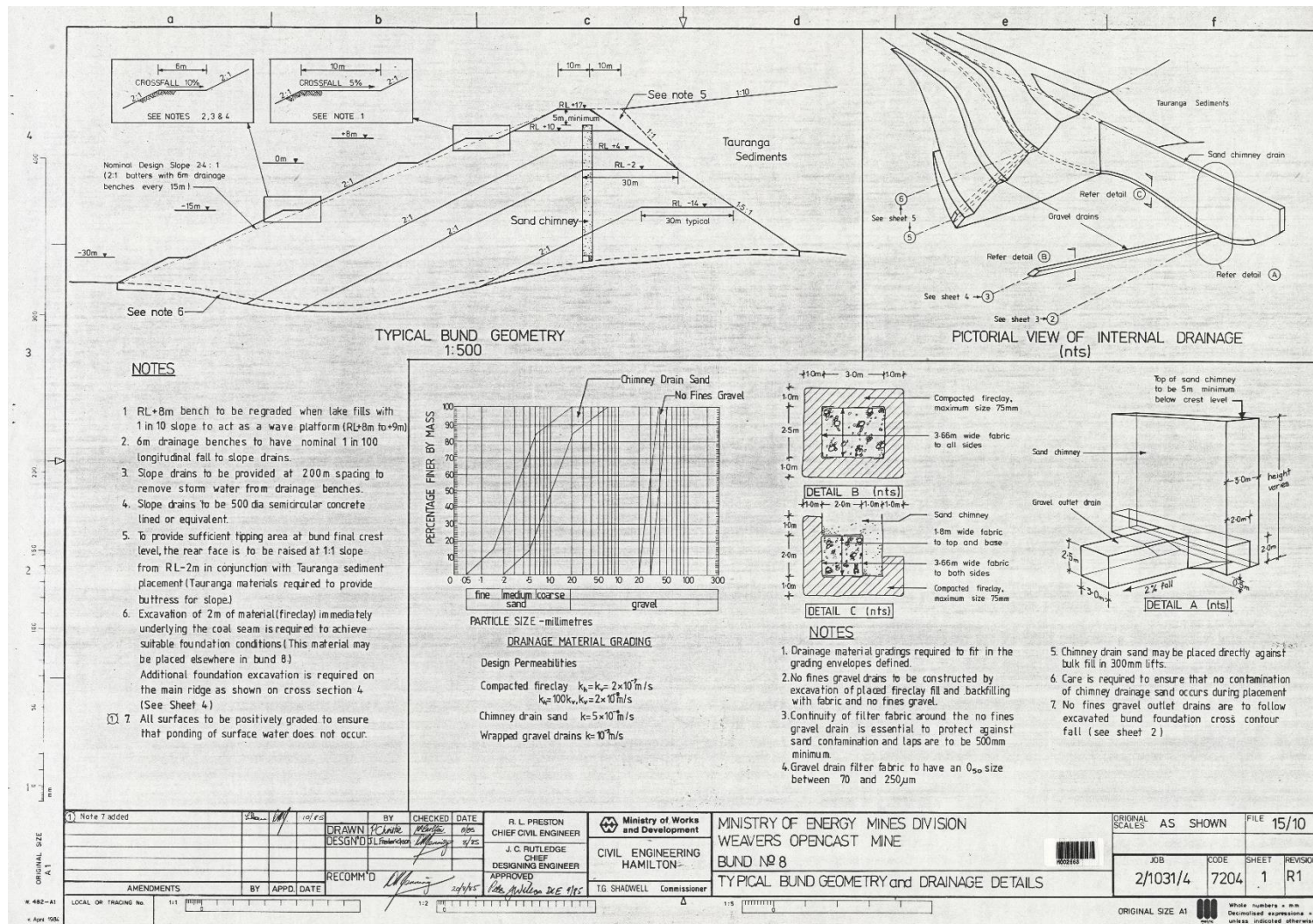


Figure 7: Engineered Earth Bund Wall (No 8) designed to retain mine spoil and form southern wall of Lake Puketirini.

The bund wall was constructed on a designed foundation keyed into basement material. Fireclay (low hydraulic conductivity) was emplaced upstream to mitigate piping failure beneath the structure, with vertical sand drains employed in the bund to manage pore water pressures.

An example of the typical bund detail and construction methodology is shown in Figure 8 (after State Coal Mines, 1985). Note the concurrent bund and spoil emplacement and fill material type - being the same as the general overburden sequence typical at Huntly.

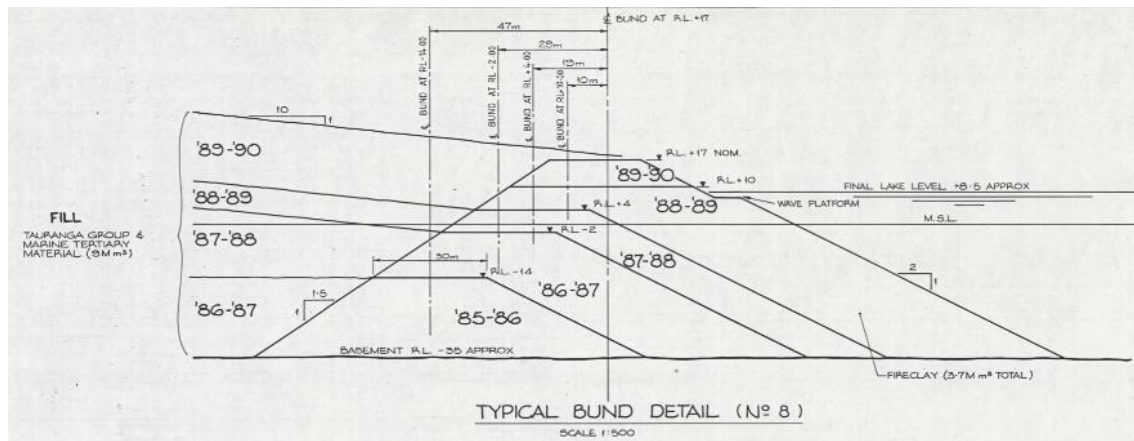


Figure 8: Typical Bund arrangement, construction sequence and fill emplacement (view looking west). Note “FILL” note on TG sediments and marine tertiary forming spoil.

6. DISCUSSION

Strata Control Technology (SCT) worked with Coal Corp NZ and subsequently Solid Energy NZ from 1989 to cessation of operations in 2017. The author has consulted to Coal Corp/SENZ from 1995 and was appointed the Geotechnical Designer at Huntly East Mine following introduction of the new mining legislation in 2016.

In all cases, there was a high level of engineering professionalism maintained within Coal Corp/SENZ and work was conducted to a very high standard. In reviewing the work conducted for the Weavers Open Cast Mine, the same level of engineering detail is apparent. The construction of the retaining Bund (No 8 Bund) and its design provide confidence that the structure has been designed and built to be fit for purpose.

The staged placement of the mine spoil, comprising sediments of the Tauranga Group and Te Kuiti Group, against the engineered foundation provide confidence that staged compaction and placement of material has occurred.

The materials comprising the mine spoil are the same as those encountered beneath most of the Huntly area. The intervening years from emplacement, nominally from 1993 to 2019, some 26 years, would be expected to provide for the majority of ground consolidation (under self weight loading and pore pressure redistribution) to have taken place.

For this high level review, no fatal flaws have been identified as to why the land would not be considered suitable (from a geotechnical perspective) for further assessment and development as residential land. Attendant issues with site specific soil types (that are endemic to the area) would form part of individual site investigations studies to ensure proper foundation design and construction.

Areas of further work are outlined below.

7. FORWARD WORK

A review of available cadastral survey data, and other terrestrial based survey data, should be conducted to assist in developing a settlement history for the site. As noted in Section 6, the majority of spoil settlement would be expected to have occurred over the 26 year period.

General site investigations relating to the sub-surface properties of the material would be considered appropriate and consistent with industry practice. This may include such things as static/dynamic cone penetrometer tests and short investigation boreholes.

Confirmation of the groundwater piezometric surfaces within the area would be recommended.

A lidar survey of the site would assist in confirming detailed slope topography, areas of potential settlement/movement and domain mapping future development based on slope, soil types and drainage.

If you have any queries or require further clarification please don't hesitate to contact me.

Yours sincerely



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