Waikato DISTRICT COUNCIL
Te Kaunihera aa Takiwaa o Waikato

RMA Form 5

Proposed Waikato District Plan

Submission form

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Closing date for submissions: 5pm on Tuesday 9 October 2018

SCANNED
Sel No

Submitter details: *(please note that the (*) are required fields and must be completed)*

First name*: Shand Properties Ltd	Last name*:
Organisation:	
On behalf of:	
Postal address*: C/- Tonkin and Taylor, PO Box 9544	
Suburb:	Town/City*: Hamilton
Country: New Zealand	Postal code*:
Daytime phone:	Mobile: 021 510 131
Email address:* geccles@tonkintaylor.co.nz	
Please tick your preferred method of contact* [x] Email [ ] Postal	
Correspondence to* [ ] Submitter [ ] Agent [x] Both	
Trade competition and adverse effects:* [ ] I could [x] I could not gain an advantage in trade competition through this submission.	
Note: If you are a person who could gain an advantage in trade competition through the submission, your right to make a submission may be limited by clause 6(4) of Part 1 of Schedule 1 of the Resource Management Act 1991.	
Would you like to present your submission in person at a hearing? [x] Yes [ ] I do NOT wish to speak in support of my submission and ask that this submission be fully considered. If others make a similar submission I will consider presenting a joint case with them at the hearing (do not tick if you would not consider a joint case). [x] Yes [ ] No	

Please complete the following for every submission point: refer to attached submission
Provision number (e.g. 22.4.1.2 P2(a)):
Physical address of the property concerned (if relevant to your submission):
Do you: ☐ Support ☐ Oppose ☐ Neutral

The decision I would like is: refer to attached submission

My reasons for the above are: refer to attached submission

Please return this form **no later than 5pm on 9 October 2018** to:
Waikato District Council, 15 Galileo Street, Private Bag 544, Ngaruawahia 3742, or e-mail: districtplan@waidc.govt.nz

Signed: ..... Date: 09 October 2018
(A signature is not required if you make your submission by electronic means)

PRIVACY ACT NOTE: Please note that all information provided in your submission will be used to progress the process for this proposed district plan, and may be made publicly available.

Tonkin+Taylor

Job No: 1008304
8 October 2018

To: Waikato District Council
Private Bag 544
Ngaruawahia 3742

Submitter: Shand Properties

Address for service: C/- Tonkin and Taylor
PO Box 9544
Hamilton
Attention: G Eccles

Phone: 021 510 131
Email: geccles@tonkintaylor.co.nz

Submission on Proposed Waikato District Plan

1 Preliminary matters

Shand Properties could not gain an advantage in trade competition through this submission.

Shand Properties wishes to be heard in support of this submission.

If others make a similar submission, we will consider presenting a joint case with them at the hearing.

2 Background

Shand Properties owns approximately 141ha of land held in several titles fronting Ohinewai North Road at Ohinewai (identified on the "Requested Zoning" plan in **Appendix A**).

Shand Properties submits on the Proposed Waikato District Plan (PWDP) requesting that Waikato District Council zone the portion of its property between the Waikato Expressway and the Waikato River as Country Living Zone rather than the "as notified" Rural Zone. This area is identified on the "Requested Zoning" plan in Appendix A (and referred to hereafter as "the site"). It equates to an area of approximately 61 ha.

2.1 Site description

The site is located just to the north of the existing settlement of Ohinewai. The existing settlement contains a Council administered reserve including tennis courts and a hall, a school, some small commercial buildings, housing, and an area of Country Living Zone to the south. Ohinewai is approximately 10 km north of Huntly and 12 km south of Te Kauwhata.

The site is currently zoned Rural in the Operative Waikato District Plan and is also proposed to be zoned Rural in the "as-notified" version of the Proposed Waikato District Plan (PWDP). Ohinewai North Road appears to be designated with a small area extending into the site (Designations J6 and

M12). However, there is a difference between the electronic maps and pdf Map 14 in the extent of these designations. Apart from the designation, there are no Overlays applying to the site.

The site is located between State Highway 1 (the Waikato Expressway, hereafter referred to as SH 1) in the east and the Waikato River in the west. SH 1 is a limited access four lane, median divided expressway. It is the primary inter-regional link between Auckland and Hamilton (and the south). No direct access is permitted to the State Highway. A full diamond grade separated interchange is present nearby to the site at Tahuna Road.

Tahuna Road is an undivided two lane - two way road, with a posted speed limit of 100km/h. It is classified as an arterial road in the PWDP. It links Ohinewai with SH 1 at the interchange and continues to the east linking with SH 27 at Tahuna. It is generally considered to be a de facto Huntly bypass attracting vehicles travelling to the Coromandel, Bay of Plenty and southern destinations.

Ohinewai North Road is an undivided two lane - two way road, with a posted speed limit of 70km/h. It is classified as a local road within the PWDP, but prior to the construction of the Waikato Expressway served as SH1

The topography of the site is flat to rolling. It is largely covered in pasture, interspersed with individual trees and several shelter belts. A drainage channel runs through the centre of the site. Until recently the site was used for dairy farming.

There is a stopbank along the Waikato River to the west of the site that forms part of the Lower Waikato Flood Control Scheme administered by Waikato Regional Council.

Although adjacent land to the north of Ohinewai North Road also forms part of the parcels owned by Shand Properties, based on preliminary information available, particularly the presence of recorded archaeological sites on the northern part of its property, Shand Properties is only seeking a change in the proposed zoning for the portion of the site shown on the plan in Appendix A.

3 Submission points

Shand Properties seeks the following decisions from Waikato District Council, for the reasons given:

Plan Section	Support/Oppose	Decision Requested	Reason for Decision Requested
Online Planning Maps Map 14	Oppose	Amend to change the zoning of the part of the site, as shown on the area identified on the plan in Appendix A, from Rural Zone to Country Living Zone.	The site is located in close proximity to the existing Ohinewai Village and is suitable to provide for rural residential capacity in the area. Further reasons are outlined in this submission below.
Chapter 5.6 Country Living Zone objectives and policies	Support	Retain the proposed objectives and policies	The proposed objectives and policies generally provide an appropriate framework for implementing rules for assessing and managing effects of activities.
Chapter 5: Rural Environment	Oppose in part	Amend Chapter 5 to clarify the scope of the application of the objectives and policies in the "Rural Environment".	It is not clear which of the "Rural Environment" objectives and policies apply just in the Rural Zone and which apply to other zones in the "Rural Environment" chapter, including the Country Living

Plan Section	Support/Oppose	Decision Requested	Reason for Decision Requested
			Zone. For example under the Chapter 5 heading it states "The following objectives and policies apply to the Rural Zone" (emphasis added) but the chapter structure and the wording in some of the objectives and policies suggest they may be intended to have wider application.
Chapter 23 Country Living Zone rules	Support in part	Retain the proposed rules, except as identified below.	The proposed rules generally provide an appropriate framework for assessing and managing effects of activities in the Country Living Zone. Some specific amendments are needed in certain areas, as identified below.
Country Living Zone 23.4 Subdivision 23.4.4 Title boundaries 23.3 Land Use - Building	Oppose	Change the standards for subdivision to address issues related to natural hazards and contaminated land in a more targeted, specific way. This could include through: • The replacement of standards 23.4.4(1)(iii)A and B; • The rewording of matters for discretion 23.4.4(b)(v) and (vi); • Addition of standards e.g. floor levels, in 23.3.	The rules should allow for addressing the issues related to natural hazards and contaminated land rather than have a blanket requirement for a non-complying activity resource consent where a boundary divides such an area.
Country Living Zone 23.4.4 Title boundaries	Oppose	Change the activity status for a subdivision not complying with the standards to discretionary.	It is also not clear why subdivision not meeting the standards is a non-complying activity but equivalent rule in the Rural Zone is discretionary. This should be changed for consistency.
Chapter 13 Definitions – new definition of natural hazard area	Oppose	Define "natural hazard area" with reference to standards and/or mapped locations	There is no definition provided for "natural hazard area", a term that is used throughout the PWDP in relation to subdivision rules. The absence of a definition makes the application of the rules unworkable in practice.
Chapter 13 Definitions – Contaminated land	Oppose	Define "contaminated land" with reference to standards and/or mapped locations	The "contaminated land" definition refers to the RMA definition. This does not include any objective standards but requires a judgement to be

Plan Section	Support/Oppose	Decision Requested	Reason for Decision Requested
			made on effects. Given that this definition determines which rules apply to subdivision it could create uncertainty and difficulties in implementation.

4 Reasons for submission

4.1 Overview

While Ohinewai is not currently explicitly recognised in existing Waikato Regional growth strategy documents as a growth node, there is considerable potential for it to accommodate some of the growth that is forecast to occur along the Auckland to Hamilton corridor.

Ohinewai has good transport connections, being located in close proximity to an interchange onto State Highway 1, providing direct access to the north and south, including Huntly, which is located approximately 10 km away. The North Island Main Trunk rail line with the mooted passanger rail stop in Huntly runs immediately to the east of Ohinewai.

Providing for rural-residential capacity in Ohinewai could support and be supported by development in Huntly, which has growth constraints produced by topography and ground conditions.

With a minimum net site area of 5000 m^2 in the Country Living Zone (Rule 23.4.2) the site could provide approximately 100 rural-residential lots (based on a site area of approximately 61 ha and allowing for 10% of the area being required for infrastructure such as subdivisional roads).

The proposed Country Living Zone rules contain provisions to avoid, remedy and mitigate potential adverse effects of subdivision, use and development, including reverse sensitivity effects. These would ensure that subdivision and development occurs on the site in an appropriate manner.

Despite its obvious advantages in terms of proximity to existing urban centres and strategic transport infrastructure, and the existence of education and recreation facilities and commercial zoning in the village, the potential for Ohinewai to transition to a node more capable of accommodating residential development of a greater density is constrained at the present time by the lack of reticulated services available to the township. This constrains the nature of the zoning request that can be made as part of this submission.

4.2 Supporting information

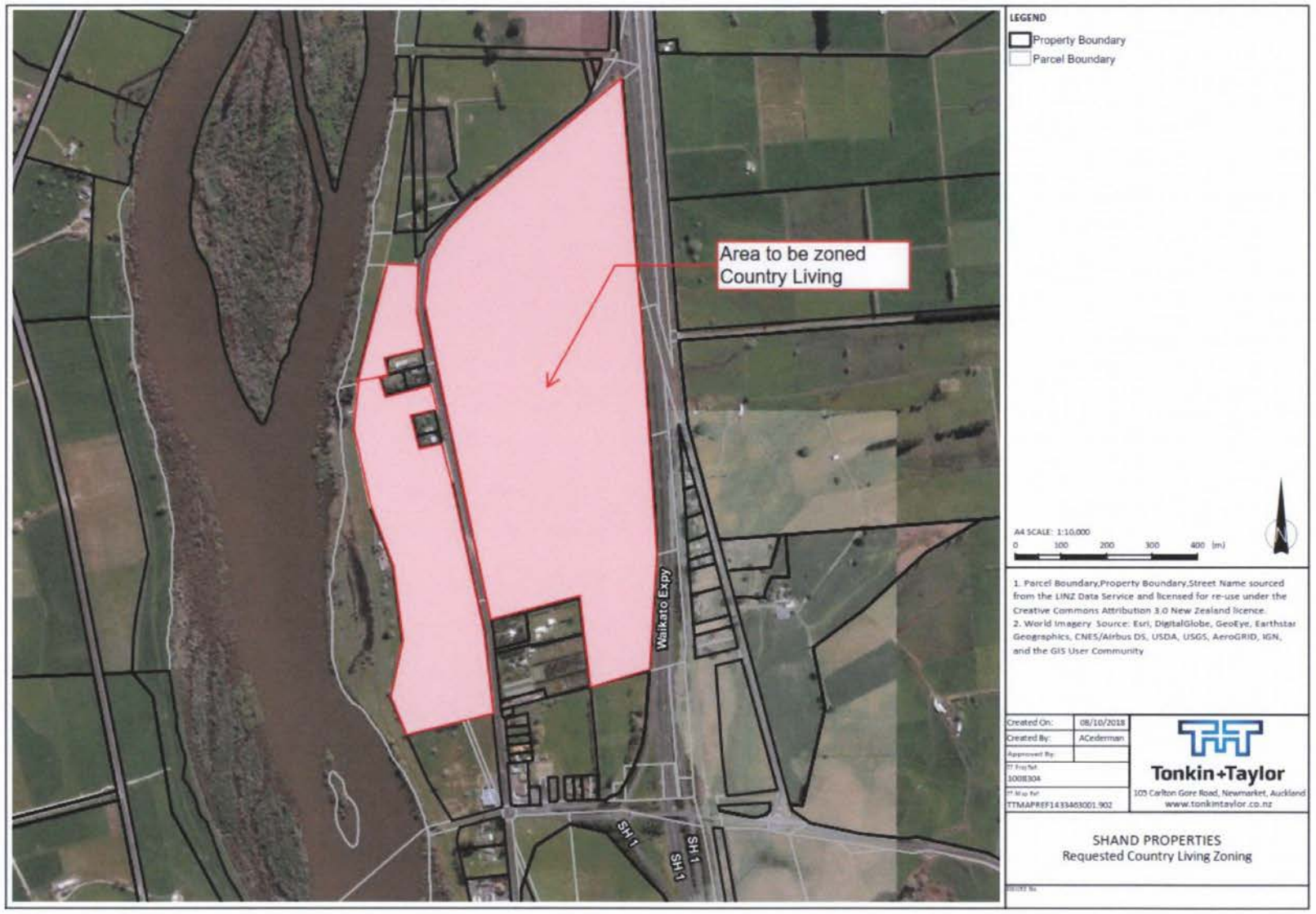
Tonkin & Taylor Limited (T+T) has undertaken several technical assessments to support this submission, including an assessment of the requested rezoning against the applicable policy framework. These are appended as Appendix B to this submission.

In summary the assessments conclude the following:

- **Planning**: The zoning of the site as Country Living Zone could provide rural-residential capacity that would support and be supported by the nearby Ohinewai village and the larger settlement of Huntly. The zoning of the site as Country Living Zone would be generally consistent with the relevant objectives and policies of the WRPS and PWDP.

- **Traffic**: The increase in traffic volumes would be modest and the level of service is not expected to deteriorate noticeably on the surrounding roads. The increase in risk is likely to be insignificant.
- **Flooding**: The site is reliant on protection afforded by the existing stopbank network to be protected from flood events. In that regard some risk exists. However there are opportunities to mitigate flood risk and reduce the extents of the existing floodplain through drainage infrastructure improvements. The risks associated with the flood hazard can be managed on the property.
- **Contaminated land**: The site has a history of farming use and activities have occurred on the site that are identified on the Hazardous Activities and Industries List (HAIL). Further detailed investigations would be required at later development stages but it is expected that any contamination encountered could be dealt with through implementation of standard methodologies.
- **Geotechnical**: Based on available geotechnical information, the site is likely to be geotechnically suitable for residential development, with specific investigation and assessment required to determine geotechnical requirements for building on each lot.

Appendix A: Plan of area sought to be zoned Country Living Zone



LEGEND

Property Boundary

Parcel Boundary

A4 SCALE: 1:10,000

0 100 200 300 400 (m)

1. Parcel Boundary,Property Boundary,Street Name sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 3.0 New Zealand licence.
2. World Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Created On:	08/10/2018
Created By:	ACederman
Approved By:	
TT Proj Ref:	1008304
TT Map Ref:	TTMAPREF1433463001.902

Tonkin+Taylor

105 Carlton Gore Road, Newmarket, Auckland
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SHAND PROPERTIES
Requested Country Living Zoning

Edition No:

Appendix B: Supporting information

Tonkin+Taylor

Job No: 1008304
8 October 2018

Shand Properties Ltd
PO Box 112
Huntly

Submission on Proposed Waikato District Plan - Zoning of land at Ohinewai North Road, Ohinewai - Planning Assessment

1 Background

Gerald Shand, Jacqueline Rogers, Catherine Baker (directors of Shand Properties) own an area of land fronting Ohinewai North Road at Ohinewai (identified on the "Requested Zoning" plan in **Appendix A**).

This assessment supports a submission by Shand Properties on the Proposed Waikato District Plan (PWDP) requesting that Waikato District Council zone a large portion of its property between the Waikato Expressway and the Waikato River as Country Living Zone rather than the "as-notified" Rural Zone. This area is identified on the "Requested Zoning" plan in Appendix A (and referred to hereafter as "the site"). It equates to an area of approximately 61 ha. The property information for this area, including the legal descriptions, is contained in **Appendix B**.

This report contains a planning assessment of the proposal, informed by appended technical assessments relating to traffic, flooding, ground contamination and geotechnical conditions.

2 Site description and context

The site is located just to the north of the existing settlement of Ohinewai. The existing settlement contains a Council administered reserve including tennis courts and a hall, a school, some small commercial buildings, housing, and an area of Country Living Zone to the south. Ohinewai is approximately 10 km north of Huntly and 12 km south of Te Kauwhata.

The site is currently zoned Rural in the Operative Waikato District Plan and is also proposed to be zoned Rural in the "as-notified" version of the Proposed Waikato District Plan (PWDP). Ohinewai North Road appears to be designated with a small area extending into the site (Designations J6 and M12). However, there is a difference between the electronic maps and pdf Map 14 in the extent of these designations. Apart from the designation, there are no Overlays applying to the site.

The site is located between State Highway 1 (the Waikato Expressway, hereafter referred to as SH 1) in the east and the Waikato River in the west. SH 1 is a limited access four lane, median divided expressway. It is the primary inter-regional link between Auckland and Hamilton (and the south). No direct access is permitted to the State Highway. A full diamond grade separated interchange is present nearby to the site at Tahuna Road.

Tahuna Road to the south is an undivided two lane - two way road, with a posted speed limit of 100km/h. It is classified as an arterial road in the PWDP. It links Ohinewai with SH 1 at the interchange and continues to the east linking with SH 27 at Tahuna. It is generally considered to be

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a de facto Huntly bypass attracting vehicles travelling to the Coromandel, Bay of Plenty and southern destinations.

Ohinewai North Road bisects the site. It is an undivided two lane - two way road, with a posted speed limit of 70km/h. It is classified as a local road within the PWDP, but prior to the construction of the Waikato Expressway served as SH1

The topography of the site is flat to rolling. It is largely covered in pasture, interspersed with individual trees and several shelter belts. A drainage channel runs through the centre of the site. Until recently the site was used for dairy farming.

There is a stopbank along the Waikato River to the west of the site that forms part of the Lower Waikato Flood Control Scheme administered by Waikato Regional Council.

Although adjacent land to the north of Ohinewai North Road also forms part of the parcels owned by Shand Properties, based on preliminary information available, particularly the presence of recorded archaeological sites on the northern part of its property, Shand Properties is only seeking a change in the proposed zoning for the portion of the site shown on the plan in Appendix A.

2.1 Supporting information

T+T has undertaken several assessments on key matters to consider in zoning and development of the site for rural-residential use. These technical reports are contained in Appendices C to F and the key findings are summarised below.

2.1.1 Traffic

A preliminary assessment of the potential traffic effects of the requested rezoning has been undertaken and is appended as Appendix C. Based on an estimated approximate 100 dwellings, the approximate daily trip generation is estimated to be 1000 vehicles, with 80 peak hour trips. The assessment concludes that, based on a conservative assessment, the increase in traffic on the wider network[1] is expected to be imperceptible.

The main areas of traffic increase will be on Ohinewai North Road and Tahuna Road (west) between Ohinewai North Road and SH 1. However, the current traffic volumes on these roads are significantly below the road and intersection capacity. Ohinewai North Road is little changed from its previous layout and use as the former SH 1. The level of service is not expected to deteriorate noticeably on these roads.

In terms of safety, the increase in traffic is modest and the increase in risk is likely to be insignificant. When the predominant cause of crashes is taken into account, it appears that unfamiliarity with the intersection between the expressway off ramp and Tahuna Road has contributed to crashes, drivers leaving and arriving at the site will be aware of the intersection and therefore unlikely to approach at an inappropriate speed.

The assessment concludes that at this stage it is considered unlikely that any major improvement to existing infrastructure will be necessary. However, intersection modelling and refinement of evaluation is recommended when further details of the proposal are developed.

2.1.2 Flooding

A preliminary assessment identifying areas subject to flooding and potential mitigation measures is appended as **Appendix D**. The assessment considers both potential flooding from the Waikato River and from the local catchment.

[1] In this context, wider network refers to SH 1 and Tahuna Road beyond the SH interchange

The property is protected by stopbanks along the eastern side of the Waikato River. Based on a review of available information the stopbanks provide protection to a flood level that exceeds the 1% Annual Exceedance Probability (AEP) flood level, therefore the site does not lie within either the existing 1% AEP or 2% AEP Waikato River floodplain[2].

Based on a high level flood assessment caused by runoff from the local catchment, Figure 1 in Appendix D provides a likely upper estimate of the existing floodplain based on existing topography (recorded by LiDAR). From this high level flood assessment, it is estimated that approximately 36 ha of the property could be subject to surface flooding, at a volume of approximately 150,000m^3.

Modifications to the site terrain and allowances for drainage infrastructure will reduce the surface flooding extent and volumes. As flooding is primarily located in the middle of the property, it is likely to be feasible to modify ground levels within the property extents to reduce the floodplain area without causing off-site effects. Further assessment would be required at design stage. In relation to potential flooding from the Waikato River, mitigation may include several measures, including upgrades to the Waikato River stopbank.

2.1.3 Ground contamination

A preliminary site investigation (PSI) has been undertaken for the site and is appended as **Appendix E**. The site has a history of use for farming and the PSI identifies that activities identified on the Hazardous Activities and Industries List (HAIL) have occurred on the site. These relate to historic land filling, application of fertilisers, burn piles, off-site orchard activities and offsite storage of chemicals.

The results of the PSI are consistent with what would be expected on a site with a history of farming and should not preclude the site being zoned Country Living. Further investigations may be required at the time of subdivision or development to determine whether any resource consents are required under the applicable rules. It is expected that if any ground contamination is found during a future detailed site investigation(s) this can be managed through the application of standard methodologies.

2.1.4 Geotechnical

A preliminary geotechnical assessment has been undertaken for the site and is appended as **Appendix F**. Based on previously reported data the assessment infers that pumiceous sands and silts of the Taupo Pumice Alluvium underlie the site. Site investigations undertaken by T+T for the assessment identified the material underlying the site to comprise a thin topsoil layer followed by sands with silts to around 1 m depth then gravels with sands. Groundwater levels were measured between 0.5 and 2.5 m below ground level (bgl). It is likely that, with the Waikato River adjacent to the western lots, the groundwater level could vary across the site, as well as seasonally.

The geotechnical assessment includes consideration of liquefaction potential for the site. The assessment shows that for a 25 year return period Serviceability Limit State (SLS) event liquefaction-induced ground damage at the surface is unlikely to affect the site, however, liquefaction-induced damage at the surface is possible in the 500 year return period Ultimate Limit State (ULS) case.

Due to the residual uncertainties inherent in a desktop study, it is not possible to quantify the degree of expected damage with any more certainty at this stage. The degree of damage can range from minor to severe depending on the water level, soil type and proximity to free faces. Mitigation measures may be incorporated into designs to address the risk of damage (e.g. robust foundation designs). The report recommends potential setbacks from swales (if used) and the farm drain (if it

[2] This assumes the stopbanks will withstand the 1% AEP flood level and will withstand extended periods of elevated flood levels without failure.

remains) and that further investigations be undertaken to determine other mitigation requirements prior to development.

The geotechnical assessment identifies potential geotechnical risks at the site and potential measures that may be applied to mitigate these risks. These are matters that can be addressed in the design of building platforms and site preparation.

The geotechnical assessment concludes that, based on available geotechnical information, the site is likely to be geotechnically suitable for residential development, with specific investigation and assessment required to determine geotechnical requirements for each lot.

3 Proposed Waikato District Plan provisions

The proposed objectives and policies relating to the Country Living Zone are contained in Chapter 5.6 and these are implemented through rules in Chapter 23. The rules contain a framework for permitted activities, subject to standards, as well as discretionary and non-complying activities. Standards include controls on noise, lighting and glare, earthworks, hazardous substances, signs, storage, and indigenous vegetation clearance. Permitted activity standards control the location of dwellings on a site (e.g. outside of specified overlays), building height, daylight admission, building coverage and building setbacks. The building setbacks include a 35 m setback from the Waikato Expressway/SH 1. Subdivision outside of specified overlays (which do not apply to the site) and complying with applicable standards is a restricted discretionary activity. Standards require a minimum net site area of 5000m^2. A boundary of a proposed lot must not divide (among other things) a natural hazard area or contaminated land. Matters to which Council's discretion is restricted include landscape values, amenity values and character, reverse sensitivity effects, effects on any existing building, effects on a natural hazard area and effects on contaminated land.

Generally these rules appear to provide an appropriate framework for assessing and managing the potential effects of subdivision and development in the Country Living Zone. However, there are some uncertainties. It is unclear what constitutes a "natural hazard area" and, while there is a definition of "contaminated land" the generality of the definition could make it difficult to implement in practice in this context. More targeted provisions, for example specific requirements to consider geotechnical risks, and a more specific definition of what constitutes contaminated land would improve the rules. The rules should allow for addressing the issues related to natural hazards and contaminated land rather than have a blanket requirement for a non-complying activity resource consent where a boundary divides such an area.

4 Policy context

4.1 Resource Management Act 1991

Section 5 of the Resource Management Act ('RMA') states the purpose of the Act which is to 'promote the sustainable management of natural and physical resources'. In this context, sustainable management means managing the natural and physical resources of the rural environment by applying the Country Living Zone to provide rural-residential living on the site. This would enable the social, economic, and cultural well-being of people and communities by providing capacity for rural-residential living in an area in close proximity to the existing village of Ohinewai and the larger urban area of Huntly.

The principles of the RMA are contained in Sections 6 – 8. Section 6 relates to 'Matters of National Importance' covering natural, physical and cultural (heritage resources). The site does not contain any identified heritage or ecological features and avoids the recorded archaeological features located in the northern area of the property.

Section 7 relates to 'Other Matters' in relation to managing the use, development, and protection of natural and physical resources. Section 7(b) requires Council to have particular regard to the efficient use and development of natural and physical resources. The application of the Country Living Zone to the site will provide for rural-residential living, and avoid dairy farming in close proximity to the Waikato River, which safeguards natural and physical resources. The site's proximity to transport connections and existing settlements also contributes to the efficient use and development of natural and physical resources.

Section 7(c) requires Council to maintain and enhance amenity values. The PWDP includes an objective and rules aimed at maintaining rural character and amenity which would apply to the site. A higher level of amenity is anticipated in the Country Living Zone than the Rural Zone.

Section 7(f) requires Council to maintain and enhance the quality of the environment. It is anticipated that the application of the provisions applying to the Country Living Zone would achieve this.

Section 8 requires Council to take into account the Principles of the Treaty of Waitangi ('Treaty'). The principles of the Treaty such as kaitiakitanga (stewardship) have been addressed in the provisions of the PWDP.

4.2 Growth strategies

There are a number of growth strategies and strategic planning processes that are either completed or underway in order to shape the development of the Waikato region.

The Future Proof Growth Strategy (updated November 2017) is a 30 year growth strategy for Hamilton city, Waipa and Waikato districts. In the Waikato District the Future Proof Strategy aims to achieve around 80% of growth into Pokeno, Tuakau, Te Kauwhata, Huntly, Ngaruawahia, Raglan and various villages. It identifies a settlement pattern which includes Huntly and Te Kauwhata. It identifies opportunities for growth in Huntly and the potential for Huntly to provide services and employment opportunities for surrounding areas including Te Kauwhata. It identifies the growing influence of Hamilton and Auckland, influencing growth and development within the sub-region. Ohinewai is not identified in the Future Proof Growth Strategy or the Future Proof area (as defined in the Waikato Regional Policy Statement (WRPS)). However, like Te Kauwhata, Ohinewai is in a location that could support and be supported by Huntly. Huntly is located approximately 10 km to the south of Ohinewai. Its development capacity is expected to be somewhat constrained due to factors such as topography, being bounded by hills, constraints placed by underground mine workings and by SH 1 forming a boundary around the settlement's edge. These factors limit the availability of easily developable land.

Waikato District Council is currently preparing "Blueprint" or "Local Area Blueprint" plans which are master plans to guide development in the district. A Blueprint has not yet been prepared for Ohinewai.

We understand that further work is also being undertaken, driven by central government, in reviewing existing strategies in the Waikato and Auckland and preparing an integrated spatial development strategy including transport, economic development and housing opportunities in the Auckland to Hamilton corridor.

Despite its obvious advantages in terms of proximity to existing urban centres and strategic transport infrastructure, and the existence of education and recreation facilities and commercial zoning in the village, the potential for Ohinewai to transition to a node more capable of accommodating residential development of a greater density is constrained at the present time by the lack of reticulated services available to the township. This constrains the nature of the zoning that can be put in place at this point in time.

4.3 Waikato Regional Policy Statement

4.3.1 Relevant objectives and policies

The RPS contains high level objectives and policies for the Waikato Region. The PWDP must give effect to the WRPS. Of particular relevant are the development principles in Chapter 6A, and these are addressed below. Also of relevance are the provisions relating to natural hazards, Objective 3.24 and Policy 13.2. These require subdivision, use and development to be managed to reduce the risks from natural hazards to an acceptable and tolerable level. Preliminary assessments relating to flooding and geotechnical conditions indicate that some mitigation measures will be required to manage potential risks relating to natural hazards.

4.3.2 Development principles

Chapter 6A of the WRPS contains "development principles" for new development. In accordance with Policy 6.1 subdivision, use and development of the built environment should occur in a planned and co-ordinated matter which has regard to these principles. An assessment against these principles is set out below. While noting that some matters would be subject to more detailed design, development of the site could be undertaken to be generally consistent with these development principles.

Table 4.1 Assessment against WRPS development principles

Principle	Comment
General development principles	
a. support existing urban areas in preference to creating new ones	The site is just to the north of the existing settlement of Ohinewai. The existing settlement contains a reserve with tennis courts and a hall, a school, some small scale commercial zoning and ex-commercial premises, housing, and a proposed area of Country Living Zone to the south. The site is therefore in a location to support the existing village.
b. occur in a manner that provides clear delineation between urban areas and rural areas;	SH 1 provides a clear boundary to the east and the Waikato River to the west. To the south are a few smaller Rural zoned properties and the village of Ohinewai. While Shand Properties is seeking rezoning from Rural Zone to another rural type zone (Country Living Zone), there are several features that would provide clear delineation.
c. make use of opportunities for urban intensification and redevelopment to minimise the need for urban development in greenfield areas;	The rezoning would not contribute to urban intensification per se.
d. not compromise the safe, efficient and effective operation and use of existing and planned infrastructure, including transport infrastructure, and should allow for future infrastructure needs, including maintenance and upgrading, where these can be anticipated;	The site is located adjacent to a State Highway 1 interchange. The traffic assessment in Appendix C considers the traffic environment and the potential effects of development. It concludes that the increase in traffic would be very modest and the increase in risk is likely to be insignificant.
e. connect well with existing and planned development and infrastructure;	The site is located in close proximity to Ohinewai village and an area of Country Living Zone. Existing transport connections are available onto Ohinewai

Principle	Comment
	North Road and State Highway 1. Despite its obvious advantages in terms of proximity to existing urban centres and strategic transport infrastructure, and the existence of education and recreation facilities and commercial zoning in the village, the potential for Ohinewai to transition to a node more capable of accommodating residential development of a greater density is constrained at the present time by the lack of reticulated services available to the township. In that regard, the planned construction of a Wastewater Treatment Plant to serve the Huntly-Te Kauwhata corridor(including Ohinewai) means that development of the sie is easily able to connect to planned infrastructure.
f. identify water requirements necessary to support development and ensure the availability of the volumes required;	The site would be expected to be self-serviced, given the expected lot size and the location.
g. be planned and designed to achieve the efficient use of water;	The site would be expected to be self-serviced, given the expected lot size and the location. Efficient use of water can be managed through use of tank systems.
h. be directed away from identified significant mineral resources and their access routes, natural hazard areas, energy and transmission corridors, locations identified as likely renewable energy generation sites and their associated energy resources, regionally significant industry, high class soils, and primary production activities on those high class soils;	The site is not located within any such areas identified on the Proposed Waikato District Plan maps, or any other relevant maps, and does not contain high class soils as defined in the Proposed Waikato District Plan. The geotechnical assessment has identified some geotechnical risk (potential for liquefaction, and isolated areas of soft soils) on the site. This risk can be substantially mitigated through appropriate design measures at later stages of site and building development.
i. promote compact urban form, design and location to: i. minimise energy and carbon use; ii. minimise the need for private motor vehicle use; iii. maximise opportunities to support and take advantage of public transport in particular by encouraging employment activities in locations that are or can in the future be served efficiently by public transport; iv. encourage walking, cycling and multi-modal transport connections; and v. maximise opportunities for people to live, work and play within their local area;	The requested zoning is for rural residential rather than urban development. However, the close proximity to Ohinewai village provides opportunities for minimising vehicle trips. The site is also in relatively close proximity (in travel time) to Huntly which may include a stop for any future commuter rail service to and from Auckland.
j. maintain or enhance landscape values and provide for the protection of historic and cultural heritage;	The requested zoning would result in maintaining relatively low density and therefore retain the area's rural character. There are no historic or cultural heritage features identified on the planning maps.

Principle	Comment
k. promote positive indigenous biodiversity outcomes and protect significant indigenous vegetation and significant habitats of indigenous fauna. Development which can enhance ecological integrity, such as by improving the maintenance, enhancement or development of ecological corridors, should be encouraged;	There are no significant ecological features on the site. A shift away from dairy farming use could result in benefits to the nearby Waikato River.
l. maintain and enhance public access to and along the coastal marine area, lakes, and rivers;	The site is set back from the Waikato River by a strip of reserve so the rezoning would not affect access.
m. avoid as far as practicable adverse effects on natural hydrological characteristics and processes (including aquifer recharge and flooding patterns), soil stability, water quality and aquatic ecosystems including through methods such as low impact urban design and development (LIUDD);	There is sufficient space on the site to incorporate measures to mitigate effects on natural hydrological characteristics through appropriate design.
n. adopt sustainable design technologies, such as the incorporation of energy-efficient (including passive solar) design, low-energy street lighting, rain gardens, renewable energy technologies, rainwater harvesting and grey water recycling techniques where appropriate;	The provisions of the Country Living Zoning would be applied to the site. There is potential for the use of sustainable design technologies to be adopted.
o. not result in incompatible adjacent land uses (including those that may result in reverse sensitivity effects), such as industry, rural activities and existing or planned infrastructure;	The location of the site reduces the potential for conflict with surrounding land uses. There is the potential for reverse sensitivity noise effects due to the proximity to the Waikato Expressway/SH 1 but these could be managed through appropriate location of dwellings and development would be regulated by the rules in the Country Living Zone, such as the building setback rules in 23.3.7.
p. be appropriate with respect to projected effects of climate change and be designed to allow adaptation to these changes;	It is anticipated that some mitigation will be required to address flooding and drainage on the site and in relation to the Waikato River stopbank. It is expected that the design of any drainage infrastructure would be designed appropriately to take into account climate change projections.
q. consider effects on the unique tāngata whenua relationships, values, aspirations, roles and responsibilities with respect to an area. Where appropriate, opportunities to visually recognise tāngata whenua connections within an area should be considered;	The provisions of the Waikato Tainui Environmental Plan are considered in Section 4.5 of this report. With appropriate design it is expected that development in this area could be consistent with the relevant objectives and policies.
r. support the Vision and Strategy for the Waikato River in the Waikato River catchment;	The development of the site would support the Vision and Strategy for the Waikato River, as discussed below.
s. encourage waste minimisation and efficient use of resources (such as through resource-efficient design and construction methods);	There is potential to encourage waste minimisation and efficient use of resources in the development.
t. recognise and maintain or enhance ecosystem services.	There are no significant ecological features on the site. There is potential for enhanced ecosystem services through potential planting of lots.

Principle	Comment
Principles specific to rural-residential development	
a. be more strongly controlled where demand is high;	The site is not on the outskirts of either Auckland or Hamilton so demand is not expected to be as high as if it were.
b. not conflict with foreseeable long-term needs for expansion of existing urban centres;	Allowing for further Country Living development at Ohinewai will compliment, rather conflict with the desired residential expansion at Huntly.
c. avoid open landscapes largely free of urban and rural-residential development;	The site is adjacent to State Highway 1 and located close to existing smaller sites and facilities such as a school, hall etc. Therefore it avoids such open landscapes.
d. avoid ribbon development and, where practicable, the need for additional access points and upgrades, along significant transport corridors and other arterial routes;	The development of the site would not require additional access points or upgrades to the State Highway 1 interchange or the intersection with Tahuna Road.
e. recognise the advantages of reducing fuel consumption by locating near employment centres or near current or likely future public transport routes;	The site is located with easy access to State Highway 1 with possible employment opportunities to the north and the south, including Huntly.
f. minimise visual effects and effects on rural character such as through locating development within appropriate topography and through landscaping;	The landscape has relatively flat topography. The change in rural character would be minimal.
g. be capable of being serviced by onsite water and wastewater services unless services are to be reticulated;	The lot size would be sufficient to accommodate on-site services.
h. be recognised as a potential method for protecting sensitive areas such as small water bodies, gully-systems and areas of indigenous biodiversity.	While there are some farm drainage ditches / modified watercourses on the site, there are no natural streams, gully systems or significant areas of indigenous biodiversity on the site that would warrant protection.

4.3.3 Vision and strategy for the Waikato River

As part of the Waikato River Settlement between the Crown and Waikato-Tainui, Te Ture Whaimana o Te Awa o Waikato – the Vision and Strategy for the Waikato River has been developed. This forms part of the WRPS (Section 2.5).

The vision is for a future where a healthy Waikato River sustains abundant life and prosperous communities who, in turn, are all responsible for restoring and protecting the health and wellbeing of the Waikato River, and all it embraces, for generations to come.

Several objectives have been identified to realise the vision, including the restoration and protection of the health and wellbeing of the Waikato River and the restoration and protection of the relationships of Waikato-Tainui with the Waikato River. Several strategies are identified to achieve the objectives.

The site is located in close proximity to the Waikato River. The change from rural production to rural-residential uses is not expected to adversely impact on the Waikato River, provided appropriate on-site wastewater systems are installed (as required by proposed Rule 14.11.1.3).

4.4 Proposed Waikato District Plan

The PWDP contains objectives and policies for the Country Living Zone in Chapter 5.6. The Country Living Zone objectives, policies and rules contain provisions to avoid, remedy and mitigate potential adverse effects of subdivision, use and development. It recognises the potential for reverse sensitivity effects and the need to manage these. Rules are therefore proposed in the Country Living Zone to address this, including for example Rule 23.3.7 which requires building setbacks from road (including the Waikato Expressway) and other boundaries.

As noted in the Section 32 Report notified with the PWDP, subdivision also results in land fragmentation by the creation of smaller land parcels which make it increasingly harder to undertake rural activities, resulting in an inefficient use and potentially over-capitalisation of rural land. The Country Living Zone has density controls (minimum lot sizes) to provide for large lot subdivision.

The Section 32 report notified with the PWDP describes the Country Living Zone as an important zone in terms of providing rural-residential living and enabling development that is compatible with its character and amenity. It provides for a specific market demand being rural-residential living.

The PWDP seeks to minimise the fragmentation of productive rural land and provide a range of lifestyle options directed away from high class soils and/or where indigenous biodiversity is being protected (Policy 5.2.3). The Country Living Zone responds to the growth pressures facing the district and provides rural residential living opportunities to alleviate pressure for the subdivision and development of rural land.

The development of the site for rural residential living would result in the loss of a small amount of potentially productive rural land. However, the site in question has historically been operated as a dairy farm, but requires significant capital investment (e.g. new milking shed, new effluent treatment/disposal system) in order to meet environmental standards moving forward, given its proximity to the Waikato River. It is not located on high class soils and the nature of the site, including its proximity to the existing village of Ohinewai, means the site could be subdivided and developed to be consistent with the strategic objective for the rural environment (Objective 5.1.1) and the objectives and policies of the Country Living Zone, namely:

- Objective 5.6.1 – Country Living Zone;
- Policy 5.6.2 – Country Living character;
- Policy 5.6.3 – Subdivision within the Country Living zone;
- Policies 5.6.4 to 5.6.18 which deal with specific matters to be managed in the Country Living Zone, including through permitted activity controls.

Objective 10.2.1 and Policy 10.2.2 seek to manage the subdivision, use and development of contaminated land to protect human health and the environment. A PSI has been undertaken (Appendix E) which has identified HAIL activities have occurred on the site consistent with those that would be expected on a rural site. The management of the disturbance of potentially contaminated soils can be dealt with through resource consent requirements (if applicable) at the time of subdivision and development.

4.5 We understand that the preparation of draft provisions for the Natural Hazards and Climate Change Chapter 11 is underway and will be notified as Stage 2 of the Proposed Plan in 2019. Waikato Tainui Environmental Plan

The Waikato-Tainui Environmental Plan, Tai Tumu Tai Pari Tai Ao contains objectives and policies relevant to the development of the site. Key relevant provisions are:

- **Land use and development**: Objectives 25.3.1, 25.3.2, 25.3.3, Policies 25.3.1.1, 25.3.2.1 and 25.3.3.1. These objectives and policies seek to apply development principles that enhance the environment and to ensure that development is well planned with positive environmental, cultural, spiritual and social outcomes. The site is located in close proximity to the existing village of Ohinewai and the loss of productive rural land would be minimal. Proposed controls in the PWDP for the Country Living Zone would guide development to be appropriately designed to address potential environmental and amenity effects.
- **Land contamination**: Objective 21.3.3 and Policy 21.3.3.1 seek to manage the impact of contaminated land on the environment. The PSI has identified that HAIL activities have occurred on the site, but the effects of the use of the land and disturbance can, if necessary, be managed through implementation of appropriate mitigation measures.
- **Flooding and drainage**: Objective 21.3.4 and Policy 21.3.4.1 promote integrated catchment management that considers land use, floodplain and drainage management and promotes habitat restoration. Drainage management measures are anticipated to form part of the development of the site and could be undertaken in a way that is consistent with these objectives and policies.

5 Section 32 matters

The PWDP identifies the following relevant objectives for the rural environment. These objectives been assessed in WDC's Section 32 Report as being the most appropriate way to achieve the purpose of the RMA.

Table 5.1 PWDP objectives

Objective reference	Objective
Objective 5.1.1 – The rural environment	Objective 5.1.1 is the strategic objective for the rural environment and has primacy over all other objectives in Chapter 5. (a) Subdivision, use and development within the rural environment where: (i) high class soils are protected for productive rural activities; (ii) productive rural activities are supported, while maintaining or enhancing the rural environment; (iii) urban subdivision, use and development in the rural environment is avoided.
Objective 5.2.1 – Rural resources	(a) Maintain or enhance the: (i) Inherent life-supporting capacity and versatility of soils, in particular high class soils; (ii) The health and wellbeing of rural land and natural ecosystems; (iii) The quality of surface fresh water and ground water, including their catchments and connections; (iv) Life-supporting and intrinsic natural characteristics of water bodies and coastal waters and the catchments between them.
Objective 5.3.1 – Rural character and amenity	(a) Rural character and amenity are maintained.
Objective 5.6.1 – Country Living Zone	(a) Subdivision, use and development in the Country Living Zone maintains or enhances the character and amenity values of the zone.

The table below considers whether the rezoning proposal is the most appropriate way to achieve these objectives.

Table 5.2 Evaluation of zoning change

		Benefits	Costs
Benefits and costs of the environmental, economic, social, and cultural effects	**Environmental**	Land in close proximity to the Waikato River would no longer be used for dairy farming with consequent potential adverse effects on water quality Provides for rural-residential development capacity in an environment that is not constrained by significant ecological features or values	Some change to existing rural character through development at a higher density Land modification required to address potential flooding and drainage issues
	Economic	Economic benefits to landowners in enabling subdivision opportunity	Loss of potentially productive rural land Measures required to address potential flooding and drainage issues
	Social	Provide for a rural-residential living option in proximity to an existing village and (Ohinewai) and larger town (Huntly) and associated social infrastructure and employment opportunities Enabling subdivision, and changes in land use activities will provide for the social wellbeing of the landowners. The proactive avoidance of reverse sensitivity effects has benefits in that community or neighbourhood disputes can be avoided for minimised in the future. Potential benefits for community facilities in having a greater population base	Pressure on community facilities (e.g. school) due to growth
	Cultural		Potential for development to uncover archaeological features. However, the proposed rezoning avoids the area immediately adjacent to the Waikato River which has recorded archaeological features and a higher likelihood of unrecorded archaeological features.

		Benefits	Costs
Other options for achieving objectives	Option: Retain Rural Zone – The proposed Rural zoning would provide for productive rural activities, but would not make use of the opportunity to provide rural-residential living options or create capacity for growth. Significant capital investment would be required to upgrade the on-site systems to allow for continued dairy farming in proximity to the Waikato River. Option: Apply another zoning e.g. Village Zone – The site is in proximity to Ohinewai Village and areas of proposed Village Zone. However, this would represent a substantial increase in the size of the village and could result in issues with servicing.		
Risk of acting or not acting if insufficient information	There is sufficient information available (including that provided in the reports attached to the submission) to enable the rezoning of the land. Further information can be obtained at a more detailed stage of development.		
Efficiency and effectiveness	The proposed zoning would be efficient and effective in achieving the stated objectives. It would provide for a rural-residential living option in proximity to an existing village and (Ohinewai) and larger town (Huntly) and associated social infrastructure and employment opportunities. It could be achieved through the application of the Country Living Zone provisions as proposed in the PWDP (with minor amendments).		

6 Conclusion

Based on a review of the information available on the site and an assessment against the applicable policy framework:

- The zoning of the site as Country Living Zone could provide rural-residential capacity that would support and be supported by the nearby Ohinewai village and the larger settlement of Huntly;
- The zoning of the site as Country Living Zone would be generally consistent with the relevant objectives and policies of the WRPS and PWDP;
- A preliminary review of key potential constraints and effects of development has not raised any matters in relation to traffic, flooding, contaminated land or geotechnical issues that cannot be assessed and dealt with through the resource consent process and appropriate conditions of consent.

7 Applicability

This report has been prepared for the exclusive use of our client Shand Properties Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:

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Alia Cederman

Senior Planner

Authorised for Tonkin & Taylor Ltd by:

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p.p. Glen Nicholson

Project Director

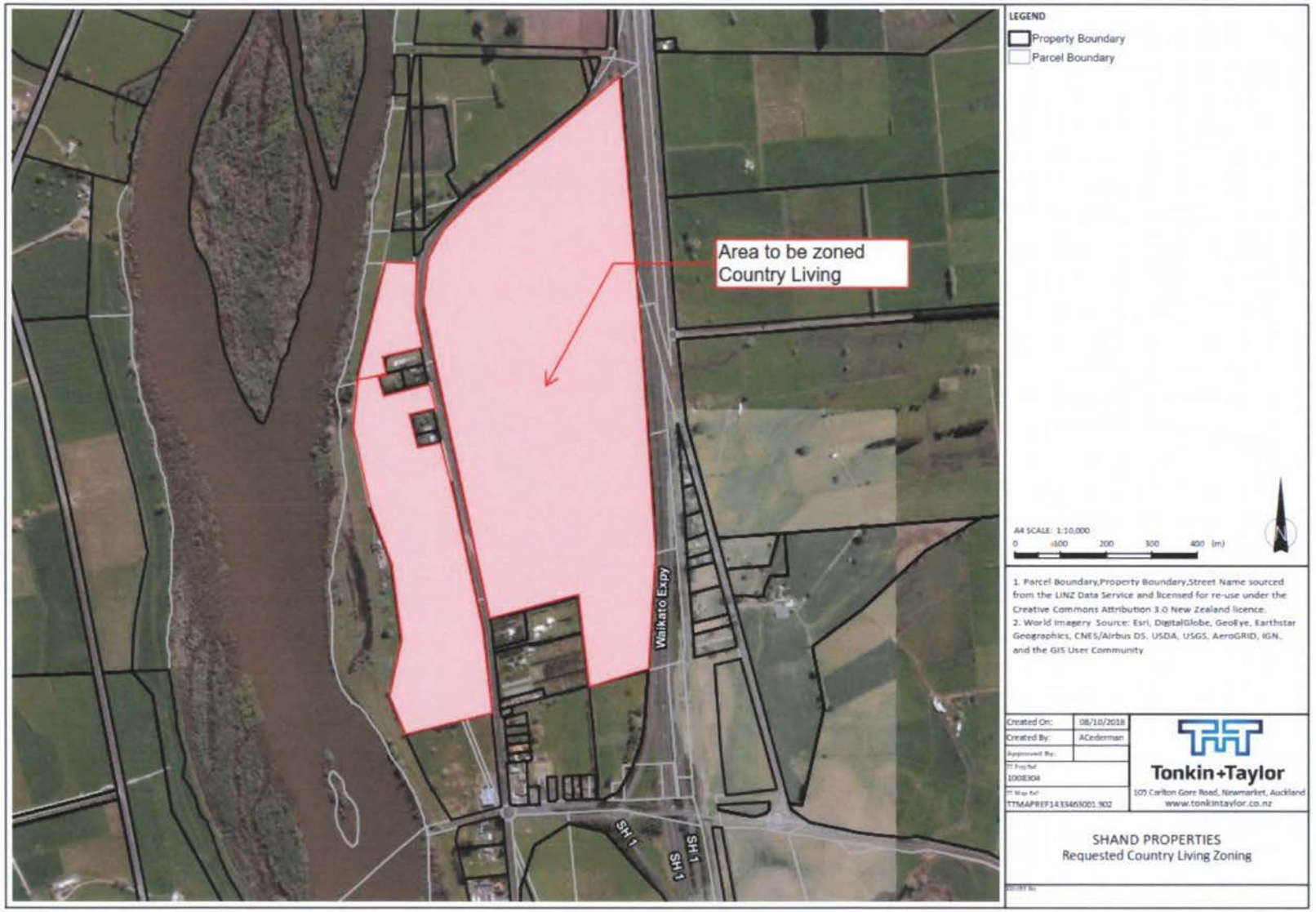
Reviewed by:

.....

Grant Eccles

Principal Planner

Appendix A: Plan of area sought to be zoned Country Living Zone



LEGEND

Property Boundary

Parcel Boundary

A4 SCALE: 1:10,000

0 100 200 300 400 (m)

1. Parcel Boundary,Property Boundary,Street Name sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 3.0 New Zealand licence.
2. World Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Created On:	08/10/2018
Created By:	ACederman
Approved By:	
TT Proj Ref	1008304
TT Map Ref	TTMAPREF1433465001.302

Tonkin+Taylor

105 Carlton Gore Road, Newmarket, Auckland
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SHAND PROPERTIES
Requested Country Living Zoning

Appendix B: Property information

Table B.1.1: Property information

Legal description	Title No.	Site owner
Part Allot 329A Taupiri PSH	SA64/283, SA33D/593	Gerald Shand, Jacqueline Rogers, Catherine Baker, Caleb Hill
Part Allot 47-48 Taupiri PSH Part Allot 44-45 Taupiri PSH Part Allot 46 Taupiri PSH Section 8-9 Block VII Rangiriri Survey District	SA1C/1280 SA33D/590 SA1412/12 SA632/43	Gerald Shand, Jacqueline Rogers, Catherine Baker
Part Allot 46 Taupiri PSH	SA557/33	Mary Silvester (minerals only)

*This property information is provided for information purposes only. The area subject to the zoning request is shown on the plan in Appendix A.

Appendix C: Traffic information

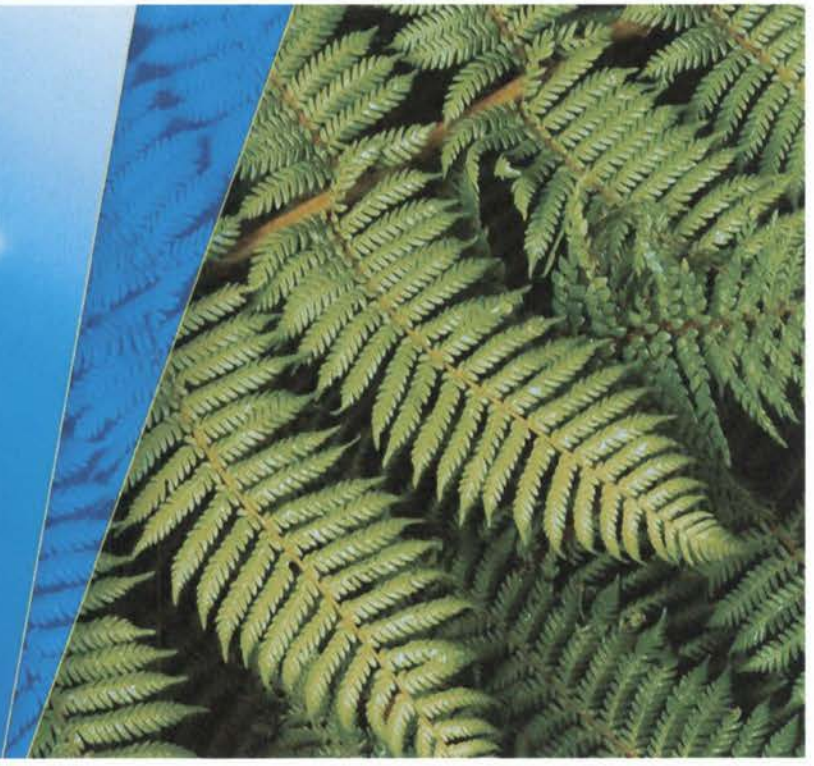
REPORT

Tonkin+Taylor

Ohinewai Rezoning

Transportation Impacts

Prepared for
Shand Properties
Prepared by
Tonkin & Taylor Ltd
Date
October 2018
Job Number
1008304.0000.v1



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Document Control

Title: Ohinewai Rezoning, Transportation Impacts					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
Sept 18	0	Draft	AGRE	RWD	
Oct 18	1	Final	AGRE	GREC	PRC

Distribution:

Shand Properties	PDF
Planning Report	PDF
Tonkin & Taylor Ltd (FILE)	PDF

Table of contents

1 Introduction

The purpose of this report is to provide a high level traffic impact assessment, based on assumed development area and yield for the requested rezoning of proposed rural land to rural residential (Country Living Zone) at Ohinewai. This assessment is intended to inform and support the planning report and not be distributed externally without supporting contextual documentation.

2 Site

We understand that the area of the property subject to the rezoning request lies within the environs of the village of Ohinewai, approximately 40 km north of Hamilton City. The site is currently rural farmland situated between the Waikato Expressway (SH 1) and the Waikato River. Ohinewai North Road, the former State Highway, runs through the site.

The area of potential rezoning therefore falls into two sections, approximately 45 ha east of Ohinewai North Road, and 16 ha west of Ohinewai North Road.

Figure 2.1 below, shows the approximate site area and location.

Figure 2.1: Ohinewai Site subject to request for rezoning to Country Living Zone (source: Google Maps)

3 Current Road Environment

The site is bisected by Ohinewai North Road bounded by SH 1 (Waikato Expressway) to the east. Tahuna Road is the only road that connects Ohinewai with the State Highway and wider transport network via a grade separated interchange.

- **SH 1** is a limited access four lane, median divided expressway, carrying approximately 24,000[1] vehicles per day (vpd). It is the primary inter-regional link between Auckland and Hamilton (and the south). No direct access is permitted to the State Highway. A full diamond grade separated interchange is present immediately south of the site at Tahuna Road.
- **Ohinewai North Road** is an undivided two lane - two way road, with a posted speed limit of 70k m/h. It is classified as a local road within the District Plan. As the former route of SH 1, it has a high level of service with 3.5 m lanes, 1.5 m shoulders and good sight distance and roadside clear zones. Its current traffic volume is below 100 vpd[2].
- **Tahuna Road** is an undivided two lane - two way road, with a posted speed limit of 100 km/h. It is classified as an arterial road in the District Plan. Tahuna Road links Ohinewai with SH 1 at the interchange, and continues 37 km to the east linking with SH 27 at Tahuna. It is generally considered to be a 'de facto' Huntly bypass attracting vehicles travelling to the Coromandel, Bay of Plenty and southern destinations. Tahuna Road carries approximately 520 vpd to the west of SH1, and 2,200 vpd east of SH1.

There are a number of dwellings, rural/agricultural businesses and a school clustered around Ohinewai South Road to the south of Tahuna Road which form the centre of the Ohinewai village. A small subdivision is accessed directly from Tahuna Road next to the village hall and tennis courts. Ohinewai North Road has sporadic dwellings and agricultural businesses, with a small construction yard at the intersection with Tahuna Road and the former retail centre (closed since the early 2000's) opposite.

4 Current Safety Performance

A review of crash records from the NZ Transport Agency Crash Analysis System (CAS) for the previous ten full calendar years reveals that there are no recorded crashes on Ohinewai North Road or Tahuna Road (Ohinewai side).

There are 13 crashes within 50 m of the intersection of Tahuna Road and the eastern (southbound) on/off ramps to the expressway as follows:

Table 4.1: Ten-year crash history at eastern ramp intersection

Year	Fatal	Serious	Minor	Non- Injury	Total
2018				1	**1**
2017					**0**
2016		1	1	1	**3**
2015					**0**
2014			1	2	**3**
2013				1	**1**
2012			1	1	**2**
2011			1	1	**2**
2010			1		**1**
2009					**0**
2008					**0**
Total	**0**	**1**	**5**	**7**	**13**

[1] Count data sourced from NZTA traffic data booklet available on NZTA website
[2] Count data sourced from WDC website

The predominant causes are loss of control on the expressway ramp due to inappropriate speed (6) and failure to give way at the intersection due to approach speed or failure to notice the priority control at the end of the off ramp (7). The serious crash was a failure to give way where alcohol was a factor.

Whilst there are a number of crashes on SH 1 itself, these have no bearing on the traffic effects of any development of the site for Country Living as they relate to through traffic and not merging or diverging traffic.

5 Development Yield

The requested rezoning would fall under the Country Living Zone criteria of the proposed District Plan, this permits an average lot size of 5,000 m^2.

With a developable area of approximately 61 ha (610,000 m^2), assuming 10% to 15% of this area is required for infrastructure and public space, and the average lot size, we have determined, for the purposes of this assessment, that the maximum number of lots would be approximately

6 Trip Generation

Based on the development potential of 100 lots with a single dwelling on each, this will result in an approximate daily trip generation of 1,000 vehicles[3].

Typically the peak traffic generation is 10% of the daily traffic, resulting in 100 peak hour trips.

However, given the relatively remote rural location of the site, it is likely that residents and visitors will be more economic with their vehicle usage and trip chaining[4] will be more prevalent. Surveys throughout the wider region[5] indicate that this can reduce daily trips by up to 40%, although peak hour volumes will typically remain one per dwelling.

7 Trip Distribution

Given the nature of the site being rural/rural-residential and remote from major employment and service centres, it is anticipated that the trip profile will be predominantly tidal during peak times, that is the majority of vehicles will leave the site during the morning and return in the evening. We have conservatively estimated this split to be 80/20 as described in Table 7.1. Further sensitivity testing is recommended when more detail is known about the proposed development.

Table 7.1: Peak hour trips

Period	Exit Site (Outbound)	Enter Site (Inbound)
AM Peak	80	20
PM Peak	20	80

Ohinewai is situated approximately a third of the way between Hamilton and Auckland, with typical peak hour journey times of 45 mins and 80 mins to those respective destinations. As a potential dormitory town, it is anticipated that residents will commute predominantly to Auckland and Hamilton. We suggest an appropriate split as follows:

[3] Derived from Table 14.12.5.13 of proposed District Plan as 10 trips per dwelling.
[4] Trip chaining is where multiple destinations are part of the same journey, (e.g. home to work to shop and back). It represents efficiencies in movement instead of making separate journeys for each task.
[5] Assessments carried out for Thames-Coromandel District Plan Review comparing traffic counts on access roads to rural subdivisions to numbers of dwellings in 2017 suggested an average of 6 trips per dwelling.

Table 7.2: Trip distribution

Destination	Proportion	AM Peak Outbound	AM Peak Inbound	PM Peak Outbound	PM Peak Inbound
North Waikato and Auckland Via SH 1	60%	48 vph	12 vph	12 vph	48 vph
South Waikato and Hamilton via SH1	30%	24 vph	6 vph	6 vph	24 vph
Eastern areas via Tahuna Road	10%	8 vph	2 vph	2 vph	8 vph

Further sensitivity testing is recommended when there is greater clarity over the number of dwellings and timing of the development.

8 Traffic Impact

All vehicle trips accessing the site must travel via Ohinewai North Road and Tahuna Road to wider destinations. Table 8.1 below summarises the potential traffic increases on each road in the immediate vicinity of the site.

Table 8.1: Traffic increase by road

Destination	Proportion	Current estimated peak	Peak Increase	Daily Increase	Proportional Increase
SH1 Northbound	60%	1,200 vph	60 vph	600 vpd	5%
SH 1 Southbound	30%	1,200 vph	30 vph	300 vpd	3%
Tahuna Road (east)	10%	220 vph	10 vph	100 vpd	5%
Tahuna Road (west)	100%	52 vph	100 vph	1,000 vpd	192%
Ohinewai North Road	100%	8 vph	100 vph	1,000 vpd	1,220%

We consider this to be a conservative assessment with trip generation overstated if the assumptions of development density and yield remain unchanged. Regardless, the increase in traffic on the wider network[6] will be imperceptible.

The main areas of traffic increase will be on Ohinewai North Road and Tahuna Road (west) between Ohinewai North Road and SH 1. However, the current traffic volumes on these roads are substantially below the road and intersection capacity. Ohinewai North Road is little changed from its previous layout and use as the former SH 1. Even with the highest predicted residential demand from the site (1,000 vpd and 100 vph), we consider that the level of service will not deteriorate noticeably on these roads.

In terms of safety, the increase in traffic is relatively modest in actual numbers, although high in proportion to the current traffic volumes. Accordingly, the increase in risk is not likely to be significant.

When the predominant cause of crashes is taken into account, it appears that unfamiliarity with the intersection between the expressway off ramp and Tahuna Road has contributed to crashes, drivers leaving and arriving at the site will be aware of the intersection and therefore unlikely to approach at an inappropriate speed.

[6] In this context, wider network refers to SH 1 and Tahuna Road beyond the SH interchange

At this stage, we consider it unlikely that any major improvement to existing infrastructure will be necessary. However, intersection modelling and refinement of evaluation is recommended when further details of the proposal are developed.

9 Site Access

The proposed District Plan requires site access to be a minimum of 200 m from any existing intersection, given the location of the requested re-zoning, all site access will be at least 200 m north of Tahuna Road.

To avoid ribbon development a local road network should be developed to remove the need for multiple direct accesses along the eastern side of Ohinewai North Road. A similar layout can be achieved to the west, however there may be a couple of lots at the northern extent which may require direct access. Given the low volume of traffic at this end of the road, it is not likely that there would be any measurable detriment to safety and efficiency of Ohinewai North Road.

All accesses should be positioned to achieve the minimum separation and sight distance requirements of the District Plan.

10 Applicability

This report has been prepared for the exclusive use of our client Shand Properties, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:

.....

Alan Gregory

Principal Transport Planner

Authorised for Tonkin & Taylor Ltd by:

pp .....

Glen Nicholson

Project Director

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Appendix D: Flooding information

Tonkin+Taylor

Job No: 1008304
9 October 2018

Shand Properties
PO Box 112
Huntly

Attention: Jackie Rogers

Dear Jackie

Ohinewai North Road - Flood hazard assessment

This letter has been prepared as part of a submission to the Proposed Waikato District Plan for 86ha of land at Ohinewai, located on Ohinewai North Road (ex-SH1).

The submission will seek that the land be rezoned from Rural to Country Living. Country Living is a rural-residential zone that allows for the creation of 5000m^2 lots unserved by a reticulated services.

This letter relates to the flood hazard assessment.

1 Purpose and Scope of works

In order to support the rezoning submission the following items were considered to support the evaluation of flood hazard (for the purposes of rezoning) against the objectives and rules in the Operative District Plan, Proposed Waikato District Plan and Regional Plan[1].

1 Floodplain identification
2 Risks from flood hazard to health, safety and property
3 Avoidance or mitigation of flooding
4 Drainage infrastructure requirements

The information provided in this report provides a high level consideration of flood hazard for the purposes of rezoning. More detailed analysis and investigations will be needed to support subsequent stages of the planning process.

The following sections provide further consideration of each of the four scope items identified above.

2 Floodplain identification

Flood hazard information held by Waikato Regional Council for the property at 105 Ohinewai North Road, Ohinewai is provided in Appendix A. The following information summarises the available information:

[1] It is understood that the preparation of draft provision for the Natural Hazards and Climate Change chapter is awaiting the completion of technical reports and that consultation on Natural Hazards and Climate Change will be undertaken during the remainder of 2018. It is anticipated that the review of the Operative Plan relating to Natural Hazards and Climate Change will be notified as Stage 2 of the Proposed Plan in 2019

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1 The property has been inundated during previous floods (e.g. 1998)

2 The maximum historical water level estimated on the property was RL 9.6m (Moturiki Vertical Datum 1953) which occurred during a 1998 event.

3 The property is protected by stopbanks along the eastern side of the Waikato River.

- The predicted flood level in the Waikato River (note not on the property) is RL 9.86-10.26m (Moturiki Vertical Datum 1953), which does not include the predicted effects of climate change.
- The design level for the stopbank adjacent to 105 Ohinewai North Road is RL10.8m (Moturiki Vertical Datum 1953).

Based on the above information the stopbanks provide protection to a flood level that exceeds the 1% AEP flood level, therefore the site does not lie within either the existing 1% AEP or 2% AEP Waikato River floodplain. However, we have made an important assumption that the stopbanks will withstand the 1% AEP flood level and will withstand extended periods of elevated flood levels without failure. The structural integrity of the stopbanks that protect Ohinewai North Road should be investigated further for subsequent stages. This is discussed further in the risk assessment and mitigation section.

The local catchment drainage is reliant on the performance of one pump station and two flood gates in the vicinity of Ohinewai North Road. T+T have carried out a high level flood level assessment[2] caused by runoff from the local catchment. Figure 2.1 provides a likely upper estimate of the existing floodplain based on existing topography (recorded by LiDAR). The rezoning property extents are shown in red and the floodplain is represented by flood depths greater than 0.1 m.

Figure 2.1: High level, local catchment floodplain assessment

[2] The high level, desk-top flood assessment uses LiDAR based topography information and "burned in" cross drainage culverts underneath the Waikato Expressway. The dimensions and levels of the culverts are unknown, and the locations were estimated from LiDAR data. The floodplain represents runoff from 24 hour 100 year ARI rainfall depth without an allowance for climate change. There are no hydrological losses represented and we have assumed that the pumps and flood gates are not operational.

Our high level flood assessment provides an indication of the surface flooding extents on the project site. From our high level flood assessment, approximately 36ha of the 86 ha site could be subject to surface flooding, at a volume of approximately 150,000 m^3. Modifications to the site terrain and allowances for drainage infrastructure will reduce the surface flooding extent and volumes.

The results of the high level assessment identify that flooding is primarily located in the middle of the property. Therefore it is likely to be feasible to modify ground levels within the property extents to reduce the floodplain area without causing off-site effects. This would need to be considered further as part of an assessment of effects for a proposed design.

3 Risks from flood hazard to health, safety and property

The major risk associated with flood hazard in the area surrounding 105 Ohinewai North Road relates to the reliance of Waikato River stopbanks to provide protection to people and property. This section identifies the risk and the following section considers avoidance and/or mitigation.

The suitability of the stopbanks and their foundations to protect land zoned for Country Living should be considered further in subsequent design/assessment/planning stages. An assessment of the stopbank design, construction and underlying geology / foundation soils has not been considered in this assessment. Soils adjacent to the Waikato River are variable, and our limited geotechnical investigations indicate site soils are primarily sands. We understand that seepage beneath stopbanks occurred in many locations along the lower Waikato River during the 1998 storm event. If seepage through the stopbanks or their foundations were to occur during future flood events, it may cause damage to people and property.

Aside from the structural integrity of the stopbanks, there are significant consequences associated with flood levels in excess of the stopbank design level. It is understood that the stopbank level is based on 1% AEP flood level with a 0.5m freeboard allowance. Flood levels above the stopbank level can occur in extreme events with a low likelihood of occurrence, and would likely cause significant damage to people and property. The mitigation of this is discussed in the next section.

The risks associated with local catchment flooding are comparatively less significant than the Waikato River flood risks. Appropriate drainage and landform design at subsequent design stages will ensure that the risks associated with local catchment flooding are addressed. This may require a large land component to be made available for floodplain storage and/or mitigation of effects on others.

4 Avoidance or mitigation of flooding

The previous section identified that the major flood risk associated with the site relates to the reliance on stopbanks that protect the site.

Due to the location of the site, it is not possible to avoid the risk because the site will always be located within a potentially hazardous area if the stopbanks or their foundations are breached. However there are measures that can be adopted to mitigate and manage the risk to acceptable levels.

Suggested measures could include:

1 Ensuring that the design, construction and maintenance of the stopbanks is commensurate with the assets they are protecting. The "assets" in the proposed plan change are people and property. Therefore agreeing an appropriate level of protection with the stopbank owner (WRC) is imperative. An assessment of the stopbanks and their foundations is recommended to determine what level of investment/upgrades may (or may not) be needed.

2 Protecting people and property by ensuring that floor levels are established above flood levels assuming that the stopbank has breached (e.g. for a 1% AEP or 2% AEP event).

3 Protecting people by ensuring adequate evacuation plans (and emergency egress paths) for flood levels above the design level of the stopbank (e.g. 0.5% AEP).

It is important to note that it will not only be the stopbanks immediately adjacent to the site that protect the property. Mitigation of flood risk will need to consider the length of stopbank that protects the site, which may extend upstream and downstream from 105 Ohinewai North Road.

5 Drainage infrastructure requirements

An assessment of existing infrastructure capacity has not been carried out as part of this assessment.

A detailed assessment of drainage infrastructure requirements can be carried out at subsequent stages and will need to consider land cover, landform, development yield and use of existing infrastructure.

The current property relies on the use of a pump station and flood gates for drainage of pasture, which will likely be an inadequate level of service for Country Living zoning. Therefore opportunities to decrease the surface flooding constraint on development yield will need to be considered alongside infrastructure upgrade decisions.

Due to the large "greenfield" component across the site, there is considerable potential to improve drainage from the local catchment.

6 Limitations

T+T have not carried out a detailed review of the information provided by WRC to complete this review. We note and highlight the disclaimer provided by Waikato Regional Council (refer Appendix A).

The potential for flooding on the site caused by groundwater lies outside the scope of this assessment. To consider this further, would require a separate hydrogeological assessment.

7 Conclusion

We have assessed flood hazard for the purposes of rezoning 86ha of land at Ohinewai to Country Living.

The assessment has identified the potential for surface flooding on the site and identified the risk associated with reliance on the Waikato River stopbanks for protection from river flooding. However there are opportunities to mitigate flood risk through site design and reduce the extents of the existing floodplain through drainage infrastructure improvements.

We understand that the review of the Operative Plan relating to Natural Hazards and Climate Change will be notified as Stage 2 of the Proposed Plan in 2019. The content of any changes to Natural Hazard and Climate Change policy may affect the content and findings of this report.

Overall we consider that the risks associated with the flood hazard can be managed on the property.

8 Applicability

This report has been prepared for the exclusive use of our client Shand Properties, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Jon Rix	pp Glen Nicholson
Senior Water Resources Consultant	Project Director

JRRR
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Appendix A: Summary of flood hazard information (Waikato Regional Council)

Summary of flood hazard information

Date:	09 April 2018
Reference:	REQ132817
Community:	Ohinewai
Waterway(s):	Waikato River
Property:	105 Ohinewai North Road, Ohinewai 3771
Prepared by:	Danielle O'Shaughnessy Regional Hazards Advisor
Checklist:	☑ **Information from previous events**
	☑ **Regional scale flood hazard map**
	☑ **Predicted flood levels**
	☑ **Local scale flood hazard map**
	☑ **Waikato Regional Council managed flood protection**
	☑ **Waikato Regional Council managed land drainage**
	☑ **River bank erosion**
	☒ Coastal inundation and erosion
	☑ **Topography (LiDAR)**

Note: Flood hazard information held by Waikato Regional Council is not complete. Therefore, a lack of information does not necessarily mean this property is not affected by flooding

Waikato REGIONAL COUNCIL

Introduction

This report provides an overview of the flood hazard information that is held by Waikato Regional Council for this property, including:

- The waterways that may affect this property.
- The information that has been recorded during previous flooding events.
- Regional and local scale flood mapping.
- Predicted flood levels.
- Other useful information.
- Where to from here.

Please read and understand the important disclaimers that accompany this information.

General

The preparation and provision of this information has been made in good faith from a number of sources. While all due care has been taken, the Waikato Regional Council does not give any warranty in regard to the availability, accuracy, completeness, currency or reliability of the information.

Organisational context

This report has been prepared by the Waikato Regional Council Integrated Catchment Management Directorate and therefore does not constitute approval from Waikato Regional Council in relation to any proposal or consent application. In order to discuss such an approval, the following contacts should be made:

- In relation to any regulatory requirements such as those required by the Waikato Regional Plan, the Waikato Regional Council should be contacted on the Resource Use freephone 0800 800 402.
- In relation to obtaining a comment or submission on behalf of Waikato Regional Council the Waikato Regional Council Science and Strategy Directorate should be contacted on 0800 800 401.

During the processing of Resource Consent applications that are associated with any proposal, the Waikato Regional Council Integrated Catchment Management Directorate may have the opportunity to submit or provide advice. This report is therefore an initial consideration of the flood risk management issues that are relevant to the property and may be subject to further submission or advice.

Limitations of this report

Waikato Regional Council, while providing the information in good faith, accepts no responsibility for any loss, damage, injury, or loss in value of any person, property, service or otherwise resulting from flood hazards or knowledge of flood hazards in the Waikato Region.
The limitations of flood hazard information contained in this report include:

- The presence of flood hazard information does not guarantee the existence of a hazard, nor does the lack of information preclude the existence of a hazard or risk.
- This flood hazard information is based on the existing condition of the catchment. Any significant change to this condition (e.g. land use changes, deforestation or the intensification of development) may alter the flood hazard that affects this property. Where significant changes do occur, this flood hazard information should be reviewed.
- This flood hazard information is based on the channel geometry and floodplain topography relevant at time of the assessment. However, this does not include obstructions such as

fences, trees and buildings. These obstructions may cause localised changes to the flood extent, depth and/or speed.

- The flood hazard information does not include instances where large debris blockages and debris flows occur.
- The flood hazard information is only relevant to identified waterways and WRC drains (if any present). Other sources of flooding (e.g. other waterways, localised ponding, stormwater infrastructure and the coastal environment) are not included and may need to be considered.
- Any design flood level information contained in this report does not represent the maximum possible flood level. During extreme river and/or tidal flood (storm tide) events, the design level may be exceeded.

Vertical datum

Unless otherwise stated, vertical levels quoted in this report are in terms of the:

Moturiki Vertical Datum 1953

The location of appropriate benchmarks and the confirmation of on-site levels should be obtained with the assistance of a Registered Surveyor.

Annual exceedance probabilities (AEP)

This report describes flood events using the "annual exceedance probability" (AEP), which is a statistic that measures the probability that a given scale of event will occur during any one year. A flood event with a 1 % AEP has a 1 % chance of happening during any one year. Flood events are also often described in terms of "return periods" but this terminology can be confusing. A 1% AEP flood is equivalent to a "100 year" flood event. While this is often perceived to occur once every 100 years, such events can occur several times or not at all during a 100 year period, as it is based on a statistical average.

A comparison of return periods and annual exceedance probabilities is provided in Table 1.

Table 1: Comparison of return periods and annual exceedance probabilities

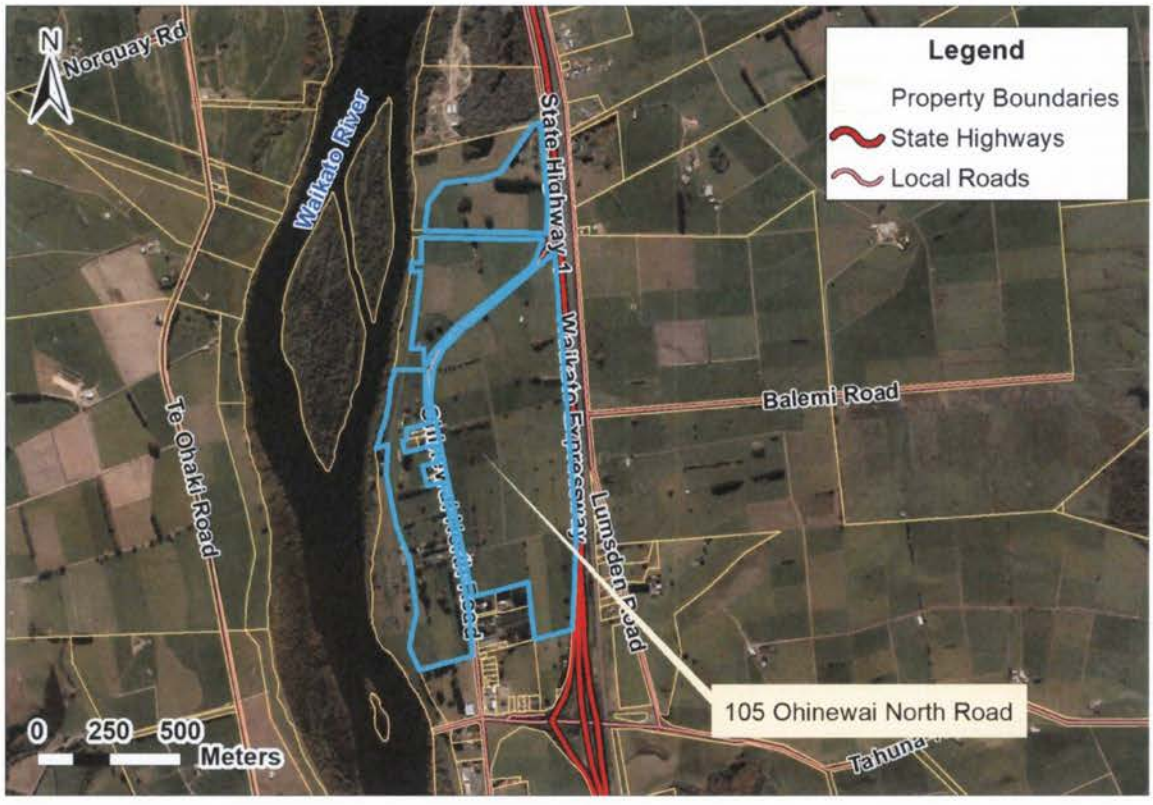
Return period	AEP
100 year	1 %
50 year	2 %
20 year	5 %
10 year	10 %
5 year	20 %
2 year	50 %

Which waterways?

The Waikato River is adjacent to this property (refer to Figure 1). It is therefore likely that this property is affected by a flood hazard.

> ! This property may be inundated due to sources that are not covered by this report (e.g. other waterways, localised ponding, storm water infrastructure and the coastal environment).

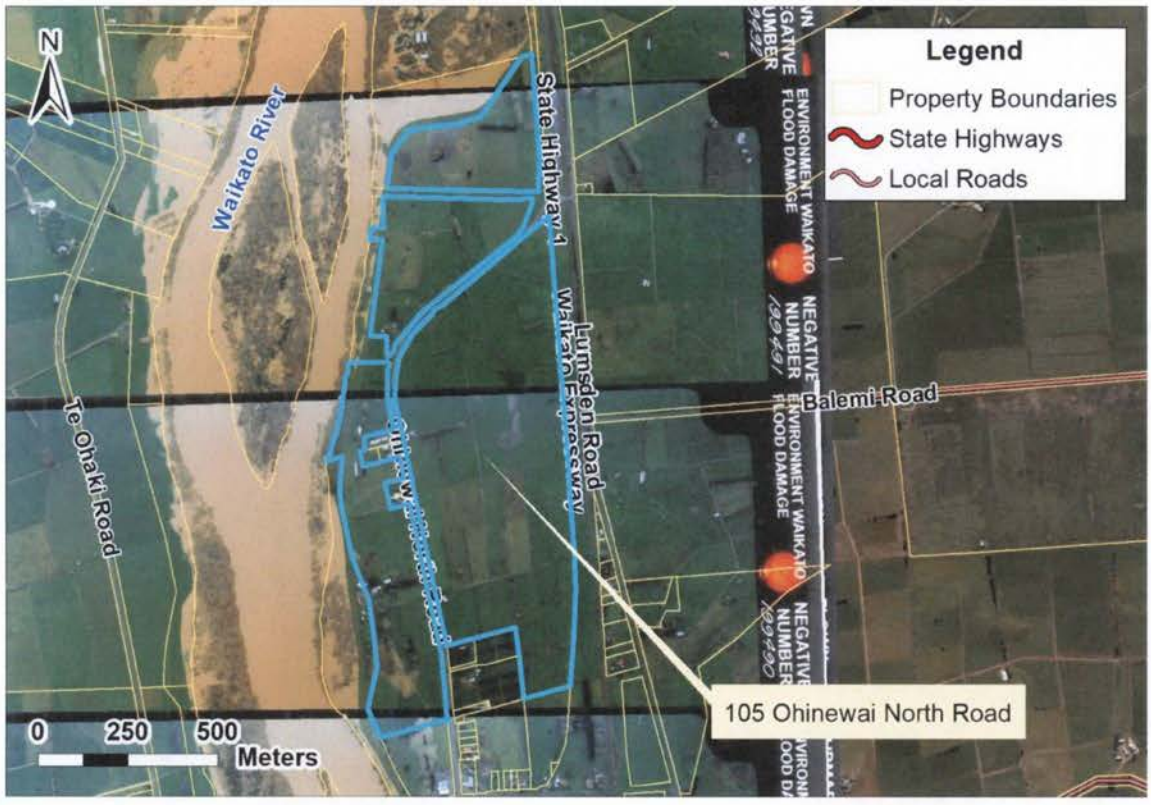
Figure 1: Location plan of 105 Ohinewai North Road, Ohinewai 3771 showing the Waikato River



Information collected during previous events

Information held by Waikato Regional Council indicates that this property has been inundated during previous flood events. This is evidenced by aerial photography that was captured during following the 1998 event (refer to Figure 2).

Figure 2: Inundation of 105 Ohinewai North Road, Ohinewai 3771 during the 1998 event



The maximum water level that has been recorded or estimated by Waikato Regional Council on or adjacent to this property is:

RL 9.6 m during the 1958 event

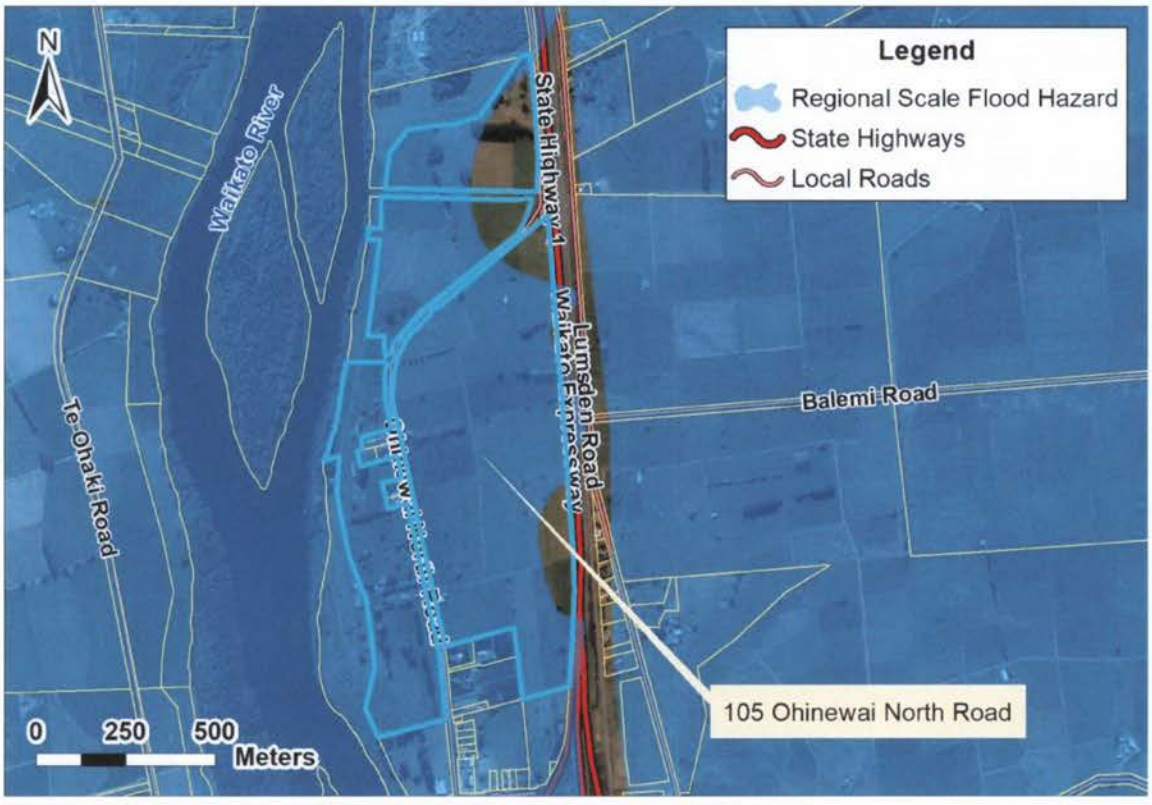
This is based on the interpolation of observations made during this event.

Regional scale flood hazard mapping

Waikato Regional Council holds regional scale flood hazard maps for the Waikato Region. These maps provide an overview of the flood hazards associated with many water bodies and may be useful for identifying potential flooding issues that require further discussion and investigation.

The regional scale flood hazard map for this property is below (refer to Figure 3).

Figure 3: Regional scale flood hazard map for 105 Ohinewai North Road, Ohinewai 3771



When using this broad scale information, it is important to understand the associated limitations:

- The accuracy of the information makes it unsuitable for determining detailed flood hazard information for a specific site (e.g. extent of inundation or design flood levels).
- The information does not consistently represent a particular design flood event (e.g. an event with a 1 % AEP). It may relate to observations after previous events and field work undertaken by WRC, territorial authorities, and consultants.
- The information does not cover all waterways in the Waikato Region, therefore the presence of a flood hazard zone does not guarantee the existence of such a hazard, nor does the lack of information preclude the existence of a hazard or risk.
- The information is not suitable for land-use planning processes, other than identifying potential flooding issues that may require further discussion and investigation.
- The information does not replace detailed flood hazard information.

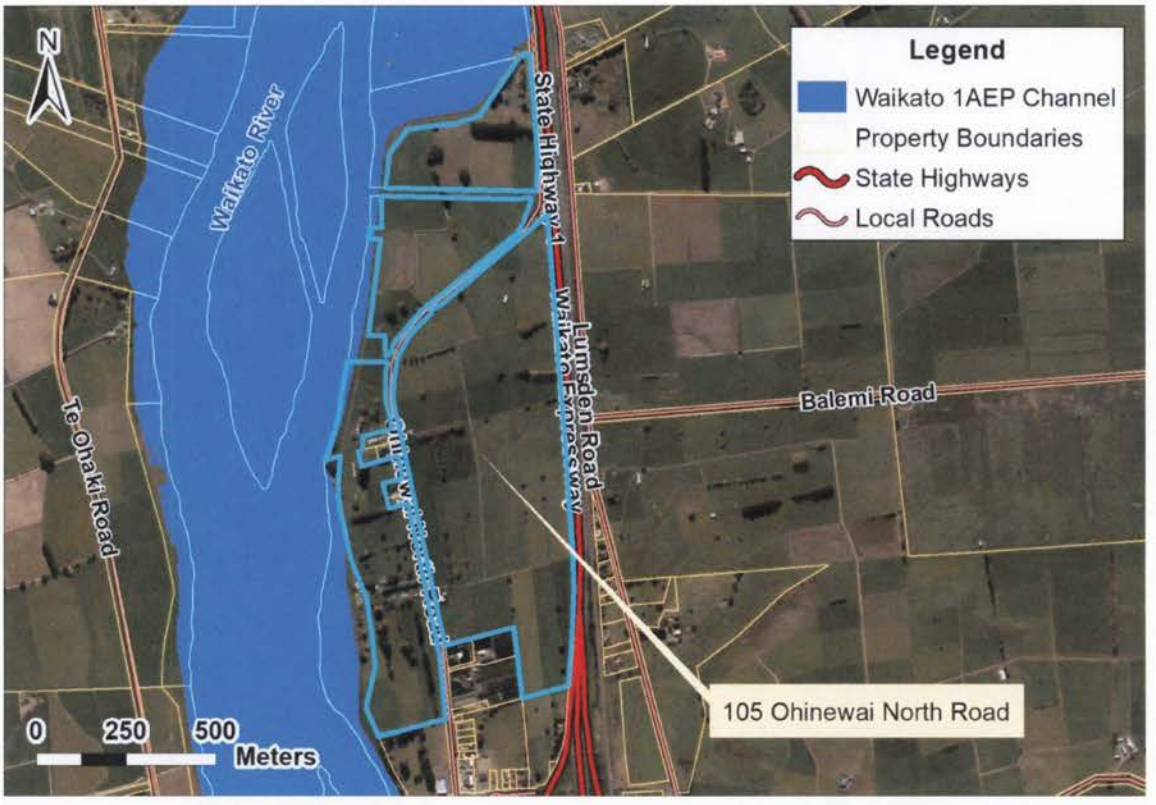
Given the limitations regarding the accuracy and completeness of this information, further investigations and discussions are recommended to confirm the nature and extent of the possible flood hazard.

Local scale flood hazard mapping

This property is covered by a local scale flood hazard map that represents a 1 % AEP river flood event in the Waikato River. The extents are based on flood modelling undertaken in 2009. The extents are not based on 1959 scheme design flood levels. The flood modelling information shows that the property is expected to be affected by inundation (refer to Figure 4).

> **!** This predicted flood hazard does not represent the maximum expected hazard. There is the potential for larger river flood events to occur, resulting in a higher hazard.

Figure 4: Local scale flood hazard map showing indicative 1% AEP (100 year Return Period) flood inundation extents for 105 Ohinewai North Road, Ohinewai 3771



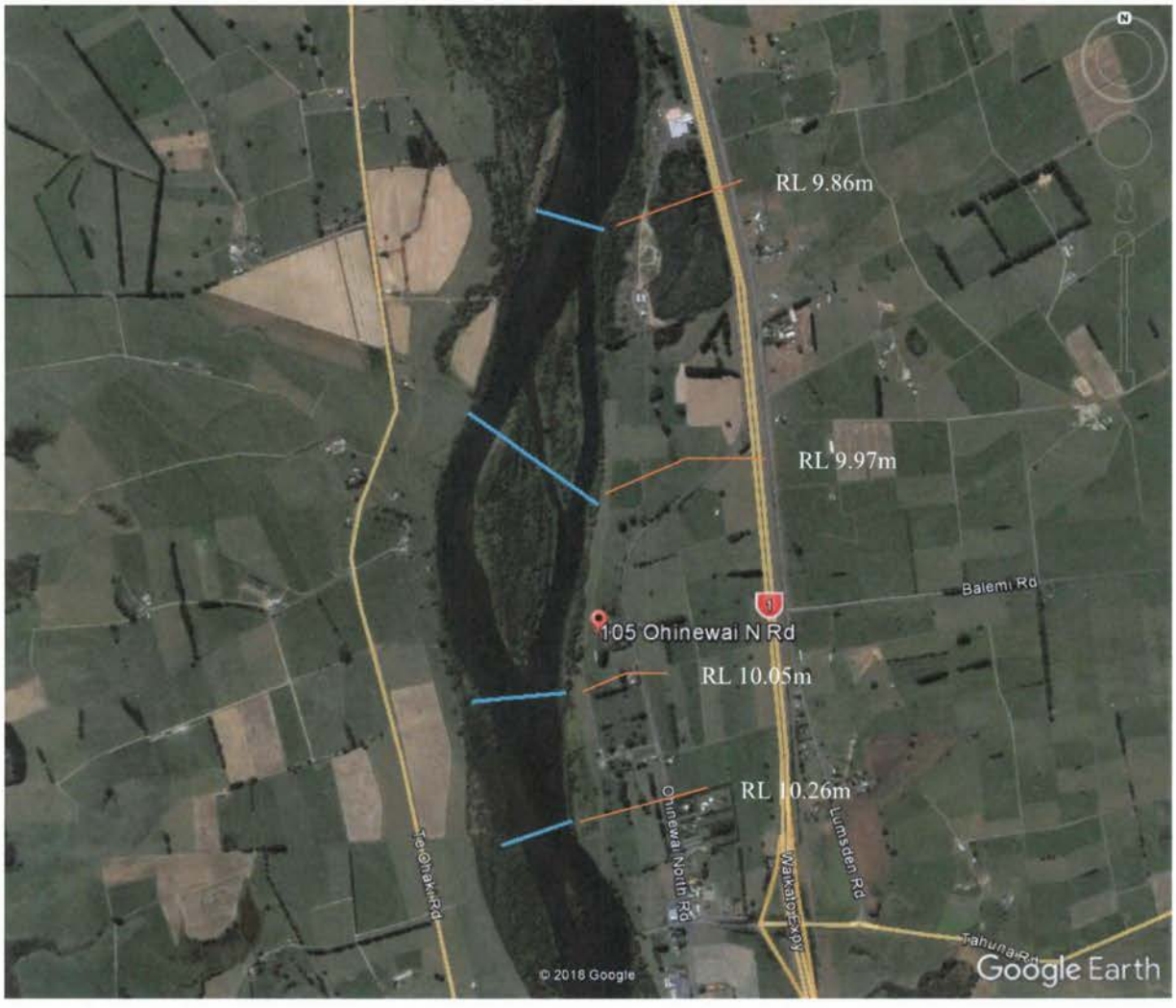
Predicted river flood levels

The predicted flood level in the Waikato River adjacent to this property is:

RL 9.86m-10.26 m during a river flood event with a 1 % AEP

This level is taken from the 1959 scheme design and does not explicitly includes the predicted effects of climate change on rainfall intensity and sea level.

! This predicted flood level does not represent the maximum expected flood. There is the potential for larger river flood events to occur, resulting in a higher flood level.



Waikato Regional Council managed flood protection

This property is located in the Lower Waikato Zone and benefits from a Waikato Regional Council stopbank, which is part of the Lower Waikato Scheme. The design flood level for the stopbank at this location is:

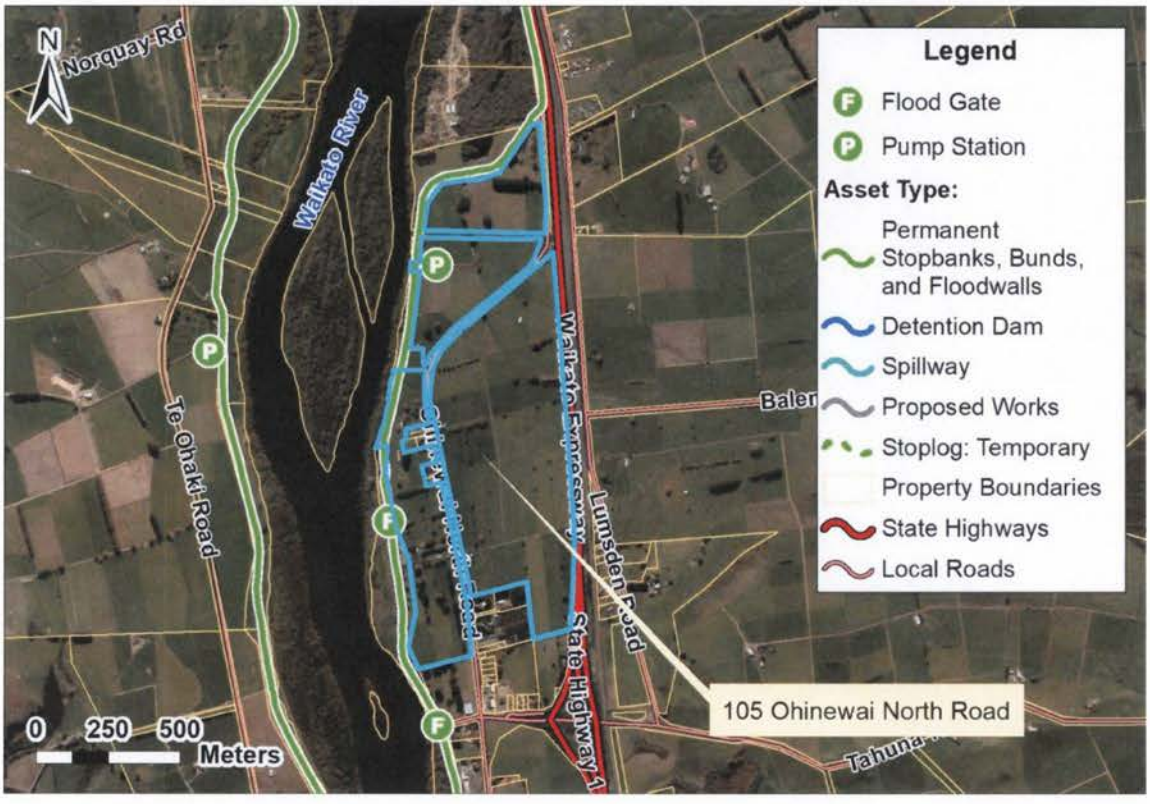
RL 10.8 m which relates to 1% AEP

> **!** During larger river flood events, this stopbank may be overtopped, potentially inundating this property. This property may also be inundated in the event of stopbank failure.

This property is also within an area that is serviced by floodgates and pumpstations, which assists with drainage. However, during heavy rainfall, ponding will still occur behind this structure that may affect this property.

> **!** High river levels or power failure may increase the amount of ponding that occurs behind this structure. Such occurrences are common during significant flood events.

Figure 5: Waikato Regional Council managed flood protection infrastructure relevant to 105 Ohinewai North Road, Ohinewai 3771



Waikato Regional Council managed land drainage

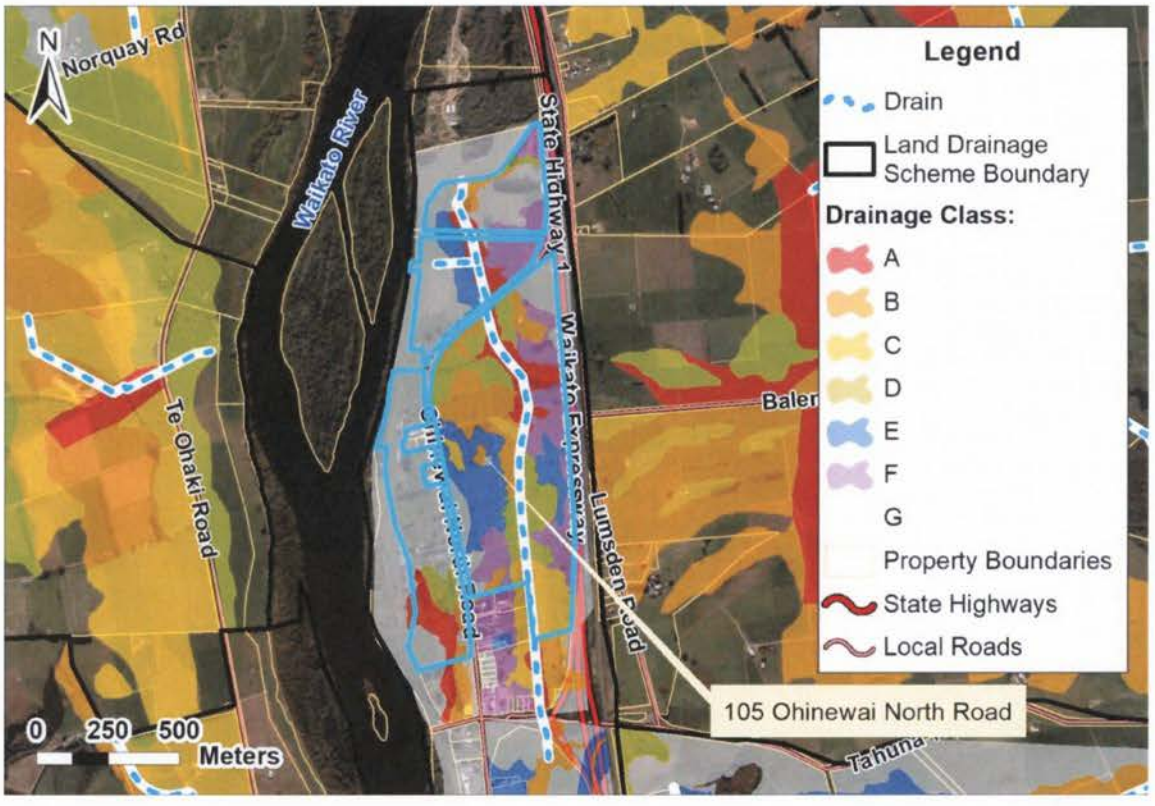
This property benefits from land drainage infrastructure that is managed by Waikato Regional Council. It is located in the Ohinewai District of the Franklin Waikato Land Drainage Scheme, which is administered by Waikato Regional Council. The land drainage class that covers this property are all from A to G (refer to Figure 6).

The open drains and culverts that are managed by Waikato Regional Council in this drainage area provide the following level of service:

10 % AEP runoff drained within 3 days.

> **!** Land drainage schemes generally provide a level of service that is designed to remove ponding from rural areas prior to pasture damage occurring, rather than preventing inundation.

Figure 6: Waikato Regional Council managed land drainage information for 105 Ohinewai North Road, Ohinewai 3771



Note: A description of the drainage benefits that are expected for each drainage class is included at the end of this document.

Riverbank erosion hazard

This property is located in close proximity to the Waikato River and may be affected by riverbank erosion.

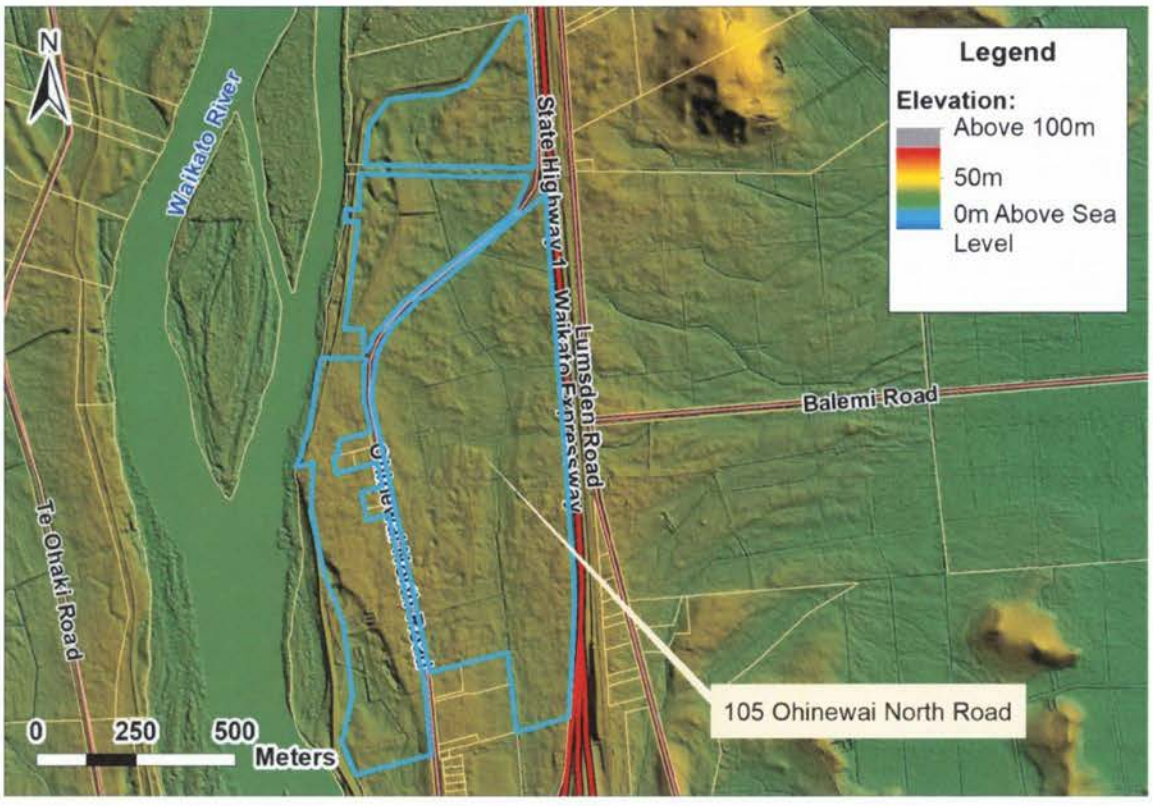
Coastal hazards

The property is outside the coastal environment and is not subject to coastal hazards.

Topographic information

Waikato Regional Council holds detailed topographic information for this property that was captured using the LiDAR surveying technique (refer to Figure 7).

Figure 7: Digital elevation model for 105 Ohinewai North Road, Ohinewai 3771

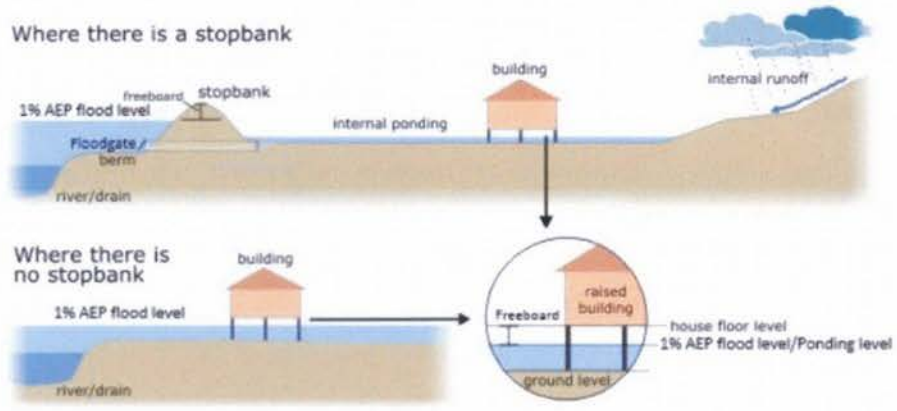


The data that underlies this digital elevation model is available to purchase from the Waikato Regional Council.

Determination of a design/predicted flood level

Waikato Regional Council or the Waikato District Council may request that a design flood level be incorporated into the design of any proposal. The information contained in this report should be discussed with the Waikato District Council to assist with the determination of such a level. If the information contained in this report is not sufficient for such a determination, Waikato Regional Council recommends that that a Chartered Professional Engineer or other suitably qualified professional be engaged to determine the appropriate design level.

An example of how a design/predicted flood level can be applied is shown below.



In the absence of a design/predicted flood level based on the above methodology, any identified flood risk can be reduced by:

- Locating any development on relatively elevated land and avoiding obvious low points.
- Maximising the setback of any development from water bodies, something that may reduce the risk of inundation as well as erosion.
- Maximising the elevation of any building floor levels, including the provision of a larger freeboard where information is uncertain (e.g. due to the impact of debris on the behaviour of flood waters) or incomplete (e.g. where the impact of climate change has not been factored into a design flood level).
- Ensuring that any building floor levels are above localised high points that may dictate the level of flood waters (e.g. instances where flood waters are impounded behind roads and other causeways).

In the absence of the required design flood level information, the level of risk reduction that could be achieved using these measures is uncertain.

Residual flood risk

'Residual flood risk' is a term used to describe the risks that exist due to the potential for flood events to occur that differ from the 'design' event. The concept of residual flood risk is relatively new, but provides a more complete description of a river flood hazard when compared with earlier approaches that tended to focus only on a 'design' event.

Residual flood risks may exist for a variety of reasons, including:

- The occurrence of larger flood events, resulting in wider, higher and faster floodwaters.
- The impact of localised obstructions (e.g. buildings and walls) that may divert floodwaters, increasing the extent, depth and speed of flooding.
- The occurrence of debris flows and blockages that may produce significantly different flooding characteristics.

- The overwhelming of stopbanks, causing overtopping, failure and inundation of previous protected properties.
- The overwhelming (or lack) of local drainage infrastructure causing localised inundation that may escalate the impact of the flood.

Climate change

Climate change is predicted to have a range of effects on our environment in the future. The Resource Management (Energy and Climate Change) Amendment Act requires local government to have particular regard to these effects when making decisions under the Resource Management Act.

This flood hazard information will assist with a variety of decisions, ranging from individual property appraisal to wider land use planning. Many of these decisions will influence land use beyond this century and beyond the timeframes that are associated with significant climate change. It is therefore important that the relevant effects of climate change are discussed by this report.

The effects of climate change that are particularly relevant to flooding are a rise in sea level and an increase in rainfall intensity. The Ministry for the Environment has produced a guidance document to help assess the magnitude of these effects in New Zealand. This guidance, which is based on the Intergovernmental Panel on Climate Change (IPCC) fourth assessment report, suggests that the average annual temperature in the Waikato Region will increase by 0.6 to 5.6°C by the late 21st century. This increase is predicted to:

- Increase the sea level by up to 1.0 m by 2115.
- Increase in rainfall intensity by 4 to 8 % per degree of temperature increase.

It is important that these predicted effects of climate change are considered when digesting this flood hazard information.

Where to from here?

If you have any information that you feel is relevant to the flood hazard that affects this property, or would like to discuss this report in more detail, please contact Waikato Regional Council on (0800) 800 401.

Otherwise, it is recommended that you discuss the implications of this report with the Waikato District Council, your current/potential insurer and any other service providers that you have engaged.

Appendix: Explanation of land drainage classes

Class	Benefit description
A	High direct benefit as it is land that would not be capable of significant production without the council maintained system, high indirect benefit, and contribution, as it is land in pasture. One category of land assigned to this type is gully systems where the area of land drained is a narrow band, which is drained by the Council system. Without a drainage system the soil water levels would be so high as to prevent the establishment of productive use within the gully. It is likely that the unproductive use would extend to the top of the gully banks, which generally results in weeds and plant pests becoming established. Another category is floodplains alongside streams/drains where regular flooding causing inundation, erosion, pasture damage, debris, stock losses and fence damage would be likely to occur if the waterway were not maintained by Council.
B	Direct benefit as it is land that requires drainage for maximum production and is adjacent to a Council maintained drain, high indirect benefit, and contribution, as it is land in pasture. This is generally a ribbon of land either side of council maintained drains that receive direct benefit from the drain.
C	Low direct benefit as it is land that requires drainage for maximum production but is removed from the council maintained system, high indirect benefit, and contribution, as it is land in pasture. This is generally land that is beyond the B Group land that requires drainage, and the drainage is provided privately but the drains discharge into the Council system.
D	No direct benefit as the land is elevated and free draining, high indirect benefit as it is surrounded by land that requires drainage and contribution, as it is land in pasture. This is generally hilly land that occurs within areas that are drained, but does not require drainage in itself.
E	No direct benefit as the land is all elevated and free draining, low indirect benefit as the land is removed from land that requires drainage, and contribution, as it is land in pasture. This is generally rolling and hilly pasture land that drains to the Council maintained system.
F	No direct benefit as the land is all elevated and free draining, low indirect benefit as the land is removed from land that requires drainage by the Council system and no contribution as the land drains away from the area where the Council works are located. This is generally land that is within the drainage area but does not benefit directly from the Council work, as it does not drain to the Council maintained system
G	Land that derives no direct or indirect benefit from the Council maintained system and does not contribute to the need for Councils work. This land is non-rateable. This is generally land such as lakes, or other land that has no productive potential. It includes land that drains to the Council maintained system that is fenced to exclude stock, and is maintained in trees or bush. It also includes land within the drainage area that drains away from the council maintained system and has no community of interest with the balance of the drainage area, and land which is excluded from rating by the RPA such as roads, schools, churches or reserves.

Appendix E: Ground contamination information

REPORT

Tonkin+Taylor

Preliminary Site Investigation

Waikato District Plan Submission on Zoning of land on Ohinewai North Road

Prepared for
Shand Properties Limited
Prepared by
Tonkin & Taylor Ltd
Date
October 2018
Job Number
1008304.vA

Exceptional thinking together
www.tonkintaylor.co.nz

Document Control

Title: Preliminary Site Investigation, Waikato District Plan Submission on Zoning of land on Ohinewai North Road					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
Oct 2018	A	Ground contamination assessment report	J. Chye	L. Phuah	Peter Cochrane

Distribution:

Shand Properties Limited	1 copy (electronic)
Tonkin & Taylor Ltd (FILE)	1 copy

Table of contents

1 Introduction

Tonkin & Taylor Ltd (T+T) has been commissioned by Shand Properties Limited to prepare and provide supporting information for a submission to the Proposed Waikato District Plan seeking to zone land at Ohinewai as Country Living rather than Rural Zone. One of the supporting documents required for the submission is a ground contamination desk study investigation for the site (referred to below as the subject site).

This report has been prepared in general accordance with the requirements for a PSI (Preliminary Site Investigation) referred to in the NES Soil regulations[1] , and as outlined in the MfE's Contaminated Land Management Guidelines[2].

The persons undertaking, managing reviewing and certifying this investigation are suitably qualified and experienced practitioners (SQEP), as required by the NES Soil and defined in the NES Soil Users' Guide (April 2012).

This investigation was undertaken in accordance with our proposal of 11 September 2018.

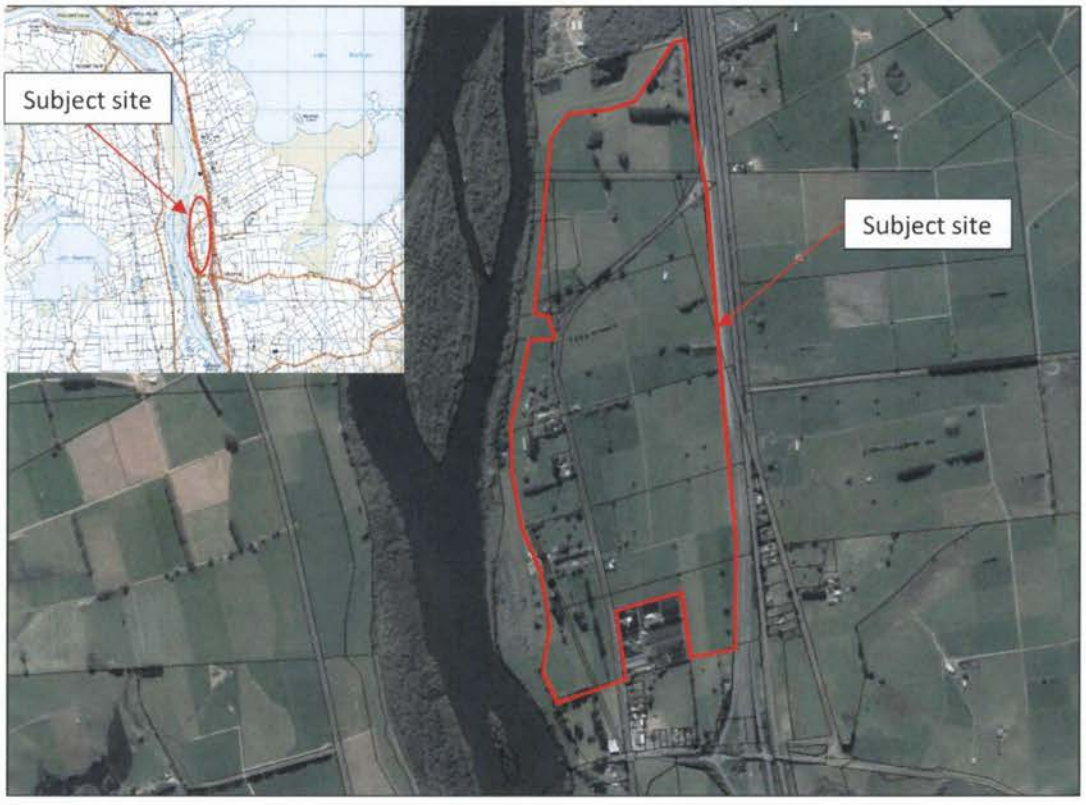


Figure 1.1 Site location plan [map sourced from Land Information New Zealand (crown copyright reserved)]

1.1 Background

The historic and present land uses at the site may have included activities which have the potential to cause land contamination. These activities are defined by the Ministry for the Environment in the Hazardous Activities and Industries List (HAIL). If an activity or industry on the HAIL is, or has

[1] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.
[2] Ministry for the Environment, updated 2011, Contaminated land management guidelines No. 1: *Reporting on Contaminated Sites in New Zealand*.

occurred on a site, the NES Soil applies to proposed soil disturbance and/or land development activities.

1.2 Objective and scope of work

T+T has undertaken this investigation to assess whether HAIL activities have occurred at the site, and the potential for these activities to have resulted in ground contamination. This report also assesses the need for further investigation and resource consents for the proposed soil disturbance and/or land development activities with regard to ground contamination as required under the NES Soil, and other relevant regulations.

The scope of work for this investigation comprised:

- Review of Waikato District Council (WDC) property files and district planning maps;
- Review of a "Site Contamination Enquiry" and Waikato Regional Council (WRC) records of pollution incidents;
- Review of selected historical aerial photographs;
- Review of current and historical certificates of title;
- Interviews with long-term employees/personnel of client or site operator about the site history and current use and site layout;
- A site walkover inspection undertaken by geologists;
- Review of ground contamination related environmental regulations and planning documents to identify potential resource consent requirements;
- Preparation of this report.

2 Site description

2.1 Site identification

The subject site is in a rural farmland area of Ohinewai, bounded by the Waikato Expressway to the east, and Waikato River to the west. The subject site consists of multiple properties with different legal descriptions and property owners, as summarised in Table 2.1 below. Note that this PSI covers the whole of the property shown on Figure 1.1, not just the area being sought to be zoned Country Living.

Table 2.1: Site identification

Street address	**Ohinewai North Road and Waikato Expressway**		
Title No.	SA9B/743 SA33D/594 SA33D/593 SA1C/1280 SA33D/591 SA3B/444 SA1412/12 SA33D/590 SA632/43	SA64/283 SA556/247	SA557/33
Site owner	Gerald Shand, Jacqueline Rogers, Catherine Baker	Caleb Hill	Mary Silvester
Site area	Approx. 115.8 ha		
Zoning	Operative Waikato District Plan zoning: Rural Proposed Waikato District Plan zoning: Rural		
Land use	Current: Farming (dairy) Proposed: Farming (drystock), Rural-residential living(Country Living)		

2.2 Site condition

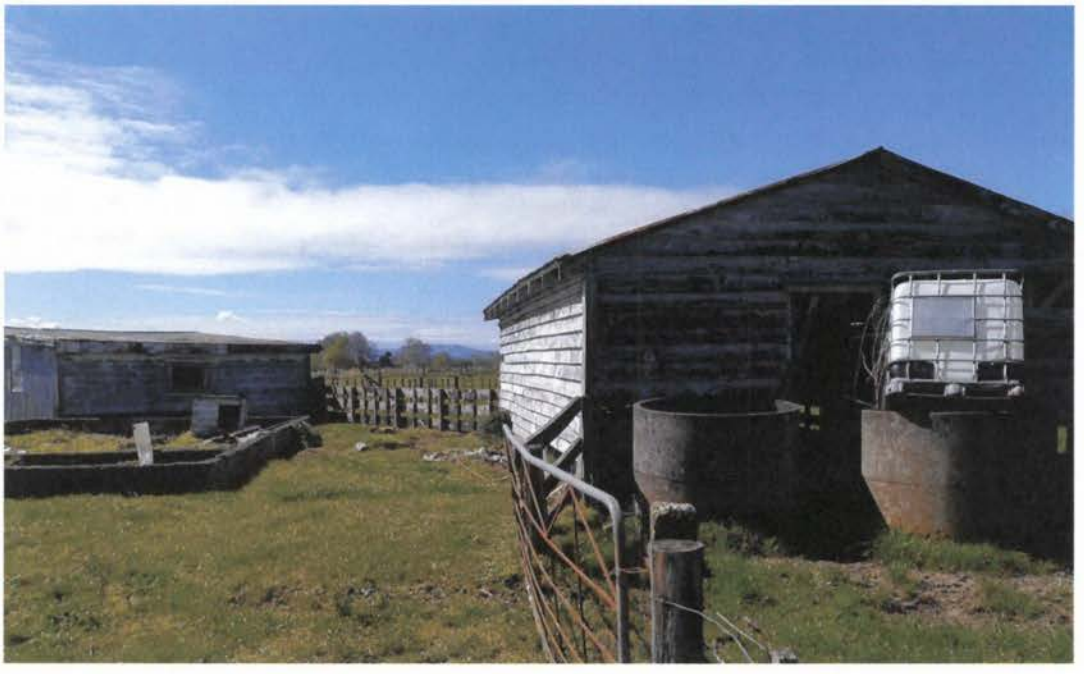
Two site visits were undertaken by T+T as part of this investigation. For the first visit on 12 September 2018, a T+T planner was accompanied by Shand Properties Ltd and had interviews with the owners on site. Later, on 20 September 2018, two geologists completed a site walkover inspection. Relevant observations and interview comments made at the time of both inspections are summarised below. Key site features are shown on Figure 1 in Appendix A and selected photographs are included as Photographs 2-1 to 2-6.

The property is currently generally vacant rural farmland area and contains the following features:

- The owner interviewed on site indicated that the farm had been historically used for dairy. Some of the farm sheds were used for milking. He also indicated that the land is proposed to continue to be used for farming (drystock grazing).
- The land on the east of Ohinewai North Road is generally gently-sloped, undulating ground. The land on the west of the Ohinewai North Road appears to have bigger mounds on the undulating ground.
- There is a river stopbank along the northern and western boundary of the site.

- A farm drain (approximately 1.0 – 1.5m wide) is observed along the eastern third of the subject site, running north-south. During the site walkover, there appears to be some drain maintenance which involved stockpiling of sediments/sludge beside the drain (Photograph 2-1). It is unknown if there is any significant ecological habitat within the farm drain.
- The majority of the features related to farming (i.e. farm sheds, storage sheds and pump sheds) were observed on the western half of the subject site (between Ohinewai North Road and the Waikato River). The features summarised below are noted from north to south of the site.
  - A relatively newly constructed pump shed was observed on the northern end of the subject site.
  - Slightly south, a number of timber farm sheds are present (Photograph 2-2). The sheds appear to be used for storage, and the inside of the sheds looks relatively clean. There are also remains of a building (concrete footings) observed between the farm sheds. It appears this area has been used for general farm storage. There also appears to be a concrete tank (aboveground) possibly used for effluent storage.
  - Further south, the stock pens that were observed in the 1970 historic aerials, appear to now be occupied by a residential house with wooden fencing.
  - More south, slightly west of the subject site (outside site boundary), there are a collection of farm sheds with multiple storage drums (Photograph 2-3), aboveground storage tank (Photograph 2-4), a pump (Photograph 2-4), and general farm maintenance chemicals (Photograph 2-5). The sheds observed appear to be directly built on dirt. There are ponded areas (some appeared to have a sheen) inside the shed.
  - And lastly, further south, there are some timber and corrugated iron cow sheds and storage sheds that appear to be abandoned (located outside site boundary). There is also a concrete tank (aboveground) possibly used for effluent storage.
  - Immediately east of the cow sheds, there appears to be a gravel pit area (a pit excavated into the undulating slope – Photograph 2-6). Google Earth photos show that this area was likely to have been used for farm mulch composting.
  - There was no evidence of Asbestos-containing Material (ACM) fragments surrounding any of the buildings.
- There are a number of water troughs across the farmland.
- There are shelter belts located all across the site, including farm fences.
- Overhead power lines were observed across the site, including along Ohinewai North Road.
- It has been noted that there are a number of recorded archaeological sites detected in the northern section of the subject site.

Photograph 2-1: Farm drain on the eastern third of the subject site. Evidence of farm drain maintenance. Photograph taken facing north.



Photograph 2-2: Farm sheds used for storage, with concrete footings (building remains) observed. Farm sheds are located on the northern third of the subject site.

Photograph 2-3: Farm sheds with pump and aboveground storage tank. Evidence of ponded area around pump in the shed. Farm sheds are located immediately outside the property boundary of the subject site, approximately in the middle third of the site.

Photograph 2-4: Farm sheds with some storage drums. Farm sheds are located immediately outside the property boundary of the subject site, approximately in the middle third of the site.

Photograph 2-5: Farm sheds with general farm maintenance chemicals. Farm sheds are located immediately outside the property boundary of the subject site, approximately in the middle third of the site.

Photograph 2-6: Gravel pits dug into the undulating slope (previously used for farm mulch composting). Gravel pits are located approximately in the southern third of the site.

2.3 Surrounding land use

The land uses in the area surrounding the site include:

- North – Waikato Wool Scourers Limited industrial building, wetland, machinery/vehicles storage area (possibly scrap yard area). There is a wetland north of the subject site (beyond the river stopbank).
- South – Orchard and residential rural areas;
- East – Rural farmland; and
- West –Waikato River.

2.4 Geology

A summary of available geological information for the area is presented in this section.

2.4.1 Published geology

The published geology of the area[3] indicates that the site is underlain by deposits comprising the Taupo Pumice Alluvium. The Taupo Pumice Alluvium comprises well bedded pumice sands, silt and gravels with charcoal fragments, deposited in the Waikato River valley following the Taupo eruption about 1850 years ago. This formation overlies the Hinuera Formation. The Hinuera Formation comprises interbedded coarse alluvium, pumice gravels, peat and silts deposited by braided river systems of the ancestral Waikato and Waipa Rivers.

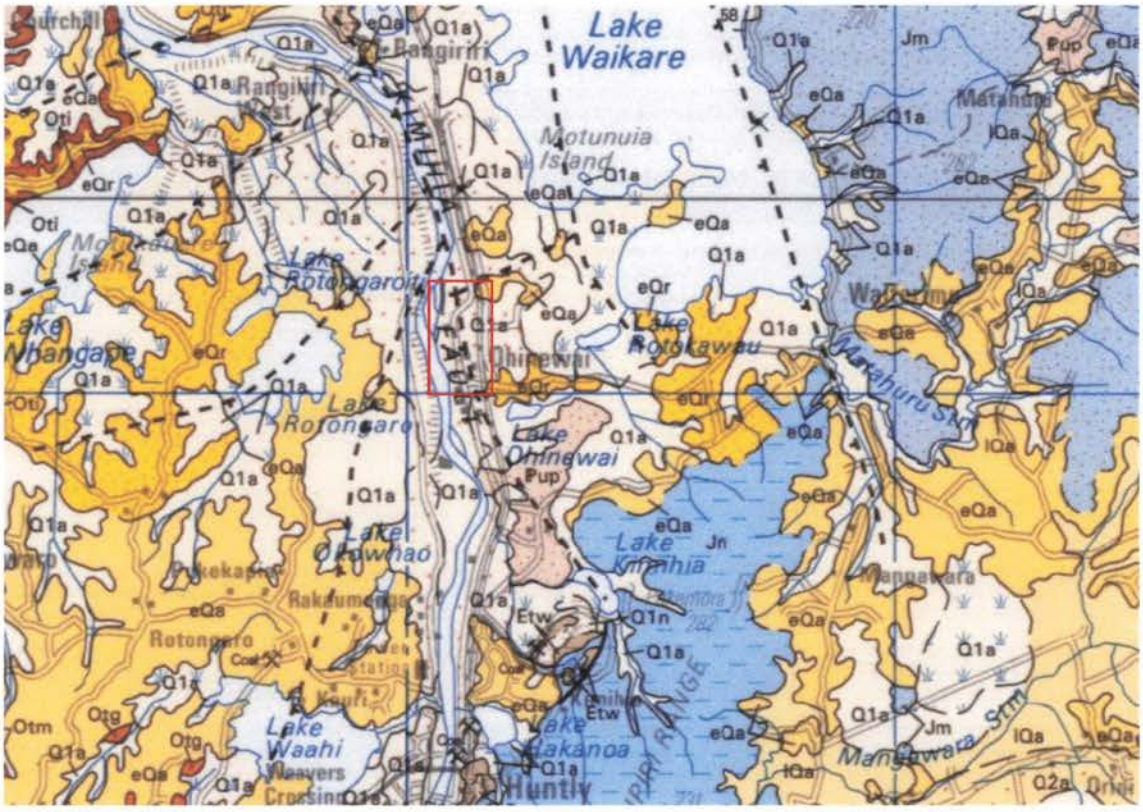


Figure 2.1 Published geology of the subject site in red box (source: Edbrooke, 2001 as per footnote).

[3] Edbrooke, S.W. (compiler) 2001: *Geology of the Auckland area*. Institute of Geological & Nuclear Sciences 1:250,000 geological map 3. 1 sheet + 74 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences Limited.

2.4.2 Site geological information

T+T is conducting a geotechnical investigation[4] concurrently with this ground contamination investigation, where twelve hand augers were undertaken across the subject site. The typical soil profile across the entire subject site is shown in Table 2.2 below. Further description of the site soils is contained within the T+T geotechnical report.

A historic geotechnical investigation[5] was undertaken by Opus International Consultants and Works Consultancy Service for the Ohinewai Bypass (now known as the State Highway 1). Testpits, hand augers, and Cone Penetration Testing (CPT) were conducted on either side of State Highway 1. The soil profile is similar to those encountered in the current geotechnical investigation, summarised in Table 2.2 below.

Table 2.2: Observed soil profile

Depth below ground level to top of layer (m)	Unit thickness (m)	Geological unit
0-0.4	0.4	SILT with some sand (TOPSOIL)
0.4-0.9	0.5	Orange brown SAND with silt
0.9-1.9	1.0	Greyish brown SAND with silts and gravels
1.9-3.2	1.3	Light grey SANDS and GRAVELS

2.5 Hydrogeology and hydrology

Based on topography, groundwater is expected to occur at around 0.5-1 m below ground level (mbgl) and predicted to flow in a westerly direction. Groundwater was encountered at 0.54 – 2.59 mbgl at the site during the T+T geotechnical investigation. The water table appears to act as expected where the shallow groundwater was encountered inland (closer to State Highway 1), and deeper groundwater encountered near the Waikato River.

Groundwater is expected to discharge to the Waikato River, which is approximately 80 m west of the site.

[4] Geotechnical assessment for Ohinewai Rezoning. T+T ref: 1008304. Prepared for Shand Properties.
[5] Opus Internation Consultants and Works Consultancy Service testpit logs, hand auger logs, and CPT logs are obtained from NZGD (New Zealand Geotechnical Database).

3 Site history

Historical information relating to the site was collected from a variety of sources. The information comprised documents for site activities, except for the aerial photograph review where comments are also provided on readily observable surrounding land use. The information that has been reviewed is summarised in this section. A more detailed review of the available information is included in Appendix B.

The earliest reviewed certificates of title date back to 1920 when the titles were created by individual farmers for different sections across the subject site. The subject site appears to have been bare rural farmland since the 1940s. Several residential houses, farm sheds, stock pens, and workshops have been erected and relocated within the subject site from 1967 to 2014 (as indicated through building consent applications). A strip of the subject site along the eastern boundary was vested for the Auckland-Hamilton motorway (now known as State Highway 1) in 1973.

Other evidence of farm management includes evidence of burn piles (aerial photographs), stockpiles lined along the farm drain (site inspection), and mulch composting (aerial photographs).

4 Site characterisation

This section characterises the likely and potential contamination status of the site based on the available information as presented in Sections 2 and 3 of this report.

4.1 Potential for contamination

This investigation has identified that HAIL activities were (or are likely to have been) undertaken at the site. The activities, potential contaminants and an assessment of the likelihood, potential magnitude and possible extent of contamination are presented in Table 4.1 below. The inferred locations of these activities are presented on Figure 1 (Appendix A).

Table 4.1: Potential for contamination

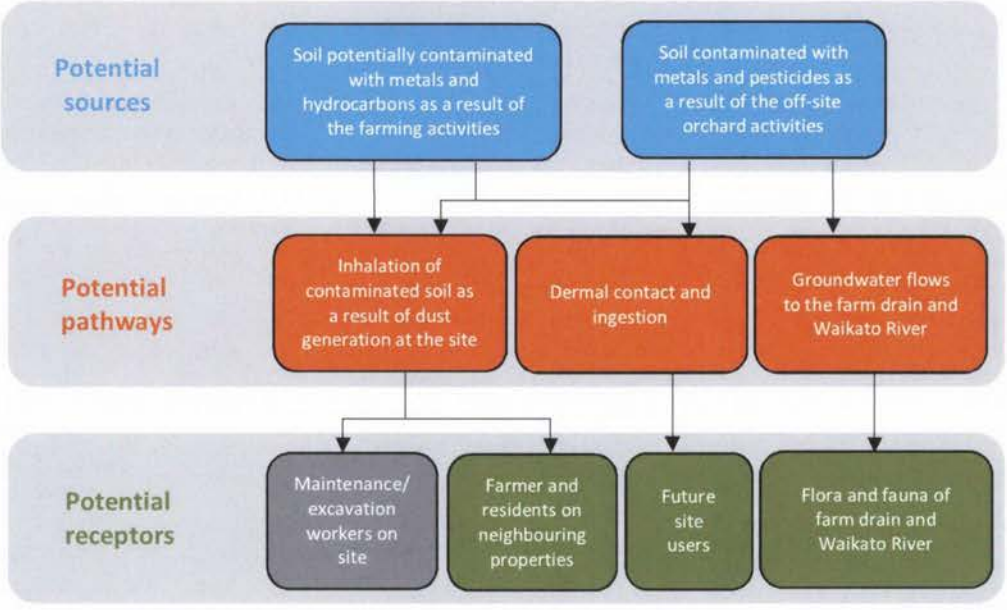
Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Historic land filling	Unknown but a broad range of contaminants possible as offsite material was sourced. If sourced from industrial areas then typical contaminants include metals and polyaromatic hydrocarbons (PAH), and asbestos.	During site walkover inspection, the undulating ground observed on the western portion of the subject site (west of Ohinewai North Road) appears to have bigger mounds on the slopes. While this is likely to indicate some historic landfilling, the likelihood of the fill to comprise industrial type waste is low. It is more likely than not that the fill is from surrounding rural farm land. Contamination, if any, is expected to be present in fill soils and immediately underlying soils.	I – Land subject to intentional or accidental release of a hazardous substance, only if it is in sufficient quantity to be a risk to human health or the environment
Application of fertilisers	Metals, particularly cadmium.	The site (with the exception of the residential areas within the site) has been used for dairy farming since possibly the 1920s. During this time, it is highly likely that fertilisers were applied to the farmland. There is a potential for near surface soils (and buried topsoil) across the site to contain cadmium and/or other metals.	Waikato Regional Council does not consider this activity to be a HAIL. This activity only becomes a HAIL if fertilisers have been applied in sufficient quantity to be a risk to human health or the environment.

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Burn piles	Metals.	There are evidences of burn piles observed in the 2015-2018 google earth images in the northern third of the subject site (north of Ohinewai North Road), away from the residential areas. Contamination, if present, is likely to be near surface soils (and buried topsoil) where these piles are located.	I – Land subject to intentional or accidental release of a hazardous substance, only if it is in sufficient quantity to be a risk to human health or the environment
Off-site orchard activities (spray drift, or runoff from neighbouring horticultural properties).	Arsenic, copper lead, mercury, zinc, organochlorine pesticides (OCP)	There is an orchard farm immediately south of the subject site (east of North Ohinewai Road), since at least 1991. Based on our experience, there is a very low potential for near surface soils adjacent to the orchard to have been contaminated via spray drift. There is also potential for contaminants to be conveyed within open drains (located immediately east of the orchard) through the site. The drain runs north-south along the eastern third of the subject site. These may be present in mucked out soils or within drains, or both.	A10 - Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds
Off-site storage drums for unknown chemical/liquid waste	Chemicals (organic and inorganic)	There were some storage drums observed during the site walkover, located immediately west, and middle third, of the subject site. The ground surrounding the drums appears to be soaked and stained. If present, contamination is not anticipated to have migrated to affect soil at the site because the contamination is located on the downgradient side of the site.	A17 – Storage tanks or drums for fuel, chemicals or liquid waste

4.2 Preliminary conceptual site model

A conceptual model as defined by the Ministry for the Environment in the contaminated land management guidelines[6], sets out known and potential sources of contamination, potential exposure pathways, and potential receptors. For there to be an effect from the proposed activity there has to be a contamination source and a mechanism (pathway) for contamination to affect human health or the environment (receptor).

A preliminary conceptual site model has been developed for the proposed activity which takes into account the available information about the site, and our understanding of the potential effects on human health and the environment. The model is presented below.



Preliminary conceptual site model for possible activities intended on site. Grey boxes indicate incomplete pathways. There are no proposed development (including excavations) of the site for the moment, therefore the maintenance/excavation workers receptors are considered incomplete.

[6] Ministry for the Environment, updated 2011, *Contaminated Land Management Guidelines No. 5 Site Investigation and Analysis of Soils*

5 Regulatory implications

The rules and associated assessment criteria relating to the control of contaminated sites in the Waikato region are specified in the following documents:

- NES Soil;
- The Waikato Regional Plan (WRP); and
- The Waikato District Plan.

The NES Soil and District Plan consider issues relating to land use and the protection of human health while the Regional Plan has regard to issues relating to the protection of the general environment, including ecological receptors. The need, or otherwise, for contamination related resource consents for the site rezoning has been evaluated against these regulatory requirements.

5.1 NES Soil

The NES Soil came into effect on 1 January 2012. This legislation sets out nationally consistent planning controls appropriate to district and city councils for assessing contaminants in soil with regard to human health. As a result, the NES Soil prevails over the rules in the District Plan, except where the rules permit or restrict effects that are not dealt with in the NES Soil.

The NES Soil applies to specific activities on land where a HAIL activity has, or is more likely than not to have occurred. Activities covered under the NES Soil include soil disturbance, soil sampling, fuel systems removal, subdivision and land use change.

As the land is currently production land and no change in use is proposed, the NES Soil does not apply.

If the land ceases to be production land, the potentially contaminating activities identified in Section 4.1 are not expected to preclude the use of the land for Country Living Zone type activities. Under the NES Soil, further investigations (Detailed Site Investigation, i.e. soil testing in areas of potential contamination) will be required to be undertaken if soil disturbance or change in land use is proposed. There are standard methods available to deal with contamination if levels that pose a risk to human health for the proposed land use is found.

5.2 Waikato Regional Plan

The policies, objectives, and implementation methods relating to the control of contaminated sites in the Waikato region are specified in the WRP.

The WRP rules relate to discharges from the remediation of contaminated land. These would apply if it is determined that remediation of contaminated soils is required.

5.3 District Plan

As noted in Section 5 the NES Soil now prevails over the rules in the District Plan, except where the rules permit or restrict effects that are not dealt with in the NES Soil.

The Proposed Waikato District Plan includes rules relating to subdivision of contaminated land and would make it a non complying activity for a boundary of a proposed lot to divide "contaminated

land"[7]. Further investigations (i.e. soil sampling and testing) would be required if subdivision of land occurs and the land is used for a more sensitive land use (e.g. residential).

[7] This is defined as the Resource Management Act 1991 definition, namely "contaminated land means land that has a hazardous substance in or on it that (a) has significant adverse effects on the environment; or (b) is reasonably likely to have significant adverse effects on the environment.

6 Conclusions

This PSI makes the following conclusions:

- The site has been a rural farmland, used by farmers since 1920. From 1967 till present, several residential houses, farm sheds, stock pens, and workshops have been erected and relocated within the subject site. A strip of the subject site along the eastern boundary was vested for the Auckland-Hamilton motorway (now known as State Highway 1) in 1973. There is evidence of farm management activities within the subject site.
- The site has been subject to potential HAIL activities including:
  - The presence of fill (HAIL I)
  - The possible usage of fertilisers (HAIL I)
  - The presence of burn piles (HAIL I)
  - Off-site orchard activities (HAIL A10)
  - Off-site storage drum (HAIL A17)

  HAIL activity I only applies if contaminants are in sufficient quantity to pose a risk to human health and the environment.
- As the land is currently production land and a change in use of the land is not being proposed, the NES Soil does not apply.
- If the land ceases to be production land, the potentially contaminating activities identified are not expected to preclude the use of the land for Country Living Zone type activities. There are standard methods available to deal with contamination if levels that pose a risk to human health for the proposed land use is found, if found. Under the NES Soil, further investigations (Detailed Site Investigation, i.e. soil testing in areas of potential contamination) will be required to be undertaken if soil disturbance or change in use of the land is proposed.

7 Applicability

This report has been prepared for the exclusive use of our client Shand Properties Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:

.....

Jean Chye

Environmental Engineer

Authorised for Tonkin & Taylor Ltd by:

.....

pp Glen Nicholson

Project Director

Technical review undertaken by Suitably Qualified Experienced Practitioner (SQEP):

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Lean Phuah
Discipline Manager – Contaminated Land

9-Oct-18

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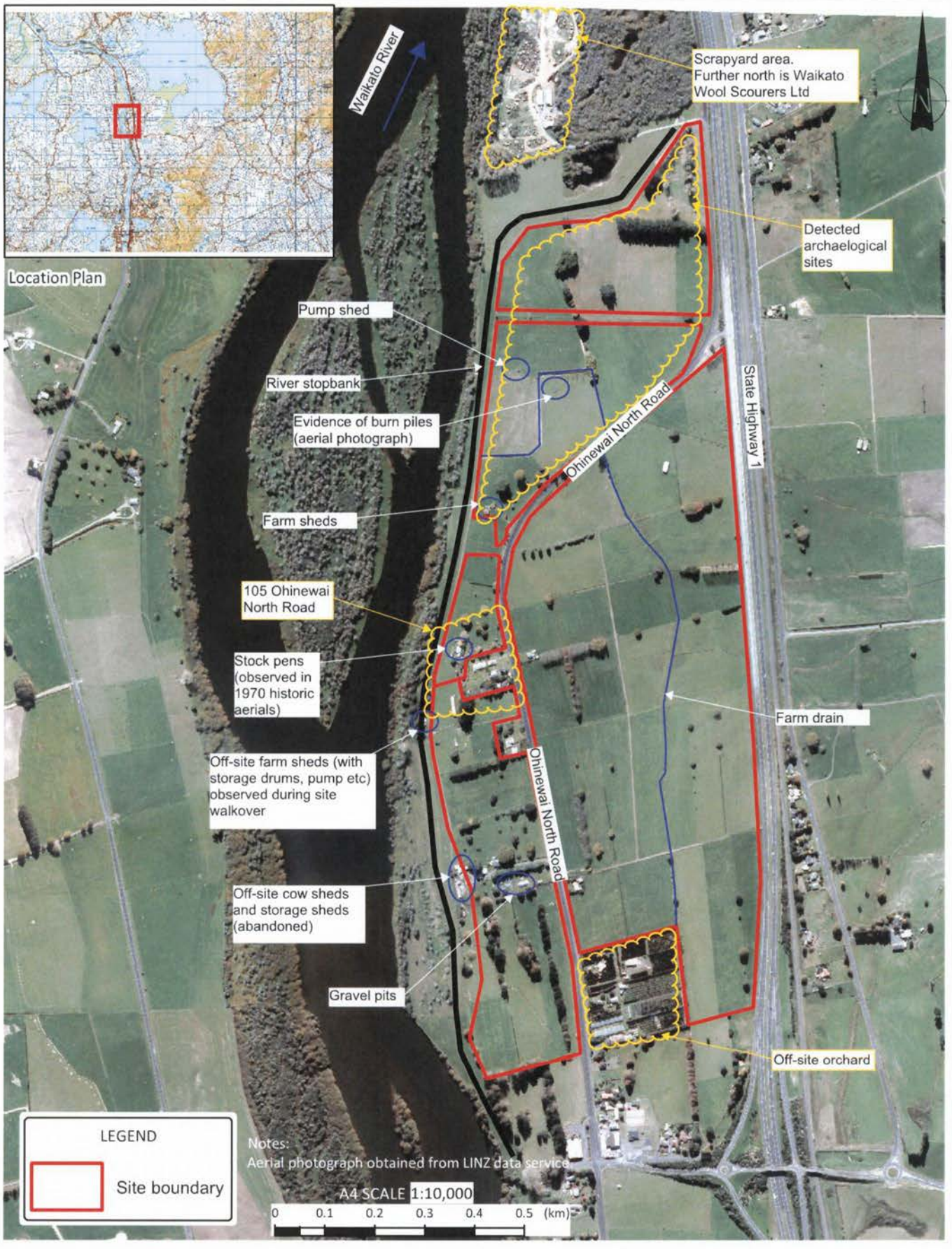
Appendix A: Figure

- Figure 1 – Site Plan



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Tonkin+Taylor
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DRAWN	JYJC	Sep.18
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APPROVED		
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OHINEWAI REZONING

SHAND PROPERTIES

GROUND CONTAMINATION ASSESSMENT

Site plan

Appendix B: Site history information

Historical information relating to the site has been collected from a variety of sources. The information presented documents on-site activities, except for the aerial photograph review where comments are also provided on readily observable surrounding land use. The information that has been reviewed is summarised in this appendix.

B1 Certificates of title

Current and historical certificates of titles (titles) for the site have been reviewed. The subject site consists of multiple current titles from three individual owners: Gerald Shand, Caleb Hill, and Mary Silvester. A summary of the information reviewed is presented below.

Gerald Shand

- Gerald Shand, Jacqueline Rogers, and Catherine Bakers are current proprietors of nine current titles, with a total area of 84.6 ha.
- The earliest reviewed title was created in 1920. The historic titles have been owned and transferred by multiple individual farmers.
- The titles were transferred to Lo-De-Bar Lands Limited in 1968 and 1975.
- Most of the titles (a small section of the property area) have been vested for the Auckland-Hamilton Motorway in 1972.

Caleb Hill

- Caleb Hill is the current proprietor of two current titles, with a total area of 11.2 ha.
- The earliest reviewed title was created in 1894.
- The two titles (a small section of the property area) have been vested for the Auckland-Hamilton Motorway in 1973.

Mary Silvester

- Mary Silvester is current proprietor of title with a total area of 20 ha.
- The earliest reviewed title was created in 1932.

B2 Historical aerial photographs

Historical aerial photographs from the T+T library and other sources have been reviewed as stated in Table B.1. Relevant features of the site and surrounding land are summarised from each aerial photograph in Table B.1.

Table B.1: Summary of aerial photograph review

Date, run number and source	Key site features	Surrounding land features
1940 SN155 Run A3-5 Retrolens	• Majority of the subject site is grassed farmland, with some residential houses located across the subject site. • A road (currently known as Ohinewai North Road) cuts across the top of the subject site, then down the left third of the subject site. • There appears to be a group of buildings, possibly farm sheds, (photo resolution is not clear) on the south western corner of the subject site.	• The subject site is bounded by a north-south unsealed road to the east, and Waikato River (with riparian vegetation) to the west. • Land to the north and south of the subject is appears to be grassed farmland with some residential houses.

Date, run number and source	Key site features	Surrounding land features
1957 SN1031 Run H7 Retrolens	• Majority of the features appear to be similar to the features observed in previous photograph. • An area mid-west of the subject site appears to have some buildings (possibly farm sheds) erected in this area, however the photo resolution is not clear. • There are some shelter belts located across the subject site.	• Surrounding features appears to be similar to features observed in the previous photograph.
1970 SN3293 Run D11-12 Retrolens	• Majority of the features appear to be similar to the features observed in previous photograph. • The farm sheds on the south western corner of the subject site has multiple sheds, including a stock pen. • The farm sheds on the mid-west of the subject site appears to have stockpiled timber as well.	• Surrounding features appears to be similar to features observed in the previous photograph.
1977 SN5164 Run L5 Retrolens	• All the features within the subject site appears to be similar to features observed in the previous photograph.	• Surrounding features appears to be similar to features observed in the previous photograph.
1991 SN9124 Run E5 Retrolens	• All the features within the subject site appears to be similar to features observed in the previous photograph.	• Majority of the features appears to be similar to the features observed in previous photograph. • Immediately south of the subject site appears to be rows of crops (either fruit trees, or vegetable crops) replacing some residential properties.
2008 Google Earth	• All the features within the subject site appears to be similar to features observed in the previous photograph (including the farm sheds and buildings on the mid-west and south west of the subject site).	• The State Highway 1 Waikato Expressway appears to have been fully constructed along the eastern boundary of the subject site. • The south of the subject site appears to have more developed residential properties, with an adjacent crop land.
2015 – 2018 Google Earth	• Majority of the features within the subject site appears to be similar to features observed in the previous photograph. • In a small area north of the subject area, it appears to be used as a hay/maize paddock. • There appears to be some burn piles located in parts of the subject site. • There is also an area where mulch composting is evident (white tarp with tyres on top).	• Immediately south of the site, some sections of the crops appear to have been replaced by a residential building, with surrounding orchard/crops. • The remaining surrounding features appears to be similar to the features observed in previous photograph.

B5 Council property files

Property files were requested from Waikato District Council (WDC) on 14 September 2018. There are only files recorded for the property of 105 Ohinewai North Road in the WDC database. The summary of the reviewed property files are provided below:

- 105 Ohinewai North Road
  - Resource consent (land use) application (by Robin Wilkins, Lo-De-Bar Lands Ltd) granted in 1994 for erection of assessor building (exceeds permitted floor area and encroaches) and erection of shed (in flood risk area).
  - A number of building permits issued from as early as 1967 to as recent as 2014. The permits include erection of stock and hay barns, garage/workshops, dwelling (and extensions), and farm shed. Permits also includes relocation of sheds/barns. Applications have been applied by Transport Equipment Ltd and Neil Farms Ltd (since 1967), and by Lo-De-Bar Lands Ltd (since 1982).

B6 Council contamination enquiry

A contamination enquiry was placed with Waikato Regional Council (WRC) on 14 September 2018. The information provided states that the subject site does not currently appear on WRC Land Use Information Register (LUIR).

Resource consents related to the site or properties immediately surrounding the site (including existing, superseded and surrendered consents), within approximately 1 km radius of the site, are summarised in Table B.2 below. All of the consents identified in Table B.2 are considered unlikely to have resulted in soil contamination at the subject. This is because of their location, distance and/or nature and likely extent of the contaminants at those locations.

Table B.2: Ground contamination-related resource consents

Location	Type of consent	Activity description	Holder	Status
850 m west of site (middle of the site)	Resource consent water permit	To take surface water from the Waikato River for Agricultural farming – dairy.	Maxwell Hill and Sheryl Hill Trust	Current. Expires 31/12/2030
920 m west of site (middle of the site)	Resource consent water permit	To take surface water from the Waikato River for Agricultural farming – dairy.	Sir/Madam LM Cameron and DM Watts	Current. Expires 31/12/2030
1.05 km west of site (middle of the site)	Resource consent land use conset	Install coffer dam and associated damming and diversion of water at 14 locations in Lower Waikato, Waihou and Piako.	Waikato Regional Council	Current. Expires 28/9/2022
1.1 km south of site (middle of the site)	Resource consent water permit	To take and use water from Waikato River for dust suppression, costurciton, and re-vegetation purposes in association with the Huntly Section of the Waikato Expressway.	New Zealant Tranport Agency – Regional Office	Current. Expires 30/6/2032

Appendix F: Geotechnical information

Tonkin+Taylor

Job No: 1008304
9 October 2018

Shand Properties
PO Box 112
Huntly

Attention: Jackie Rogers

Dear Jackie

Waikato District Plan Submission

Ohinewai Rezoning - Preliminary Geotechnical Assessment

1 Introduction

Tonkin & Taylor Ltd (T+T) has been engaged by Shand Properties to undertake a preliminary geotechnical assessment to support a submission to the Proposed Waikato District Plan for your land at Ohinewai. This work has been undertaken in accordance with the agreed proposal and terms and conditions dated 11 September 2018.

2 Background

We understand that Shand Properties are requesting that Waikato District Council zones its land in Ohinewai Country Living rather than Rural. The submission to Waikato District Council requires several supporting technical specialist reports, including this geotechnical assessment of the site. This geotechnical assessment will collect information to ascertain whether the land is prone to geohazards such as liquefaction.

3 Scope of work

In accordance with our correspondence including your confirmation to proceed with Option B (email to Grant Eccles dated 11/08/2018), the scope of works for the geotechnical assessment consisted of the following:

- A site walkover
- Review of available information:
  - New Zealand Geotechnical Database
  - T+T Geotechnical Database, including T+T projects in the area
  - Readily available council files
  - LiDAR surface levels
- Review of published literature, including:
  - Geological maps
  - Relevant academic papers
- Ground truthing the site to undertake a liquefaction assessment, including:
  - Twelve (12) hand auger investigations
  - Twelve (12) Scala penetrometer tests
  - Installation of five (5) piezometers for groundwater monitoring
- Producing a letter report with a statement regarding the suitability of the land for development.

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This letter report will outline the results of the above desk study and geotechnical investigations, including figures and references required to support the submission for rezoning. The geotechnical investigations undertaken will satisfy a Level B liquefaction assessment in line with MBIE (2017)[1] Planning and Engineering Guidance for potentially liquefaction-prone land.

4 Site description

The subject site consists of multiple parcels with different legal descriptions and property owners. Based on the Certificate of Title for the lots that make up the subject site, the land area is approximately 115.8 hectares. The subject site is in a rural farmland area of Ohinewai bounded by the Waikato Expressway to the east, and Waikato River to the west, as shown on Figure 1, Appendix A. Ohinewai North Road runs roughly north-south through the majority of the existing parcels.

Note that this geotechnical assessment covers the whole of the property shown on Figure 1, Appendix A, not just the area being sought to be zoned Country Living.

From aerial imagery, the site appears to be relatively flat at an average RL of 9.5 m, with a stopbank at approximately RL10.3m along the Waikato River to the west of the site. The Waikato River level is at approximately RL6.6m at the site. A farm drain appears to run through multiple parcels to the east of Ohinewai North Road in a roughly north-south orientation.

Use of LiDAR imagery of the site shows that the area is gently to moderately undulating, with the farm drain clearly visible. To the south-west of the site, west of Ohinewai North Road, it appears that the land has multiple terraces between the road and the river. We note that further assessment of these landforms should be undertaken if residential development in this area is considered in the future.

Information provided by the archaeological database ArchSite[2], shows that several borrow pits have been recorded on the two northern lots within the site (north of Ohinewai North Road, it is likely that this is beyond the area sought to be rezoned in this case). We note that the borrow bits were identified using 2012 aerial photography and LiDAR-derived hillshade data.

4.1 Site walkover

A site walkover was undertaken by two Engineering Geologists from T+T on 20 September 2018. Generally, the smaller part lots that run to the west of the site, between the stopbank and Ohinewai North Road were moderately undulating. The larger part lots to the east of the road were gently undulating. Through the eastern lots, the farm drain had high water levels and it appeared to have been recently dredged in multiple parts of the site. The farm drain was approximately 1 m wide by 1 m deep and did not appear to be retained in any way.

No slopes were observed within the site that were deemed to require any slope stability analyses. Due to the undulations across the site, we note that retaining walls may be required for development of level ground on some proposed lots. Site specific requirements will be assessed at resource consent stage for individual lots.

The stopbank along the Waikato River is located to the west of the subject sites, beyond the property boundaries of this study. While the composition and design of the stopbank is unknown, the height of the stopbank appeared to be consistent over the site. Some of the land to the west of the stopbank, between the stopbank and the banks of the river, was gently undulating. When walking between the stopbank and the riverbank, it appeared that trees on the riverbank were

[1] MBIE, MfE, and EQC, 2017: Planning and engineering guidance for potentially liquefaction-prone land: Resource Management Act and Building Act aspects.
[2] Archaeological Site Recording Scheme: ArchSite, accessed September 2018, https://archsite.eaglegis.co.nz/

leaning back into the land. It is likely that this represents slow slumping of the toe of the river bank, downslope of the stopbank. This is not likely to affect the lots to the east of the stopbank as they are further inland.

Photographs of the site can be found in Appendix C.

5 Site conditions

5.1 Published geology

The published geology of the area[3] indicates that the site is underlain by the Taupo Pumice Alluvium. The Taupo Pumice Alluvium is of late Holocene in age and comprises well bedded pumice sands, silt and gravels with charcoal fragments, deposited in the Waikato River valley following the Taupo eruption about 1850 years ago. This formation overlies the late Pleistocene deposits of the Hinuera Formation. The Hinuera Formation comprises interbedded coarse alluvium, pumice gravels, peat and silts deposited by braided river systems of the ancestral Waikato and Waipa Rivers.

The GNS New Zealand Active Fault Database[4] identifies the Kerepehi Fault as the closest active fault to the site, approximately 45 km to the east. The geological map of Auckland identifies the concealed, deep, Kimihia Fault running approximately north-south to the east of Ohinewai North Road, and through the centre of the northern lots within this study (see Figure 5.1). While this fault exists, it is not classed as active, and it is not thought to present a risk to the site.

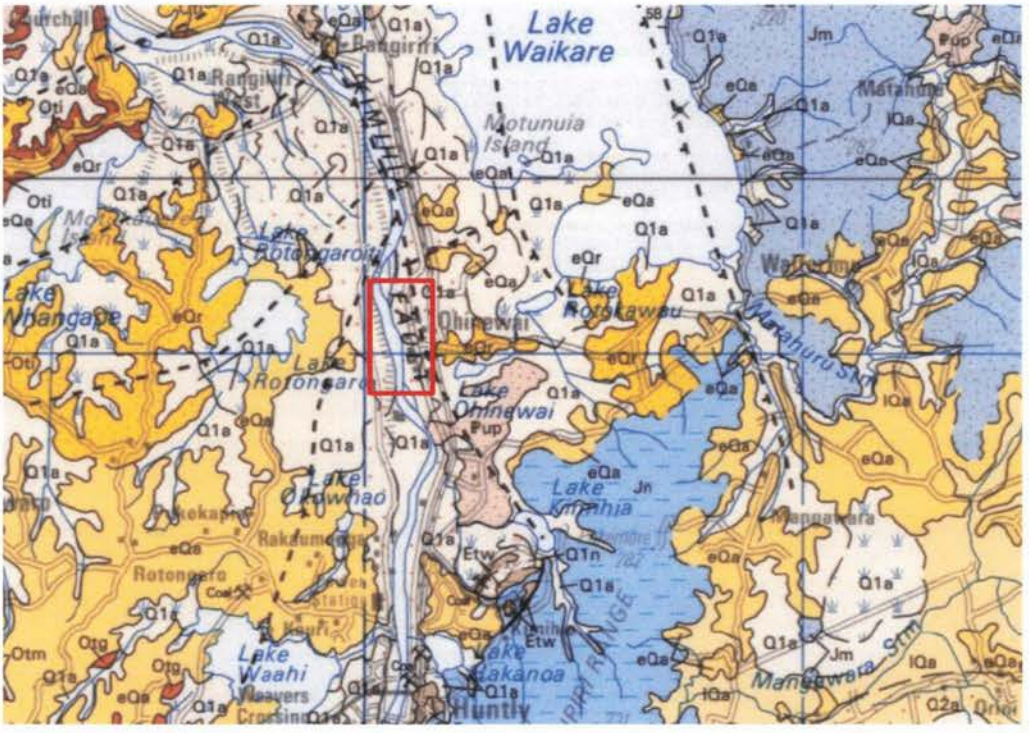

Figure 5.1: Published geological map of the area. The site is identified by the red box.

[3] Edbrooke, S.W. (compiler) 2001: *Geology of the Auckland area*. Institute of Geological & Nuclear Sciences 1:250,000 geological map 3. 1 sheet + 74 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences Limited.
[4] GNS New Zealand Active Fault Database. Accessed from https://data.gns.cri.nz/af/ September 2018.

5.2 Review of available site investigation data

As part of the desk study to understand the nature of the soils underlying the site, existing logs were identified from the New Zealand Geotechnical Database[5]. These investigations were aligned with the Ohinewai North Road, and the junction to State Highway 1. The location of these investigations are shown on Figure 1, Appendix A.

Shallow investigations (hand augers and test pits) identified pumiceous sands to approximately 2.5 m depth. The water levels recorded ranged between 1.5 – 2.2 m below ground level (mbgl). A deep borehole investigation to 38 m depth identified pumiceous sands with some silts. Organic silt layers were encountered between 21 – 30mgbl. Two Cone Penetration tests (CPTs) extended deeper than 20 mbgl. These appear to show sands to around 22 mbgl, followed by silts to around 32 mbgl. Water levels recorded in the borehole ranged from 1.6 – 1.75 mbgl.

From this information we can infer that pumiceous sands and silts represent the Taupo Pumice Alluvium, with a groundwater level between 1.5 and 2.2 mbgl. It is likely that, with the Waikato River adjacent to the western lots, the groundwater level could vary across the site, as well as seasonally.

6 Ground investigations

Geotechnical investigations were carried out at the project site between 19 and 21 September 2018. The investigations comprised:

- Twelve (12) hand augured boreholes.
- Twelve (12) Scala penetrometer tests.

Actual investigation locations were selected by T+T on the basis of access and presence of buried services. Due to the possibility of archaeological sites in the two northern lots in the study, ground investigations were not undertaken within these lots.

The locations of the investigations were surveyed by hand held GPS and are presented on Figure 1, Appendix A. Summary borehole logs are presented in Appendix B.

6.1.1 Summary of ground investigations

The drilling of twelve (12) hand augered boreholes and twelve (12) Scala penetrometer tests was carried out by field geologists from Geotechnics Ltd, to a target depth of 4 mbgl. Shear vane tests were undertaken when cohesive materials were encountered. The Scala penetrometer tests were taken to either the target depth of 4 mbgl or finished in line with the hand auger test.

A summary of the investigations are presented in Table 6.1 below.

[5] New Zealand Geotechnical Database. Accessed from https://www.nzgd.org.nz September 2018.

Table 6.1: Investigation Summary

HA ID	Location (NZTM)		Ground Surface Elevation RL (m)	Hand Auger Depth (m)	Scala Penetrometer Depth (m)	Groundwater level (mbgl)
	Easting (m)	Northing (m)				
HA1	1790449	5848804	9.5	2.7	3.0	1.4
HA2	1790871	5848980	9.5	1.8	2.0	0.6
HA3	1790926	5849225	9.5	2.15	3.0	1.0
HA4	1790760	5849507	9.0	2.4	3.0	1.3
HA5	1790556	5849203	10.0	3.1	4.0	2.5
HA6	1790363	5849361	10.0	2.9	4.0	2.5
HA7	1790563	5849480	9.5	2.7	4.0	1.2
HA8	1790886	5849658	9.0	1.5	2.0	0.7
HA9	1790519	5849728	9.0	2.2	3.0	0.9
HA10	1790670	5849879	9.0	1.4	2.0	0.5
HA11	1790050	5849615	9.5	3.2	4.0	2.6
HA12	1790662	5849509	9.5	2.6	4.0	1.8

Note 1: Elevations estimated based on Moturiki 1953 contours.

Note 2: Groundwater levels measured during drilling

6.2 Ground conditions

The materials encountered generally comprise a thin topsoil layer (up to 0.4 m thick), followed by sands with silts to around 1 m depth, then gravels with sands to the base of the hand augers. The density of the sand varies between loose and medium dense based on Scala penetrometer results.

Groundwater levels were recorded upon completion of each hand auger. The depths ranged from 0.5 mbgl to 2.5 mbgl at the time the hand augers were undertaken. The depths to groundwater appear to be deeper to the west of the sites, closer to the Waikato River, and shallower to the east of the site indicating that the groundwater levels are controlled by the Waikato River. Subsequent monitoring of the groundwater levels shows similar depths to water across the site.

The water levels recorded during this investigation were taken after a prolonged period with no rain and may not be representative of the seasonal high groundwater levels. Further monitoring of groundwater levels is recommended for later stages of the project.

7 Liquefaction assessment

MBIE/MfE/EQC (2017) guidelines recommend a minimum of a Level A liquefaction assessment is undertaken for a rural-residential setting at Plan Change stage. As part of the investigation for this site, a number of shallow investigations were undertaken allowing for a calibrated desktop assessment in line with a Level B liquefaction assessment.

7.1 Seismic site subsoil class

The seismic subsoil class in accordance with NZS 1170.5:2004 (Section 3.1.3) for the site is considered to be 'Class D – Deep Soil Sites'. Although a BH undertaken 3km for the Huntly Section of the Waikato Expressway encountered rock at 50 mbgl, the site is in a different geomorphological setting and is too far away from the site to be considered in this assessment.

7.2 Ground shaking hazard

The seismic hazard in terms of Peak Ground Acceleration (PGA) for the area has been assessed based on the NZTA Bridge Manual in accordance with the approach recommended in NZGS Module 1 (NZGS/MBIE, 2016).

The design return periods considered for this study are 25 and 500 year. The 25 and 500 year return periods correspond to Serviceability Limit State (SLS) and Ultimate Limit State (ULS) design events for importance level two structures respectively specified by the Building Code.

Table 7.1 presents the return periods for earthquakes with various 'unweighted' PGAs with corresponding earthquake magnitudes.

Table 7.1: Ground seismic hazard

Event	Return period (years)	PGA (g)	Magnitude (M_{eff})
SLS	25	0.054	5.8
ULS	500	0.215	5.8

7.3 Liquefaction potential

Liquefaction potential for the site has been assessed by geological screening with qualitative calibration and using semi-quantitative screening criteria based on age, peak ground acceleration expected and the depth to groundwater.

The site is underlain by the Late Holocene deposits of the Taupo Pumice Alluvium, comparing the age and seismic hazard factors presented Table 7.1 to the screening criteria suggested in the MBIE/MfE/EQC (2017) guidelines (Figure 7.1) shows that for a SLS event liquefaction-induced ground damage at the surface is unlikely to affect the site, however, liquefaction-induced damage at the surface is possible in the ULS case.

Due to the residual uncertainties inherent in a desktop study, it is not possible to quantify the degree of expected damage with any more certainty at this stage. The degree of damage can range from minor to severe depending on the water level, soil type and proximity to free faces.

The consequences of the liquefaction assessment are discussed in greater detail in section 8.10.

TYPE OF SOIL DEPOSIT	A LIQUEFACTION VULNERABILITY CATEGORY OF LIQUEFACTION DAMAGE IS UNLIKELY CAN BE ASSIGNED IF EITHER OF THESE CONDITIONS IS MET:	
	DESIGN PEAK GROUND ACCELERATION (PGA) FOR 500-YEAR INTENSITY OF EARTHQUAKE SHAKING[1]	DEPTH TO GROUNDWATER[2]
Late Holocene age Current river channels and their historical floodplains, marshes and estuaries, reclamation fills	Less than 0.1 g[3]	More than 8 m
Holocene age Less than 11,000 years old	Less than 0.2 g	More than 6 m
Latest Pleistocene age Between 11,000 and 15,000 years old	Less than 0.3 g	More than 4 m

Notes:

1. The listed PGA values correspond to a magnitude 7.5 earthquake. For screening purposes using this table, earthquake scenarios with different magnitudes may be scaled using the magnitude scaling factor (MSF) proposed by Idriss and Boulanger (2008): MSF = [6.9 exp (-M/4) – 0.058], up to a maximum value of 1.8.
2. For screening purposes using this table, a high groundwater scenario should be assumed (eg a typical seasonal high groundwater level).
3. For many types of late Holocene age deposits (and especially reclamation fills), if liquefaction is triggered then ***Moderate to Severe*** ground damage often results. Therefore careful consideration should be given to the uncertainties in the seismic hazard estimate before screening out these soils on the basis of the expected intensity of earthquake shaking. It is important to understand the potential consequences if earthquake shaking is stronger than expected.

These criteria are adapted (with modifications) from California Department of Conservation (2004).

Figure 7.1: Semi-quantitative screening criteria for identifying land where liquefaction-induced ground surface damage is unlikely (MBIE/MfE/EQC (2017)

8 Potential geotechnical risks

We understand that the development is likely to be low density, large lot rural living, and have undertaken our assessment with this assumption. If future development of this site could include high density housing, more detailed assessments of the sites may need to be considered.

Below is a summary table of potential geotechnical risks that were identified from the desktop study and site walkover, with possible mitigations for each risk.

Table 8.1: Potential Geotechnical Risks

Hazard	Potential risk	Likelihood of presence on site	Potential mitigation
Soft or compressible soils, including peat	Settlement (total and differential)	Possible in isolated areas	Removal of near surface soft/loose soils and replace with engineered fill. Use foundation system or building structure capable of withstanding anticipated ground movements, or preload/ surcharge the building footprint.
Bearing capacity	Low bearing capacity near surface	Generally unlikely but possible in isolated areas	Undercut soft/loose material and backfill with engineered fill, or specifically designed foundations for soils with low bearing capacity e.g. raft foundations.
Subgrade CBR	Low CBR for pavements and floor slab	Possible in isolated areas	Design for low CBR and allow for undercutting.
Expansive soils	Shrink/swell around foundations, differential settlement	Unlikely	Not applicable.
Uncontrolled fill	Settlement, construction difficulties	Possible	Removal of material and replacement with engineered fill.
Lateral variability	Differential settlement	Likely	Undercut to consistent layer and replace with engineered fill.
Voids, piping	Settlement, construction difficulties	Unlikely	Not applicable.
Erosion	Inundation/evacuation of land	Unlikely	Not applicable.
Slope stability	Inundation/evacuation of land	Unlikely	Not applicable.
Liquefaction	Settlement, lateral spread, loss of shear strength	Settlement – Likely Lateral Spread - Possible	Undertake site specific ground investigation and liquefaction analyses. Use of foundation system or building structure capable of withstanding anticipated ground movement. Use of setbacks from farm drains and stopbanks

8.1 Soft or compressible soils

Soft/loose layers have been identified within the investigations. The farm drains are also likely to contain a limited amount of soft alluvial materials. Soft or loose materials encountered at the surface should be removed and replaced with engineered fill.

The effect of settlement caused from consolidation soils at depth will need to be assessed with further, deeper geotechnical investigations to ensure the developments will meet the requirements of the building code (25 mm differential settlement over 6 m length).

8.2 Bearing capacity

Based on the results of the Dynamic Cone Penetrometer tests undertaken, it is anticipated that an Ultimate Geotechnical Bearing Capacity (UGBC) of 200kPa to 300kPa will generally be available for building lots. Isolated softer areas may be encountered during site specific investigations or during construction. These softer areas should be excavated and replaced with engineered fill or a different foundation system should be provided for lower UGBCs.

8.3 Subgrade CBR

Based on the Austroads[6] correlation between subgrade CBR and Scala penetration blows, the range of subgrade CBR for the top 1 m of soil is between 2 and 8. A typical CBR value is 4. The measurements from the top 1 m of soil excludes topsoil. These values should be adopted for pavement design, pending any further investigations undertaken at design stage.

8.4 Expansive soils

Expansive soils were not encountered during the investigation, however, lot specific investigations should be undertaken to confirm if these soils are present.

8.5 Uncontrolled fill

Areas of uncontrolled fill may be encountered during the construction phase of the project. These are expected to be treated by excavation and replacement with compacted engineered fill. These may be encountered in small gullies or as isolated areas within the site. The subgrade should be inspected before construction of buildings or pavements.

8.6 Lateral variability

The Taupo Pumice Alluvium and Hinuera Formation have inherent lateral and vertical variability. This is illustrated in the investigation logs available for the site. Site specific investigations are required prior to construction on each site to better understand the local variabilities.

8.7 Voids, piping

Not anticipated in the current site condition.

8.8 Erosion

Not anticipated in the current site condition.

[6] AUSTROADS (2012) Pavement Design - A Guide to the Structural Design of Road Pavements. Figure 5.3.

8.9 Slope stability

Not anticipated in the current site condition.

We note that due to the undulations around the site, retaining walls may be required for levelling sites for development. Site specific assessments, especially in the terraced part to the south-west of the site, will likely be required to establish this prior to construction.

8.10 Liquefaction

Whilst it can be demonstrated that for the 25 year event (i.e. SLS) liquefaction is unlikely, in the 500 year event (i.e. ULS) case, the presence of near surface non-plastic, Late Holocene soils and the high groundwater table measured between 0.5 and 2.5 mgbl indicates that liquefaction damage is possible.

Potential design options to mitigate the damaging effects of liquefaction are discussed in the series of guidance documents produced by MBIE for repairing and rebuilding houses affected by the Canterbury earthquakes (MBIE, 2012). Generally, the type of damage experienced may result in differential settlements, global settlements and ingress of liquefaction ejecta that could damage infrastructure and buildings. The risk of damage such as this is normally treated in one of or a combination of the following ways:

- Undertake **ground improvement** so that a higher level of earthquake shaking is required to trigger liquefaction. In some cases it may be possible to change the fundamental behaviour of the ground (e.g. by physically removing or cementing susceptible soil) so that liquefaction will not occur even under the highest levels of earthquake shaking expected.
- Specify **robust foundation systems** that are able to tolerate liquefaction related land damage, such as thick reinforced foundations or stiff platforms. The specific ground conditions at the site would inform the performance standard required for these foundation systems.
- Specify **readily repairable foundation systems** that are able to be reinstated relatively easily following liquefaction induced land damage.
- Specify the use of **lightweight building materials** for construction of buildings. Adopting lightweight cladding and roofing materials reduces the required bearing strength of the underlying soils and the severity of structural shaking imposed on the foundations. As such, lightweight building materials reduce the potential for liquefaction-induced foundation and building damage to occur.

Assuming that the existing farm drains will be infilled, lateral spreading caused by liquefaction is not anticipated on this site. If the design is to incorporate swales, then considerations should be given to potential setbacks to mitigate the effects of lateral spreading. The Planning and engineering guidance for potentially liquefaction-prone land (MBIE/MfE/EQC, 2017) recommends that particular attention should be given to land that is susceptible to liquefaction within 100m of a free face less than 2 m high; or within 200 m of a free face greater than 2 m high.

It is recommended that Cone Penetration Tests (CPTs) and deeper boreholes be undertaken for each of the large lot sites to gain a better understanding of the liquefaction risk for each site and to determine the mitigation requirements.

9 Conclusions and recommendations

Based upon available geotechnical information, we consider the site is likely to be geotechnically suitable for residential development, noting that specific investigation and assessment is required to determine geotechnical requirements for each lot.

It is likely that some sort of mitigation in the form of robust foundation design will be required for the effect of liquefaction-induced ground damage. The specific requirements for this will be determined following a detailed liquefaction assessment.

The free faces of the farm drain are likely to have a liquefaction induced lateral spreading risk which should be considered prior to the generation of individual lots and siting of building platforms. We also note that any earthworks required as part of the subdivision works will require an erosion and sediment control plan.

Due to the nature of the undulating land adjacent to the Waikato River, soft soils or fill materials may be encountered during development. We recommend that these areas are removed and replaced with engineered fill prior to construction.

Depending on the areas chosen for development of buildings, the undulating land may require retaining in some areas to provide a flat platform for construction. This is to be assessed on a site specific basis.

Archaeological sites have been identified within the two northern lots within this study. Due to this discovery, ground investigations were not undertaken in these areas and it is understood that developments within these areas is not anticipated at this stage.

10 Applicability

This report provides recommendations and opinions based upon desk study information and limited ground truthing to gain a high level understanding of geotechnical hazards and risks prior to development of this site. The nature of the subsoil is inferred from available information but it must be appreciated that the actual conditions could vary from the assumed model.

This report has been prepared for the exclusive use of our client Shand Properties, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement. Further site specific geotechnical investigations and detailed analyses are required prior to final designs.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Hannah Udell	pp Glen Nicholson
Engineering Geologist	Project Director

Reviewed by John Brzeski (Senior Engineering Geologist) and Grant Eccles (Principal Planner)

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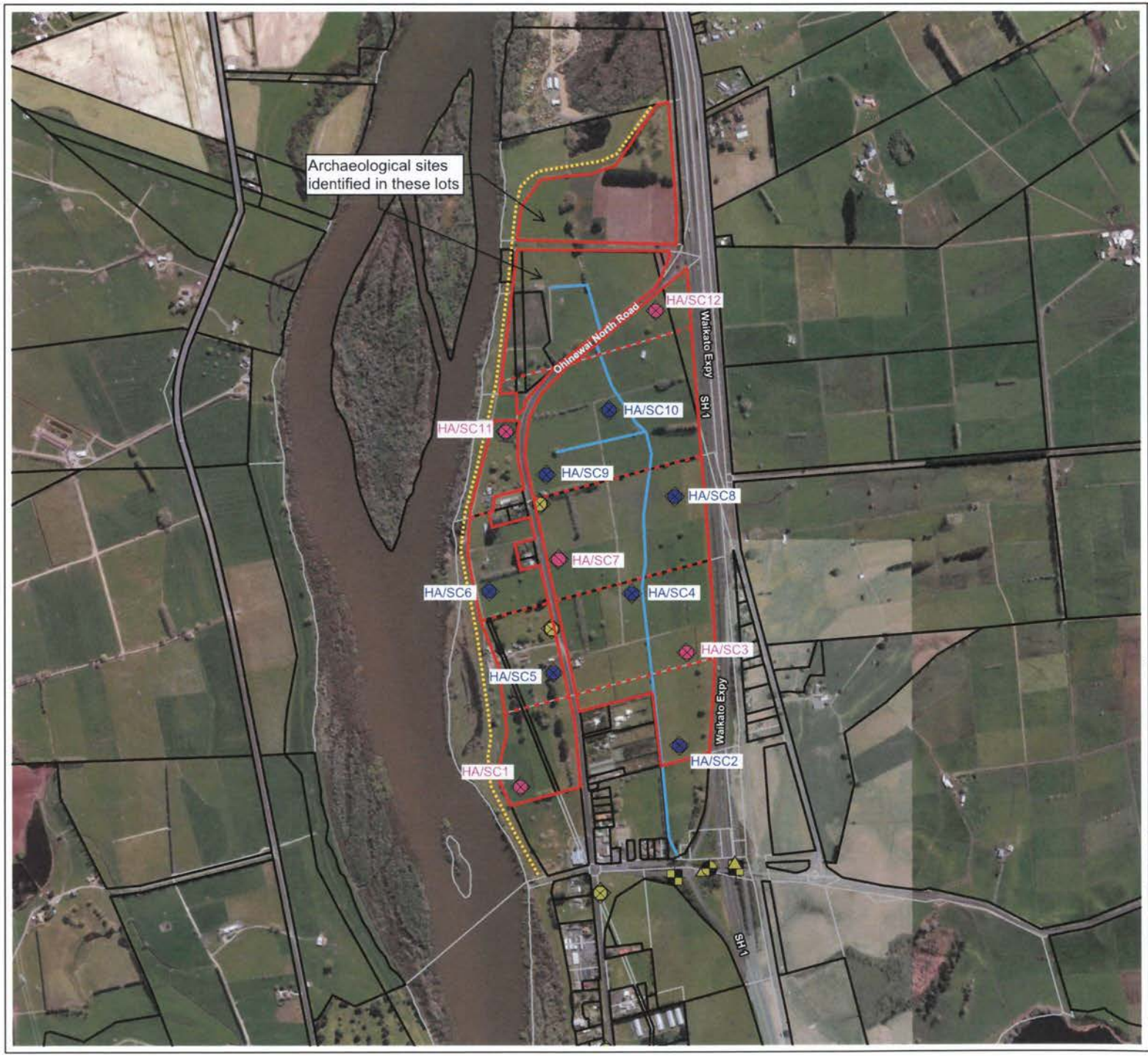
Appendix A: Site Plan



LEGEND

Public Investigations (NZGD)

Investigation Type

- Cone Penetrometer Test
- Hand Auger Scala
- Machine Borehole
- Test Pit
- Property Boundary
- Parcel Boundary
- Site Boundary
- Lot Boundaries
- Farm drain
- Axis of Stopbank

Geotechnical Investigations (Sept 2018)

Investigation Type

- Hand Auger Scala
- Hand Auger Scala with Piezometer

A3 SCALE: 1:10,000

0 100 200 300 400 500 (m)

N

1. Parcel Boundary,Property Boundary,Street Name sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 3.0 New Zealand licence.
2. World Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Created On:	24/09/2018
Created By:	HUdell
Approved By:	HU
TT Proj Ref:	1008304.0000
TT Map Ref:	TTMAPREF1433463001.902

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SHAND PROPERTIES
OHINEWAI PLAN CHANGE
Geotechnical Assessment
Site Plan

FIGURE No.
1

Appendix B: Investigations

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA01**

Hole Location: Refer to site plan.

SHEET: 1 OF 1

PROJECT: GHAM T+T Ohinewai - SI

LOCATION: 61 Ohinewai North Road, Ohinewai JOB No.: 1008376.0000

CO-ORDINATES: (NZTM2000) 5848804.00 mN 1790449.00 mE

R.L.: 9.50m

DATUM: NZVD2016

DRILL TYPE: Hand Auger

DRILL METHOD: HA

HOLE STARTED: 19/09/2018

HOLE FINISHED: 19/09/2018

DRILLED BY: GEOTECHNICS

LOGGED BY: TURI CHECKED: HU

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/30mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 15 25 50 100 200	Description and Additional Observations
				2					TS	M	L		SILT, with minor sand, trace rootlets; blackish brown. Loose, moist, non-plastic; sand, fine to coarse.
				1 1 2 1 1 1 1									Sandy SILT; brownish orange. Loose, moist, non-plastic; sand, fine to coarse.
				1 1 1 2 1 1 1 1 1 2 1 1 2 2 1 1 1 2 1 1 2 2 1 1 2 3 2 3 2 2 2 3 1 2 2 2 2 3 2 3 3 4			9	0.5					Silty, fine to coarse SAND; brownish orange. Loose, moist, well graded.
	19/09/2018	100	HA		● 41/20 kPa			1.0			F		SILT, with minor sand, trace rootlets; light greyish brown with orange mottling. Firm, moist, low plasticity, slow dilatancy; sand, fine.
					● 44/26 kPa		8	1.5		S			1.35m: Changes to saturated.
	28/09/2018												SILT, with minor sand; grey. Firm, saturated, low plasticity, slow dilatancy; sand, fine.
								2.0			MD		Fine to coarse SAND; greyish brown with minor orange mottling. Medium dense, saturated, well graded.
				3 4 3 3 4 3			7	2.5					2.7m: Effective refusal
								3.0					

COMMENTS:

Hole Depth 2.7m

Scale 1:18

Rev.: A

HandAugerLog - 8/10/2018 1:42:09 PM - Produced with Core-GS by GeRoc

HAND AUGER LOG

GEOTECHNICS

HOLE Id: **HA02**

Hole Location: Refer to site plan.

SHEET: 1 OF 1

PROJECT: GHAM T+T Ohinewai - SI	LOCATION: 61 Ohinewai North Road, Ohinewai — JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000) 5848980.00 mN 1790871.00 mE	DRILL TYPE: Hand Auger
R.L.: 9.50m	DRILL METHOD: HA
DATUM: NZVD2016	HOLE STARTED: 19/09/2018; HOLE FINISHED: 19/09/2018; DRILLED BY: GEOTECHNICS; LOGGED BY: LIMU; CHECKED: HU

GEOLOGICAL — ENGINEERING DESCRIPTION

Depth (m)	RL (m)	Water	Core Recovery (%)	Method	Tests	Graphic Log	Moisture Condition	Strength/Density Classification	Description and Additional Observations
0.0–0.4			100	HA	67/18 kPa	TS	M	St	SILT, with minor sand, trace rootlets; blackish brown. Stiff, moist, low plasticity; sand, fine to coarse.
0.4–0.6	9	▼ 19/09/2018					M-W	VL	Fine to medium SAND, with some silt; greyish brown. Very loose, moist to wet, well graded.
0.6–1.8	8						W; S (from 0.95m)	MD	Fine to coarse SAND, with minor silt; brownish grey. Loose to medium dense, wet, well graded. 0.95m: Changes to saturated.
1.8									1.8m: Effective refusal

Scala Penetrometer (Blows/50mm), from top: 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 2, 1, 2, 1, 2, 1, 2, 2, 2, 2, 1, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2

COMMENTS:

Hole Depth 1.8m

Scale 1:13

Rev.: A

HandAugerLog - 8/10/2018 1:46:48 PM - Produced with Core-GS by GeRoc

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA03**

Hole Location: Refer to site plan.

SHEET: 1 OF 1

PROJECT: GHAM T+T Ohinewai - SI

LOCATION: 61 Ohinewai North Road, Ohinewai JOB No.: 1008376.0000

CO-ORDINATES: 5849225.00 mN
(NZTM2000) 1790926.00 mE

R.L.: 9.50m

DATUM: NZVD2016

DRILL TYPE: Hand Auger

DRILL METHOD: HA

HOLE STARTED: 19/09/2018

HOLE FINISHED: 19/09/2018

DRILLED BY: GEOTECHNICS

LOGGED BY: LIMU CHECKED: HU

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENETIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations
	19/09/2018	100	HA		● 88/26 kPa		9	0.5	TS	M	St		SILT, with minor sand, trace rootlets; blackish brown. Stiff, moist, low plasticity; sand, fine.
										M-W	MD		Fine to coarse SAND, with some silt; greyish brown. Medium dense, moist to wet, well graded.
													0.55m: Changes to brownish grey.
								1.0		S			1.0m: Changes to saturated.
											L		1.1m: Changes to loose.
											MD		1.3m: Changes to medium dense
							8	1.5					
								2.0					Fine to coarse SAND, with some gravel, trace silt; brownish grey. Medium dense, saturated, well graded; gravel, fine to medium, well rounded, pumice.
							7	2.5					2.15m: Effective refusal
								3.0					

COMMENTS:

Hole Depth
2.15m

Scale 1:18

Rev.: A

HandAugerLog - 8/10/2018 1:47:01 PM - Produced with Core-GS by GeRoc

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA04**

Hole Location: Refer to site plan.

SHEET: 1 OF 1

PROJECT: GHAM T+T Ohinewai - SI

LOCATION: 61 Ohinewai North Road, Ohinewai JOB No.: 1008376.0000

CO-ORDINATES: (NZTM2000) 5849507.00 mN 1790760.00 mE

R.L.: 9.00m

DATUM: NZVD2016

DRILL TYPE: Hand Auger

DRILL METHOD: HA

HOLE STARTED: 19/09/2018

HOLE FINISHED: 19/09/2018

DRILLED BY: GEOTECHNICS

LOGGED BY: LIMU CHECKED: HU

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT / GENERIC NAME / ORIGIN / MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
	19/09/2018	100	HA	1 1 1 1 1 2 2 1 2 2 3 3 3 4 3 4 4 4 5 4 5 4 4 4 4 5 3 4 4 4 5 3 4 3 5 6 6 5 5 5 4 5 5 4 4 4 3 4 4 5 5 5 5 6 5 5 5 4 4 5 5	● 132/29 kPa		8 7 6	0.5 1.0 1.5 2.0 2.5 3.0	TS TS	M S	VSt MD D	10 25 50 100 200	SILT, with minor sand, trace rootlets; blackish brown. Very stiff, moist, low plasticity; sand, fine.
													Medium SAND, with minor silt; light greyish brown, with minor orange discolouration. Medium dense, moist, poorly graded.
													0.7m: Orange discoloration ends.
													Fine to medium SAND, with minor gravel; light grey. Dense, moist, well graded; gravel, fine, rounded, highly weathered, pumice.
													1.1m: Changes to saturated.
													Gravelly, fine to medium SAND; dark grey, with minor black specks. Dense, saturated, poorly graded; gravel, fine, rounded, highly weathered, pumice.
													2.4m: Effective refusal

COMMENTS:

Hole Depth 2.4m

Scale 1:18

Rev.: A

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA05**

Hole Location: Refer to site plan.

SHEET: 1 OF 2

PROJECT: GHAM T+T Ohinewai - SI		LOCATION: 61 Ohinewai North Road, Ohinewai	JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000)	5849203.00 mN 1790556.00 mE	DRILL TYPE: Hand Auger	HOLE STARTED: 19/09/2018
		DRILL METHOD: HA	HOLE FINISHED: 19/09/2018
R.L.:	10.00m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: LIMU CHECKED: HU

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT
GENERIC NAME
ORIGIN
MATERIAL COMPOSITION

WATER: 19/09/2018 ▼

CORE RECOVERY (%): 100

METHOD: HA

SCALA PENETROMETER (Blows/50mm): 1 2 3 4 5 6 7 8 9

TESTS

SAMPLES

RL (m) | DEPTH (m)

GRAPHIC LOG | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa): 12 50 100 200

DEPTH (m)	RL (m)	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
0.0		M	S-F	SILT, with minor sand, trace rootlets; blackish brown. Soft to firm, moist, low plasticity; sand, fine.
0.3			MD	Sandy SILT, with minor gravel; brownish orange. Medium dense, moist, non-plastic; sand, fine; gravel, fine, rounded, highly weathered, pumice.
0.5			VL	Fine to medium SAND, with trace silt; light greyish brown. Medium dense, moist, well graded.
				0.55m: Changes to very loose.
0.9	9			Gravelly, fine to medium SAND; light greyish brown. Very loose, moist, well graded; gravel, fine to medium, rounded, highly weathered, pumice.
1.0			MD	Fine to medium SAND, with minor gravel; brown. Very loose, moist, well graded; gravel, fine, rounded, highly weathered, pumice.
				1.2m: Changes to medium dense.
1.5				Gravelly, fine to medium SAND; light grey. Medium dense, moist, well graded; gravel, fine to medium, rounded, highly weathered, pumice.
1.8	8			Fine to medium SAND, trace gravel; light grey. Medium dense, moist, well graded; gravel, fine, rounded.
2.0			D	
				2.25m: Changes to dense.
2.5		S		2.5m: Changes to saturated.
3.0	7			
3.1				3.1m: Effective refusal
3.5				
4.0	6			

COMMENTS:

Hole Depth 3.1m

Scale 1:23

Rev.: A

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GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA05**

Hole Location: Refer to site plan.

SHEET: 2 OF 2

PROJECT: GHAM T+T Ohinewai - SI		LOCATION: 61 Ohinewai North Road, Ohinewai	JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000)	5849203.00 mN 1790556.00 mE	DRILL TYPE: Hand Auger	HOLE STARTED: 19/09/2018
		DRILL METHOD: HA	HOLE FINISHED: 19/09/2018
R.L.:	10.00m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: LIMU CHECKED: HU

GEOLOGICAL								ENGINEERING DESCRIPTION				
GEOLOGICAL UNIT GENERIC NAME ORIGIN MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 75 100 150 200	Description and Additional Observations

COMMENTS:

Hole Depth 3.1m

Scale 1:23

Rev.: A

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA06**

Hole Location: Refer to site plan.

SHEET: 1 OF 2

PROJECT: GHAM T+T Ohinewai - SI		LOCATION: 61 Ohinewai North Road, Ohinewai	JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000)	5849361.00 mN 1790363.00 mE	DRILL TYPE: Hand Auger	HOLE STARTED: 21/09/2018
		DRILL METHOD: HA	HOLE FINISHED: 21/09/2018
R.L.:	10.00m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: TURI CHECKED: HU

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION

WATER: 21/09/2018

CORE RECOVERY (%): 100

METHOD: HA

SCALA PENETROMETER (Blows/50mm): 1 2 3 4 5 6 7 8 9

TESTS

SAMPLES

RL (m): 9, 8, 7, 6

DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0

GRAPHIC LOG: TS

MOISTURE CONDITION / WEATHERING: M; S

STRENGTH/DENSITY CLASSIFICATION: L-MD; MD; VL; MD; D; D

SHEAR STRENGTH (kPa): 10, 25, 50, 100, 200

Description and Additional Observations

Sandy SILT, with minor rootlets; blackish brown. Loose to medium dense, moist, non-plastic; sand, fine.

Fine to coarse SAND, with some gravel, trace rootlets; light brown. Medium dense, moist, well graded; gravel, fine to medium, rounded.

0.35m: Changes to very loose.

Silty, fine to medium SAND; brownish orange. Very loose, moist, well graded.

Fine to medium SAND, with minor silt; light brownish white. Medium dense, moist, well graded.

1.25m: Changes to dense.

1.3m: Changes to brownish grey.

2.5m: Changes to saturated.

Gravelly, fine to coarse SAND, trace silt; brownish grey, with orange mottling. Dense, saturated, well graded; gravel, fine to medium, rounded, pumice.

2.9m: Effective refusal

COMMENTS:

Hole Depth 2.9m

Scale 1:23

Rev.: A

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GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA06**

Hole Location: Refer to site plan.

SHEET: 2 OF 2

PROJECT: GHAM T+T Ohinewai - SI		LOCATION: 61 Ohinewai North Road, Ohinewai	JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000)	5849361.00 mN 1790363.00 mE	DRILL TYPE: Hand Auger	HOLE STARTED: 21/09/2018
		DRILL METHOD: HA	HOLE FINISHED: 21/09/2018
R.L.:	10.00m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: TURI CHECKED: HU

GEOLOGICAL								ENGINEERING DESCRIPTION				
GEOLOGICAL UNIT GENETIC NAME ORIGIN MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations

COMMENTS:
Hole Depth 2.9m

Scale 1:23

Rev.: A

HandAugerLog - 8/10/2018 1:47:26 PM - Produced with Core-GS by GeRoc

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA07**

Hole Location: Refer to site plan.

SHEET: 1 OF 2

PROJECT: GHAM T+T Ohinewai - SI		LOCATION: 61 Ohinewai North Road, Ohinewai	JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000)	5849480.00 mN 1790563.00 mE	DRILL TYPE: Hand Auger	HOLE STARTED: 21/09/2018
		DRILL METHOD: HA	HOLE FINISHED: 21/09/2018
R.L.:	9.50m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: TURI CHECKED: HU

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 20 50 100 200	Description and Additional Observations
							9	0.0	TS	M	F		SILT, with minor sand, trace rootlets; blackish brown. Firm, moist, low plasticity; sand, fine.
								0.5			MD		SILT, with minor sand; brownish orange. Medium dense, moist, non-plastic; sand, fine.
	21/10/2018									W			Fine to coarse SAND, with some silt; greyish brown. Medium dense, wet, well graded.
	28/09/2018	100	HA					1.0					
							8	1.3		S			1.3m: Changes to saturated.
								1.5					
								2.0					
							7	2.25			VL		2.25m: Changes to very loose.
								2.5					
													2.7m: Effective refusal
							6	3.0					
								3.5					
								4.0					

COMMENTS:

Hole Depth 2.7m

Scale 1:23

Rev.: A

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA07**

Hole Location: Refer to site plan.

PROJECT: GHAM T+T Ohinewai - SI		LOCATION: 61 Ohinewai North Road, Ohinewai	JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000)	5849480.00 mN 1790563.00 mE	DRILL TYPE: Hand Auger	HOLE STARTED: 21/09/2018
		DRILL METHOD: HA	HOLE FINISHED: 21/09/2018
R.L.:	9.50m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: TURI CHECKED: HU

GEOLOGICAL								ENGINEERING DESCRIPTION				
GEOLOGICAL UNIT GENERIC NAME ORIGIN MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 12 K 50 100 200	Description and Additional Observations

COMMENTS:

Hole Depth 2.7m

Scale 1:23

Rev.: A

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA08**

Hole Location: Refer to site plan.

SHEET: 1 OF 1

PROJECT: GHAM T+T Ohinewai - SI		LOCATION: 61 Ohinewai North Road, Ohinewai	JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000)	5849658.00 mN 1790886.00 mE	DRILL TYPE: Hand Auger	HOLE STARTED: 19/09/2018
		DRILL METHOD: HA	HOLE FINISHED: 19/09/2018
R.L.:	9.00m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: LIMU CHECKED: HU

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT / GENERIC NAME / ORIGIN / MATERIAL COMPOSITION

WATER: 19/09/2018

CORE RECOVERY (%): 100

METHOD: HA

SCALA PENETROMETER (Blows/50mm)

TESTS

SAMPLES

RL (m) / DEPTH (m)

GRAPHIC LOG

MOISTURE CONDITION / WEATHERING

STRENGTH/DENSITY CLASSIFICATION

SHEAR STRENGTH (kPa)

Depth (m)	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
0.0	M	S-F	SILT, with minor sand, trace rootlets; blackish brown. Soft to firm, moist, low plasticity; sand, fine.
0.3		MD	Gravelly SILT, with minor sand; reddish brown, with light brown mottling. Medium dense, moist, non-plastic; gravel, fine to medium, angular; sand, fine to coarse.
0.5			Fine to medium SAND, with trace silt; light grey. Medium dense, moist, well graded.
0.65	S		0.65m: Changes to saturated.
0.7		L	Fine to medium SAND, with minor gravel; grey. Loose, saturated, poorly graded; gravel, fine to medium, rounded, highly weathered, pumice.
0.85		MD	0.85m: Changes to medium dense.
1.5			1.5m: Effective refusal

RL (m): 8 at 1.0; 7 at 2.0

COMMENTS:

Hole Depth 1.5m

Scale 1:13

Rev.: A

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HAND AUGER LOG

GEOTECHNICS

HOLE Id: **HA09**

Hole Location: Refer to site plan.

SHEET: 1 OF 1

PROJECT: GHAM T+T Ohinewai - SI	LOCATION: 61 Ohinewai North Road, Ohinewai — JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000) 5849728.00 mN, 1790519.00 mE	DRILL TYPE: Hand Auger
R.L.: 9.00m	DRILL METHOD: HA
DATUM: NZVD2016	
HOLE STARTED: 19/09/2018	HOLE FINISHED: 19/09/2018
DRILLED BY: GEOTECHNICS	LOGGED BY: LIMU — CHECKED: HU

GEOLOGICAL — ENGINEERING DESCRIPTION

Water: 19/09/2018 (at approx. 0.7m). Core recovery (%): 100. Method: HA.

Scala penetrometer (Blows/50mm): 1, 1, 1, 1, 0.5, 0.5, 1, 1, 0.5, 0.5, 1, 1, 1, 2, 2, 2, 2, 3, 4, 4, 4, 3, 3, 4, 5, 3, 3, 4, 6, 5, 3, 3, 4, 3, 3, 4, 3, 2, 1, 1, 2, 3, 3, 3, 2, 3, 3, 4, 2, 4, 4, 4, 4, 4, 3, 3, 4, 3, 3, 4

Depth (m)	RL (m)	Graphic log	Moisture	Strength/Density	Description and Additional Observations
0.0	9	TS	M	S-F	SILT, with minor sand, trace rootlets; blackish brown. Soft to firm, moist, low plasticity; sand, fine.
0.25		Sand		VL	Fine to medium SAND, with trace silt; light greyish brown, with orange mottling. Very loose, moist, well graded.
0.5					0.5m: Orange mottling ends.
0.65				MD	0.65m: Changes to medium dense.
0.7			S		0.7m: Changes to saturated.
0.9				D	0.9m: Changes to dense.
1.0	8				
1.5					
1.85				L	1.85m: Changes to loose.
2.0	7				
2.05				MD	2.05m: Changes to medium dense.
2.2					2.2m: Effective refusal
2.5					
3.0	6				

COMMENTS:

Hole Depth 2.2m

Scale 1:18

Rev.: A

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA10**

Hole Location: Refer to site plan.

SHEET: 1 OF 1

PROJECT: GHAM T+T Ohinewai - SI

LOCATION: 61 Ohinewai North Road, Ohinewai JOB No.: 1008376.0000

CO-ORDINATES: 5849879.00 mN
(NZTM2000) 1790670.00 mE

R.L.: 9.00m

DATUM: NZVD2016

DRILL TYPE: Hand Auger

DRILL METHOD: HA

HOLE STARTED: 19/09/2018

HOLE FINISHED: 19/09/2018

DRILLED BY: GEOTECHNICS

LOGGED BY: LIMU CHECKED: HU

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations
				1 1 1 1 1 1 1 1 1 1					TS TS	M	S-F		SILT, with minor sand, trace rootlets; blackish brown. Soft to firm, moist, low plasticity; sand, fine.
											L		Fine to medium SAND, with trace silt; light greyish brown, with orange mottling. Loose, moist, well graded.
				2 2 1 2 1 2 1 1 2 1 2 1 1 2 2 1 1 1				0.5			MD		Fine to medium SAND, with minor gravel; brownish orange, with grey mottling. Medium dense, moist, well graded; gravel, fine, rounded, highly weathered.
	▼ 19/09/2018	100	HA				8	1.0		S			0.9m: Changes to saturated.
											L		1.15m: Changes to loose.
				1 3 2 3 3 2 4 3 4 4 4 4			7	1.5 2.0					1.4m: Effective refusal

COMMENTS:

Hole Depth 1.4m

Scale 1:13

Rev.: A

HandAugerLog - 8/10/2018 1:48:04 PM - Produced with Core-GS by GeRoc

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA11**

Hole Location: Refer to site plan.

SHEET: 1 OF 2

PROJECT: GHAM T+T Ohinewai - SI		LOCATION: 61 Ohinewai North Road, Ohinewai	JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000)	5849615.00 mN 1790050.00 mE	DRILL TYPE: Hand Auger	HOLE STARTED: 21/09/2018 HOLE FINISHED: 21/09/2018
R.L.:	9.50m	DRILL METHOD: HA	DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: TURI CHECKED: HU

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT
GENERIC NAME
ORIGIN
MATERIAL COMPOSITION

WATER: 21/09/2018

CORE RECOVERY (%): 100

METHOD: HA

SCALA PENETROMETER (Blows/50mm): 1 2 3 4 5 6 7 8 9

TESTS

SAMPLES

RL (m): 9 | 8 | 7 | 6

DEPTH (m): 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0

GRAPHIC LOG: TS

MOISTURE CONDITION / WEATHERING: M | W | S

STRENGTH/DENSITY CLASSIFICATION: S-F | L | MD | L | MD

SHEAR STRENGTH (kPa): 10 | 50 | 100 | 200

Description and Additional Observations
SILT, with minor sand, trace rootlets; blackish brown. Soft to firm, moist, low plasticity; sand, fine.
Sandy SILT; brownish orange. Loose, moist, non-plastic; sand, fine.
0.45m: Changes to medium dense.
0.7m: Changes to loose.
Fine to medium SAND, with trace silt; greyish brown. Medium dense, wet, well graded.
1.8m: Changes to saturated.
2.35 - 3.2m: Trace pumice, fine.
3.2m: Effective refusal

COMMENTS:

Hole Depth 3.2m

Scale 1:23

Rev.: A

HandAugerLog - 8/10/2018 1:48:11 PM - Produced with Core-GS by GeRoc

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA11**

Hole Location: Refer to site plan.

SHEET: 2 OF 2

PROJECT: GHAM T+T Ohinewai - SI		LOCATION: 61 Ohinewai North Road, Ohinewai	JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000)	5849615.00 mN 1790050.00 mE	DRILL TYPE: Hand Auger	HOLE STARTED: 21/09/2018
		DRILL METHOD: HA	HOLE FINISHED: 21/09/2018
R.L.:	9.50m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: TURI CHECKED: HU

GEOLOGICAL								ENGINEERING DESCRIPTION				
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 12 50 100 200	Description and Additional Observations

COMMENTS:

Hole Depth 3.2m

Scale 1:23

Rev.: A

HandAugerLog - 8/10/2018 1:48:11 PM - Produced with Core-GS by GeRoc

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA12**

Hole Location: Refer to site plan.

SHEET: 1 OF 2

PROJECT: GHAM T+T Ohinewai - SI | LOCATION: 61 Ohinewai North Road, Ohinewai | JOB No.: 1008376.0000

CO-ORDINATES: 5849509.00 mN, 1790662.00 mE (NZTM2000)
R.L.: 9.50m
DATUM: NZVD2016

DRILL TYPE: Hand Auger
DRILL METHOD: HA

HOLE STARTED: 21/09/2018
HOLE FINISHED: 21/09/2018
DRILLED BY: GEOTECHNICS
LOGGED BY: TURI CHECKED: HU

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
	28/09/2018 ▼						9	0.5	TS	M	S-F		SILT, with minor sand, trace rootlets; blackish brown. Soft to firm, moist, low plasticity; sand, fine.
											L		Sandy SILT; brownish orange. Loose, moist, non-plastic; sand, fine to coarse.
	21/09/2018 ▼	100	HA				8	1.0			MD		Fine to medium SAND, with trace silt; brownish orange. Medium dense, moist, well graded.
								1.5		S			1.25m: Changes to greyish brown.
								2.0					1.4m: Changes to saturated.
							7	2.5			MD-D		2.45m: Changes to medium dense to dense.
							6	3.0					2.6m: Effective refusal
								3.5					
								4.0					

COMMENTS:

Hole Depth 2.6m

Scale 1:23

Rev.: A

HandAugerLog - 8/10/2018 1:48:16 PM - Produced with Core-GS by GeRoc

GEOTECHNICS

HAND AUGER LOG

HOLE Id: **HA12**

Hole Location: Refer to site plan.

PROJECT: GHAM T+T Ohinewai - SI		LOCATION: 61 Ohinewai North Road, Ohinewai	JOB No.: 1008376.0000
CO-ORDINATES: (NZTM2000)	5849509.00 mN 1790662.00 mE	DRILL TYPE: Hand Auger	HOLE STARTED: 21/09/2018
		DRILL METHOD: HA	HOLE FINISHED: 21/09/2018
R.L.:	9.50m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: TURI CHECKED: HU

GEOLOGICAL									ENGINEERING DESCRIPTION				
GEOLOGICAL UNIT: GENERIC NAME: ORIGIN: MATERIAL COMPOSITION:	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations

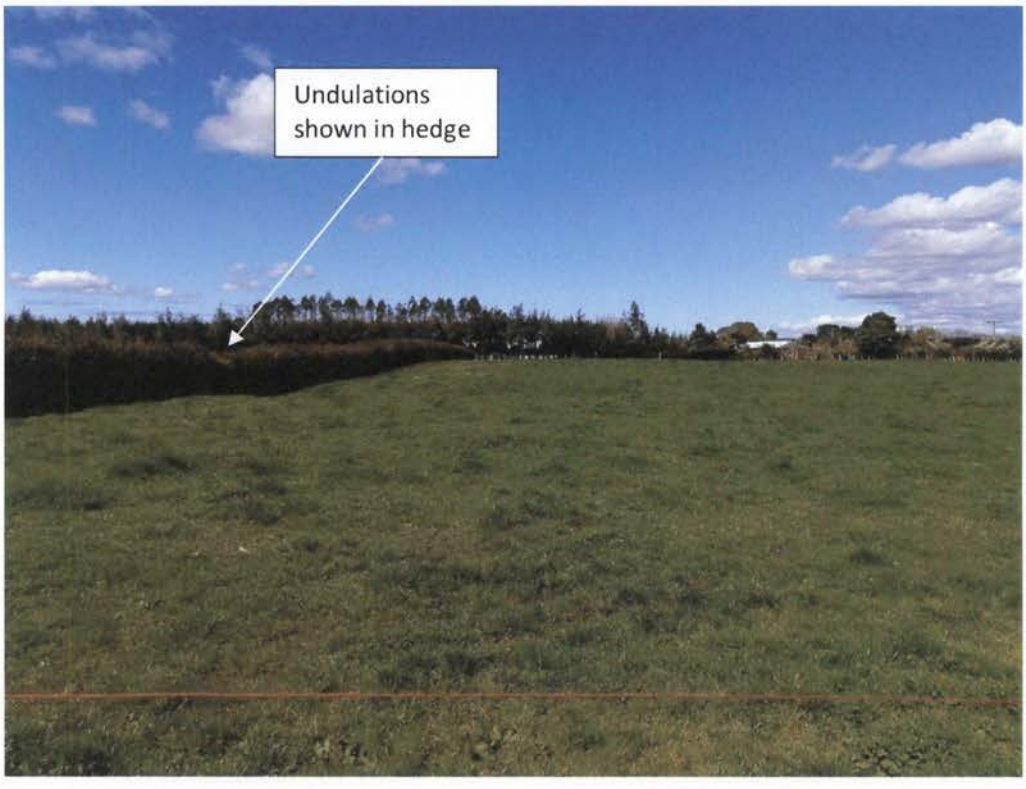
COMMENTS:

Hole Depth 2.6m

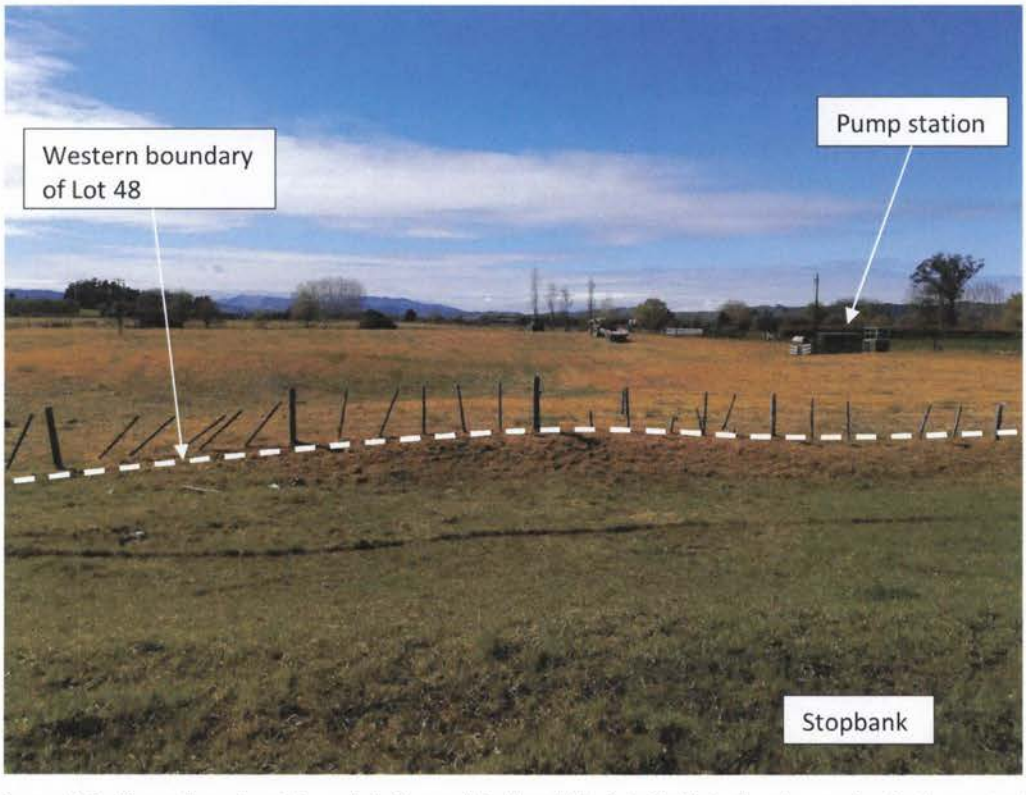
Scale 1:23

Rev.: A

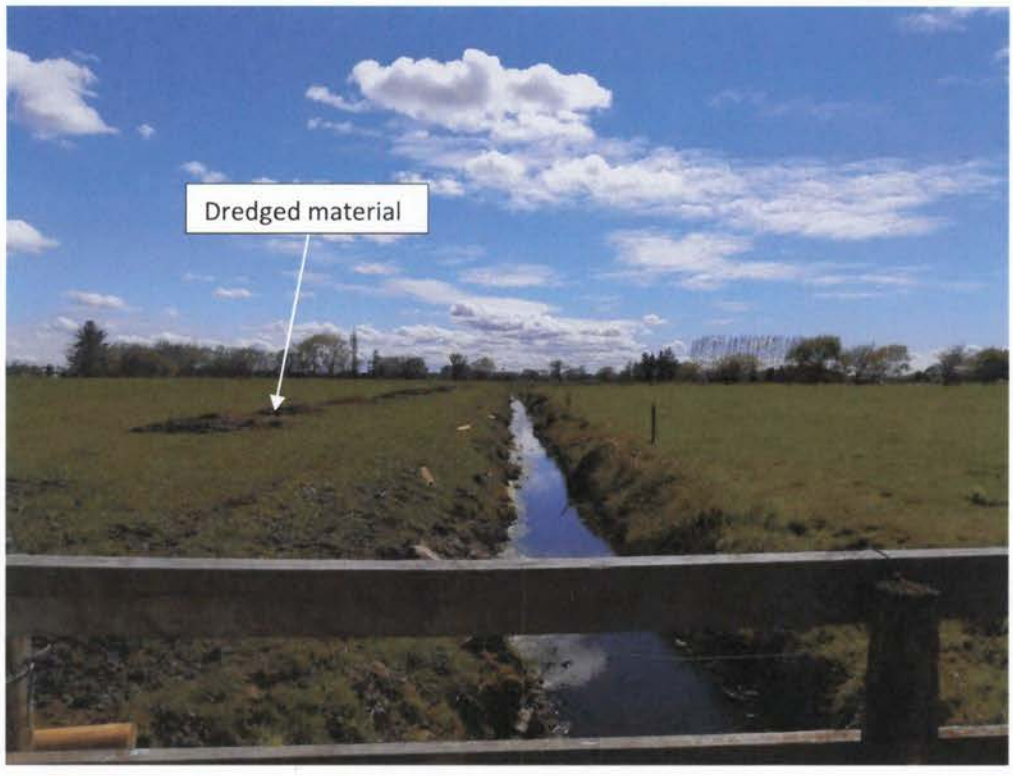
Appendix C: Site Photographs



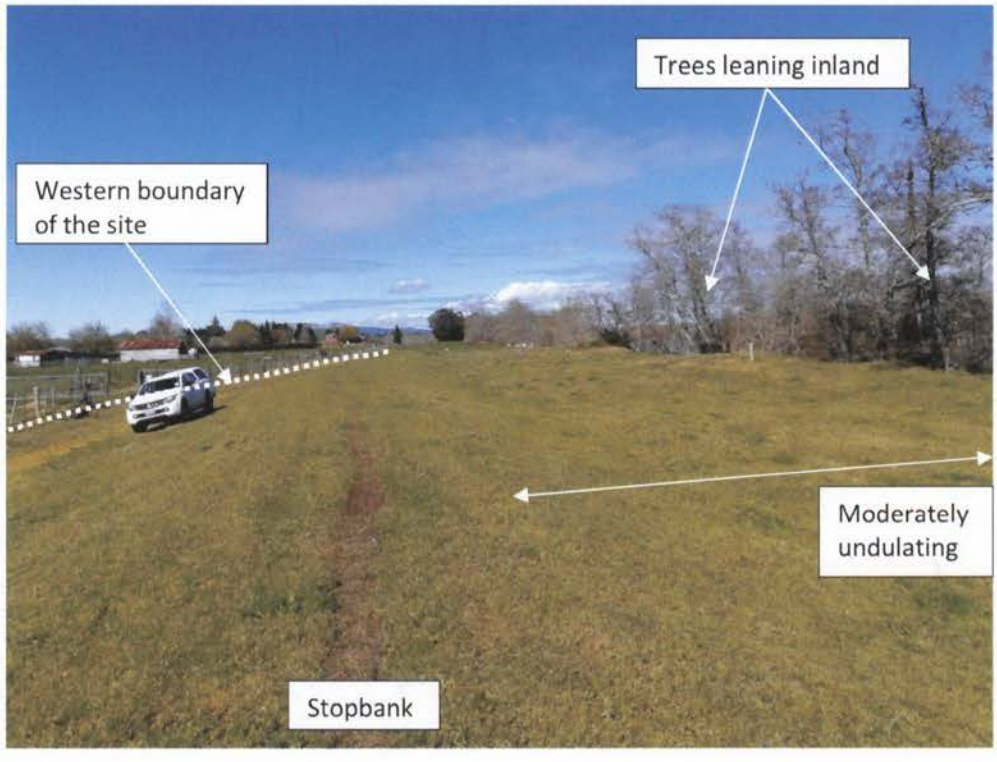
Photograph 1: View of gently undulating paddocks looking south within Lot 45.



Photograph 2: View of moderately undulating paddocks within Lot 48. Note the depression in the centre left of the photo could be a borrow pit as identified on ArchSite from hillshade mapping.



Photograph 3: View of the farm drain looking north through Lot 45. Evidence of recent dredging from stockpiles along the farm drain.



Photograph 4: View of the stopbank to the west of the site, looking south. Moderate undulations evident between stopbank and the bank of the Waikato River. Evidence of trees leaning into the land.