I hereby give notice that a hearing by commissioners will be held on:

Date:	**Mondays through Thursdays from 18 September until 12 October 2023**
Time:	**9:30am**
Meeting Room:	**Council Chambers**
Venue:	**Level 2, Henderson Civic, 3 Smythe Road, Henderson, Auckland 0612**

NOTIFICATION MATERIAL

VOLUME 12

NORTH-WEST HOUSING INFRASTRUCTURE FUND (HIF): PROJECT ON TRIG ROAD (NoR)

TE TUPU NGĀTAHI SUPPORTING GROWTH

AUCKLAND TRANSPORT & WAKA KOTAHI NZ TRANSPORT AGENCY

COMMISSIONERS

Chairperson	**Richard Blakey (Chairperson)**
Commissioners	**Mark Farnsworth** **Vaughan Smith**

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Note: The reports contained within this agenda are for consideration and should not be construed as a decision of Council. Should Commissioners require further information relating to any reports, please contact the Team Leader Hearings.

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ATTACHMENT 18

TRIG ROAD CORRIDOR UPGRADE
ASSESSMENT OF ECOLOGICAL EFFECTS

TE TUPU NGĀTAHI
SUPPORTING GROWTH

Trig Road Corridor Upgrade

Assessment of Ecological Effects

December 2022

Version 1

Document Status

Version no.	Responsibility	Name
2020 Draft	Author	Lisa Simonsen, Conor Reid
	Reviewer	Fiona Davies Lyndsey Smith Matthew Kerr-Ridge Matt Baber Gerry Kessels - Blue Wattle Ecology
1.0	Author	Dannie Cullen Michiel Jonker
	Reviewer	Fiona Davies
	Approver	Bridget O'Leary

Revision Status

Version	Date	Reason for Issue
1.0	2022	Final for Lodgement

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Glossary of Defined Terms and Acronyms

Acronym/Term	Description
AEE	Assessment of Environmental Effects
ABM	Automatic Bat Monitor
AT	Auckland Transport
AUP:OP	Auckland Unitary Plan: Operative in Part
EcIA	Ecological Impact Assessment
EIANZ	Environment Institute of Australia and New Zealand
Impact Management	Includes the full range of actions taken to address adverse effects on indigenous biodiversity and ecosystems. This includes: • Avoid • Remedy (remediate, restore, rehabilitate, reinstate) • Mitigate • Offset • Compensate
NPS	National Policy Statement
NPS:FM	National Policy Statement on Freshwater Management 2020
NPS:IB	National Policy Statement for Indigenous Biodiversity 2019 (Draft)
NG	Net Gain
NNL	No Net Loss
NoR	Notice of Requirement
Project	Trig Road Corridor Upgrade Project
Project Area	Area that is located within the designation footprint
RMA	Resource Management Act 1991
SEA	Significant Ecological Area
TAR	Threatened or At Risk
Te Tupu Ngātahi	Te Tupu Ngātahi Supporting Growth Alliance
Waka Kotahi	Waka Kotahi New Zealand Transport Agency
ZOI	Zone of Influence

1 Executive Summary

Assessment Methodology

This assessment of effects on ecology has been undertaken in accordance with the Ecological Impact Assessment (EcIA) Guidelines, published by the Ecological Institute of Australia and New Zealand (Roper Lindsay et al., 2018) (hereinafter referred to as the EIANZ Guidelines) and best practice methodology. It utilises EIANZ Guidelines ecological value ratings (Very High, High, Moderate, Low, Very Low, and Negligible) to classify ecological features (i.e., aquatic, wetland and terrestrial habitats and their fauna), for the purposes of making an ecological assessment of Project impacts (Appendix 2). This is based on a relative scale and indicates the level of intactness or modification/damage to a feature or system. The aim of this approach is to protect the highest value features and to highlight more degraded systems where there is the potential for enhancement and restoration (if possible, within the Project scope or as part of possible compensation/offset proposals). Where features are unavoidable, this approach also allows prioritisation of features of greater value.

This report does not include an assessment of effects on Māori cultural values, Māori cultural matters may encompass a wider range of values than those covered in the report. This assessment does not denote the habitat or features of cultural value to Mana Whenua, and such assessments should only be made by Mana Whenua.

A desktop study was completed to identify existing records of native species and habitats that could be present within and adjacent to the Project Area and associated zone of influence (ZOI). These findings guided field assessment/effort, which included a high-level site walkover to classify habitats using Singers et al., 2017. A bat survey was completed to determine the presence or likely absence of long-tailed bats in the Project Area. No dedicated surveys were completed for native lizards and birds, however incidental site observations and habitat suitability appraisal was made. Where wetland habitat occurred, wetlands were delineated using the MfE (2020b) Wetland Delineation Protocols. Using the EIANZ Guidelines, ecological value was assigned, and assessment of the magnitude of effects was made, based on predicted impacts for construction and operation stages of the Project. Except where legislation or policy dictates the requirement for impact management, impact management was recommended where the overall level of effect (value x magnitude) was considered to be **Moderate** or greater. Where residual effects remain, these have been addressed through offset/compensation.

Ecological Baseline

Aquatic, wetland, and terrestrial features were described based on desktop and site investigations. A summary of ecological features and their value within the Project Area are provided in Table 1-1.

Table 1-1 Summary of ecological features and their value for aquatic, wetland and terrestrial habitat and associated fauna within the Project Area

Ecological Feature	Ecological Value
Aquatic Ecology	
TR-S1 (associated with TR-W3) TR-S2 (associated with TR-W1)	Low

Ecological Feature	Ecological Value
TR-S3 (associated with TR-W4) W5-S2 (associated with TR-W7)	
Wetland Ecology	
TR-W1, TR-W2, TR-W3, TR-W7	Low
TR-W4, TR-W5&W6	Moderate
Terrestrial Ecology (Flora)	
Brown Field (BF) Exotic Grassland (EG)	Negligible
Planted Vegetation – Native (recent) (PL.1) Planted Vegetation – Exotic/Native (amenity) (PL.3) Treeland – Exotic Dominated (TL.3)	Low
Terrestrial Ecology (Fauna)	
Long-tailed bat	Very High
Non-TAR bird	Low
North Island fernbird	High
Copper skink	High

Assessment of Ecological Effects and Impact Management

The overall level of effect from the construction and operation of the Project to aquatic, wetland and terrestrial habitats and associated fauna was calculated (prior to and after impact management) as per the EIANZ Guidelines.

Terrestrial Ecology

The terrestrial vegetation within the Project site is of **Negligible** to **Low** ecological value. There are no construction or operational effects for terrestrial ecology where the level of effect was assessed to be **Moderate** or higher, however habitat is provided to native fauna including:

- Long-tailed bats (**Very High** ecological value)
- Non-TAR native birds (**Low** ecological value)
- North Island fernbird (**High** ecological value)
- Copper skink (**High** ecological value)

During vegetation removal there is the potential to kill/injure native fauna. All native fauna is protected by the Wildlife Act 1953; therefore, this effect will need to be avoided and mitigated.

Aquatic Ecology

All works (excluding minor stormwater outfall works) will be outside the riparian setback and therefore no instream works will occur. Therefore, potential effects on instream habitat due to hydrology and water quality impacts during construction and operation have been assessed for the corresponding wetland.

Wetland Ecology

Where possible the Project has minimised impacts on wetlands, however, the reclamation of the upper portions of TR-W1 and TR-W4 during construction is unavoidable. The loss of TR-W4 is considered a **Moderate** level of effect therefore impact management is required, however, the loss of TR-W1 and TR-W4 also requires impact management as a result of the NPS:FM requirements. The loss of these wetlands can be sufficiently offset through wetland habitat restoration and wetland margin planting of the lower portions of the respective wetlands within the Project designation. The proposed wetland offset areas will allow the Project to achieve No Net Loss in ecological value.

2 Introduction

2.1 Background

Auckland's population is growing rapidly; driven by both natural growth (more births than deaths) and migration from overseas and other parts of New Zealand. The Auckland Plan 2050 anticipates that this growth will generate demand for an additional 313,000 dwellings and require land for approximately 263,000 additional employment opportunities.

In response to this demand, the Auckland Unitary Plan Operative in Part (AUP:OP) identifies 15,000 hectares of predominantly rural land for future urbanisation. To enable the urban development of greenfield land, appropriate bulk infrastructure needs to be planned and delivered.

The Supporting Growth Programme is a collaboration between Auckland Transport (AT) and Waka Kotahi NZ Transport Agency to investigate, plan and deliver the transport network needed to support Auckland's future urban growth areas over the next 30 years.

2.2 Purpose and Scope of this Report

Trig Road, Whenuapai has been identified in the Supporting Growth Programme as a future arterial corridor that is needed to support the urban development of Whenuapai.

This report has been prepared to support AT's notice of requirement (NoR) and application for resource consents for the Trig Road Corridor Upgrade (the Project). The NoR under the Resource Management Act 1991 (RMA) is to designate land for the construction, operation and maintenance of the Project.

Funding for the upgrade of Trig Road between Hobsonville Road and State Highway 18 (SH18) has been made available through the Housing Infrastructure Fund[1]. As there is funding available for construction, AT are also applying for the necessary resource consents under the RMA, concurrently with the NoR process.

This report provides an assessment of ecological effects associated with the construction, operation and maintenance of the Project. This assessment has been prepared to inform the Assessment of Environmental Effects (AEE) for the NoR and resource consent application.

The key matters addressed in this report are as follows:

(a) Identify and describe the existing and potential ecological environment and associated ecological values;

(b) Describe the actual and potential adverse ecological effects associated with construction and operation of the Project;

(c) Recommend measures as appropriate to avoid, remedy or mitigate actual and potential adverse ecological effects (including any conditions/management plan(s) required);

[1] See North West Housing Infrastructure Fund Assessment of Environmental Effects for further detail regarding the Housing Infrastructure Fund.

(d) Recommend measures to offset or compensate for any residual effects that cannot be avoided, remedied or mitigated (including any conditions/management plan(s) required); and

(e) Present an overall conclusion of the level of actual and potential adverse ecological effects of the Project after recommended measures are implemented.

3 Project Description

The Project consists of the widening and upgrade of Trig Road between the SH18 off-ramps and Hobsonville Road. The widening has capacity to provide for a two-lane arterial standard corridor including new footpaths on both sides of the road and a cycleway which is indicatively shown as a dedicated bi-direction cycleway on the eastern side of the corridor. The Project will upgrade the current rural standard corridor to an urban standard, which is appropriate to support the soon to be urban environment on either side of Trig Road.

To tie into the existing road network, the Project also includes the signalisation of the intersections at Trig Road/Hobsonville Road and Luckens Road/Hobsonville Road and upgrade of Hobsonville Road between these intersections. This will require some localised widening of the road corridor along Hobsonville Road.

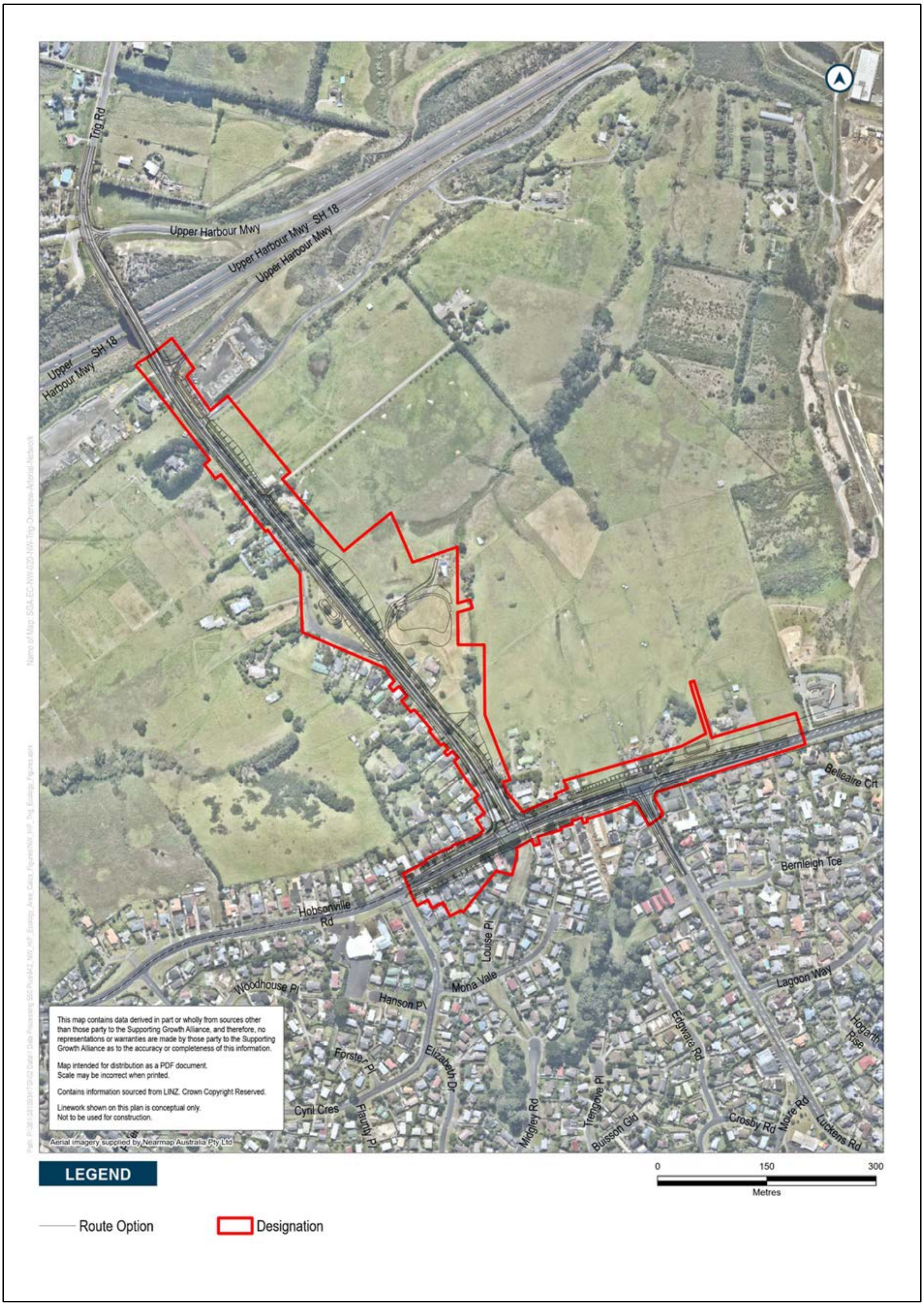

Figure 3-1 Overview of Trig Road Corridor Upgrade

3.1 Project Features

The features of the Project that have the potential to impact on ecological values include:

- The widening of the existing road corridor by 4 m, including a cycleway and footpath;
- Construction of a dry stormwater retention pond;
- Culverting/piping of a wetland, and associated disturbance that may result in the loss of wetland habitat;
- Construction machinery and earthworks within the Project area;
- Street lighting; and
- Upgrades to existing culverts.

3.2 Indicative Construction Methodology

An indicative construction methodology has been prepared to inform the assessment of the Project and while subject to change, assists in determining the envelope of effects. An overview of the indicative construction methodology is set out in the AEE. The final construction methodology for the Project will be confirmed during detailed design phase and finalised once a contractor has been engaged for the work.

A summary of the key components of the indicative construction methodology that are relevant to this report are outlined in the sub-sections below.

3.2.1 General Construction Overview

The total construction phase of the Project is expected to take approximately 18 to 24 months. It is anticipated that the works will be broken down into separate construction zones based on the type of works required and the nature of the work environment. These anticipated zones are:

- Zone 1: Trig Road North of the SH18 bridge
- Zone 2: Trig Road South including the SH18 bridge
- Zone 3: Hobsonville Road

3.2.2 Construction Methodology

Each zone has different construction activities depending on the type of work to be done and the surrounding environment. In all cases the general sequence of construction is likely to be:

1. Divert or remove services
2. Construct permanent and temporary stormwater drainage and controls
3. Move traffic away from works longitudinally
4. Construct earthworks and any retaining structures
5. Construct new longitudinal drainage
6. Construct new pavement to half of the road
7. Move traffic onto newly constructed pavement
8. Complete longitudinal drainage
9. Complete pavement and median
10. Move traffic to new alignment
11. Complete footpath and cycleway

4 Statutory Context

4.1 Notice of Requirement

This assessment has been prepared to support the NoR process for the Project. Section 171 of the RMA sets out the matters that must be considered by a territorial authority in making a recommendation on a NoR. This includes consideration of the actual or potential effects (including positive effects) on the environment of allowing the requirement.

4.2 Resource Consent Application

AT are also seeking regional resource consents under the AUP:OP and resource consents under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health and National Environmental Standard for Freshwater.

Overall, the application is assessed as a Discretionary Activity

5 Receiving Environment

5.1 Approach to the Receiving Environment

A key objective of the Supporting Growth Programme is to protect land now to ensure that the transport networks required to support growth areas in the future, around Auckland, can be provided in an efficient and co-ordinated manner. This Project supports the development of housing in the immediate vicinity of Trig Road and has funding to be constructed in the near future.

In the context of an RMA assessment process, considering the environment as it exists today will not be a true reflection of the real-world environment in which the transport corridor will operate. Accordingly, when considering the environment within which the effects of the construction and operation of the transport corridor are likely to occur, this assessment considers both the existing environment and the likely future environment for the Project Area.

The following outlines the key elements of the planning context for the Project:

- The existing corridor for Trig Road is approximately 20 m wide and zoned ‘Road’ under the AUP:OP.
- The proposed designation will be wider than the existing corridor to provide for the construction and operation of a 24 m wide transport corridor cross section, and additional space for construction activities and mitigation.

Table 5-1 sets out the likely future receiving environment of the Project. This rezoning signals a high probability of land use change over time for the majority of the Project Area from the current mostly rural character to higher density urban development. This ‘likely future receiving environment’ has been used to inform this assessment.

Table 5-1 Whenuapai – Trig Road Corridor Upgrade Likely Receiving Environment

Whenuapai – Trig Road Corridor Upgrade Likely Receiving Environment	
Residential – Mixed Housing Urban Zone	• ‘Reasonably high-intensity zone enabling greater intensity of development than previously provided for’. • Development ‘typically up to three storeys in a variety of sizes and forms including detached dwellings, terraced housing and low-rise apartments’.
Residential – Terraced Housing and Apartment Building Zone	• ‘A high-intensity zone…providing for urban residential living in the form of terraced housing and apartments…with the greatest density, height and scale of development of all the residential zones’. • Buildings enabled up to five, six or seven storeys. • ‘Predominantly located around metropolitan, town and local centre zones and the public transport network’, also providing for a range of non-

Whenuapai – Trig Road Corridor Upgrade Likely Receiving Environment	
	residential activities within an 'urban residential character'.

5.2 Existing and Future Environment Specific Context

The existing environment within the Project area is mostly highly modified rural land uses. The intersection of Trig Road and Hobsonville Road is an existing urban environment, with housing extending up the lower portion of the western side of Trig Road.

Remaining habitat in the locality of the Trig Road corridor within the Project Area is limited to small patches of remnant native forest and scattered native and exotic trees, streams and freshwater wetlands, dominated by exotic plant species. The Project Area is in relatively close proximity (approximately 1-2 km away), but not directly abutting, estuarine and harbour ecosystems.

It is anticipated that the Project will be constructed before or at the same time as urban development begins to occur in the vicinity. As such the effects of the road development and urbanisation on the natural environment may be cumulative rather than independent from each other.

This assessment assesses the construction impacts on the existing mostly rural environment, through which the construction will occur and the operational impacts on a future urbanised environment within which the Project will operate.

Historically in Auckland the Ministry for the Environment has observed that as land use changes from rural to urban the condition of streams has declined and there has been a loss of remaining native vegetation. However, the AUP:OP and NES:FW/NPS:FW place greater emphasis on the protection and enhancement of existing watercourses and require that these are accommodated within the future urban environment. Accordingly, it is assumed that in a future urbanised scenario stream corridors and areas of indigenous vegetation will be largely retained. It is also assumed that where practicable stormwater design will be integrated into the green network and sediment and pollutants will be controlled at source.

6 Assessment Methodology

This ecological impact assessment has been undertaken in general accordance with the EIANZ Guidelines and best practice methodology. It utilises EIANZ Guidelines ecological value ratings (Very High, High, Moderate, Low, Very Low, and Negligible) to classify ecological features (i.e., aquatic, wetland and terrestrial habitats and their fauna), for the purposes of making an ecological assessment of Project impacts (Appendix 2). This is based on a relative scale and indicates the level of intactness or modification/damage to a feature or system. This approach aims to protect the highest value features and to highlight more degraded systems where there is the potential for enhancement and restoration (if possible, within the Project scope or as part of possible compensation/offset proposals). Where features are unavoidable, this approach also allows prioritisation of features of greater value.

This report does not include an assessment of effects on Māori cultural values, Māori cultural concerns may encompass a wider range of values than those covered in the report. This assessment does not denote the habitat or features of cultural value to Mana Whenua, and such assessments should only be made by Mana Whenua.

6.1 Preparation for this Report

A desktop review was also undertaken to inform this report (Section 6.5) and field surveys were completed by AECOM Ecologists in December 2019, and September 2022. Full details on survey methodologies are provided in Section 6.6 to 6.8. These surveys formed the basis for the results which are presented in the 'Ecological Baseline' in Section 7.1.

6.2 Relevant Standards and Guidelines

A list of relevant legislation, policy, plans and strategies for this assessment are presented below. A more detailed summary is provided in Appendix 1:

- Resource Management Act 1991;
- Wildlife Act 1953;
- National Policy Statement for Freshwater Management (Ministry for the Environment, 2020a);
- Auckland Unitary Plan Operative in Part 2016 (Auckland Council, 2016);
- New Zealand Biodiversity Strategy (Department of Conservation & Ministry for the Environment, 2000);
- Protecting Our Places (Department of Conservation & Ministry for the Environment, 2007);
- Auckland Conservation Management Strategy 2014-2024 (Department of Conservation, 2014);
- Auckland Council Indigenous Biodiversity Strategy (Auckland Council, 2012);
- New Zealand's Fish Passage Guidelines (Franklin, et al., 2018); and
- EcIA Ecological Institute of Australia and New Zealand (EIANZ) guidelines for use in New Zealand: Terrestrial and freshwater ecosystems (Roper Lindsay et al., 2018).

6.3 Ecological Impact Assessment Approach

The approach followed for this ecological impact assessment (EcIA) for Project activities is consistent with the methodology outlined in the EIANZ Guidelines.

The EcIA approach is represented in Figure 6-1 and is summarised in Appendix 2.

1.Ecological Value

- Desktop assessment and literature review;
- Site investigation;
- Data processing;
- Ecological Value assessment (1) Representativeness, (2) Rarity, (3) Diversity and pattern, (4) Ecological context

2.Level of Effect

- Description of Project features and activities;
- Identification and description of Project effects;
- Magnitude of Effects assessment based on (1) Type, (2) Extent, (3) Duration, (4) frequency, (5) Probability and (6) Reversibility
- Level of Effect assessment; systematic approach based on the outcome of Ecological Value and Magnitude of Effects assessments

3.Mitigation

- Mitigate in line with mitigation hierarchy;
- Specific focus on Moderate or higher level of effects that can be avoided, minimised, remedied*

4.Residual Effects

- Assessment of residual effects after measures to avoid, minimise and remedy have been applied;
- Address residual effects through offset or compensation measures to achieve No Net Loss or Net Gain

* The Wildlife Act 1953 must be complied with, as such management measures must always be implemented to ensure that Project activities do not injure or kill native wildlife.

Figure 6-1 EcIA approach followed for this assessment (Appendix 2)

6.4 Project Area and Zone of Influence

The Project has been described in Section 3. ‘Project Area’ has been used within this report as a term to describe the area that is located within the designation footprint.

The Zone of Influence (ZOI) of the Project relates to an area occupied by habitats and species that are adjacent to and may go beyond the boundary of the Project Area. It is defined in the EIANZ Guidelines as “the areas/resources that may be affected by the biophysical changes caused by the proposed Project and associated activities.” The distance of the ZOI and type of effect from the Project can be different for different species and habitat types. ZOI is used throughout this report to describe the impacts of the Project (construction and operation) on adjacent or connected terrestrial, freshwater and wetland habitats and associated (often highly mobile) native species. This includes indirect effects on sensitive receiving environments and the potential for protected fauna and flora to be present within or adjacent to the Project Area.

The ZOI of the Project on different species differs depending on how they use their environment e.g., mobile species such as long-tailed bats have a larger home range and more diverse habitat requirements compared to lizards and threatened plant species which may be restricted to a small area or specific habitat type. This affects how a species could be impacted by the Project and this was taken into consideration during the desktop review and site investigations. To reflect the likelihood of a species occurring or dispersal ability within the Project Area, varying search distances were used depending on the species context. The size of this search area is stated alongside any species or habitat records identified within the relevant sections of this report. ZOI is also relevant to habitats, as indirect impacts on the receiving environment such as sedimentation of waterbodies could affect habitats far beyond the Project Area. Similarly, habitats which require permanent or intermittent inundation such as wetlands could be negatively impacted by changes to hydrology as a result of Project design.

6.5 Desktop Review

A desktop review of existing ecological records was undertaken to gain an understanding of the aquatic, wetland[2] and terrestrial habitats and species that could be present within the ZOI of the Project Area.

The sources of information that were reviewed to determine the likelihood of a species or habitat occurring within or adjacent to the Project Area included:

- Auckland Council Geomaps[3];
- Department of Conservation (DOC) Bioweb records[4];
- Department of Conservation Threat Classification Series[5];
- Ecological Regions and Districts of New Zealand (McEwen, 1987);
- iNaturalist records[6], within approximately 5 km radius from each NoR. GPS coordinates are ‘obscured’ for Threatened species which may affect the accuracy of records within the study area;
- Indigenous terrestrial and wetland ecosystems of Auckland (Singers et al., 2017);
- National Institute of Water and Atmospheric Research (NIWA) freshwater fish database;
- New Zealand Bird Atlas eBird database[7]; recorded within 10 km^2 grid squares;
- Supporting Growth Alliance (SGA) – North West – Assessment of Ecological Effects (SGA, 2022a; SGA, 2022b).

6.6 Aquatic Ecology Assessment Methodology

6.6.1 Site Investigations

Field surveys were completed in December 2019 and September 2022 for watercourses associated with the Project Area. Section 6.6.2 outlines the specific methodology employed to determine baseline

[2] The RMA defines wetland as including *‘permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions’*.

The NPS:FM excludes wetlands which do not meet its definition of ‘*natural wetlands*’ as:

a) a wetland constructed by artificial means (unless it was constructed to offset impacts on, or restore, an existing or former natural wetland); or b) a geothermal wetland; or c) any area of improved pasture that, at the commencement date, is dominated by (that is more than 50% of) exotic pasture species and is subject to temporary rain derived water pooling.

[3] https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html

[4] https://www.doc.govt.nz/our-work/monitoring-reporting/request-monitoring-data/

[5] All Department of Conservation Threat Classification Documents are listed in the below webpage. When individual reports are referenced hereafter, they are referenced in-text. https://www.doc.govt.nz/about-us/science-publications/conservation-publications/nz-threat-classification-system

[6] https://www.inaturalist.org/

[7] https://ebird.org/atlasnz/home

conditions and ecological value. A short summary of the freshwater field assessments is provided below. For a detailed methodology refer to Appendix 3.

- General notes on the stream and river including name, catchment, hydrological regime, channel morphology, cross-sectional features, and REC classification based on the River Environment Classification (REC) (Snelder et al., 2004);
- Stream classification as per Storey and Wadhwa (2009) into ephemeral, intermittent and permanent hydroperiods (Appendix 3, Section 3.1);
- No streams are directly impacted by the Project. Therefore, the Rapid Habitat Assessment methodology (Clapcott, 2015) was used for streams to inform ecological condition to understand indirect effects. In the Project Area, streams are associated with wetland complexes (and the hydrology is mainly wetland). The reference state is likely to be inconsistent with what is presumed within the Stream Ecological Valuation (SEV) model, and the hydrology was mainly wetland.

6.6.2 Assessing Aquatic Ecological Value

The different aquatic ecological assessment methods were applied to inform the ecological value (ranging from **Negligible** to **Very High**) of rivers and streams within the ZOI and are consistent with the EIANZ Guidelines. This was done by using all or selected parts of different methods (Table 6-1) to inform matters influencing the ecological importance and sensitivity of the receiving environment (Figure 6-1). Each EclA 'Matter' and corresponding method/s used to inform the matter are summarised in Table 6-1. To help inform the effects assessment, fish have been assigned a separate ecological value which corresponds to the ecological value of the river/stream it likely occupies.

Table 6-1 Summary of how different methods of assessment have been applied to inform aquatic ecological value

EclA Matter	Rapid Habitat Assessment	Fish community (desktop assessment)
Matter 1 Representativeness	✓	✓
Matter 2 Rarity/distinctiveness		✓
Matter 3 Diversity and pattern	✓	
Matter 4 Ecological context		✓

6.7 Wetland Ecology Assessment Methodology

6.7.1 Site Investigation

Wetlands were delineated in September 2022 as per the MfE (2020b) Wetland Delineation Protocols. This included reference to Clarkson (2018), Fraser et al. (2018) and MfE's Hydrology Tool (2021). Wetland habitats were initially classified based on Singers et al. (2017), to describe the wetland habitats present based on vegetation assemblage within and adjacent to the Project Area.

Potential wetlands were identified and delineated on desktop prior to field verification. All wetlands within 100 m of the Project designation were delineated. Wetlands potentially affected by the project activities were included within the field verification. For the field verification the wetland delineation was based on sampled quadrats, within and across vegetation types. Representative vegetation plots were sampled for each plant community observed, using a 2m × 2m quadrat. Estimate % cover was recorded for each species within each quadrats.

Wetland extent was then delineated based on the dominance of hydrophytic plants according to Clarkson (2018). This classifies plant species, according to fidelity to wetland soil conditions, into the following groups: obligate wetland (OBL: occurs almost always in wetlands), facultative wetland (FACW: occurs usually in wetlands), facultative (FAC: equally likely in wetlands or non-wetlands), facultative upland (FACU: usually in no wetlands) or obligate upland (UPL: almost always in non-wetlands). The dominance and prevalence of OBL, FACW and FAC species are then assessed through the Dominance Test (i.e., wetland plant species >50%) and Prevalence Index. In instances where the Dominance Test mainly consists of FAC species, the presence of hydric soils was used to inform the Prevalence Index. A Prevalence Index score below 3 confirmed the presence of a wetland. For vegetation plots where results are ambiguous, the delineation then relied on wetland soil and hydrology characteristics.

The vegetation quadrats were also used to inform NPS:FM exclusions, for exotic pasture species. Potential exclusion from an NPS:FM natural wetland was tested where pasture species[8] were dominant (>50%) and rain derived soil saturation was considered temporary. Additionally, where a wetland was identified to be constructed by artificial means this was also excluded (Appendix 1, Section 1.2.1).

All wetlands delineated were subject to a wetland condition assessment to inform ecological value. This was done using the method outlined by Clarkson et al. (2004) and augmented with a wetland condition classification adopted from Kleynhans (2007) (Appendix 3, Table 9-7) which assesses direct modification to the wetland (Appendix 3, Table 9-7) and impacts within its wider catchment (Appendix 3, Table 9-8). The functional importance of wetlands was also assessed through the application of Brinson's (1993) hydrogeomorphic (HGM) classification, while the functional value of each HGM (in terms of flood attenuation, stream flow regulation, water quality enhancement and carbon storage) was inferred from Kotze et al. (2007). The different HGM types and associated functional values are provided in Appendix 3.

6.7.2 Assessing Wetland Ecological Value

The different wetland assessment methods described in Section 6.7.1 were applied to inform the ecological value (ranging from **Negligible** to **Very High**) of wetland habitat associated with the Project Area and were consistent with the EIANZ Guidelines. This was done by using all or selected parts of different methods employed to inform matters influencing the ecological importance and sensitivity of the receiving environment (Figure 6-1). Each ecological EcIA 'Matter' and corresponding method/s used to inform the matter are summarised in Table 6-2.

[8] Technical guidance for the determination of natural wetlands under Greater Wellington's proposed Natural Resources Plan. Available: http://www.gw.govt.nz/assets/Biodiversity/Wetland-Technical-Determination.pdf

Table 6-2 Summary of how different methods of assessment have been applied to inform wetland ecological value

EcIA Matter	Vegetation type (Singers et al., 2017)	Functional value[9] (Kotze et al., 2007)	Wetland Condition Index (Clarkson et al., 2004)
Matter 1 Representativeness			✓
Matter 2 Rarity/distinctiveness	✓		
Matter 3 Diversity and pattern	✓	✓	
Matter 4 Ecological context		✓	

6.8 Terrestrial Ecology Assessment Methodology

6.8.1 Site Investigation

6.8.1.1 Vegetation Communities and Habitats

Site walkovers were undertaken in December 2019, and September 2022 by experienced ecologists to map and describe the habitats[10] present within and adjacent to the Project Area. Habitats were classified into ecosystem type based on those described in Singers et al. (2017). The habitats were also assessed as to their potential to support native fauna, including birds, bats, lizards, fish and macroinvertebrates.

Habitat assessment focused on areas of potentially significant value, such as stream corridors and areas of vegetation (trees, scrub) based on aerial photos and during site investigation. Species records from relevant literature and biodiversity databases were utilised to focus search efforts on certain areas within the Project Area.

Broad indigenous vegetation communities were mapped on recent aerial photography and incorporated into the Project's GIS database. The vegetation assessment included recording the dominant or characteristic species present and the general quality described, including structure, maturity, presence of weeds and evidence of disturbance.

6.8.1.2 Terrestrial Fauna

Incidental observations of any native species seen during site walkover were recorded. For lizard species, this included incidental searches of natural/artificial refugia, such as turning over logs/wood/corrugated iron on the ground. For birds, incidental observations were made during other field surveys for forest or wetland bird species.

[9] Functional wetland values were informed by generic wetland functions including flood attenuation, stream flow regulation, sediment trapping, water purification, erosion control and carbon storage associated with different HGM units based on Kotze et al. (2007)
[10] Ecosystem codes from Singers et al. (2017) were used to describe the habitats encountered on site.

To determine the presence or likely absence of long-tailed bats in the Project Area, two Automatic Bat Monitors (ABMs) (SM4BAT FS with SMM-U2 microphone) were placed along vegetated linear features, where bats were most likely to be foraging (in accordance with recommendations from Borkin and Parsons 2009 and O'Donnell et al., 2006). The ABMs were left on site for a minimum of 14 nights, during weather conditions when bats would be active[11] (Sedgeley, 2012). The locations of these ABMs are illustrated in Figure 6-2.

[11] ABM data was excluded from the analysis if conditions would affect bat activity (O'Donnell & Sedgeley, 1999);

- Air temperatures dropped below 10°C overnight
- Mean overnight wind speed exceed 20km/h, maximum overnight wind gust exceeded 60km/h; and / or
- Persistent heavy rain through the night.

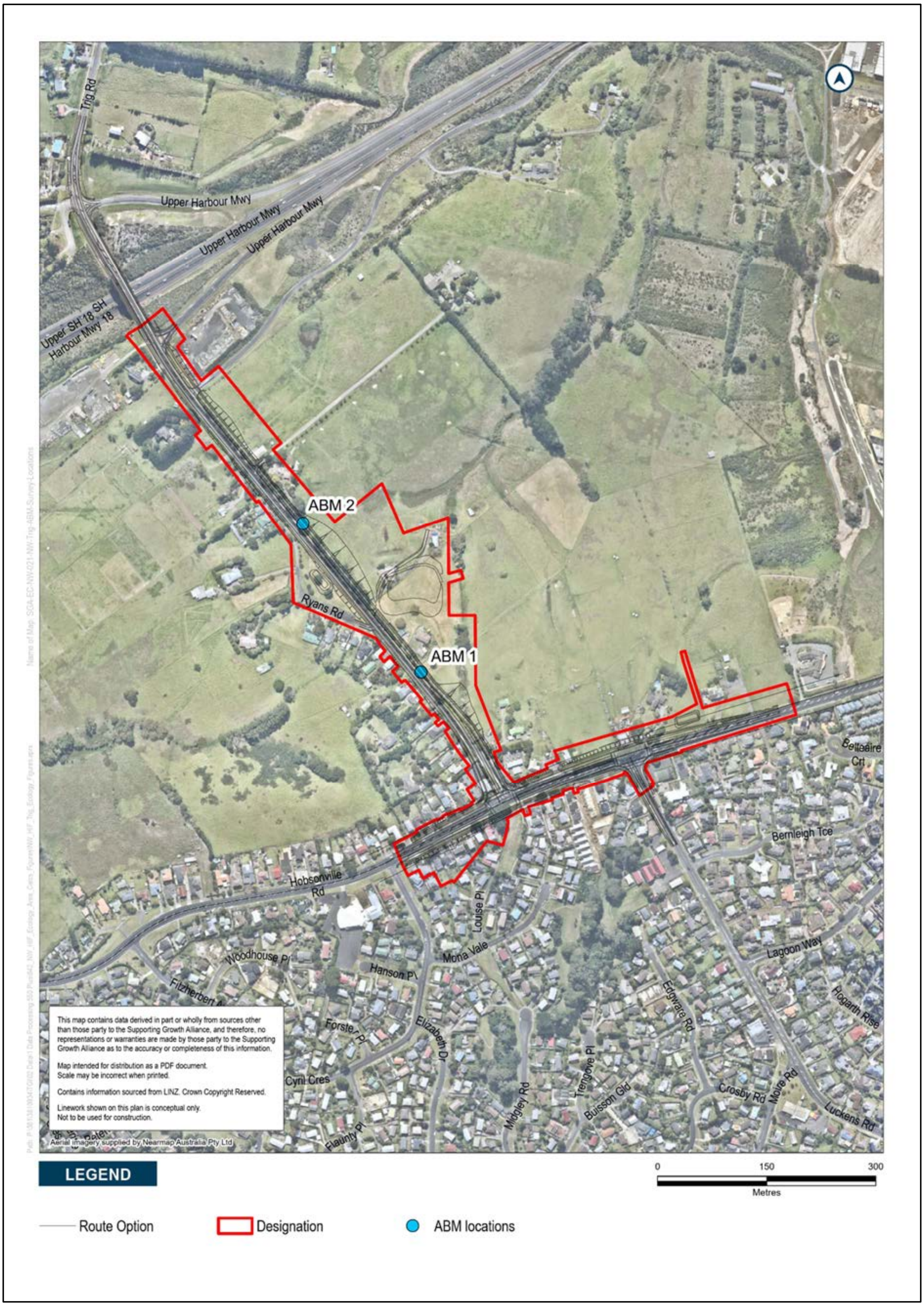

Figure 6-2 ABM survey locations

6.8.2 Assessing Terrestrial Ecological Value

The different terrestrial assessment methods were applied to inform the ecological value (ranging from **Negligible** to **Very High**) of terrestrial habitat associated with the Project Area and were consistent with the EIANZ Guidelines. This was done by using all or selected parts of different methods employed to inform matters influencing the ecological importance and sensitivity of the receiving environment. Each ecological EcIA 'Matter' and corresponding method(s) used to inform the matter are summarised in Table 6-3.

Table 6-3 Summary of how different methods of assessment have been applied to inform terrestrial ecological value

EcIA Matter	Habitat description (Singers et al., 2017)	Presence of TAR species or habitats
Matter 1 Representativeness	✓	✓
Matter 2 Rarity/distinctiveness	✓	✓
Matter 3 Diversity and pattern	✓	
Matter 4 Ecological context	✓	

In accordance with the EIANZ Guidelines, assigning ecological value at the species level considers the current threat status of a species (in accordance with the NZ Threat Classification system) that is present in areas potentially impacted by the Project (refer Appendix 2). For example, exotic species are assigned a **Negligible** ecological value and Native Threatened (Nationally Critical/Endangered/Vulnerable) species are assigned a **Very High** ecological value.

7 Assessment of Effects

7.1 Ecological Baseline

This section presents the findings of the desktop study (which includes a review of the documents listed in Section 6.5) and site investigations for all of the habitats and species ('ecological features') present within the Project Area. Based on this information, an ecological value has been calculated for each ecological feature using the assessment method outlined in Sections 6.6.2, 6.7.2 and 6.8.2.

7.1.1 Historic Ecological Context

The Project lies within the Tāmaki Ecological District, which has a warm, humid climate and is characterised by volcanic cones, isthmus, harbours and volcanic terrain (McEwen, 1987). Historically, the terrestrial portions of the Project Area would have been forested, and composed of species including pūriri (*Vitex lucens*), tōtara (*Podocarpus totara*), mataī (*Prumnopitys taxifolia*), kahikatea (*Dacrycarpus dacrydioides*) and tītoki (*Alectryon excelsus subsp. excelsus*), kōwhai (*Sophora sp.*) and taraire (Singers et al., 2017).

7.1.2 Terrestrial Ecology (Flora)

7.1.2.1 Desktop Review

Aerial imagery shows that the historical habitats described in Section 7.1.1 had been cleared prior to 1959 (earliest available aerial image). The habitats within the Project Area currently comprises grazed pasture, residential gardens, and native road plantings (Upper Harbour Motorway) (Appendix 5). No naturally occurring shrubland or forested habitat is currently present within the Project footprint.

Aerial imagery (Auckland Council, 2022) shows the presence of three terrestrial Significant Ecological Areas (**SEA**s) within 2 km of the Project Area (there are no SEAs located within the Project Area) and early route selection work sought to avoid these areas. These SEAs are identified in AUP:OP and include:

- SEA_T_2040: 1.0 km southwest of the Project Area.
- SEA_T_4661: 0.98 km south of the Project Area.
- SEA_T_4733: located within the wider stream catchment, approximately 2 km northeast of the Project Area, adjacent to the Waiarohia Stream. Tributaries to the Waiarohia Stream flow through from the Project Area.

7.1.2.2 Site Investigation

The Project Area is dominated by hard standing (existing roads and a footpath on the southern part of the western side), grazed exotic grasses, planted native and exotic trees consisting of mostly mature pines (*Pinus radiata*) and exotic garden species.

The surveys identified the presence of kānuka (*Kunzea robusta*) and mānuka (*Leptospermum scoparium*) within areas of native planting (< 20 years old) along the Upper Harbour Motorway and Trig Road, and pōhutukawa (*Metrosideros excelsa*) surrounding a pump station located at the junction between Trig Road and Hobsonville Road. These species are listed as 'Threatened – Nationally Vulnerable' because of the spread of myrtle rust within New Zealand and the risk that this poses to all Myrtaceae species. These species are currently common throughout the Tāmaki Ecological District and, in addition, the individuals within the Project Area are all newly planted and either immature or semi-mature. Therefore, the presence of these Threatened species has not altered the valuation of the habitats within which they occur (Table 7-1). A detailed list of vegetation species observed during the site investigations is included in Appendix 0.

Table 7-1 below describes the habitats identified within the Project Area through site investigations and their value in accordance with EIANZ guidelines (Appendix 2). The extent of these habitats, in relation to the Project Area, is presented in Appendix 5.

Table 7-1 Terrestrial habitats in the Project Area

Classification (Singers et al., 2014)	Vegetation Type	Description
BF	Brown Field (includes cropland)	This definition includes Industrial zones, metaled carparks, rail corridors, unmanaged or managed land within urban settings, road median strips, pavements, cracks in concrete. Substrate includes metal (stone chip) and concrete surfaces. largely exotic herbfield (weeds) and occasional exotic or native woody species.
EG	Exotic Grassland	Grassland dominated by exotic species. This includes pasture, and garden lawns.
PL.1	Planted Vegetation – Native (recent)	Native restoration plantings with <50% exotic biomass. Recently planted native scrub and forest <20 years old.
PL.3	Planted Vegetation – Exotic/Native (amenity)	Amenity plantings. This includes planted native and/or exotic vegetation within parks, amenity areas and private gardens.
TL.3	Treeland – Exotic-Dominated	Tree canopy cover 20-80%: <25% native with exotic tree cover dominant. For the purposes of mapping this includes planted and wilding exotic vegetation and mature shelterbelts. This includes mature riparian vegetation and scattered or discontinuous canopy of mature trees within gardens, farms and amenity areas.

7.1.2.3 Ecological Value

The terrestrial habitats within the Project Area are dominated by exotic grasslands (EG) (managed cut grassland), which is of **Negligible** ecological value. The Project Area also includes planted amenity areas or self-seeded (scrub), which are entirely or predominantly exotic habitats (exotic scrubland, (ES), exotic treeland (TL.3) and planted vegetation (PL.1 and PL.3). These habitats are considered to be of **Low** ecological value due to their low botanical diversity (lack of native species) and predominance of pest species.

These exotic vegetation types although of limited value botanically provide some value in terms of ecosystem function, such as, bank stability and stream shading of the adjacent streams. In addition, they may provide habitat utilised by long-tailed bat (Threatened – Nationally Critical), non-TAR birds, and copper skink (At Risk – Declining):

- Long-tailed bat potential habitat: TL.3
- Non-TAR bird potential habitat: PL.1, PL.3, TL.3
- Copper skink potential habitat: EG, PL.1, PL.3, TL.3 (with appropriate understorey)

These habitat provisioning aspects of ecological value have been considered in the overall assessment of terrestrial habitats presented in Table 7-2. A detailed justification for the value assessment is outlined in Appendix 4 and ecological habitat maps are provided in Appendix 5.

Table 7-2 Terrestrial habitat ecological value assessment associated with Trig Road

Ecological Feature	Ecological Value
BF	Negligible
EG	Negligible
PL.1	Low
PL.3	Low
TL.3	Low

7.1.3 Terrestrial Ecology (Fauna)

7.1.3.1 Bats

Desktop Review

Existing records (Department of Conservation, 2022; Supporting Growth Alliance, 2022a) confirm the presence of long-tailed bats (*Chalinolobus tuberculatus*) in the wider landscape (Figure 7-1). The conservation status of this species is ‘Threatened - Nationally Critical’ (O’Donnell et al., 2017). The nearest record is approximately 1.5 km north of the Project Area (Figure 7-2).

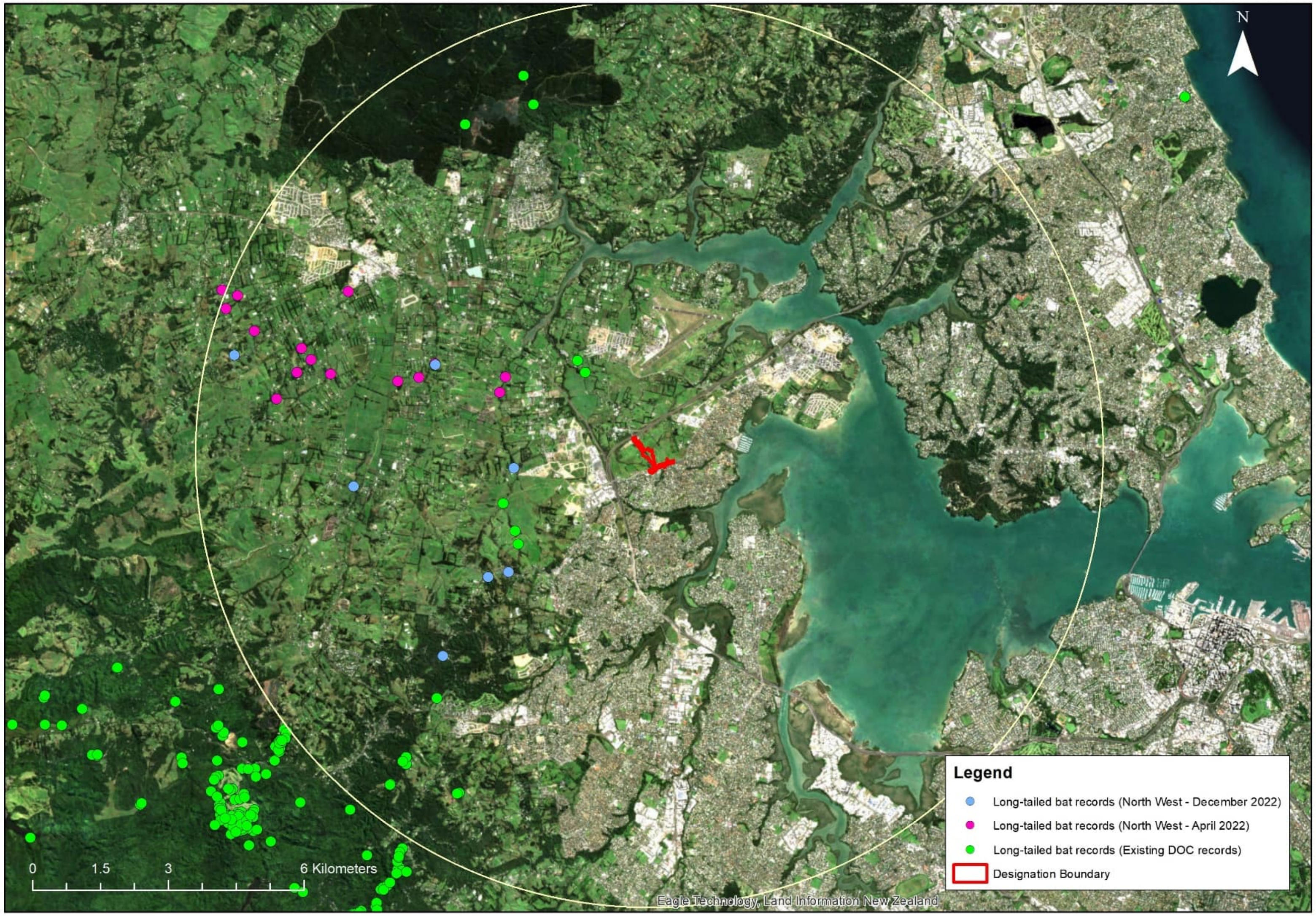

Figure 7-1 Existing long-tailed bat records within a 10 km radius of the Project Area (Department of Conservation, 2022; Supporting Growth Alliance, 2022a)

Figure 7-2 Existing long-tailed bat records within a 5 km radius of the Project Area (Department of Conservation, 2022; Supporting Growth Alliance, 2022a)

Site Investigation

Two ABMs were placed in the Project Area within linear vegetation located at the headwaters of Trig Stream for 17 nights between 1 November and 18 November 2019. No bat activity was recorded at either ABM during the monitoring period. Weather conditions were suitable during the monitoring period for bats to be active on 12 nights (Appendix 4 presents weather data from the monitoring period).

The habitat surrounding the Project Area is not considered to be optimal for bats (being agricultural fields and residential gardens) and the wetland/stream areas are dominated by pasture grass with only scattered stands of exotic trees. The standing dead timber around wetland TR-W4 did contain cracks, splits and rot holes within which bats could roost if present. However, bats would need to be foraging and commuting through this area to be able to identify these trees for roosting.

Survey information suggests that the habitat quality for long-tailed bats is poor and that they are not regularly present within the Project Area. However, as long-tailed bats are known to be present in the wider landscape, it is not possible to completely exclude the potential for bat presence.

Ecological Value

The conservation status of long-tailed bats is ‘Threatened – Nationally Critical’ (O’Donnell et al., 2017), therefore the ecological value of long-tailed bats is **Very High**.

7.1.3.2 Birds

Desktop Review

The New Zealand Bird Atlas[12] and iNaturalist identified 40 bird species within 2 km of the Project Area (Appendix 0). This included 21 native bird species, which are listed as ‘At Risk’ or ‘Threatened’ (TAR) species (Table 7-3). These species are predominantly coastal, excluding kākā (*Nestor meridionalis septentrionalis*) and New Zealand pipit (*Anthus novaeseelandiae novaeseelandiae*). Most of these species would be very unlikely to utilise habitats within the Project Area, apart from occasional flyovers, or to occasionally feed within the pasture wetland areas.

Table 7-3 Threatened or At Risk (TAR) native bird species recorded within 2 km of the Project Area

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
Banded dotterel	Pohowera	*Charadrius bicinctus*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Banded rail	Mioweka	*Gallirallus philippensis assimilis*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Black shag	Māpunga	*Phalacrocorax carbo*	At Risk - Relict	Desktop record - iNaturalist

12 https://birdatlas.co.nz/

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
Caspian tern	Taranui	*Hydroprogne caspia*	Threatened - Nationally Vulnerable	Desktop record - iNaturalist/eBird (Bird Atlas)
Bar-tailed godwit	Kuaka	*Limosa lapponica bauer*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Black-billed gull	Tarāpuka	*Larus bulleri*	At Risk - Declining	Desktop record - iNaturalist
Dabchick	Weweia	*Poliocephalus rufopectus*	Threatened – Nationally Increasing	Desktop record - iNaturalist/eBird (Bird Atlas)
Lesser knot	Huahou	*Calidris canutus rogersi*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Little black shag	Kawau tūī	*Phalacrocorax sulcirostris*	At Risk – Naturally Uncommon	Desktop record - iNaturalist
New Zealand pipit	Hīoi	*Anthus novaeseelandiae novaeseelandiae*	At Risk – Declining	Desktop record - iNaturalist
North Island fernbird	Mātātā	*Poodytes punctatus*	At Risk – Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
North Island kākā	Kākā	*Nestor meridionalis septentrionalis*	At Risk – Recovering	Desktop record - iNaturalist
Northern New Zealand dotterel	Tūturiwhatu	*Charadrius obscurus aquilonius*	At Risk - Recovering	Desktop record - eBird (Bird Atlas)
Pied shag	Kāruhiruhi	*Phalacrocorax varius*	At Risk – Recovering	Desktop record - iNaturalist/eBird (Bird Atlas)
Red-billed gull	Tarāpunga	*Larus novaehollandiae scopulinus*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Lesser knot	Huahou	*Calidris canutus rogersi*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Royal spoonbill	Kōtuku ngutupapa	*Platalea regia*	At Risk – Naturally Uncommon	Desktop record - iNaturalist/eBird (Bird Atlas)

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
South Island pied oystercatcher	Tōrea	*Haematopus finschi*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Variable oystercatcher	Tōrea pango	*Haematopus unicolor*	At Risk - Recovering	Desktop record - eBird (Bird Atlas)
White-fronted tern	Tara	*Sterna striata*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Wrybill	Ngutu parore	*Anarhynchus frontalis*	Threatened – Nationally Increasing	Desktop record - iNaturalist

Site Observations

Formal bird surveys for wetland or forest bird species were not completed within the Project Area, as limited habitat was present for TAR species. However, during site visits, birds were recorded incidentally, the full list is presented in Appendix 0. Table 7-4 lists the native species observed within the Project Area, all of which are Not Threatened. The native species recorded are typical of a modified agricultural landscape with areas of open water and residential gardens.

Table 7-4 Native bird species recorded incidentally during site walkover

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)
Australasian harrier	Kāhu	*Circus approximans*	Not Threatened
Grey warbler	Riroriro	*Gerygone igata*	Not Threatened
Pūkeko	Pūkeko	*Porphyrio melanotus melanotus*	Not Threatened
Tūī	Tūī	*Prosthemadera novaeseelandiae novaeseelandiae*	Not Threatened
Welcome swallow	Warou	*Hirundo neoxena*	Not Threatened
White-faced heron	Matuku moana	*Ergretta novaehollandiae*	Not Threatened

Ecological Value

The desktop review and site investigations identified 21 TAR bird species within 2 km of the Project Area. These bird species included coastal, freshwater and forest species. There is the potential that several of these species could stop to feed or rest within the areas of open farmland that surround the Project Area (e.g., black-billed and red-billed gulls) and that these species could occasionally fly over the Project Area (e.g., kākā). New Zealand pipit has been recorded in the local area and can use areas of long grass along field margins to nest, but within the Project Area this habitat type is impacted by intensive stock grazing minimising cover and likely disturbance from the existing road network, and it is considered suboptimal for this species. North Island fernbird are associated with wetland habitats in the Project Area and are likely to be present and considered to be a transient visitor to the wetlands.

If any of the habitats surrounding the Project Area were to be used by TAR bird species, this would most likely be infrequently and not during critical stages of their lifecycle (e.g., nesting) (with the exception of North Island fernbird). Non-TAR native bird species would most likely forage and nest within vegetation within residential gardens that line the existing road network.

Table 7-5 Ecological value for TAR bird species

Common Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Ecological Value
Non-TAR birds	-	Not Threatened	Low
North Island fernbird/ Mātātā	*Poodytes punctatus*	At Risk - Declining	High

7.1.3.3 Herpetofauna

Desktop Review

A desktop review confirmed eight herpetofauna records within 2 km of the Project Area (Appendix 0). No herpetofauna records were found within the Project Area. This does not confirm that herpetofauna are not present in the Project Area, but most likely that the habitat is too modified to be suitable for the majority of these species. Of the six native herpetofauna records, only copper skink is likely to be found within the Project Area based on habitat preference (Table 7-6).

Table 7-6 Native lizard species recorded within 2 km of the Project Area

Common Name	Scientific Name	Threat Class (Hitchmough et al., 2021; Burns et al., 2017)	Record Source	Likelihood of Presence
Pāpā/Pacific gecko	*Dactylocnemis pacificus*	At Risk – Not Threatened	iNaturalist	Unlikely
Hochstetter's frog	*Leiopelma hochstetteri*	At Risk - Declining	iNaturalist	Unlikely
Elegant gecko	*Naultinus elegans*	At Risk – Declining	DOC Bioweb	Unlikely

Common Name	Scientific Name	Threat Class (Hitchmough et al., 2021; Burns et al., 2017)	Record Source	Likelihood of Presence
Moko pirirākau/Forest gecko	*Mokopirirakau granulatus*	At Risk – Declining	iNaturalist	Unlikely
Mokomoko/Copper Skink	*Oligosoma aeneum*	At Risk – Declining	iNaturalist	Likely
Ornate skink	*Oligosoma ornatum*	At Risk – Declining	iNaturalist	Unlikely

Site Investigation

Habitats within the Project Area were assessed for their potential to support native lizards. This was completed during the site walkover along with consideration of lizard presence from desktop records. Where present, suitable refugia were inspected (i.e., logs, rocks etc) for the presence of lizards.

Although no lizards were identified during the site walkover, it was concluded that the rank grassland that is present along the existing road margins, and areas of leaf litter beneath exotic trees and native plantings could support copper skink (At Risk – Declining). Potential copper skink habitat that was observed during the site walkover (approximately 6195 m^2) is presented in Figure 7-3.

The exotic trees within the Project Area are unlikely to support geckos due to their open form and lack of connectivity to established stands of native vegetation. The closely grazed pasture (without any refugia e.g., log piles) provide suboptimal habitat for native lizards. The Project Area potentially include habitats where ornate skink ('At Risk – Declining') could be present, however it is not connected to indigenous habitat that would support a population and as such they are considered unlikely to be present within the Project Area.

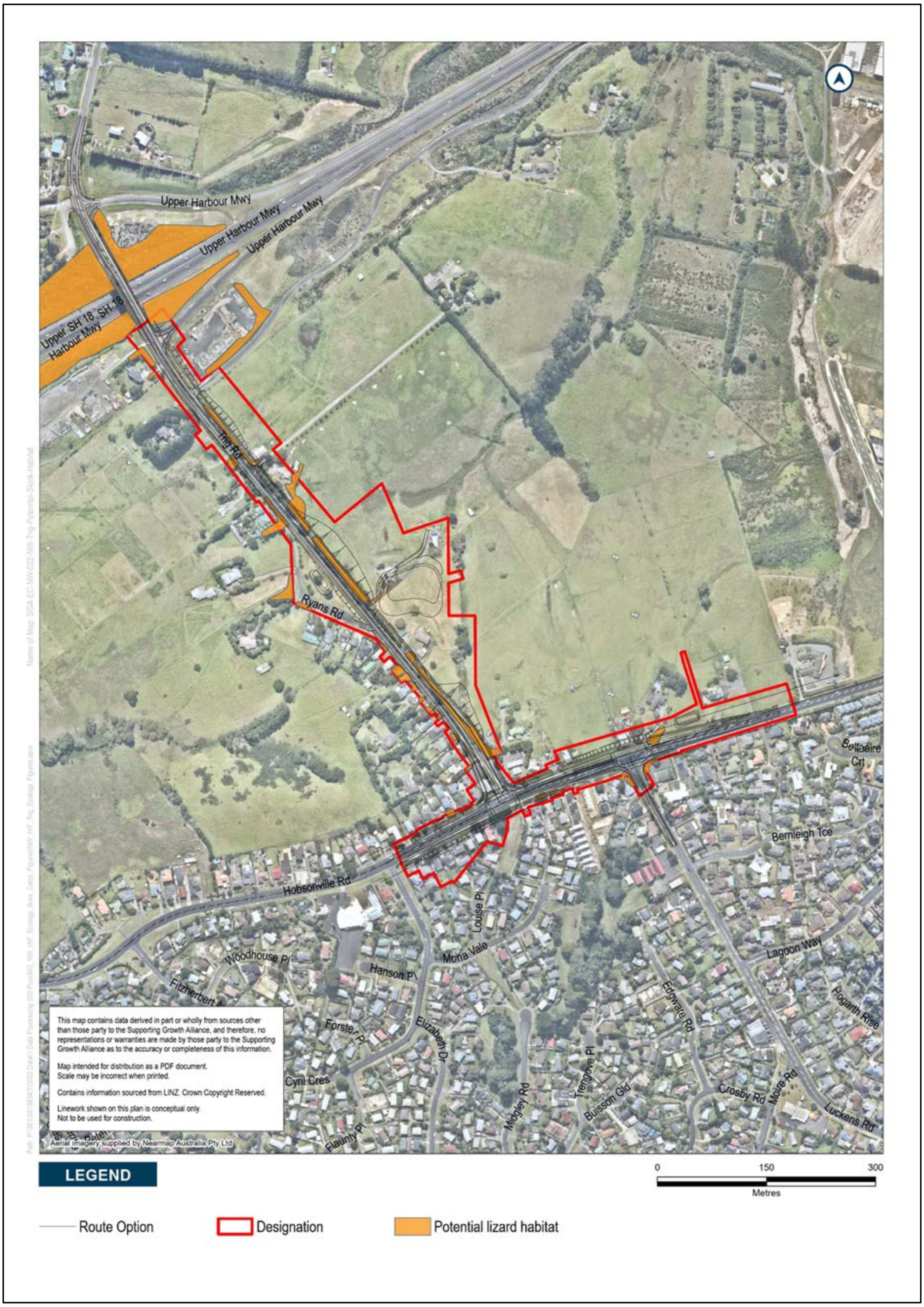

Figure 7-3 Potential copper skink habitat within and adjacent to the Project Area

Ecological Value

The conservation status of copper skink is 'At Risk – Declining' (Hitchmough et al., 2021), therefore the ecological value of copper skink is **High**.

7.1.4 Aquatic Ecology

7.1.4.1 Desktop Review

One stream (Trig Stream) was identified within the Project Area using Auckland Council Geomaps 'rivers and permanent streams' layer (Auckland Council, 2022). Stream habitats within the Project Area were assessed for their potential to support native fish and a desktop review of existing records was completed. The desktop review identified the presence of six native fish species in Waiarohia Stream (Table 7-7). There is the potential for eel species to be present within the upper stream and wetland reaches, and there is a low probability for longfin eel due to poor habitat. A detailed list of fish species identified in the desktop review is included in Appendix 0.

Table 7-7 Native fish species recorded within 2 km of the Project Area

Common Name	Scientific Name	Threat class (Dunn et al., 2018)	Record source
Shortfin eel	*Anguilla australis*	Not Threatened	NIWA, iNaturalist
Longfin eel	*Anguilla dieffenbachii*	At Risk - Declining	NIWA, iNaturalist
Banded kokopu	*Galaxias fasciatus*	Not Threatened	NIWA, iNaturalist
Īnanga	*Galaxias maculatus*	At Risk – Declining	NIWA, iNaturalist
Common bully	*Gobiomorphus cotidianus*	Not Threatened	NIWA, iNaturalist
Giant bully	*Gobiomorphus gobioides*	At Risk – Naturally Uncommon	iNaturalist

7.1.4.2 Site Investigation

Stream Classification

The four streams identified within the Project Area were classified according to their Hydroperiod Classification (Appendix 4, Table 9-10). The results are described in Table 7-8, with all streams classified as intermittent. All streams were associated with valley head seep wetlands and are generally dominated by wetland hydrology (lateral soil seepage). Where present, stream channels were poorly defined but seasonally intercept the saturated soils and are therefore classified as intermittent streams.

Table 7-8 Description of hydrogeomorphic features for streams TR-S1 to TR-S3 and W5-S2

Stream ID	Hydroperiod	Channel Morphology	Substrate Dominance
TR-S1	Intermittent	Soft bottom	Silt, mud and clay (>75% of reach)

Stream ID	Hydroperiod	Channel Morphology	Substrate Dominance
TR-S2	Intermittent	Soft bottom	Silt, mud and clay (>75% of reach)
TR-S3	Intermittent	Soft bottom	Silt, mud and clay (>75% of reach)
W5-S2	Intermittent	Soft bottom	Silt, mud and clay (>75% of reach)

Rapid Habitat Assessment

All streams were surveyed using the Rapid Habitat Assessment protocol (Clapcott, 2015). The streams measured overall habitat quality scores that were considered 'Poor' (Table 7-9). Detailed RHA results are presented in Appendix 4. The RHA category was included within the ecological value assessment for each of the streams where it was applied.

Table 7-9 RHA results for streams TR-S1 to TR-S3 and W5-S2

Stream ID	RHA Score	RHA Category
TR-S1	18	Poor
TR-S2	16	Poor
TR-S3*	18	Poor
W5-S2*	18	Poor

Notes: * = Stream assessed at a desktop level due to property access constraints.

7.1.4.3 Ecological Value

Based on the overall freshwater assessment, all four streams are associated with wetland complexes and were assessed to have **Low** ecological value (Table 7-10). A detailed justification for the value assessment is outlined in Appendix 4 and ecological habitat maps are provided in Appendix 5.

Table 7-10 Aquatic ecological features and overall ecological value

Ecological Feature	Ecological Value
TR-S1 (associated with TR-W3)	Low
TR-S2 (associated with TR-W1)	Low
TR-S3 (associated with TR-W4)	Low
W5-S2 (associated with TR-W7)	Low

7.1.5 Wetland Ecology

7.1.5.1 Site Investigation

Seven wetlands potentially affected by the Project have been identified, five within the Project Area (TR-W1, TR-W2, TR-W3, TR-W4, and TR-W5) and two directly adjacent (TR-W6 and TR-W7) to the

Project Area. All seven wetland areas were described as Exotic Wetland (EW) (Singers et al., 2017), due to the dominance of exotic hydrophytic plant species. Wetland descriptions and analysis are presented in Table 7-11 and the results of vegetation plots, Dominance Test, Prevalence Index, wetland condition assessment and wetland function assessment have been included in Appendix 4.

Based on results of the site investigation all wetlands have been classified as NPS:FM natural wetlands because they do not meet the NPS:FM exclusions that are outlined in Appendix 1, Section 1.2.1.

Table 7-11 Wetland description and analysis

Reference No. and location	Hydrogeomorphic type	Vegetation	Wetland condition	Wetland description in relation to NPS:FM
TR-W1	Seasonally saturated hillslope seep (headwater seep) connected to a channelled valley bottom	Exotic grass and sedges (>50% exotic pasture species)	Largely modified	Natural wetland
TR-W2	Seasonally saturated hillslope seep connected to a channelled valley bottom	Exotic grass and sedges (>50% exotic pasture species)	Largely modified	Natural wetland
TR-W3	Seasonal channelled valley bottom system	Exotic grass and sedges (>50% exotic pasture species)	Largely modified	Natural wetland
TR-W4	Permanently to seasonally saturated hillslope seep connected to stream network	Exotic grass and shrubs (>50% exotic pasture species)	Largely modified	Natural wetland
TR-W5&6	Channelled valley bottom system with permanent zone associated with channel and seasonal zone adjacent hillslopes	Exotic grass and sedges (>50% exotic pasture species)	Largely modified	Natural wetland
TR-W7	Seasonally saturated hillslope seep connected to stream network	Exotic grass and shrubs (>50% exotic pasture species)	Largely modified	Natural wetland

7.1.5.2 Ecological Value

Wetland habitats present within the Project Area are dominated by exotic plant species, degraded vegetation removal, artificial drainage and grazing and pugging from livestock. Alongside the wetland delineation process, the wetland condition was also assessed, and a value given based on the four "Matters": representativeness, rarity/distinctiveness, diversity and pattern, and ecological context. Although highly modified, taking into consideration the retained ecological functionality of these systems for attenuation of stormwater and nutrient removal, the ecological value of these exotic wetlands is considered to be **Low** to **Moderate (**Table 7-12**)**. A detailed justification for the value assessment is outlined in Appendix 4 and ecological habitat maps are provided in Appendix 5.

Table 7-12 Wetland ecological features and overall ecological value

Ecological Feature	Ecological Value
TR-W1	Low
TR-W2	Low
TR-W3	Low
TR-W4	Moderate
TR-W5&W6	Moderate
TR-W7	Low

7.1.6 Summary of Ecological Value

Table 7-13 summarises the ecological values of the ecological features (aquatic, wetland and terrestrial) present within the Project Area.

Table 7-13 Summary of ecological values for aquatic, wetland and terrestrial habitat and species within the Project Area

Ecological Feature	Ecological Value
Habitats	
Aquatic Ecology	
TR-S1	Low
TR-S2	Low
TR-S3	Low
W5-S2	Low
Wetland Ecology	
TR-W1	Low

Ecological Feature	Ecological Value
TR-W2	Low
TR-W3	Low
TR-W4	Moderate
TR-W5&W6	Moderate
TR-W7	Low
Terrestrial Ecology (Flora)	
Brown Field (BF)	Negligible
Exotic Grassland (EG)	Negligible
Planted Vegetation – Native (recent) (PL.1)	Low
Planted Vegetation – Exotic/Native (amenity) (PL.3)	Low
Treeland – Exotic-Dominated (TL.3)	Low
Terrestrial Ecology (Fauna)	
Long-tailed bats	Very High
Native birds (Non-TAR)	Low
North Island fernbird	High
Native herpetofauna	High

7.2 Assessment of Ecological Effects

7.2.1 Positive Effects

Wetland compensation within the Project designation will occur, which will include wetland planting and wetland buffer planting. As this will significantly enhance the existing, largely exotic (weed dominated) vegetation, this will in turn provide improved habitat for any remaining or recolonising native bird species and herpetofauna.

Additionally, further positive ecological outcomes and enhancement opportunities will be developed during detailed design. When implemented, these will include:

- Opportunities for green infrastructure and habitats within the Project Area. For example, planting native street trees, and planting native vegetation rather than grass, on roadside berms and around stormwater wetlands.
- Landscape planting that enhances existing retained habitat (e.g., underplant retained exotic treeland with native understorey vegetation and replace exotic scrub habitat with native species).

7.2.2 Assessment of Construction Effects

The proposed construction activities (described in Sections 7.2.2.1 to 0) have the potential to cause impacts on ecological features (aquatic, wetland and terrestrial) within and adjacent to the Project Area, without appropriate construction impact management. The effects assessment has considered the current ecological baseline only, under the assumption that the likely future ecological environment (considering permitted activities) will not change substantially.

7.2.2.1 Terrestrial Ecology (Flora)

Table 7-14 lists the potential effects to the terrestrial vegetation within the Project Area and their magnitude of effect. This is then used to calculate an overall level of effect to each ecological feature, prior to impact management. A detailed justification for the ecological value assessment and the magnitude of effect assessment that has resulted in the level of effect as per the EIANZ Guidelines is presented in Appendix 4.

Table 7-14 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (flora) during construction

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Brown Fields (BF) (18,600 m^2) Exotic Grassland (EG) (17,302 m^2)	Negligible	Vegetation removal: Permanent loss of habitat/ecosystem, fragmentation and edge effects due to vegetation removal.	High	Effect is direct, local, permanent, and definite.	Very Low
Planted Vegetation – Native (recent) (PL.1) (149 m^2) Planted Vegetation - Amenity (PL.3) (3846 m^2) Treeland – Exotic-Dominated (TL.3) (3991 m^2)	Low	Vegetation removal: Permanent loss of habitat/ecosystem, fragmentation and edge effects due to vegetation removal.	High	Effect is direct, local, permanent, and definite.	Low
Exotic Grassland (EG) Planted Vegetation – Native (recent) (PL.1) Planted Vegetation - Amenity (PL.3) Treeland – Exotic-Dominated (TL.3)	Negligible - Low	Earthworks: Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity.	Negligible	Effect is direct, local and short-term (<5 years). The effect is considered to be infrequent and unlikely.	Very Low

7.2.2.2 Terrestrial Ecology (Fauna)

Table 7-15 lists the potential effects to the fauna within the Project Area and their magnitude of effect. This is then used to calculate an overall level of effect to each ecological feature, prior to impact management. A detailed justification for the ecological value assessment and the magnitude of effect assessment that has resulted in the level of effect as per the EIANZ Guidelines is presented in Appendix 4.

Long-tailed bats

Table 7-15 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (long-tailed bats) during construction

Ecological Feature	Ecological Value	Effects Description*	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Long-tailed bats	Very High	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Negligible	Effect is indirect, local, short term (<5 years) and unlikely. The effect will have a periodic frequency and is totally reversible.	Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Negligible	Effect is direct, local and permanent (>25 years). However, long-tailed bat habitat in the context of the Project Area is small, isolated, and adjacent to an existing road, therefore loss of habitat is considered unlikely.	Low
		Vegetation removal: Potential to kill/injure long-tailed bat, causing adverse effects on population dynamics.	Negligible	Effect is direct, local, and short term (<5 years). Although long-tailed bats are known to be in the wider landscape, no moderate or high roosting potential was identified in the Project Area, therefore the likelihood of the effect is considered unlikely. As long-tailed bat presence cannot be excluded in the future, the requirements of the Wildlife Act 1953 will need to be adhered to during vegetation removal.	Low **WA 1953 requirements** (refer Section 7.3.1.1)

Notes: * = Roost loss has been considered but discounted as an effect as the consequence of roost loss (if it does occur at all) is considered less than Negligible in the context of this Project.

Birds

Table 7-16 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (birds) during construction

Ecological feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Non-TAR birds	Low	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Low	Effect is indirect, local, short term (<5 years) and highly likely. The effect will have a periodic frequency and is totally reversible.	Very Low
		Vegetation removal: Nest loss.	Low	Effect is direct, local, short term (<5 years) and is considered highly likely.	Very Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	High	Effect is direct, local, permanent and the likelihood is considered definite due to the definite presence of native bird habitat in the Project Area.	Low
		Vegetation removal: Potential to kill/injure non-TAR birds, causing adverse effects on population dynamics.	Negligible	Effect is direct, local, and short term (<5 years). Although native birds are definitely present in the Project Area, an effect on population dynamics is considered unlikely. However, as all native birds are protected under the WA 1953, requirements of the WA 1953 will need to be adhered to during vegetation removal.	Very Low **WA 1953 requirements** (refer Section 7.3.1.1)
North Island fernbird	High	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Negligible	Effect is indirect, local, short term (<5 years) and unlikely. The effect will have a periodic frequency and is totally reversible.	Very Low
		Vegetation removal: Nest loss.	Negligible	Effect is direct, local, and short term (<5 years). However, North Island fernbird potential nesting habitat in	Very Low

Ecological feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
				the Project Area is suboptimal, therefore nest loss in considered unlikely.	
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Negligible	Effect is direct, local, and permanent. However, North Island fernbird habitat is already isolated and surrounded by pasture, therefore the effect is considered unlikely.	Very Low
		Vegetation removal: Potential to kill/injure birds, causing adverse effects on population dynamics.	Negligible	Effect is direct, local, and short term (<5 years) and considered unlikely. However, as all native birds are protected under the WA 1953, requirements of the WA 1953 will need to be adhered to during vegetation removal.	Very Low **WA 1953 requirements** (refer Section 7.3.1.1)

Herpetofauna

Table 7-17 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (herpetofauna) during construction

Ecological feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Copper skink	High	Disturbance and displacement to individuals (existing) due to construction activities (noise, light, dust etc).	Negligible	Effect is indirect, local, short term (<5 years) and unlikely. The effect will have a periodic frequency and is totally reversible.	Very Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation	Low	Effect is direct, local, and permanent. Copper skink are anticipated to be utilising all terrestrial features in the	Low

		of habitat, causing adverse effects on population dynamics.		Project Area (excluding Brown Fields). Approximately 6195 m^2 of potential copper skink habitat will be removed, therefore the effect is considered likely. Additionally, a project specific Wildlife Act Permit (WAP) will be required for lizard salvage. The current expectations of Department of Conservation are that habitat restoration to address residual effects (of habitat loss and salvage) is required to issue a WAP. This will need to be considered.	**Wildlife Act Permit (WAP)** (refer Section 7.3.1.1)
		Vegetation removal: Potential to kill/injure copper skink, causing adverse effects on population dynamics.	Negligible	Effect is direct, local, and short term (<5 years) and considered unlikely. However, as all native herpetofauna are protected under the WA 1953, requirements of the WA 1953 will need to be adhered to during vegetation removal.	Very Low **WA 1953 requirements** (refer Section 7.3.1.1)

7.2.2.3 Aquatic Ecology

All works (excluding minor stormwater outfall works) will be outside the stream riparian setback and therefore no instream works will occur. Additionally, all streams are associated with wetland complexes. The main hydrological maintenance of these complexes is associated with wetland hydrology. Therefore, potential effects on instream habitat due to hydrology and water quality impacts during construction have been assessed in Section 0 for the corresponding wetlands.

7.2.2.4 Wetland Ecology

Table 7-18 lists the potential construction effects (direct and indirect) to the wetland ecology within the Project Area and their magnitude of effect. This is then used to calculate an overall level of effect to each habitat, prior to impact management. A detailed justification for the ecological value assessment and the magnitude of effect assessment that has resulted in the level of effect as per the EIANZ Guidelines is presented in Appendix 4.

The effects assessment is based on the following assumptions and embedded mitigation being delivered as part of the Project:

- A provisional Erosion and Sediment Control Plan has been prepared for the Project which describes how the effects of sedimentation from construction earthworks will be managed. As such, it is assumed that issues related to sediment generation will be adequately mitigated and will not lead to adverse ecological effects. This includes the potential effects on the downstream receiving environment as it has been assumed that it can be acceptably managed as part of project delivery.
- Stormwater generated from the construction area will be treated through industry standard best practice measures, to remove or reduce contaminants to acceptable levels prior to discharge into any waterway within or adjacent to the proposed works area. It is assumed that the hydrology of the receiving wetlands will be maintained through the stormwater controls.

Table 7-18 Magnitude of effects and subsequent level of effect (without impact management) of the Project on wetland ecology during construction

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
TR-W1	Low	Vegetation removal/reclamation: Road embankment will result in the permanent loss of approximately 1000 m^2 (0.1 ha) of a 3,700 m^2 (0.37 ha) hydrogeomorphic unit (HGM) of natural wetland associated with TR-W1 (approximately 27% of the hydrogeomorphic unit).	High	Permanent, irreversible loss of wetland habitat that will definitely occur. Although the level of effect is considered low, offset is required under the NES-FW due to loss in wetland extent.	Low **NES-FW requirements** (refer Section 7.3.2)
TR-W4	Moderate	Vegetation removal/reclamation: Road embankment will result in the permanent loss of approximately 780 m^2 (0.078 ha) of a 2,800 m^2 (0.28 ha) HGM unit of natural wetland associated with TR-W4 (approximately 29% of the hydrogeomorphic unit).	High	Permanent, irreversible loss of wetland habitat that will definitely occur. Level of effect is **Moderate** and offset is required. This is also required under the NES-FW due to a loss in wetland extent.	**Moderate** **NES-FW requirements** (refer Section 7.3.2)
TR-W1, TR-W2	Low	Earthworks: Detrimental effects on habitats including plant composition and fauna due to diversion,	Moderate	Regardless of embedded controls, earthworks for all wetlands have potential of affecting the hydrology of the receiving environment through disrupting soil-water pathways.	Low

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
		abstraction or bunding of watercourses and water level/flow/periodicity changes.		TR-W1: TR-W1 is a seasonal wetland and therefore has a reduced likelihood of this effect occurring relative to other wetlands. TR-W2: Earthworks for this wetland is mainly associated with the dry pond construction.	
TR-W3	Low		Low	Wetland TR-W3 is located further away from construction and the upslope hydrology is more ephemeral, resulting in a lower likelihood of this impact occurring.	Very Low
TR-W4	Moderate		Low	Wetland TR-W4 is potentially spring fed. Earthworks will occur within a portion of this wetland, therefore posing a risk of disrupting soil-water pathways.	Low
TR-W5&W6	Moderate		Low	Wetland not directly associated with earthworks and maintained through multiple sub-catchments therefore reducing the likelihood.	Low
TR-W7	Low		Negligible	TR-W7 is approximately 37 m away from the relatively small stormwater outfall construction. Earthwork related flow disruption is unlikely due to the distance and the large additional catchment maintaining TR-W7.	Very Low
TR-W1, TR-W2, TR-W3	Low	Earthworks: Uncontrolled discharge leading to habitat and water quality degradation.	Low	Uncontrolled discharge from construction stormwater possible (therefore allocated 'Likely' probability) despite embedded controls.	Very Low

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
TR-W4, TR-W5&W6	Moderate		Low	Uncontrolled discharge from construction stormwater possible (therefore allocated 'Likely' probability) despite embedded controls.	Low
TR-W7	Low		Negligible	Uncontrolled discharge from construction stormwater unlikely due to distance to wetland and scale of construction (therefore allocated 'Unlikely' probability) despite embedded controls.	Very Low

7.2.3 Assessment of Operational Effects

The operation of the Project has the potential to cause impacts on ecological features (terrestrial and wetland) within and adjacent to the Project Area, without impact management. Section 7.2.3.2 to 7.2.3.4 details the magnitude of effect and subsequent level of effect on ecological features (further detail regarding how these were determined are provided in Appendix 2). The effects assessment has considered the current ecological baseline only, under the assumption that the likely future ecological environment (considering permitted activities) will not change substantially.

7.2.3.1 Terrestrial Ecology (Flora)

Operational effects on terrestrial ecology include weed dispersal to previously unaffected areas of indigenous vegetation due to presence of the infrastructure, and increased weed incursion and unintentional spray of indigenous vegetation due to maintenance. This is detailed further in Table 7-19.

Table 7-19 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (flora) during operation

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Exotic Grassland (EG)	Negligible	Presence of the infrastructure: Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity due to the presence of the infrastructure, use of infrastructure edges as dispersal corridors by invasive plant species.	Negligible	Effect is direct, local, permanent, and is considered infrequent and unlikely.	Very Low
Planted Vegetation – Native (recent) (PL.1) Planted Vegetation - Amenity (PL.3) Treeland – Exotic-Dominated (TL.3)	Low	Presence of the infrastructure: Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity due to the presence of the infrastructure, use of infrastructure edges as dispersal corridors by invasive plant species.	Negligible	Effect is direct, local, permanent, and is considered infrequent and unlikely.	Very Low
Exotic Grassland (EG)	Negligible	Maintenance: Increased weed incursion, unintentional spray of indigenous vegetation due to maintenance, increased use of herbicides.	Low	Effect is direct, local, permanent, and is considered likely with a periodic frequency.	Very Low
Planted Vegetation – Native (recent) (PL.1) Planted Vegetation - Amenity (PL.3) Treeland – Exotic-Dominated (TL.3)	Low	Maintenance: Increased weed incursion, unintentional spray of indigenous vegetation due to maintenance, increased use of herbicides.	Low	Effect is direct, local, permanent, and is considered likely with a periodic frequency.	Very Low

7.2.3.2 Terrestrial Ecology (Fauna)

The loss of connectivity through permanent habitat loss due to the presence of the road, and disturbance such as operational noise/vibration and light can lead to an overall reduction in size and quality of habitat and can impact bats, birds, and herpetofauna. This is detailed further in Table 7-20 to Table 7-22.

Long-tailed bats

Table 7-20 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (long-tailed bats) during operation

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Long-tailed bats	Very High	Disturbance and displacement of (new and existing) roosts and individuals due to lighting and noise/vibration.	Negligible	Effect is indirect, local, and permanent. However, due to the restricted bat habitat within the Project Area, the effect is considered unlikely.	Low
		Loss in connectivity due to permanent habitat loss, light, and noise effects from the road, leading to fragmentation of terrestrial habitat and influencing bat movement in the broader landscape.	Negligible	Effect is indirect, local, and permanent. However, due to the restricted bat habitat and existing fragmentation within the Project Area, the effect is considered unlikely.	Low

Birds

Table 7-21 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (birds) during operation

Ecological feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Non-TAR birds	Low	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc).	Moderate	Effect is indirect, local, permanent, and is considered highly likely due to the definite presence of native birds in the Project Area.	Low
		Loss in connectivity due to permanent habitat loss, light and noise effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.	Negligible	Effect is indirect, local, permanent, and is considered unlikely due to the existing fragmentation of the habitat.	Very Low

North Island fernbird	High	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc).	Negligible	Effect is indirect, local, and permanent. However, due to the restricted North Island fernbird habitat within the Project Area, the effect is considered unlikely.	Very Low
		Loss in connectivity due to permanent habitat loss, light and noise effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.	Negligible	Effect is indirect, local, and permanent. However, due to the restricted North Island fernbird habitat and existing fragmentation within the Project Area, the effect is considered unlikely.	Very Low

Herpetofauna

Table 7-22 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (herpetofauna) during operation

Ecological feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Copper skink	High	Disturbance and displacement of existing and future copper skink due to light, noise and vibration effects from the presence of the road.	Negligible	Effect is indirect, local, permanent and is considered unlikely.	Very Low
		Loss in connectivity due to permanent habitat loss, light and noise/vibration effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.	Negligible	Effect is indirect, local, permanent and is considered unlikely due to the existing fragmentation of copper skink habitat within the Project Area.	Very Low

7.2.3.3 Aquatic Ecology

All works (excluding minor stormwater outfall works) will be outside the stream riparian setback and therefore no instream works will occur. Therefore, potential effects on instream habitat due to hydrology and water quality impacts during operation have been assessed in Section 7.2.3.4 for the corresponding wetlands.

7.2.3.4 Wetland Ecology

Table 7-23 lists the potential operational effects (direct and indirect) to the wetland ecology within the Project Area and their magnitude of effect. This is then used to calculate an overall level of effect to each habitat, prior to impact management. A detailed justification for the ecological value assessment and the magnitude of effect assessment that has resulted in the level of effect as per the EIANZ Guidelines is presented in Appendix 4.

Table 7-23 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon wetland ecology during operation

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
TR-W1, TR-W2, TR-W3	Low	Change in hydrology: Effect on downstream habitat (including erosion/sediment discharge) due to change in hydrology (increase or decrease) due to gradual change in hydrology from the presence of the infrastructure/stormwater, including reclamations.	Negligible	Wetland water budget (volume and timing) will be maintained through stormwater management. No increase in flood frequency post development relative to baseline.	Very Low
TR-W4	Moderate		Low	Groundwater management will convey the constant groundwater feed out of the fill embankment footprint where the spring seepage occurs for Wetland TR-W4. This control is considered sufficient to address operational changes to the hydrology of the receiving environment. However, the probability classes have conservatively been adjusted one class up	Low
TR-W5&W6	Moderate		Negligible	Wetland water budget (volume and timing) will be maintained through stormwater management. No increase in flood frequency post development relative to baseline.	Very Low
TR-W1, TR-W2, TR-W3	Low	Stormwater discharge: Permanent degradation of wetland habitat and water quality due to stormwater discharges - pollutants (such as heavy metals and herbicides).	Negligible	All stormwater from the road pavement will be directed to the kerb channels and treated through the proposed stormwater treatment dry pond.	Very Low
TR-W4, TR-W5&W6	Moderate		Negligible	All stormwater from the road pavement will be directed to the kerb channels and treated through the proposed stormwater treatment dry pond.	Very Low

7.3 Impact Management

In accordance with the EIANZ Guidelines, measures to avoid, remedy or mitigate effects is focused on ecological features where the level of effect was assessed to be **Moderate** or higher. There were no construction or operational effects (except for the unavoidable loss of wetland TR-W4) that were assessed as **Moderate** or higher. However, there are construction related effects for fauna that requires impact management as a result of the Wildlife Act 1953 requirements, and construction related effects for wetlands that requires impact management as a result of the NPS:FM requirements. This is detailed further in Section 7.3.1 to 7.3.2.

7.3.1 Terrestrial Ecology

There are no construction or operational effects for terrestrial ecology where the level of effect was assessed to be **Moderate** or higher. However, all native fauna is protected by the Wildlife Act 1953, therefore requirements of this legislation will need to be adhered to. These requirements are detailed further in Section 7.3.1.1.

7.3.1.1 Wildlife Act 1953

Long-tailed bats

As long-tailed bat presence cannot be excluded in the future, the requirements of the Wildlife Act 1953 will need to be adhered to during vegetation removal of exotic-dominated treeland (TL.3) in the Project Area. This should include the implementation of vegetation removal protocols (including pre-felling surveys).

Birds

The Project Area is likely to contain native birds. Any vegetation clearance within the bird nesting season (September to February) will need to be managed to avoid harm to native bird species and their nests e.g., programming vegetation clearance to avoid bird nesting season or else undertaking nesting bird checks.

Herpetofauna

The Project Area is likely to contain copper skink. Methods to manage effects should be detailed in a Lizard Management Plan (LMP) and should address the following (as appropriate):

- Credentials and contact details of the ecologist/herpetologist who will implement the plan.
- Timing of the implementation of the LMP.
- A description of methodology for survey, trapping and relocation of lizards rescued including but not limited to salvage protocols, translocation protocols (including method used to identify suitable relocation site(s)), nocturnal and diurnal capture protocols, supervised habitat clearance/transfer protocols, artificial cover object protocols, and opportunity relocation protocols.
- A confirmation of the translocation site. Potential sites identified include:
  - 100 Hobsonville Road - TEMP (20 metre riparian corridor of Rawiri Stream)
  - Trig Reserve (located off Ryans Road)
  - Suitable habitat within Project Area
- For the confirmed translocation site, a discussion of:
  - Provision for additional refugia, if required e.g., depositing salvaged logs, wood or debris for newly released skinks that have been rescued.

- Any protection mechanisms (if required) to ensure the relocation site is maintained (e.g.) covenants, consent notices etc.
- Any weed and pest management to ensure the relocation site is maintained as appropriated habitat.

- Monitoring methods, including but not limited to the following: baseline surveying with the site, baseline surveys outside the site to identify potential release sites for salvaged lizard populations and lizard monitoring sites, ongoing annual surveys to evaluate translocation success, pre- and post-translocation surveys, and monitoring of effectiveness of pest control and/or any potential adverse effects on lizards associated with pest control.
- A post-vegetation clearance search for remaining lizards.
- Details of lizard habitat restoration to compensation for the loss of lizard habitat (approximately 6195 m^2) within the Project Area and to address residual effects of lizard salvage. It is recommended that restoration is accommodated within the designation as part of the Landscape Restoration Plans.

In order to implement the LMP, a project specific Wildlife Authority Permit (WAP) under the Wildlife Act 1953 is required and should be held by a suitably experienced Herpetologist (to handle or translocate indigenous wildlife and/or to destroy their habitat) which is administrated by the Department of Conservation. Permits can take several months to obtain and should be programmed appropriately prior to commencing vegetation/site clearance.

7.3.2 Wetland Ecology

The wetland ecology features that require mitigation are presented in Table 7-24. Although the level of effect for the permanent loss of TR-W1 was considered **Low**, offset is required under the NES-FW due to the loss in wetland extent.

Table 7-24 Wetland ecology features requiring mitigation

Ecological Feature	Effects Description	Level of Effect, Without Impact Management	Mitigation
TR-W1	Vegetation removal/reclamation: Road embankment will result in the permanent loss of approximately 1000 m^2 (0.1 ha) of a 3,700 m^2 (0.37 ha) hydrogeomorphic unit (HGM) of natural wetland associated with TR-W1 (approximately 27% of the hydrogeomorphic unit).	Low **NES-FW requirements**	The loss of wetland habitat at TR-W1 and TR-W4 cannot be mitigated 'at the point of impact'; therefore, this effect is considered further in Section 7.3.2.1.
TR-W4	Vegetation removal/reclamation: Road embankment will result in the permanent loss of approximately 780 m^2 (0.078 ha) of a 2,800 m^2 (0.28 ha) HGM unit of natural wetland associated with TR-W4 (approximately 29% of the hydrogeomorphic unit).	**Moderate** **NES-FW requirements**	

7.3.2.1 Residual Effects

The loss of wetland habitat at TR-W1 and TR-W4 cannot be mitigated 'at the point of impact' (due to unavoidable loss of wetland); therefore, offsetting is required. The proposed location for this offset is within the downslope areas of the remaining portions of wetland habitat associated with both wetlands (TR-W1 and TR-W4). The proposed designation boundary provides sufficient room for this offset to be finalised at detailed design stage.

Based on the current design, the area of wetland enhancement/planting required has been calculated using a Biodiversity Offset Accounting Model to ensure No Net Loss in ecological value. Appendix 8 presents an Indicative Wetland Offset/Compensation Restoration Plan and outlines the results of the offset modelling to identify the amount and type of wetland enhancement required. The model shows that restoring the downslope portions of the HGMs associated with TR-W1 (2,700 m^2) and TR-W4 (1,000 m^2) will result in a No Net Loss outcome.

It is recommended that the Biodiversity Offset Accounting Model, set out in Appendix 8, be re-calculated at the time of detailed design (if design changes effects on wetlands) and form the basis of a detailed Wetland Restoration and Enhancement Plan, which shall as a minimum include a methodology for the wetland enhancement and restoration.

8 Conclusions

Terrestrial Ecology

The terrestrial vegetation within the Project site is of **Negligible** to **Low** ecological value. There are no construction or operational effects for terrestrial ecology where the level of effect was assessed to be **Moderate** or higher, however habitat is provided to native fauna including:

- Long-tailed bats (**Very High** ecological value)
- Non-TAR native birds (**Low** ecological value)
- North Island fernbird (**High** ecological value)
- Copper skink (**High** ecological value)

During vegetation removal there is the potential to kill/injure native fauna. All native fauna is protected by the Wildlife Act 1953; therefore, this effect will need to be avoided and mitigated at the start of construction.

Aquatic Ecology

All works (excluding minor stormwater outfall works) will be outside the stream riparian setback and therefore no instream works will occur. Therefore, potential effects on instream habitat due to hydrology and water quality impacts during construction and operation have been assessed for the corresponding wetland.

Wetland Ecology

Where possible the Project has minimised impacts on wetlands, however, the reclamation of the upper portions of TR-W1 and TR-W4 during construction is unavoidable. The loss of TR-W4 is considered a **Moderate** level of effect therefore impact management is required, however, the loss of TR-W1 and TR-W4 also requires impact management as a result of the NPS:FM requirements. The loss of these wetlands can be sufficiently offset through wetland habitat restoration and wetland margin planting of the lower portions of the respective wetlands within the Project designation. The proposed wetland offset areas will allow the Project to achieve No Net Loss in ecological value.

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1 Appendix 1 – Regulatory Assessment

1.1 Legislation

1.1.1 Resource Management Act 1991

The purpose of the RMA is to achieve sustainable development of natural and physical resources. Important elements of this are the maintenance of indigenous biodiversity and protection of significant indigenous vegetation and habitats. These elements are given effect in Sections 5, 6 and 7, and Schedule 4 sets out the requirements for effects assessments.

1.1.2 Wildlife Act 1953

The Wildlife Act 1953 provides statutory protection for all indigenous lizard, frog, bat and bird species, and for the control of those species listed in Schedules 1 to 6. This includes a number of invertebrates (terrestrial and freshwater) and marine animals.

1.1.3 Conservation Act 1987

The Conservation Act 1987 provides for the protection of New Zealand's natural and historic resources. This includes protection of resources within public conservation land, including marginal strips and specially protected areas. Part 5B sets out protection for indigenous freshwater fish, including spawning habitat and individuals, and requirements regarding fish translocation.

1.2 National Policy Statements

1.2.1 National Policy Statement for Freshwater Management 2020

The National Policy Statement for Freshwater Management (MfE 2020a) provides national direction for decisions regarding water quality and quantity, and integrated management of land, freshwater and coastal environments under the RMA. The National Policy Statement for Freshwater Management contains national objectives that specify what local authorities, in their governance and management roles, must do to help achieve those objectives and policies.

The NPS:FM excludes wetlands which do not meet its definition of '*natural wetlands'* as:

a) a wetland constructed by artificial means (unless it was constructed to offset impacts on, or restore, an existing or former natural wetland); or

b) a geothermal wetland; or

c) any area of improved pasture that, at the commencement date, is dominated by (that is more than 50% of) exotic pasture species and is subject to temporary rain derived water pooling.

1.3 Auckland Unitary Plan Operative in Part 2016

The AUP:OP sets out the direction and rules for land, water, air and coastal use activities and development in the region and provides measures to protect natural and physical resources.

The AUP:OP became operative in part on 15 November 2015, replacing most district and regional plans in the Auckland Region.

1.4 Additional Planning Guidance

1.4.1 New Zealand's Fish Passage Guidelines 2018

This guidance document sets out recommended practice for the design of instream infrastructure to provide for fish passage. The intent of these guidelines is to set the foundation for the improvement of fish passage management in New Zealand.

1.4.2 New Zealand Biodiversity Strategy

The New Zealand Biodiversity Strategy (DOC and MfE 2000) was prepared in response to the state of decline of New Zealand's indigenous biodiversity and establishes a strategic framework for the conservation, sustainable use and management of New Zealand's biodiversity. This includes indigenous biodiversity and 'important' introduced species.

1.4.3 Protecting our Places

Protecting our Places (DOC & MfE, 2007) forms part of a Department of Conservation (DOC) and Ministry for the Environment (MfE) programme and intends to provide a framework for decision making regarding biodiversity management on private land. It is an important document for managing biodiversity under the RMA and its key provisions have been incorporated into the Proposed National Policy Statement for Biodiversity (refer to Sections 3.1.1 and 3.2.2).

It is supported by the 'Statement of National Priorities for protecting rare and threatened indigenous biodiversity on private land' and includes the provision of identifying rare and threatened environments and ecosystems in New Zealand:

National Priority 1: To protect indigenous vegetation associated with land environments (defined by Land Environments of New Zealand at Level IV), that have 20% or less remaining in indigenous cover.

National Priority 2: To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.

National Priority 3: To protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by priorities 1 and 2.

National Priority 4: To protect habitats of acutely and chronically threatened indigenous species.

1.4.4 Auckland Conservation Management Strategy 2014 to 2024

The Auckland Conservation Management Strategy (DOC, 2014) describes the conservation values present in Auckland and provides guidance for conservation work in the Auckland region. The purpose of the Auckland Conservation Management Strategy is to implement DOC's general policies and establishes objectives and milestones for integrated management of the region's natural and historic resources. A priority of the strategy is the maintenance and enhancement of ecosystems, habitats and species vulnerable to the adverse effects of human activities.

1.4.5 Auckland Council's Indigenous Biodiversity Strategy 2012

The Council's Indigenous Biodiversity Strategy (Auckland Council, 2012) provides an approach for managing indigenous biodiversity in the region and gives guidance for the development of statutory plans, while upholding the Council's statutory obligations to biodiversity under the RMA and the Proposed National Policy Statement for Biodiversity.

It provides objectives and performance measures for:

- Conserving Auckland's indigenous ecosystems;
- The Long-term recovery of threatened species;
- The maintenance and enhancement of ecosystem services;
- Sustaining and protecting cultural values; and
- Improving understanding biodiversity, collaboration and implementation of statutory responsibilities.

2 Appendix 2 – Summary of Ecological Impact Assessment Methodology

A1. Assessment of Ecological Value

The first step in the Ecological Impact Assessment (EcIA) approach is to assess the value of ecological features identified as part of the ecological baseline in terms of Representativeness, Rarity, Diversity and Pattern, and Ecological context.

The ecological value of terrestrial, freshwater and wetland ecological features was assessed by assigning a score of 0 (None), 1 (Low), 2 (Moderate), 3 (High) or 4 (Very High) based on professional judgement (with justification) to aspects associated with each of the four ecological matters (1) Representativeness 2) Rarity/distinctiveness 3) Diversity and pattern 4) Ecological context) including:

Terrestrial Ecology

1) **Representativeness**: Typical structure, species composition and indigenous representation
2) **Rarity/distinctiveness**: Species of conservation significance, distinctive ecological values
3) **Diversity and pattern**: Habitat diversity, species diversity and patterns in habitat use
4) **Ecological context**: Size, shape and buffering function, sensitivity to change, ecological networks (linkages, pathways, migration)

Freshwater Ecology

1) **Representativeness**: RHA score for accessible sites and riparian habitat modification based on desktop stream and catchment assessments
2) **Rarity/distinctiveness**: Species of conservation significance informed by the potential occurrence of Threatened and At-Risk (TAR) fish species
3) **Diversity and pattern**: Level of natural diversity informed by the habitat diversity subsection of the RHA. Stream order, slope and hydroperiod were applied as desktop proxies to judge the likely habitat diversity for streams where access was constraint
4) **Ecological context**: Stream order and hydroperiod

Wetland Ecology

1) **Representativeness**: Informed by wetland condition assessment. Hydrological modification based on observations of drains, ponds and catchment land use. Native vegetation informed by site visit and review of landcover information;
2) **Rarity/distinctiveness**: Wetland type (rare or distinctive); distinctive ecological values (ecosystem services) in a larger catchment context;
3) **Diversity and pattern**: Representation of different hydroperiods (permanent, seasonal or temporary) and the structural complexity of vegetation cover
4) **Ecological context**: flood attenuation, streamflow regulation, sediment trapping, water purification, connectivity and migration

The score for each matter was constrained to the highest score for each aspect (for example a High score allocated to a wetland for flood attenuation will result in a High score for the Ecological context matter). The combined ecological value score (ranging from **Very High** to **Negligible**), for the four matters, was then determined in accordance with the EIANZ Guidelines.

Species

Assigning value at the terrestrial species level considers the current threat status of a species (in accordance with the NZ Threat Classification system) that is present in areas potentially impacted by the Project. The ecological value of the species is assigned in accordance with the table below.

Table 9-1 Attributes to consider when assessing ecological value of terrestrial species

Threat Class	Threat Sub-class	Value
Exotic: Introduced and Naturalised	-	Negligible
Indigenous: Common/not threatened	-	Low
Indigenous: Locally uncommon or distinctive species	-	Moderate
Indigenous: At Risk	Naturally uncommon Relict Recovering	Moderate
	Declining	High
Indigenous: Threatened	Nationally Critical Nationally Endangered Nationally Vulnerable	Very High

A2. Assessment of ecological effects

The ecological effects assessment includes several steps that collectively assess the way the Project will interact with elements of the physical and biological, environment to produce effects to habitat and receptors. The method for determining the level of effect are outlined in the following sections.

Magnitude of effect

The magnitude of effects from a Project is firstly determined by the characteristics in the following table.

Table 9-2 Magnitude of effect characteristics

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect)	Direct
		Indirect
Extent[13]	The “reach” of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.)	Local
		Regional
		National
Duration	The time period over which a resource/receptor is affected	Temporary (days or months)
		Short-term (<5 years)
		Long-term (15-25 years)

[13] Extent for streams and wetlands differs. The extent is as follows: score of 1 = <10% of reach length, 2 = 10-20% of stream length, 3 = 20-40% of stream length, 4 = 40-70% of stream length, 5 = >70% of stream length. Downstream flow/water quality effects are as follows: (a score of 1 is not appropriate in this context), score of 2 = stream reach 100-500 m, 3 = stream reach 500 m – 1 km, 4 = stream reach 1 – 10 km, 5 = stream reach >10 km.

Characteristic	Definition	Designations
		Permanent (>25 years)
Frequency	A measure of the constancy or periodicity the receptor will be affected	Infrequently
		Periodically
		Frequently
		Continuously
Likelihood	The probability of an effect occurring if it is unplanned	Highly Unlikely
		Unlikely
		Likely
		Highly Likely
		Definite
Reversibility	The degree to which the ecological effect can be reversed in a reasonable time scale through natural processes or mitigation	Totally
		Partially
		Irreversible
		Not applicable

Based on the above-mentioned characteristics, a magnitude is assigned for each Project effect and are defined in the table below

Table 9-3 Magnitude of effect – levels

Magnitude	Description
Very High	Total loss of, or very major alteration to, key elements/features of the existing baseline conditions, such that the post-development character, composition and or attributes will be fundamentally changes and may be lost from the site altogether; and/or loss of very high proportion of the known population or range of the elements/features
High	Major loss or major alteration to key elements/features of the existing baseline such that the post-development character, composition and/or attributes will be fundamentally changed; and/or loss of a high proportion of the known population or range of the element/feature
Moderate	Loss or alteration to one or more key elements/features of the existing baseline such that the post-development character, composition and/or attributes will be partially changed; and/or loss of a moderate proportion of the known population or range of the element/feature
Low	Minor shift away from the existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline conditions will be similar or pre-development circumstances or patterns; and or having a minor effect on the known population or range of the element/feature

Magnitude	Description
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; and/or having negligible effect on the known population or range of the element/feature

Level of effect

Once the magnitude of effect and the ecological value of the feature have been determined, the level of effect on that feature, can be assigned for each effect, using the matrix shown in the table below

Table 9-4 Ecological effect matrix

		Ecological Values				
		Very High	High	Moderate	Low	Negligible
Magnitude	Very High	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Negligible	Negligible	Negligible	Negligible	Negligible

A3. Impact Management

Results from the matrix were used to determine the type of responses that may be required to mitigate potential direct and indirect impacts within the Project Area and within the zone of influence, considering the following:

- A '**Low**' or '**Very Low**' level of impact is not normally of concern, though design should take measures to minimise potential effects.
- A '**Moderate**' to '**High**' level of impact indicates a level of impact that qualifies careful assessment on a case-by-case basis. Such activities could be managed through avoidance (revised design) or appropriate mitigation. Where avoidance is not possible, No Net Loss of biodiversity values would be appropriate.
- A '**Very High**' level of impact is are unlikely to be acceptable on ecological grounds alone and should be avoided. Where avoidance is not possible, a net gain in biodiversity values would be appropriate.

Residual impact

Once impact management measures are declared, the next step in the effects assessment process was to assign determine whether any residual effects remain and to implement further mitigation, offset or compensation measures to reduce the effect. This is a repeat of the impact assessment steps discussed above (until an acceptable level of effect remains – usually **Low/Very low/Negligible**), considering the implementation of the additional recommended impact management measures.

Managing uncertainty

Biophysical impacts are difficult to predict with certainty, but uncertainty stemming from on-going development of the Project design and implementation is inevitable, and the environment is variable over time. If uncertainties are relevant to the effect assessment, they were stated and approached conservatively, to identify a range of likely residual effects and relevant mitigation measures.

Cumulative effects

Cumulative impacts and effects are those that arise because of an impact and effect from the Project interacting with those from another activity to create an additional impact and effect. These are termed cumulative impacts and effects. No structed methods were employed to assess cumulative impacts, but where relevant descriptions of potential cumulative effects have been provided.

3 Appendix 3 – Aquatic and Wetland Methodologies

3.1 Storey & Wadha (2009) Stream Classification Methodology

During the site walkovers detailed in Section 7.1.4.2, all streams within the Project Areas identified on Auckland Council Geomaps were ground truthed and classified as permanent, intermittent or ephemeral, according to the stream definitions described by Storey and Wadhwa (2009), which are presented in Table 9-5. Any additional streams observed during site walkovers were also classified and where appropriate artificial swales, ditches and piped flow paths were also recorded.

Table 9-5 Stream classification criteria (Storey and Wadhwa, 2009)

Criteria	Definition
Permanent stream	
1	Evidence of continuous flow
Intermittent or ephemeral stream*	
1	Evidence of natural pools
2	Well defined banks and bed
3	Retains surface water present more than 48 hours after a rain event
4	Rooted terrestrial vegetation not established across channel
5	Organic debris from flooding present on floodplain
6	Evidence of substrate sorting, including scour and deposition
*If three or more of the six assessment criteria can be met with confidence, the watercourse is considered intermittent. If at least three criteria cannot be met, the watercourse is considered ephemeral.	
Ephemeral	
Stream reach with a bed above the water table at all times. Concentrated flow for short periods of time during and/or after rainfall. Not confined within a defined channel.	

3.2 Rapid Habitat Assessment

Freshwater assessments were undertaken on all streams identified on site and included the implementation of the Rapid Habitat Assessment (RHA) protocol either onsite or at a desktop level (Clapcott, 2015) (Figure 9-1). The RHA provides a standardised protocol for making a quick, qualitative, site-based assessment of physical stream habitat conditions.

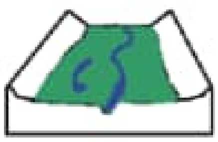
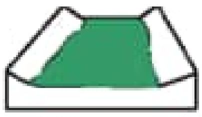
Habitat parameter	Condition category										SCORE
1. Deposited sediment	*The percentage of the stream bed covered by fine sediment.*										
	0	*5*	*10*	*15*	*20*	*30*	*40*	*50*	*60*	*≥ 75*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
2. Invertebrate habitat diversity	*The number of different substrate types such as boulders, cobbles, gravel, sand, wood, leaves, root mats, macrophytes, periphyton. Presence of interstitial space score higher.*										
	≥ 5	*5*	*5*	*4*	*4*	*3*	*3*	*2*	*2*	*1*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
3. Invertebrate habitat abundance	*The percentage of substrate favourable for EPT colonisation, for example flowing water over gravel-cobbles clear of filamentous algae/macrophytes.*										
	95	*75*	*70*	*60*	*50*	*40*	*30*	*25*	*15*	*5*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
4. Fish cover diversity	*The number of different substrate types such as woody debris, root mats, undercut banks, overhanging/encroaching vegetation, macrophytes, boulders, cobbles. Presence of substrates providing spatial complexity score higher.*										
	≥ 5	*5*	*5*	*4*	*4*	*3*	*3*	*2*	*2*	*1*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
5. Fish cover abundance	*The percentage of fish cover available.*										
	95	*75*	*60*	*50*	*40*	*30*	*20*	*10*	*5*	*0*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
6. Hydraulic heterogeneity	*The number of of hydraulic components such as pool, riffle, fast run, slow run, rapid, cascade/waterfall, turbulance, backwater. Presence of deep pools score higher.*										
	≥ 5	*5*	*4*	*4*	*3*	*3*	*2*	*2*	*2*	*1*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
7. Bank erosion	*The percentage of the stream bank recently/actively eroding due to scouring at the water line, slumping of the bank or stock pugging.*										
Left bank	*0*	*≤ 5*	*5*	*15*	*25*	*35*	*50*	*65*	*75*	*> 75*	
Right bank	*0*	*≤ 5*	*5*	*15*	*25*	*35*	*50*	*65*	*75*	*> 75*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
8. Bank vegetation	*The maturity, diversity and naturalness of bank vegetation.*										
Left bank AND Right bank	*Mature native trees with diverse and intact understorey*		*Regenerating native or flaxes/sedges/tussock > dense exotic*			*Mature shrubs, sparse tree cover > young exotic, long grass*			*Heavily grazed or mown grass > bare/impervious ground*		
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
9. Riparian width	*The width (m) of the riparian buffer constrained by vegetation, fence or other structure(s).*										
Left bank	*≥ 30*	*15*	*10*	*7*	*5*	*4*	*3*	*2*	*1*	*0*	
Right bank	*≥ 30*	*15*	*10*	*7*	*5*	*4*	*3*	*2*	*1*	*0*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
10. Riparian shade	*The percentage of shading of the stream bed throughout the day due to vegetation, banks or other structure(s).*										
	≥ 90	*80*	*70*	*60*	*50*	*40*	*25*	*15*	*10*	*≤ 5*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
TOTAL	(Sum of parameters 1-10)										

Figure 9-1 Rapid Habitat Assessment (RHA) protocol (Clapcott, 2015)

3.3 Wetland Assessment Methodology

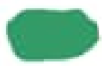
3.3.1 Hydrogeomorphic Unit

Conceptual model for different HGM units as applied within this assessment (Figure 9-2).

Hydrogeomorphic types		Description	Source of water maintaining the wetland[1]	
			Surface	Sub-surface
Floodplain		Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel		Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/ ***
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans)		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source: * Contribution usually small

*** Contribution usually large  Wetland

*/ *** Contribution may be small or important depending on the local circumstances

*/ *** Contribution may be small or important depending on the local circumstances.

Figure 9-2 The HGM classification according Brinson (1993) and adopted from Kotze et al. (2007)

3.3.2 Wetland Functional Value

The matrix outlining the likely presence of specific wetland functions associated with different wetland types is presented in Table 9-6.

Table 9-6 Likely presence of different functional wetland values associated with different HGM units (wetland types)

	Early wet season Flood attenuation	Late wet season Flood attenuation	Stream flow regulation	Erosion control	Sediment trapping	Phosphate removal	Nitrate removal	Toxicants
Depression	Likely	Likely	Unlikely	Unlikely	Unlikely	Unlikely	Likely	Likely
Hillslope seep (isolated)	Likely	Unlikely	Unlikely	Very likely	Unlikely	Unlikely	Very likely	Likely
Hillslope seep (connected)	Likely	Unlikely	Likely	Very likely	Unlikely	Unlikely	Very likely	Very likely
Unchanneled valley bottom	Likely	Likely	Unlikely	Very likely	Very likely	Likely	Likely	Very likely
Channelled valley bottom	Likely	Unlikely	Likely	Very likely	Likely	Likely	Likely	Likely
Floodplain	Very likely	Likely	Unlikely	Very likely	Very likely	Very likely	Likely	Likely

3.3.3 Wetland Condition

Based on Clarkson et al. (2004) handbook for monitoring wetland condition, to assess a range of external pressures which can lead to a decline in the health or condition of the wetland. For example, changes in hydrology, water pollution, nutrient enrichment, and invasion by weeds and pests can lead to biodiversity loss and impaired wetland functioning (Table 9-7). The wetland condition score was interpreted through wetland condition categories proposed by Kleynhans (2007) (Table 9-7). These conditions where used to value the functional integrity of the wetland habitat and therefore provide a way to value the system with regards to the EIANZ Guidelines.

Table 9-7 Summary of aspects and components considered within the wetland condition assessment (Clarkson et al., 2004). The degree of modification was assessed using the following scoring: 5=very low/none, 4=low, 3=medium, 2=high, 1=very high and 0=extreme

Impact indicator	Indicator components
Hydrological integrity	Impact of manmade structures
	Water table depth
	Dryland plant invasion
Physico-chemical parameters	Fire damage
	Degree of sedimentation
	Nutrient levels
	Von Post index
Change in ecosystem intactness	Loss in area of original wetland
	Connectivity barriers
Change in browsing, predation and harvesting regimes	Damage by domestic or feral animals
	Introduces predator impacts on wildlife
	Harvesting levels
Change in dominance of native plants	Introduced plant canopy cover
	Introduced plant understory cover
Total wetland condition index/25	

Table 9-8 Key wetland pressures assessed within the catchment of the wetland (Clarkson et al., 2004). Pressure scores were assigned as follows:5=very high, 4= high, 3=medium, 2=low, 1=very low, 0=none

Pressure
Modification to catchment hydrology
Water quality within the catchment
Animal access
Key undesirable species

Pressure
% catchment introduced vegetation
Other
Total catchment pressure index/30

Table 9-9 Wetland condition categories and associated descriptions used within this assessment

Category Wetland Condition	Description	%
Unmodified	Unmodified/ natural	100%
Largely natural	Largely natural with a few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota have taken place	80-100%
Moderately	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	60-80%
Largely	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred	40-60%
Seriously	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable	20-40%
Critically	Critically modified. Modifications have rich a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota	<20%

4 Appendix 4 – Aquatic, Wetland and Terrestrial Ecology Results

4.1 Aquatic Ecology Results

4.1.1 Stream Hydroperiod Classification

Table 9-10 Stream classification results, based on Storey and Wadhwa (2009)

Stream	Stream classification	Criteria met based on Storey and Wadhwa (2009) – refer Appendix 3, Section 3.1
TR-S1	Intermittent	Evidence of natural pools, defined banks and bed, rooted vegetation not established across channel. Riverbed seasonally intercepting the saturated soil zone
TR-S2	Intermittent	Evidence of natural pools, defined banks and bed, rooted vegetation not established across channel. Riverbed seasonally intercepting the saturated soil zone
TR-S3	Intermittent	Evidence of natural pools, defined banks and bed, rooted vegetation not established across channel. Riverbed seasonally intercepting the saturated soil zone
W5-S2*	Intermittent	Evidence of natural pools, well defined banks and bed, rooted vegetation not established across channel.

Notes: * = Desktop assessment.

4.1.2 Rapid Habitat Assessment

Table 9-11 Summary of RHA values

Stream ID	Deposited Sediment	Invertebrate habitat diversity	Invertebrate habitat abundance	Fish cover diversity	Fish cover abundance	Hydraulic heterogeneity	Bank erosion	Bank vegetation	Riparian width	Riparian shade	RHA Habitat Quality Score	Corresponding Habitat Value*
TR-S1	1	1	1	1	1	1	9	1	1	1	**18**	**Poor**
TR-S1	1	1	1	1	1	1	7	1	1	1	**16**	**Poor**
TR-S1	1	1	1	1	1	1	9	1	1	1	**18**	**Poor**
W5-S2	1	1	1	1	1	1	9	1	1	1	**18**	**Poor**

Notes:

* = Corresponding habitat values for each habitat quality score

P = Poor (Score 10-40)

M = Moderate (Score 41-60)

G = Good (Score 61-80)

E = Excellent (Score 81+)

4.1.3 Aquatic Ecology - Value Assessment

Table 9-12 Ecological value assessment for aquatic ecological features

Attributes	Ecological Feature				Justification
	TR-S1	TR-S2	TR-S3	W5-S2*	
Representativeness (including SEV, RHA and ecological integrity)	**1**	**1**	**1**	**1**	**-**
Instream habitat modification	1	1	1	-	Poor RHA scores for all streams.
Riparian habitat modification	1	1	1	1	Poor RHA scores for all streams.
Invertebrate assemblage representation	-	-	-	-	-
Fish assemblage representation	1	1	1	-	Habitat is largely unsuitable or inaccessible for potential assemblage.
SEV scores relative to potential score	-	-	-	-	-
RHA score relative to potential score	-	-	-	-	-
Rarity/distinctiveness	**3**	**3**	**3**	**1**	**-**
Range restricted or endemic species	-	-	-	-	-
Species of conservation significance	3	3	3	1	Desktop review: Potential for longfin eel (At Risk - Declining).
Stream type (rare or distinctive)	1	1	1	-	-
Distinctive ecological values (ecosystem services)	-	-	-	-	-
Diversity and pattern	**0**	**0**	**0**	**1**	**-**
Level of natural diversity	-	-	-	1	-
Species diversity	-	-	-	-	-
Complexity of community	-	-	-	-	-

Attributes	Ecological Feature				Justification
	TR-S1	TR-S2	TR-S3	W5-S2*	
Ecological context (Ecosystem services, importance and sensitivity)	**3**	**3**	**3**	**3**	**-**
Stream order	1	2	2	1	TR-S1: Zero order TR-S2: Order 1 TR-S3: Zero order
Hydroperiod	3	3	3	3	TR-S1: Intermittent stream TR-S2: Intermittent stream TR-S3: Intermittent stream
Sensitivity to flow and water quality modification	1	1	1	-	Habitat already significantly altered by human activities, therefore less easily affected by anthropogenic changes.
Connectivity and migration	-	-	-	-	Habitat is not important in terms of connectivity for the survival of any species at any scale.
Protected status	-	-	-	-	Streams do not fall within any category of protected status.
Ecological Value	**Low**	**Low**	**Low**	**Low**	**-**

Notes: * = Ecological value assessment as per draft Assessment of Ecological Effects for North West – Whenuapai (Supporting Growth, 2022b).

4.2 Wetland Ecology Results

4.2.1 Wetland Vegetation Plots

A site plan showing the location of the wetland vegetation plots is presented in Figure 9-3 and further detail is provided in Table 9-13.

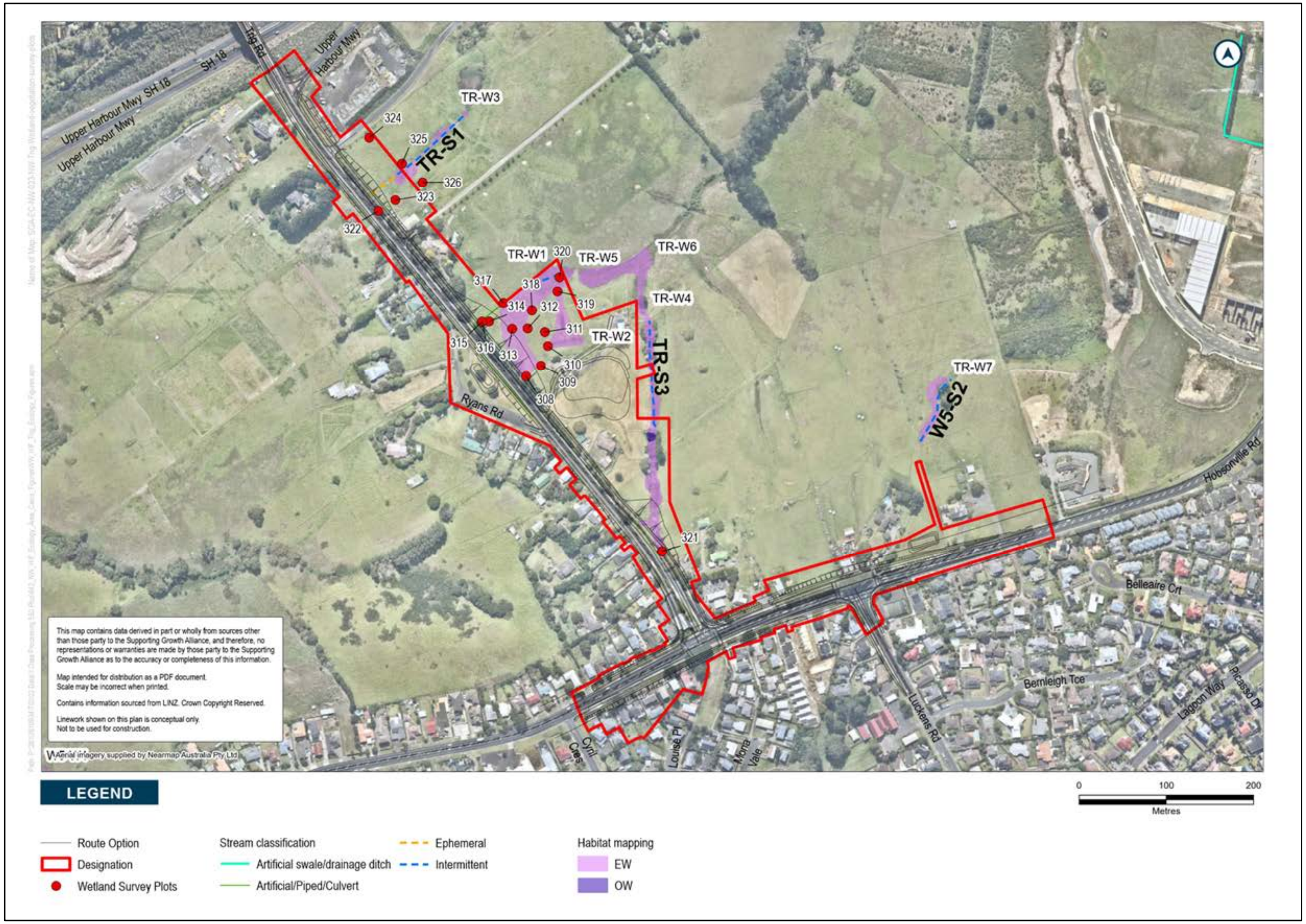


Figure 9-3 Trig Road wetland vegetation survey plots

Table 9-13 Wetland vegetation plots, dominance test (Dom T) and Prevalence Index (PI)

Plot ID	Index	Common Name	Scientific Name	Cover (%)*	Rating	Exotic/Native	Pasture Dom (>50%) T	Wetland Dom T	PI
Plot 308	**45**	Kikuyu grass	*Cenchrus clandestinus*	20	FACU	Exotic	No	Yes	Yes (3.0)
	54	Creeping buttercup	*Ranunculus repens*	70	FAC	Exotic			
	28	Soft rush	*Juncus effusus*	20	FACW	Exotic			
Plot 309	**43**	Mercer grass	*Paspalum distichum*	40	FACW	Exotic	No	Yes	Yes (2.8)
	54	Creeping buttercup	*Ranunculus repens*	40	FAC	Exotic			
	45	Kikuyu grass	*Cenchrus clandestinus*	20	FACU	Exotic			
Plot 310	**43**	Mercer grass	*Paspalum distichum*	25	FACW	Exotic	No	Yes	Yes (2.5)
	54	Creeping buttercup	*Ranunculus repens*	50	FAC	Exotic			
	28	Soft rush	*Juncus effusus*	25	FACW	Exotic			
Plot 311	**43**	Mercer grass	*Paspalum distichum*	40	FACW	Exotic	Yes	No	No (3.3)
	45	Kikuyu grass	*Cenchrus clandestinus*	80	FACU	Exotic			
	54	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic			
	67	White clover	*Trifolium repens*	10	FACU	Exotic			
Plot 312	**43**	Mercer grass	*Paspalum distichum*	50	FACW	Exotic	No	Yes	Yes (2.3)
	54	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic			
Plot 313	**45**	Kikuyu grass	*Cenchrus clandestinus*	90	FACU	Exotic	Yes	No	No (3.7)
	54	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic			
	43	Mercer grass	*Paspalum distichum*	10	FACW	Exotic			
Plot 315	**45**	Kikuyu grass	*Cenchrus clandestinus*	70	FACU	Exotic	Yes	No	No (3.5)

Plot ID	Index	Common Name	Scientific Name	Cover (%)*	Rating	Exotic/Native	Pasture Dom (>50%) T	Wetland Dom T	PI
	54	Creeping buttercup	*Ranunculus repens*	40	FAC	Exotic			
	28	Soft rush	*Juncus effusus*	10	FACW	Exotic			
Plot 316	**45**	Kikuyu grass	*Cenchrus clandestinus*	100	FACU	Exotic	Yes	No	No (3.8)
	54	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic			
Plot 317	**54**	Creeping buttercup	*Ranunculus repens*	100	FAC	Exotic	No	Yes	No (3.2)
	45	Kikuyu grass	*Cenchrus clandestinus*	30	FACU	Exotic			
Plot 318	**43**	Mercer grass	*Paspalum distichum*	50	FACW	Exotic	No	Yes	Yes (2.9)
	45	Kikuyu grass	*Cenchrus clandestinus*	30	FACU	Exotic			
	54	Creeping buttercup	*Ranunculus repens*	30	FAC	Exotic			
	67	White clover	*Trifolium repens*	10	FACU	Exotic			
Plot 319	**43**	Mercer grass	*Paspalum distichum*	50	FACW	Exotic	No	Yes	Yes (2.9)
	45	Kikuyu grass	*Cenchrus clandestinus*	40	FACU	Exotic			
	54	Creeping buttercup	*Ranunculus repens*	30	FAC	Exotic			
Plot 320	**28**	Soft rush	*Juncus effusus*	70	FACW	Exotic	No	Yes	Yes (2.3)
	54	Creeping buttercup	*Ranunculus repens*	30	FAC	Exotic			
	43	Mercer grass	*Paspalum distichum*	10	FACW	Exotic			
Plot 321	**28**	Soft rush	*Juncus effusus*	80	FACW	Exotic	No	No	Yes (2.4)
	45	Kikuyu grass	*Cenchrus clandestinus*	20	FACU	Exotic			
Plot 322	No property access. Review of previous field assessment and roadside observation, determined as wetland.								
Plot 323	**45**	Kikuyu grass	*Cenchrus clandestinus*	100	FACU	Exotic	Yes	No	Yes (3.8)

Plot ID	Index	Common Name	Scientific Name	Cover (%)*	Rating	Exotic/Native	Pasture Dom (>50%) T	Wetland Dom T	PI
	54	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic			
Plot 324	**45**	Kikuyu grass	*Cenchrus clandestinus*	95	FACU	Exotic	Yes	No	No (3.9)
	54	Creeping buttercup	*Ranunculus repens*	10	FAC	Exotic			
Plot 325	**45**	Kikuyu grass	*Cenchrus clandestinus*	40	FACU	Exotic	No	No	Yes (3.0)
	43	Mercer grass	*Paspalum distichum*	30	FACW	Exotic			
	67	White clover	*Trifolium repens*	5	FACU	Exotic			
Plot 326	**45**	Kikuyu grass	*Cenchrus clandestinus*	100	FACU	Exotic	Yes	No	No (4.0)

Notes: * - Absolute % cover for each species is estimated as the vertical projection (natural spread) of the above ground live biomass for each species irrespective of the position of other vegetation. Individual species cover cannot be more than 100% but total vegetation cover can >100%.

Plate 1 – Wetland TR-W1: General area of TR-W1.

Plate 2 – Wetland TR-W1: Plot 312 dominated by *Paspalum distichum* (FACW). *Ranunculus repens* (FAC) also present.

Plate 3 – Wetland TR-W3: General area of TR-W3.

Plate 4 – Wetland TR-W3: Plot 323 dominated by *Paspalum distichum* (FACW). *Ranunculus repens* (FAC) also present.

Plate 5 – Wetland TR-W4: General area of TR-W4.

Plate 5 – Wetland TR-W4: General area of TR-W4.

Figure 9-4 Wetland delineation observations

4.2.2 Wetland Condition Assessment

The condition of wetlands TR-W1 to TR-W7 were assessed using Clarkson et al., 2004 and the results of the assessment are provided in Table 9-14. A value of 1 corresponds to a very high degree of modification and a value of 5 corresponds to a very low degree of modification.

The overall condition scores ranged between 7/25 and 11/25 which translate to a **Largely Modified** state (a large change in ecosystem processes and loss of natural habitat and biota has occurred) or **Seriously Modified** state (the change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable).

Table 9-14 Wetland condition scores for impact indicators and indicator components for TR-W1 to TR-W7

Impact Indicator	Indicator Components	TR-W1 Impact Score	TR-W2 Impact Score	TR-W3 Impact Score	TR-W4 Impact Score	TR-W5&6 Impact Score	TR-W7 Impact Score
Hydrological integrity	Impact of manmade structures	4	3	2	4	4	4
	Water table depth	-	-	-	-	-	-
	Dryland plant invasion	-	-	-	-	-	-
Mean Score		**4.0**	**3.0**	**2.0**	**4.0**	**4.0**	**4.0**
Physico-chemical parameters	Fire damage	-	-	-	-	-	-
	Degree of sedimentation	-	-	-	-	-	-
	Nutrient levels	2	1	1	2	1	1
	Von Post index	-	-	-	-	-	-
Mean score		**2.0**	**1.0**	**1.0**	**2.0**	**1.0**	**1.0**
Change in ecosystem intactness	Loss in area of original wetland	3	3	2	3	3	3
	Connectivity barriers	-	-	-	-	-	-
Mean score		**3.0**	**3.0**	**2.0**	**3.0**	**3.0**	**3.0**
Change in browsing, predation and harvesting regimes	Damage by domestic or feral animals	1	1	1	1	1	1
	Introduces predator impacts on wildlife	-	-	-	-	-	-
	Harvesting levels	-	-	-	-	-	-
Mean score		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**

Impact Indicator	Indicator Components	TR-W1 Impact Score	TR-W2 Impact Score	TR-W3 Impact Score	TR-W4 Impact Score	TR-W5&6 Impact Score	TR-W7 Impact Score
Change in dominance of native plants	Introduced plant canopy cover	1	1	1	1	1	1
	Introduced plant understory cover	-	-	-	-	-	-
Mean score		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
Average condition score		**11.0**	**9.0**	**7.0**	**11.0**	**10.0**	**10.0**
Average condition %		**44.00%**	**36.00%**	**28.00%**	**44.00%**	**40.00%**	**40.00%**
Condition index category		**Largely**	**Seriously**	**Seriously**	**Largely**	**Largely**	**Largely**

Notes: 1 = Very high degree of modification to 5 = Very low degree of modification.

The catchment pressure assessment resulted in total overall catchment pressure scores of 18/25 (Table 9-15). This score reflects a High degree of catchment modification. A score of 0 corresponds to no catchment modification, and a score of 5 corresponds to a very high degree of catchment modification.

Table 9-15 Catchment impact score for TR-W1 to TR-W7

Catchment Pressure	TR-W1 Impact Score	TR-W2 Impact Score	TR-W3 Impact Score	TR-W4 Impact Score	TR-W5&W6 Impact Score	TR-W7 Impact Score
Modification to catchment hydrology	2	2	2	2	2	2
Water quality within the catchment	4	4	4	4	4	4
Animal access	5	5	5	5	5	5
Key undesirable species	2	2	2	2	2	2
% catchment introduced vegetation	5	5	5	5	5	5
Total catchment pressure index/25	**18.0**	**18.0**	**18.0**	**18.0**	**18.0**	**18.0**
Total catchment pressure (%)	**28.00%**	**28.00%**	**28.00%**	**28.00%**	**28.00%**	**28.00%**

Catchment Pressure	TR-W1 Impact Score	TR-W2 Impact Score	TR-W3 Impact Score	TR-W4 Impact Score	TR-W5&W6 Impact Score	TR-W7 Impact Score
Degree of modification	**High**	**High**	**High**	**High**	**High**	**High**

Notes: 0 = No catchment modification to 5 = Very high degree of catchment modification

4.2.3 Wetland Function Assessment

Likely functional values were assigned based on wetland type. TR-W1, TRW2, TR-W4, and TR-W7 represents a hillslope seep wetland connected to the stream network. Likely functional values associated with connected hillslope seep systems are provided in Table 9-16.

TR-W3 and TR-W5/W6 mostly represent channelled valley bottom wetlands. Likely functional values associated with channelled valley bottom systems are provided in Table 9-17. Given the catchment pressures outlined in Table 9-15, all wetlands can provide these functional services, albeit with an impaired capacity due to the degree of modification. The residual functional value for each wetland informed the ecological context score under "Matter 4" of the EIANZ Guidelines. This was achieved through relating the probability score outlined in Table 9-16 to a value score under Matter 4 (Table 9-18), while considering the wetlands size and slope in relation to its catchment.

Table 9-16 The likelihood of different functional wetland values generically associated with Hillslope seep wetlands connected to the stream network (Kotze et al., 2007)

Hydrological/Functional Importance			Description	Probability
Regulating & supporting benefits		**Flood attenuation**	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream	Likely
		Streamflow regulation	Sustaining streamflow during low flow periods	Likely
	Water Quality Enhancement	**Sediment trapping**	The trapping and retention in the wetland of sediment carried by runoff waters	Unlikely
		Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality	Unlikely
		Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality	Very likely
		Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality	Very likely
		Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.	Very likely
		Carbon storage	The trapping of carbon by the wetland, principally as soil organic matter	
			TOTAL OVERALL SCORE AND CONFIDENCE:	

Table 9-17 The likelihood of different functional wetland values generically associated with channelled valley bottom wetlands (Kotze et al., 2007)

Hydrological/Functional Importance			Description	Probability
Regulating & supporting benefits		**Flood attenuation**	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream	Likely
		Streamflow regulation	Sustaining streamflow during low flow periods	Likely
	Water Quality Enhancement	**Sediment trapping**	The trapping and retention in the wetland of sediment carried by runoff waters	Likely
		Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality	Likely
		Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality	Likely
		Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality	Likely
		Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.	Very likely
	Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter	
			TOTAL OVERALL SCORE AND CONFIDENCE:	

4.2.4 Wetland Ecology - Value Assessment

Table 9-18 Ecological value assessment for wetland ecological features

Attributes	Ecological Feature						Justification
	TR-W1	TR-W2	TR-W3	TR-W4	TR-W5 & TR-W6	TR-W7	
Representativeness (Wetland condition assessment)	**2**	**2**	**2**	**2**	**2**	**2**	**-**
Hydrological modification	-	-	-	-	-	-	-
Physico-chemical modification	-	-	-	-	-	-	-
Sediment and geomorphological modification	-	-	-	-	-	-	-
Biota	-	-	-	-	-	-	-
Wetland Condition Index Score	2	2	2	2	2	2	Wetland condition assessment consistent with large digression from benchmark for all wetlands. Hydrological integrity and wetland extent is generally retained, but wetland condition mainly affected by changes in water quality, browsing pressure and dominance of exotic species.
Rarity/distinctiveness	**1**	**1**	**1**	**3**	**2**	**1**	**-**
Species of conservation significance	-	-	-	-	-	-	-
Range restricted or endemic species	-	-	-	-	-	-	-
Wetland type (rare or distinctive)	1	1	1	3	2	1	All wetland types (except for TR-W4) common at any scale. TR-W4 likely spring fed.
Distinctive ecological values (ecosystem services) larger context	-	-	-	-	-	-	-
Diversity and pattern	**2**	**2**	**1**	**3**	**2**	**2**	**-**
Diversity of habitat types	2	2	1	3	2	2	Wetlands are > 500 m^2 in size, permanent, temporary, seasonal areas of saturation present for TR-W1, W2 and

Attributes	Ecological Feature						Justification
	TR-W1	TR-W2	TR-W3	TR-W4	TR-W5 & TR-W6	TR-W7	
							W4, W5 and W6. TR-W3 mainly seasonally saturated, while the relatively large proportion of W4 is represented by permanent saturation
Species diversity	1	1	1	1	1	1	Species diversity is not significant at any scale (exotic wetland).
Ecological context (ecosystem services, importance, and sensitivity)	**3**	**3**	**3**	**3**	**3**	**2**	**-**
Sensitivity to change in floods	-	-	-	-	-	-	-
Sensitivity to change in baseflows (low flows)	-	-	-	-	-	-	-
Sensitivity to change in water quality	1	1	1	1	1	1	No sensitivity to change in water quality.
Flood attenuation	2	2	2	3	3	1	Frequency with which stormflows are spread across the wetlands are estimated to be >1 per year and therefore frequently plays a role in flood attenuation. Variation in scores reflect differences in the ratio between catchment size and wetland size as well as wetland slopes.
Streamflow regulation	2	2	1	3	3	2	TR-W1 and W2: Permanent & seasonal zones both present but collectively <30%. TR-W4, W5 and W6: Seasonal & permanent zone both present & collectively 30-60% of wetland (likely spring fed). TR-W3: Seasonal zone present but permanent zone absent.
Sediment trapping	3	3	2	1	3	1	All wetlands in the study area are associated with sediment yielding landuse. Differences in scores relate to wetland slope (TR-W4 approximately 9%) and more affectively drained wetlands (TR-W3).
Phosphate assimilation	-	-	-	-	-	-	-
Nitrate assimilation	3	3	3	3	3	2	Majority of local catchment associated with nutrient producing landuse. All the wetlands within the study area

Attributes	Ecological Feature						Justification
	TR-W1	TR-W2	TR-W3	TR-W4	TR-W5 & TR-W6	TR-W7	
							have the capacity to perform nutrient treatment functions. TR-W7 drains the larges catchment relative to the wetlands size.
Toxicant assimilation	-	-	-	-	-	-	-
Erosion control	-	-	-	-	-	-	-
Carbon storage	-	-	-	-	-	-	-
Connectivity and migration	-	-	-	-	-	-	-
Protected status of the wetland	-	-	-	-	-	-	-
Ecological Value	**Low**	**Low**	**Low**	**Moderate**	**Moderate**	**Low**	

4.2.5 Wetland Ecology - Magnitude of Effect and Level of Effect Assessment

Table 9-19 Wetland ecology – magnitude of effect and level of effect assessment in terms of the EIANZ Guidelines

Phase	Wetland	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
Construction	TR-W1	Permanent loss/modification of habitat/ecosystem due to reclamation/culverting/other structures (e.g., bank armouring)	Direct	3	Permanent (>25 years)	-	Definite	-	High	Low
	TR-W4		Direct	3	Permanent (>25 years)	-	Definite	-	High	**Moderate**
	TR-W1	Detrimental effects on habitats including plant composition and fauna due to diversion, abstraction or bunding of watercourses and water level/ flow/ periodicity changes.	Direct	4	Temporary (days or months)	-	Highly Likely	-	Moderate	Low
	TR-W2		Direct	4	Temporary (days or months)	-	Highly Likely	-	Moderate	Low
	TR-W3		Direct	4	Temporary (days or months)	-	Likely	-	Low	Very Low
	TR-W4		Direct	4	Temporary (days or months)	-	Highly Likely	-	Low	Low
	TR-W5&W6		Direct	4	Temporary (days or months)	-	Likely	-	Low	Low

Phase	Wetland	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
	TR-W7		Direct	1	Temporary (days or months)	-	Unlikely	-	Negligible	Very Low
	TR-W1	Uncontrolled discharge leading to habitat and water quality degradation due earthworks (leading to sediment discharge), machinery use and chemical storage (leading to leaks/spills).	Direct	4	Temporary (days or months)	Frequently	Likely	-	Low	Very Low
	TR-W2		Direct	4	Temporary (days or months)	Frequently	Likely	-	Low	Very Low
	TR-W3		Direct	4	Temporary (days or months)	Frequently	Likely	-	Low	Very Low
	TR-W4		Direct	4	Temporary (days or months)	Frequently	Likely	-	Low	Low
	TR-W5&W6		Direct	4	Temporary (days or months)	Frequently	Likely	-	Low	Low
	TR-W7		Direct	1	Temporary (days or months)	-	Unlikely	-	Negligible	Very Low
Operation	TR-W1	Effect on downstream habitat (including erosion/sediment	Direct	3	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low

Phase	Wetland	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
	TR-W2	discharge) due to change in hydrology (increase or decrease) due to gradual change in hydrology from the presence of the infrastructure/stormwater, including reclamations.	Direct	3	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low
	TR-W3		Direct	3	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low
	TR-W4		Direct	3	Permanent (>25 years)	-	Likely	-	Low	Low
	TR-W5&W6		Direct	3	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TR-W1	Permanent degradation of wetland habitat and water quality due to stormwater discharges - pollutants (such as heavy metals and herbicides)	Direct	2	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TR-W2		Direct	2	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TR-W3		Direct	2	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TR-W4		Direct	2	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TR-W5&W6		Direct	2	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low

4.3 Terrestrial Ecology Results

4.3.1 ABM Weather Data

Table 9-20 Ecological value assessment for terrestrial ecological features (flora)

Date	Maximum overnight wind gust (km/h)	Average Nightly Windspeed (km/h)	Minimum temperature in first four hours after sunset (°C)	Total rainfall in first two hours after sunset (mm)	Suitable for ABM data to be used
1-Nov	36.0	13.7	9.2	0.0	No
2-Nov	23.8	9.2	11.0	0.0	Yes
3-Nov	22.3	7.8	8.7	0.0	No
4-Nov	18.0	5.8	11.0	0.0	Yes
5-Nov	17.3	5.1	7.7	0.0	No
6-Nov	15.5	2.6	14.8	0.0	Yes
7-Nov	23.8	5.7	14.6	0.0	Yes
8-Nov	23.8	7.6	18.1	0.0	Yes
9-Nov	41.8	14.7	17.0	0.0	Yes
10-Nov	45.7	16.7	13.1	4.2	No
11-Nov	33.8	12.5	11.3	0.0	Yes
12-Nov	29.2	7.0	5.4	0.0	No
13-Nov	18.4	4.1	11.4	0.0	Yes

Date	Maximum overnight wind gust (km/h)	Average Nightly Windspeed (km/h)	Minimum temperature in first four hours after sunset (°C)	Total rainfall in first two hours after sunset (mm)	Suitable for ABM data to be used
14-Nov	46.8	13.6	13.2	0.0	Yes
15-Nov	39.6	9.4	7.1	0.0	No
16-Nov	19.8	6.3	13.0	0.0	Yes
17-Nov	19.4	6.7	16.5	0.0	Yes
18-Nov	26.6	7.3	10.0	0.2	Yes

4.3.2 Terrestrial Ecological - Value Assessment

Table 9-21 Ecological value assessment for terrestrial ecological features (flora)

Attributes to be considered	BF	EG	PL.1	PL.3	TL.3	Justification
Representativeness	1	1	4	2	2	
Typical structure and composition	1	1	2	1	1	BF, EG, ES, PL.3, TL.3: Habitats have been significantly altered by human activities (exotic dominated). PL.1: Habitat and species have been affected by human activities.
Indigenous representation	1	1	4	2	2	BF, EG: <10% of the species are indigenous. PL.3, TL.3: 10-50% of the species are indigenous. PL.1: >90% of the species are indigenous.
Rarity/distinctiveness	**0**	**3**	**3**	**3**	**4**	

Attributes to be considered	BF	EG	PL.1	PL.3	TL.3	Justification
Range restricted or endemic species	-	-	1	-	-	PL.1: One population (or taxon) judged to be unique at a local scale.
Species of conservation significance	-	3	3	3	4	Long-tailed bat (Threatened – Nationally Critical, value score of 4) potentially using ecological features associated with the Project Area (TL.3). Bats were not detected within Project Area, however bats are present in wider landscape, therefore TL.3 likely to only provide infrequent stepping-stone habitat for bats. Non-TAR bird species expected to utilise EG, PL.1, PL.3, TL.3. No terrestrial TAR bird species expected to be reliant on terrestrial ecological features (BF, EG, PL.1, PL.3, TL.3) associated with the Project Area. Copper skink (At Risk - Declining, value score 3) likely to utilise ecological features within the Project Area (EG, PL.1, PL.3, and TL.3 (with appropriate understorey)).
Distinctive ecological values	-	-	1	1	1	PL.1, PL.3, TL.3: Habitat playing an important role in provisional or regulatory ecosystem services typically on Local scale.
Diversity and pattern	**0**	**0**	**1**	**0**	**1**	
Habitat diversity	-	-	1	-	1	Increased habitat diversity in areas with indigenous species present: PL.1 Increased habitat diversity in areas with late succession: TL.3
Species diversity	-	-	1	-	1	Increased species diversity in areas with indigenous species present: PL.1

Attributes to be considered	BF	EG	PL.1	PL.3	TL.3	Justification
						Increased species diversity in areas with late succession: TL.3
Patterns in habitat use	-	-	-	-	-	All habitats are not significant for lifecycle completion or periodic habitat utilisation on any scale.
Ecological context	**0**	**0**	**0**	**0**	**1**	
Size, shape, and buffering	-	-	-	-	-	All terrestrial ecology features are represented by small (or isolated) patches of habitat surrounded by pasture.
Sensitivity to change	-	-	-	-	-	Largely modified habitats.
Ecological networks (linkages, pathways, migration)	-	-	-	-	1	TL.3 likely to provide infrequent stepping-stone habitat for long-tailed bats.
Protected status	-	-	-	-	-	-
Ecological Value	**Negligible**	**Negligible**	**Low**	**Low**	**Low**	

Table 9-22 Ecological value assessment for terrestrial ecological features (fauna)

Attributes to be considered	Long-tailed bat	Non-TAR bird	North Island fernbird	Copper skink	Justification
Representativeness	**0**	**2***	**0**	**0**	
Typical structure and composition	-	2*	-	-	-
Indigenous representation	-	-	-	-	-
Rarity/distinctiveness	**4**	**2**	**3**	**3**	
Range restricted or endemic species	-	-	-	-	-

Attributes to be considered	Long-tailed bat	Non-TAR bird	North Island fernbird	Copper skink	Justification
Species of conservation significance	4	2*	3	3	NZ Conservation Status: Long-tailed bat: Threatened - Nationally Critical Copper skink: At Risk - Declining North Island fernbird: At Risk - Declining
Distinctive ecological values	-	-	-	-	-
Diversity and pattern	**0**	**2***	**0**	**0**	
Habitat diversity	-	2*	-	-	-
Species diversity	-	-	-	-	-
Patterns in habitat use	-	-	-	-	-
Ecological context	**0**	**2***	**0**	**0**	
Size, shape, and buffering	-	2*	-	-	-
Sensitivity to change	-	-	-	-	-
Ecological networks (linkages, pathways, migration)	-	-	-	-	-
Protected status	-	-	-	-	-
Ecological Value	**Very High**	**Low**	**High**	**High**	

Notes: * = Scores not representative of corresponding row, scores required to produce ‘Low’ combined value.

4.3.3 Terrestrial Ecology - Magnitude of Effect and Level of Effect Assessment

Table 9-23 Impact assessment for terrestrial ecological features (flora)

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude of Effect (pre-mitigation)	Level of Effect (pre-mitigation)
Construction	BF	Vegetation removal: Permanent loss of habitat/ecosystem, fragmentation and edge effects due to vegetation removal.	Direct	Local	Permanent (>25 years)	-	Definite	-	High	Very Low
	EG		Direct	Local	Permanent (>25 years)	-	Definite	-	High	Very Low
	PL.1		Direct	Local	Permanent (>25 years)	-	Definite	-	High	Low
	PL.3		Direct	Local	Permanent (>25 years)	-	Definite	-	High	Low
	TL.3		Direct	Local	Permanent (>25 years)	-	Definite	-	High	Low
	EG	Earthworks: Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity.	Direct	Local	Short-term (<5 years)	Infrequently	Unlikely	-	Negligible	Very Low
	PL.1		Direct	Local	Short-term (<5 years)	Infrequently	Unlikely	-	Negligible	Very Low
	PL.3		Direct	Local	Short-term (<5 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TL.3		Direct	Local	Short-term (<5 years)	Infrequently	Unlikely	-	Negligible	Very Low

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude of Effect (pre-mitigation)	Level of Effect (pre-mitigation)
Operation	EG	Presence of the infrastructure: Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity due to the presence of the infrastructure, use of infrastructure edges as dispersal corridors by invasive plant species.	Direct	Local	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	PL.1		Direct	Local	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	PL.3		Direct	Local	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TL.3		Direct	Local	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	EG	Maintenance: Increased weed incursion, unintentional spray of indigenous vegetation due to maintenance, increased use of herbicides.	Direct	Local	Permanent (>25 years)	Periodically	Likely	-	Low	Very Low
	PL.1		Direct	Local	Permanent (>25 years)	Periodically	Likely	-	Low	Very Low
	PL.3		Direct	Local	Permanent (>25 years)	Periodically	Likely	-	Low	Very Low
	TL.3		Direct	Local	Permanent (>25 years)	Periodically	Likely	-	Low	Very Low

Table 9-24 Impact assessment for terrestrial ecological features (fauna)

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
Construction	Long-tailed bats	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Indirect	Local	Short-term (<5 years)	Periodically	Unlikely	Totally	Negligible	Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Low
		Vegetation removal: Potential to kill/injure long-tailed bat, causing adverse effects on population dynamics.	Direct	Local	Short-term (<5 years)	Infrequently	Unlikely	Irreversible	Negligible	Low
	Non-TAR birds	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Indirect	Local	Short-term (<5 years)	Periodically	Highly Likely	Totally	Low	Very Low
		Vegetation removal: Nest loss.	Direct	Local	Short-term (<5 years)	-	Highly Likely	-	Low	Very Low

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Direct	Local	Permanent (>25 years)	-	Definite	-	High	Low
		Vegetation removal: Potential to kill/injure non-TAR birds, causing adverse effects on population dynamics.	Direct	Local	Short-term (<5 years)	-	Unlikely	Irreversible	Negligible	Very Low
	North Island fernbird	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Indirect	Local	Short-term (<5 years)	Periodically	Unlikely	Totally	Negligible	Very Low
		Vegetation removal: Nest loss.	Direct	Local	Short-term (<5 years)	-	Unlikely	-	Negligible	Very Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low
		Vegetation removal: Potential to kill/injure birds,	Direct	Local	Short-term (<5 years)	-	Unlikely	Irreversible	Negligible	Very Low

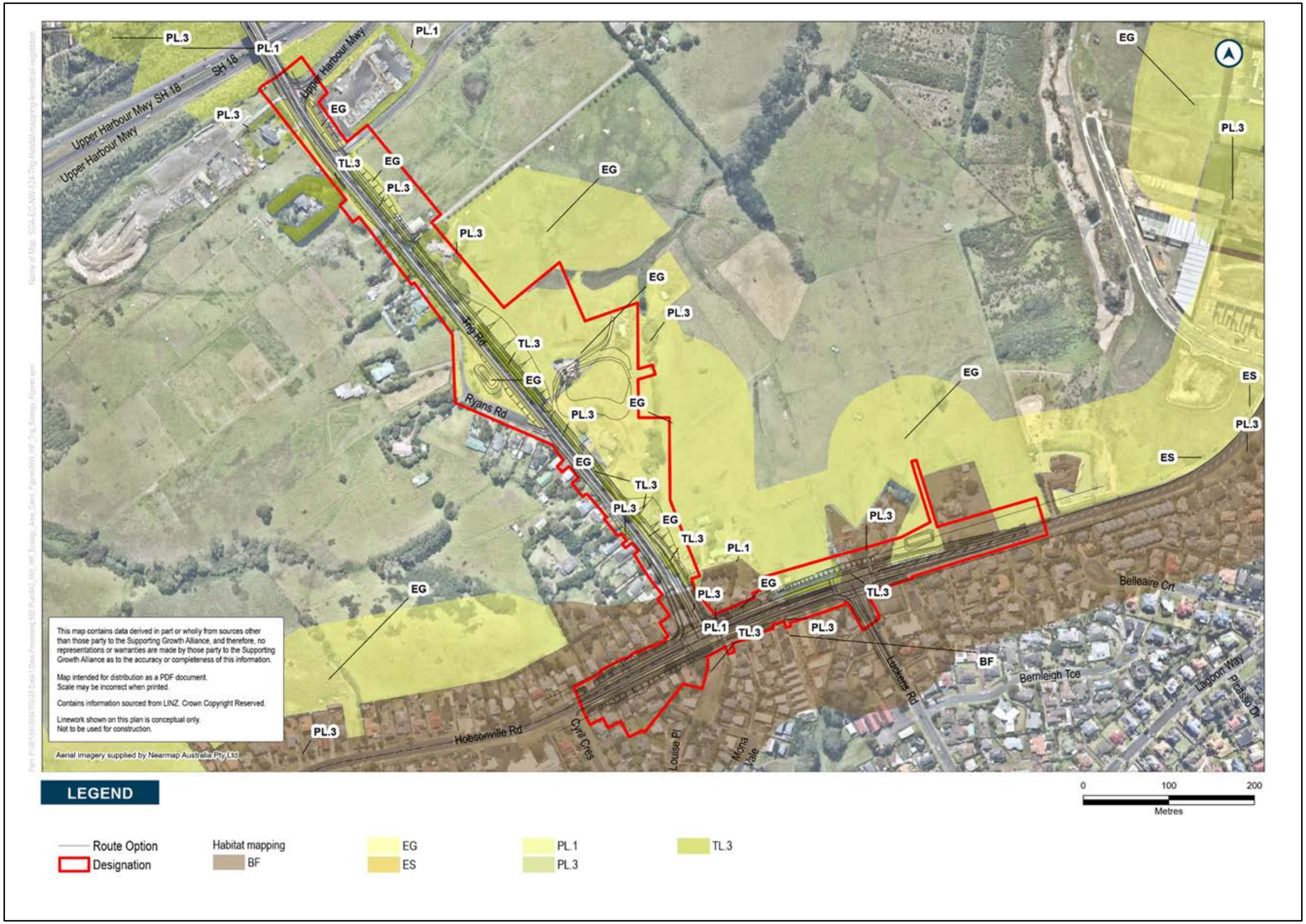
Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
		causing adverse effects on population dynamics.								
	Copper skink	Disturbance and displacement to individuals (existing) due to construction activities (noise, light, dust etc).	Indirect	Local	Short-term (<5 years)	Periodically	Unlikely	Totally	Negligible	Very Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Direct	Local	Permanent (>25 years)	-	Likely	-	Low	Low
		Vegetation removal: Potential to kill/injure copper skink, causing adverse effects on population dynamics.	Direct	Local	Short-term (<5 years)	-	Unlikely	Irreversible	Negligible	Very Low
Operation	Long-tailed bats	Disturbance and displacement of (new and existing) roosts and individuals due to lighting and noise/vibration.	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Low
		Loss in connectivity due to permanent habitat loss, light, and noise effects	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Low

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
		from the road, leading to fragmentation of terrestrial habitat and influencing bat movement in the broader landscape								
	Non-TAR birds	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)	Indirect	Local	Permanent (>25 years)	-	Highly Likely	Irreversible	Moderate	Low
		Loss in connectivity due to permanent habitat loss, light and noise effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Very Low
	North Island fernbird	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Very Low
		Loss in connectivity due to permanent habitat loss, light and noise effects from the road, leading to	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Very Low

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
		fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.								
	Copper skink	Disturbance and displacement of existing and future copper skink due to light, noise and vibration effects from the presence of the road.	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Very Low
		Loss in connectivity due to permanent habitat loss, light and noise/vibration effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Very Low

5 Appendix 5 – Ecological Habitat Maps

5.1 Terrestrial Habitat



Upper Harbour Mwy SH 18
Upper Harbour Mwy
SH 18
Trig Rd
Ryans Rd
Hobsonville Rd
Cyril Cres
Louise Pl
Mona Vale
Luckens Rd
Belleaire Crt
Bernleigh Tce
Lagoon Way
Plasso Dr
PL.1
PL.3
EG
ES
TL.3
BF
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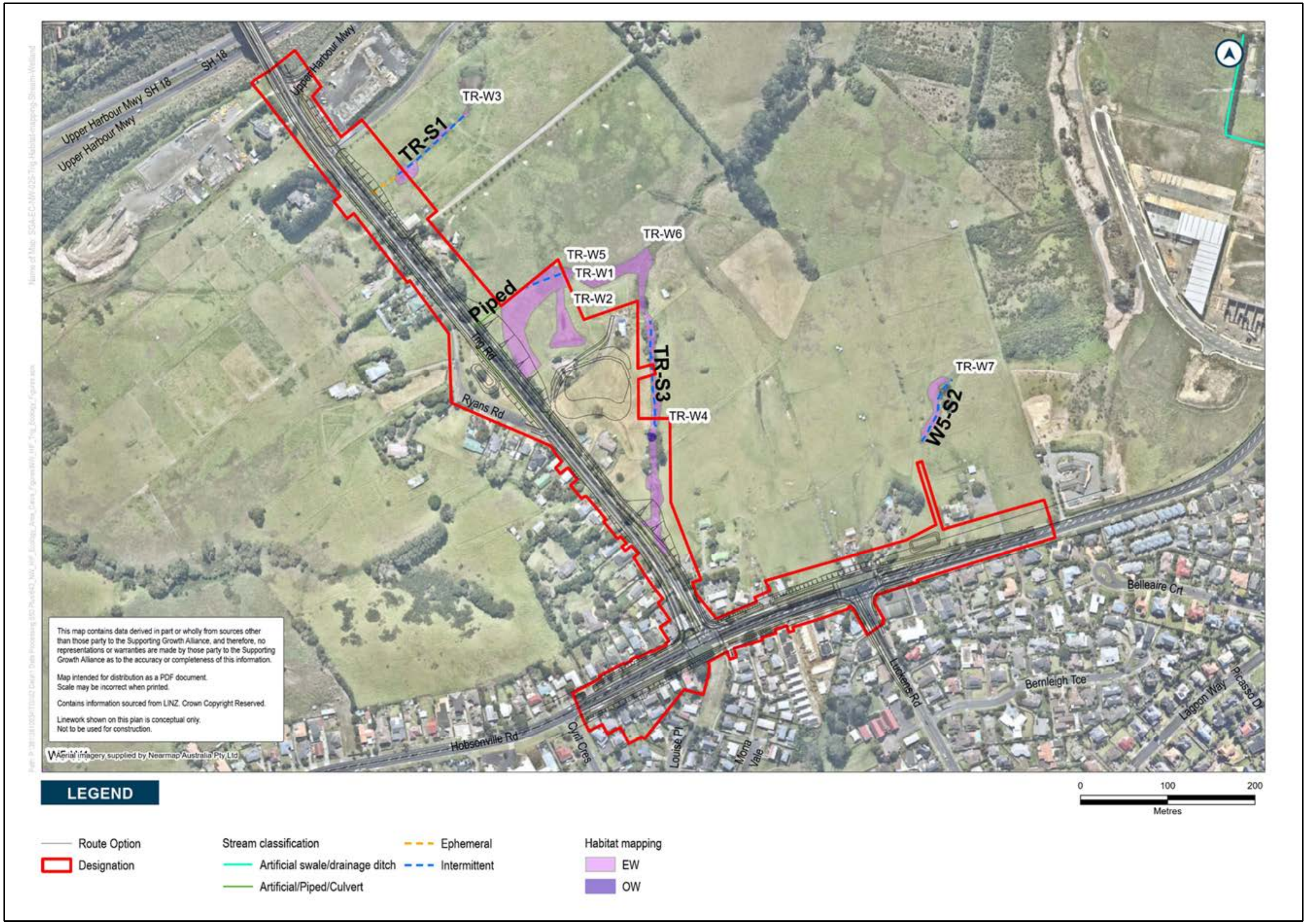
Aerial imagery supplied by Nearmap Australia Pty Ltd
0
100
200
Metres
LEGEND
Route Option
Designation
Habitat mapping
BF
EG
ES
PL.1
PL.3
TL.3

5.2 Stream and Wetland Habitat


Upper Harbour Mwy SH 18
Upper Harbour Mwy
SH 18
Upper Harbour Mwy
TR-W3
TR-S1
TR-W6
TR-W5
TR-W1
TR-W2
Piped
Trig Rd
TR-S3
Ryans Rd
TR-W4
TR-W7
W5-S2
Belleaire Crt
Bernleigh Tce
Lagoon Way
Picasso Dr
Luckens Rd
Hobsonville Rd
Cyril Cres
Louise Pl
Mona Vale
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LEGEND
0
100
200
Metres
Route Option
Designation
Stream classification
Artificial swale/drainage ditch
Artificial/Piped/Culvert
Ephemeral
Intermittent
Habitat mapping
EW
OW

6 Appendix 6 – Desktop and Incidental Fauna Records

Table 9-25 Desktop bird records within 2 km of the Project Area

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
Banded dotterel	Pohowera	*Charadrius bicinctus*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Banded rail	Mioweka	*Gallirallus philippensis assimilis*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Barbary dove	-	*Streptopelia risoria*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Bar-tailed godwit	Kuaka	*Limosa lapponica bauer*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Black shag	Māpunga	*Phalacrocorax carbo*	At Risk - Relict	Desktop record - iNaturalist
Black-billed gull	Tarāpuka	*Larus bulleri*	At Risk - Declining	Desktop record - iNaturalist
Blackbird	Manu pango	*Turdus merula*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Canada goose	-	*Branta canadensis*	Introduced and Naturalised	Desktop record - eBird (Bird Atlas)
Caspian tern	Taranui	*Hydroprogne caspia*	Threatened - Nationally Vulnerable	Desktop record - iNaturalist/eBird (Bird Atlas)
Chaffinch	Pahirini	*Fringilla coelebs*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Common pheasant	Peihana	*Phasianus colchicus*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Dabchick	Weweia	*Poliocephalus rufopectus*	Threatened – Nationally Increasing	Desktop record - iNaturalist/eBird (Bird Atlas)

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
Domestic duck	-	*Anas platyrhynchos domesticus*	Introduced and Naturalised	Desktop record - iNaturalist
Dunnock	-	*Prunella modularis*	Introduced and Naturalised	Desktop record - eBird (Bird Atlas)
Goldfinch	-	*Carduelis carduelis*	Introduced and Naturalised	Desktop record - eBird (Bird Atlas)
Greenfinch	-	*Carduelis chloris*	Introduced and Naturalised	Desktop record - iNaturalist
Greylag goose	Kuihi	Anser anser	Introduced and Naturalised	Desktop record - eBird (Bird Atlas)
House sparrow	Tiu	*Fringilla coelebs*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Lesser knot	Huahou	*Calidris canutus rogersi*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Lesser knot	Huahou	*Calidris canutus rogersi*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Little black shag	Kawau tūī	*Phalacrocorax sulcirostris*	At Risk – Naturally Uncommon	Desktop record - iNaturalist
Magpie	Makipae	*Gymnorhina tibicen*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Mallard	-	*Anas platyrhynchos*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Muscovy duck	-	*Cairina moschata*	Introduced, not established	Desktop record - eBird (Bird Atlas)
Myna	-	*Acridotheres tristis*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
New Zealand pipit	Hīoi	*Anthus novaeseelandiae novaeseelandiae*	At Risk – Declining	Desktop record - iNaturalist
North Island fernbird	Mātātā	*Poodytes punctatus*	At Risk – Declining	Desktop record - iNaturalist/eBird (Bird Atlas)

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
North Island kākā	Kākā	*Nestor meridionalis septentrionalis*	At Risk – Recovering	Desktop record - iNaturalist
Northern New Zealand dotterel	Tūturiwhatu	*Charadrius obscurus aquilonius*	At Risk - Recovering	Desktop record - eBird (Bird Atlas)
Pied shag	Kāruhiruhi	*Phalacrocorax varius*	At Risk – Recovering	Desktop record - iNaturalist/eBird (Bird Atlas)
Red-billed gull	Tarāpunga	*Larus novaehollandiae scopulinus*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Rock pigeon	-	*Columba livia*	Introduced and Naturalised	Desktop record - eBird (Bird Atlas)
Royal spoonbill	Kōtuku ngutupapa	*Platalea regia*	At Risk – Naturally Uncommon	Desktop record - iNaturalist/eBird (Bird Atlas)
Song thrush	-	*Turdus philomelos*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
South Island pied oystercatcher	Tōrea	*Haematopus finschi*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Spotted dove	-	*Streptopelia chinensis tigrina*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Variable oystercatcher	Tōrea pango	*Haematopus unicolor*	At Risk - Recovering	Desktop record - eBird (Bird Atlas)
White-fronted tern	Tara	*Sterna striata*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Wrybill	Ngutu parore	*Anarhynchus frontalis*	Threatened – Nationally Increasing	Desktop record - iNaturalist
Yellowhammer	-	*Emberiza citrinella*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)

Table 9-26 Incidental bird species identified in the Project Area during the site investigation

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)
Australasian harrier	Kāhu	*Circus approximans*	Not Threatened
Blackbird	Manu pango	*Turdus merula*	Introduced and Naturalised
Canada goose	-	*Branta canadensis*	Introduced and Naturalised
Chaffinch	Pahirini	Fringilla coelebs	Introduced and Naturalised
Common pheasant	Peihana	*Phasianus colchicus*	Introduced and Naturalised
Eastern rosella	Kākā uhi whero	*Platycercus eximius*	Introduced and Naturalised
Goldfinch	Kōurarini	*Carduelis carduelis*	Introduced and Naturalised
Grey warbler	Riroriro	*Gerygone igata*	Not Threatened
Mallard	Rakiraki	*Anas platyrhynchos*	Introduced and Naturalised
Myna	Maina	*Acridotheres tristis*	Introduced and Naturalised
Pūkeko	Pūkeko	*Porphyrio melanotus melanotus*	Not Threatened
Skylark	Kairaka	*Alauda arvensis*	Introduced and Naturalised
Song thrush	Manu-kai-hua-rakau	*Turdus philomelos*	Introduced and Naturalised
Tūī	Tūī	*Prosthemadera novaeseelandiae novaeseelandiae*	Not Threatened
Welcome swallow	Warou	*Hirundo neoxena*	Not Threatened
White-faced heron	Matuku moana	*Ergretta novaehollandiae*	Not Threatened

Table 9-27 Desktop herpetofauna records within 2 km of the Project Area

Common Name	Māori Name	Scientific Name	Conservation Status (Hitchmough et al., 2016)	Record Source
Elegant gecko	Moko kākāriki	*Naultinus elegans*	At Risk – Declining	DoC
Copper skink	-	*Oligosoma aeneum*	At Risk – Declining	iNaturalist
Forest gecko	Moko pirirākau	*Mokopirirakau granulatus*	At Risk – Declining	iNaturalist
Green and golden bell frog	Poraka	*Litoria aurea*	Introduced and Naturalised	iNaturalist
Ornate skink	-	*Oligosoma ornatum*	At Risk - Declining	iNaturalist
Pacific gecko	Teretere	*Dactylocnemis pacificus*	Not Threatened	iNaturalist
Plague skink	-	*Lampropholis delicata*	Introduced and Naturalised	DoC, iNaturalist
Hochstetter's frog	Peketua	*Leiopelma hochstetteri*	At Risk - Declining	iNaturalist

Table 9-28 Desktop freshwater fish records

Common Name	Scientific Name	Conservation Status (Dunn et al., 2017)	Record Source
Shortfin eel	*Anguilla australis*	Not Threatened	NIWA, iNaturalist
Longfin eel	*Anguilla dieffenbachii*	At Risk - Declining	NIWA, iNaturalist
Grass carp	*Ctenopharyngodon idella*	Introduced and Naturalised	NIWA
Koi carp	*Cyprinus rubrofascus*	Introduced and Naturalised	iNaturalist
Banded kokopu	*Galaxias fasciatus*	Not Threatened	NIWA, iNaturalist
Īnanga	*Galaxias maculatus*	At Risk – Declining	NIWA, iNaturalist
Mosquito fish	*Gambusia affinis*	Introduced and Naturalised	NIWA, iNaturalist
Common bully	*Gobiomorphus cotidianus*	Not Threatened	NIWA, iNaturalist

Common Name	Scientific Name	Conservation Status (Dunn et al., 2017)	Record Source
Giant bully	*Gobiomorphus gobioides*	At Risk – Naturally Uncommon	iNaturalist
Freshwater shrimp	*Paratya curvirostis*	Not Threatened	NIWA

Table 9-29 Vegetation species identified during site investigation

Common Name	Scientific Name	Threat Class (de Lange et al., 2017)
Agapanthus	*Agapantus praecox*	Introduced
Bent grass	*Agrostis* spp.	Introduced
Titoki	*Alectryon excelsus*	Not Threatened
Sweet vernal	*Anthoxanthum odoratum*	Introduced
Oioi	*Apodasmia similis*	Not Threatened
Climbing asparagus	*Asparagus scandens*	Introduced
Bottlebrush	*Callistemon citrinus*	Introduced
Swamp oak	*Casuarina glauca*	Introduced
Karamu	*Coprosma robusta*	Not Threatened
Tī kōuka / cabbage tree	*Cordyline australis*	Not Threatened
Cotoneaster	*Cotoneaster glaucophyllus*	Introduced
Japanese cedar	*Cryptomeria japonica*	Introduced
Bermuda grass	*Cynodon dactylon*	Introduced
Umbrella sedge	*Cyperus ustulatus*	Not Threatened
Whekī	*Dicksonia squarrosa*	Not Threatened
Broadleaf	*Griselinia littoralis*	Not Threatened
Yorkshire fog	*Holcus lanatus*	Introduced
Soft rush	*Juncus effusus*	Introduced
Kānuka	*Kunzea robusta*	Threatened – Nationally Vulnerable
Mānuka	*Leptospermum scoparium* var. *scoparium*	Threatened – Nationally Vulnerable
Chinese privet	*Ligsustrum sinense*	Introduced

Common Name	Scientific Name	Threat Class (de Lange et al., 2017)
Tree privet	*Ligustrum lucidum*	Introduced
Ryegrass	*Lolium perenne*	Introduced
Pohutukawa	*Metrosideros excelsa*	Threatened – Nationally Vulnerable
Māpou	*Myrsine australis*	Not Threatened
Watercress	*Nasturtium officinale*	Introduced
Brush wattle	*Paraserianthes lophantha*	Introduced
Ironwood	*Parrotia persica*	Introduced
Water pepper	*Persicaria hydropiper*	Introduced
Harakeke	*Phormium tenax*	Not Threatened
Pine	*Pinus radiata*	Introduced
Karo	*Pittosporum crassifolium*	Not Threatened
Lemonwood	*Pittosporum eugenioides*	Not Threatened
Ribwort	*Plantago lanceolata*	Introduced
Totara	*Podocarpus totara*	Not Threatened
Poplar	*Populus* sp.	Introduced
Turkey oak	*Quercus cerris*	Introduced
Buttercup	*Ranunculus repens*	Introduced
Rose	*Rosa* spp.	Introduced
Curled dock	*Rumex crispus*	Introduced
Wooly nightshade	*Solanum mauritianum*	Introduced
Kowhai	*Sophora microphylla*	Not Threatened
Windmill palm	*Trachycarpus fortunei*	Introduced
Red clover	*Trifolium pratense*	Introduced
White clover	*Trifolium repens*	Introduced
Arum lily	*Zantedeschia aethiopica*	Introduced

7 Appendix 7 – Site Photographs (2019)

Plate 1 – Exotic treeland (TL.3) present in the Project Area.

Plate 2 – Amenity garden planting (PL.3) present in the Project Area.

Plate 3 – Potential copper skink habitat present in the Project Area.

Plate 4 – Potential long-tailed bat roost habitat present in the Project Area.

Figure 9-5 Site photographs (2019)

8 Appendix 8 – Wetland Offset & Conceptual Restoration Design

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Memorandum

To:	Bridget O'Leary
From:	Michiel Jonker (Author) and Fiona Davies (Reviewer)
CC:	Fiona Davies
Date:	3 November 2022
Subject:	Trig Road Corridor Upgrade – Wetland Offset & Conceptual Restoration Design

1 Background

As part of the Assessment of Ecological Effects for the proposed Trig Road Corridor Upgrade notice of requirement (NoR) and application for resource consents, four modified wetlands were identified within the designation footprint (Figure 1). All four wetlands are dominated by exotic facultative wetland plant species and retain reasonably intact hydrological functionality so that they can be defined as wetlands. The Assessment of Ecological Effects identifies that construction of Trig Road will result in the permanent loss of 0.1 ha (1000 m^2) of wetland TR-W1 and 0.078 ha (780 m^2) of wetland TR-W4. Mitigation cannot be undertaken at the point of impact. As such, this results in a Low and Moderate residual level of effect respectively (owing to the differences in value between the two wetlands) that cannot be avoided, remedied, or mitigated. The policy direction (NES-FW) is for no loss in wetland extent, therefore both wetlands are included within this offset memo.

This memo presents offset modelling to identify the amount and type of wetland enhancement required to address the wetland loss at both wetlands. It also presents a conceptual restoration design.

It is expected that this memo shall provide guidance to the NoR and resource consent conditions and to the detailed Wetland Restoration and Enhancement Plan (WREP). The WREP shall, provide confirmation in detailed design that the wetland hydrological system allows for a wide range of indigenous wetland plants to establish and become a self-sustaining native wetland system.

Figure 1 Location and classification of TR-W1 and TR-W4

2 Ground rules for applying biodiversity offsetting and compensation

Biodiversity offsetting is defined by Maysek et al. 2018 as:

A measurable conservation outcome resulting from actions designed to compensate for residual adverse biodiversity effects arising from activities after appropriate avoidance, remediation, and mitigation measures have been applied. The goal of a biodiversity offset is to achieve no-net-loss and preferably a net-gain of indigenous biodiversity values[1]*.*

Biodiversity compensation provides an option to address residual biodiversity losses that are not or cannot be offset, although it generally should be explored as a last resort. Although compensation does not require the same numerical rigour as biodiversity offsetting, outcomes can be improved by implementing offsetting principles and rules as a guideline when designing compensation packages.

The document 'Guidance on Good Practice Biodiversity Offsetting in New Zealand' provides a detailed and comprehensive account of the theory and possible application of the use of biodiversity offset mitigation in NZ (New Zealand Government et al., 2014). However, in the absence of clear over-arching policy and lack of practitioner consensus as to how biodiversity offsetting is defined and fits into the RMA context, ambiguity over how biodiversity offsetting should be implemented, monitored, and enforced is commonplace.

In New Zealand, offset models have generally only been used for large developments (e.g., wind farms, dams, and mines) where biodiversity matters are broad-ranging and offset models are correspondingly complex. However, a disaggregated condition-area model template has been developed for the Department of Conservation (Maseyk et al., 2015) which provides a more accessible, transparent, flexible, and structured means of assessing an offset proposal than those previously used in New Zealand for terrestrial and wetland ecosystems (Maseyk et al., 2016). The actual Accounting Model is a non-prescriptive, flexible 'empty shell' Microsoft Excel spreadsheet that the user populates by entering biodiversity measures, estimates, and discount rates[2]. As stated in the User Guide, in summary the Accounting Model:

- Accounts only for 'like for like' biodiversity trades aimed at demonstrating no net loss (the model does not address 'like for unlike' exchanges);
- Relies on three hierarchical levels to categorise biodiversity (1: biodiversity types; 2: biodiversity components; 3: biodiversity attributes);
- Uses a disaggregated area/condition currency;
- Calculates net present biodiversity value (NPBV) for individual biodiversity attributes and average NPBV across the range of attributes representing a biodiversity component (as defined by Overton et al., 2013);
- Uses NPBV to estimate whether no net loss is achieved in the exchange with project level no net loss being demonstrated when all components demonstrate no net loss;
- Incorporates the use of a discount rate;
- Increases transparency of input values;
- Adjusts for uncertainty of success regarding the proposed offset actions; and

[1] ND: This definition differs slightly from that within the Good Practice Guidance as the terminology used in this definition has been altered to align with that of the RMA. The meaning and intent of the two definitions is the same.

[2] Biodiversity offsets accounting system - Microsoft Excel template accessed 1 November 2022. Retrieved from: https://www.doc.govt.nz/about-us/our-policies-and-plans/guidance-on-biodiversity-offsetting/biodiversity-offsets-accounting-system/

– Includes in-model explanations to assist the user.

3 Application of a Biodiversity Offset Accounting Model for wetland loss

3.1 Model definitions and parameters

The Biodiversity Offset Accounting Model (BOAM) as developed by Maseyk et al. (2015) has been used to determine if no net loss of biodiversity values for wetlands TR-W1 and TR-W4 is likely to be achieved through downslope restoration of the remaining portions of wetland habitat associated with both wetlands. Section 4 outlines the conceptual restoration design.

The model is an accounting system/mathematical framework used to balance the losses at the impact site with the predicted gains at the offset site by comparing the value of biodiversity lost at the impact site (biodiversity value post-impact minus biodiversity value pre-impact) with the predicted value of biodiversity gained at the offset site (biodiversity value post-offset minus biodiversity value pre-offset).

The BOAM comprises an Impact Model and an Offset Model. Both need to be used to calculate the Net Present Biodiversity Value of each Biodiversity Attribute (NPBV) following the proposed Offset Action.

In this case the model has been used to calculate the NPBV for wetland condition attributes based on Clarkson et al. (2003) for TR-W1 and TR-W4 respectively. Condition attributes assessed included[3]:

- Hydrological integrity;
- Physico-chemical integrity;
- Ecosystem intactness;
- Browsing, predation and harvesting regimes;
- Dominance of native plants.

For each wetland the condition assessment was completed for the following scenarios:

- Impact Site - Before Impact: condition of the wetland under baseline (current) conditions;
- Impact Site - Potential: condition of the wetland given theoretical potential state. This assessment assumed current legal provisions for natural wetlands which mainly relate to stock exclusion;
- Impact Site - After Impact: condition of the wetland after the impact occurred;
- Offset Site - Baseline: The baseline condition of the wetland earmarked for restoration;
- Offset Site - After Offset: the condition of the wetland after restoration.

A detail justification of the condition assessment is presented in **Attachment 2**. To simplify the use of the BOAM the wetland extent and condition for both wetlands were combined and averaged respectively. This was considered appropriate due to the similarities in wetland type and condition. The combined extent and average wetland condition scores are also presented in **Attachment 2** (Table 7) while the definitions and biodiversity attributes used are detailed in **Attachment 3.**

3.2 Impact Model results

Table 1 presents the output of the Impact Model as Biodiversity Value loss scores (expressed as five Biodiversity Attributes of Wetland Condition) resulting from 0.178 ha of wetland loss (TR-W1 = 0.1 ha

[3] The catchment impact module for the wetland condition assessment has not been included in the condition assessment for purposes of the BOAM model. This is because the restoration actions mainly pertains to the wetland area.

and TR-W4 = 0.078 ha combined). **Attachment 3** (Table 8), provides detail on the definitions and justifications for each of the attribute cells.

Table 1 shows that within the 0.178 ha of proposed reclaimed wetlands, three of the five Biodiversity Attributes will be reduced to 0. Note that the measure score prior to impact represents the potential value of the wetlands. Thus, the Biodiversity Value is correspondingly reduced to a net negative value as shown in the last column of Table 1. These represent the residual adverse effects which require offsetting, as this loss cannot be directly avoided, remediated, or mitigated.

For 'Browsing pressure' and 'Dominance of native vegetation' no change in condition is predicted or shown in the Impact Model, as the decrease in the extent of the wetlands due to the road upgrades will not influence these attributes. Conversely, 'Ecosystem intactness' best represents the loss in wetland extent, while 'Hydrological integrity' and 'Physico-chemical parameters' have also been scored zero to account for the loss of wetland habitat within the condition assessment[4]. Refer to stormwater report for details on the groundwater treatment design.

The most ecologically intact state of wetland condition is expressed as a maximum value of 5 for each Biodiversity Attribute as shown in the Benchmark column, which is assessed against the current degraded (potential) state of for each wetland and then averaged for input into the Impact Model (**Attachment 3**). This benchmark becomes the aspirational restoration state, which is inputted into the Offset Model (discussed further below).

Table 1 Results of Impact Model where 0.178 ha of wetland habitat is reclaimed

	This section captures which elements of biodiversity, and over what area, will be impacted by the proposal					This section is where the change in measure of each Biodiversity Attribute due to the proposed Impact is quantified, and Attribute Biodiversity Value calculated. Inputs are derived from direct measures, existing data or models where available, or expert estimated predictions			
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
1.1	Habitat quality	1.1a	Hydrological integrity	Condition Rating	0.178	5	4	0	-0.14
		1.1b	Physico-chemical parameters	Condition Rating	0.178	5	3	0	-0.11
		1.1c	Ecosystem intactness	Condition Rating	0.178	5	3	0	-0.11
		1.1d	Browsing and predation	Condition Rating	0.178	5	4	4	0.00
		1.1e	Dominance of native plants	Condition Rating	0.178	5	2	0	-0.07

3.3 Offset Model results

Table 2 presents the results of the Offset Model. This assumes that a total of 0.37 ha (0.27 ha for TR-W1 and 0.1 ha for TR-W4) associated with the unaffected downstream portions of each wetland, is restored within the NoR designation (Figure 2)[5], which is shown in the Offset Area column of the model. The detailed definitions of the Offset Model are shown in **Attachment 3** (Table 9).

[4] Embedded controls (stormwater management and erosion and sediment controls) mitigate for the loss functional wetland values as they relate to the receiving environment including, flood control, water treatment and erosion control. Therefore, there is no 'indirect' effect on the condition of wetland habitat outside of the portion of each wetland that will be permanently reclaimed.

[5] Buffer planting has not been presented on the figure. It is expected to be a 10 metre buffer planting around the offset areas (where possible within the designation boundary).

The Offset Model takes across the Biodiversity Value at the Impact Site and Benchmark scores from the Impact Model.

An NPBV discount rate of 3% has been applied to this restoration project in consideration of the time delay of the restoration being successfully realised. Further detail on how this rate was determined is provided in the User Manual (Maseyk et al., 2015).

Biodiversity Attribute measures prior to the Offset have been taken from the scores presented in condition assessment in the Measure prior to Offset column of the model. The likely improvement of wetland condition score has been provided for each Biodiversity Attribute in the Measure after Offset column of the model.

Benefits associated with planting, pest plant control and stock exclusion are expected to accrue within five years. This is expressed for each Biodiversity Attribute in the Time till endpoint column of the Offset Model.

The model determines the Biodiversity Value at the Offset Site for each Biodiversity Attribute and presents an Attribute Net Present Biodiversity Value for each of these attributes.

The final output of the Offset Model shows that the five key Biodiversity Attributes measuring wetland condition are improved through restoration and hence a Component Net Present Biodiversity Value of 0.00 is achieved after five years (Table 2).

This is a neutral NPBV value indicating that, if successfully implemented, restoration of 0.37 ha of unaffected downstream portions of TR-W1 and TR-W4 will offset the loss of 0.178 ha of the upstream portions of the same wetlands associated with the construction and operation of the Trig Road Corridor Upgrade.

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Table 2 Results of Offset Model where 0.37 ha (consisting of 0.27 ha for TR-W1 and 0.1 ha for TR-W4) is restored as an offset (with a 3% discount rate applied)

	This section captures which elements of biodiversity are to be accounted for, and the benchmark value for the Attribute. The information matches that in the Impact Model					These cells provide information about the proposed Offset Actions			Calculations can be made for a finite end point, or at five yearly time-steps over 35 years. Indicate preference in Column K and Follow the instructions in Column L		This section is where the marginal change in the measure of Biodiversity Attribute due to the Offset Action is quantified. Inputs are derived from direct measure, existing data or models where available, or expert estimated predictions. Attribute Biodiversity Value at the Offset Site is compared to the Attribute Biodiversity Value at the Impact Site to calculate the Net Present Biodiversity Value for each Attribute						This is the average Net Present Biodiversity Value for the Biodiversity Component
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Benchmark	Proposed Offset Actions	Offset area (ha)	Confidence in Offset Actions			Measure prior to Offset	Measure after Offset	Time till endpoint (years)	Biodiversity Value at Offset Site	Biodiversity Value at Impact Site	Attribute Net Present Biodiversity Value	Component Net Present Biodiversity Value
1.1	Habitat quality	1.1a	Hydrological integrity	Condition Rating	5	Hydrology for offset wetlands will be maintained	0.37	Confident 75-90%	Finite end point	Continue to Column M	4	4	5	0.00	-0.14	-0.14	0.00
		1.1b	Physico-chemical parameters	Condition Rating	5	Stock exclusion, fencing ,10 m buffer planting and wetland planting will improve Physico-	0.37	Confident 75-90%	Finite end point	Continue to Column M	2	4	5	0.11	-0.11	0.00	
		1.1c	Ecosystem intactness	Condition Rating	5	Offset wetland extent will remain the same as baseline	0.37	Very confident >90%	Finite end point	Continue to Column M	3	3	5	0.00	-0.11	-0.11	
		1.1d	Browsing and predation	Condition Rating	5	Stock will permanently be excluded	0.37	Confident 75-90%	Finite end point	Continue to Column M	1	5	5	0.21	0.00	0.21	
		1.1e	Dominance of native plants	Condition Rating	5	Replant with native wetland plants including 10 m native buffer planting and a 5 year	0.37	Low confidence >50% <75%	Finite end point	Continue to Column M	1	4	5	0.12	-0.07	0.05	

Figure 2 Indicative location and extent of the proposed offset wetland areas

4 Conceptual restoration design

The proposed offset wetlands will be situated within the downslope portions of TR-W1 and TR-W4 (Figure 2). The BOAM demonstrated that a net gain (NPBV of 0.01) in wetland condition will be achieved through restoration of 0.37 ha of wetland habitat. This extent does not include an additional 10 m native buffer planting where practicable.

Subject to further ground survey, and detailed design in accordance with the final WREP, the following steps will be required to recreate wetland habitat in these locations:

i. Confirmation in detailed design that the wetland hydrological system allows for a wide range of wetland plants to establish and become a self-sustaining native wetland system;
ii. Measures to protect the wetland so it is protected in perpetuity and excludes stock;
iii. Initial and ongoing plant pest control for a period of five years from establishment to minimise exotic plant cover in the wetland; and
iv. Initial and infill planting of an array of wetland and wetland edge native plants to achieve a minimum 80% native wetland plant cover five years from establishment.

4.1 Hydrology

The final layout of the offset wetlands will be undertaken during detailed design by a suitably experienced and qualified ecologist in conjunction with the design engineers. Achieving an optimal hydrological regime in the wetland is critical to the success of the wetland plantings.

4.2 Plantings

The offset wetlands will contain a mosaic of permanently submerged wetland vegetation and low-growing shrubby species with thick, strong root systems that tolerate sediment deposition and frequent periods of inundation (Figure 3). This vegetation shall naturally establish or be planted. These plants will provide ideal wetland bird feeding habitat as well as preventing bank erosion and slowing down surface water flows. Along the margins riparian tree and shrub species will dominate. These trees will provide shade over the water, and habitat protection for wildlife.

Two benchmark wetland types are recommended to be re-created within the proposed offset area of TR-W1 and TR-W4:

i. <u>*Carex - Machaerina* swampland</u>: The majority of the wetland area should be planted with the aim of establishing a vegetation assemblage dominated by *Carex* and *Machaerina* sedges with harakeke, tī kōuka, manuka and *Coprosma* species interspersed throughout. This type of vegetation association is likely to have been present prior to European habitation of the area and subsequent drainage and clearance for farming. Target vegetation communities should therefore be dominated by native wetland species more suited to high levels of nutrients. Other species to plant include giant umbrella sedge, *Machaerina sinclarii, Astelia grandis,* raupō, and *Schoenoplectus tabernaemontani.*
ii. <u>Kahikatea-dominated swamp forest</u>: Along the less saturated and riparian margins planting is intended to be restored to kahikatea-dominated swamp forest. As well as kahikatea, species such as tī kōuka, toetoe, koromiko, putaputaweta, manuka, pukatea, and swamp maire should be utilised. Kahikatea can be planted at relatively high density but should be part of a mix which includes fast-growing small trees and shrubs which will provide some shelter to the larger trees when they are young. Kahikatea forest has a diverse understorey and groundcover flora which

includes small-leaved shrub species such as *Coprosma rigida, C. rotundifolia, Melicytus micranthus, Raukaua anomalus*, and *Melicope simplex* as well as a range of lianes, sedges, and fern species.

The dry, upper slopes of the wetlands will be somewhat restricted in plant selection by the presence of the road and other safety and landscape design restrictions. The target vegetation type here should be dominated by plantings of smaller flowering tree and species such as small-leaved kōwhai, wineberry, and koromiko, as well as occasional pūriri and tītoki where they are unlikely to pose a long-term hazard to the road.

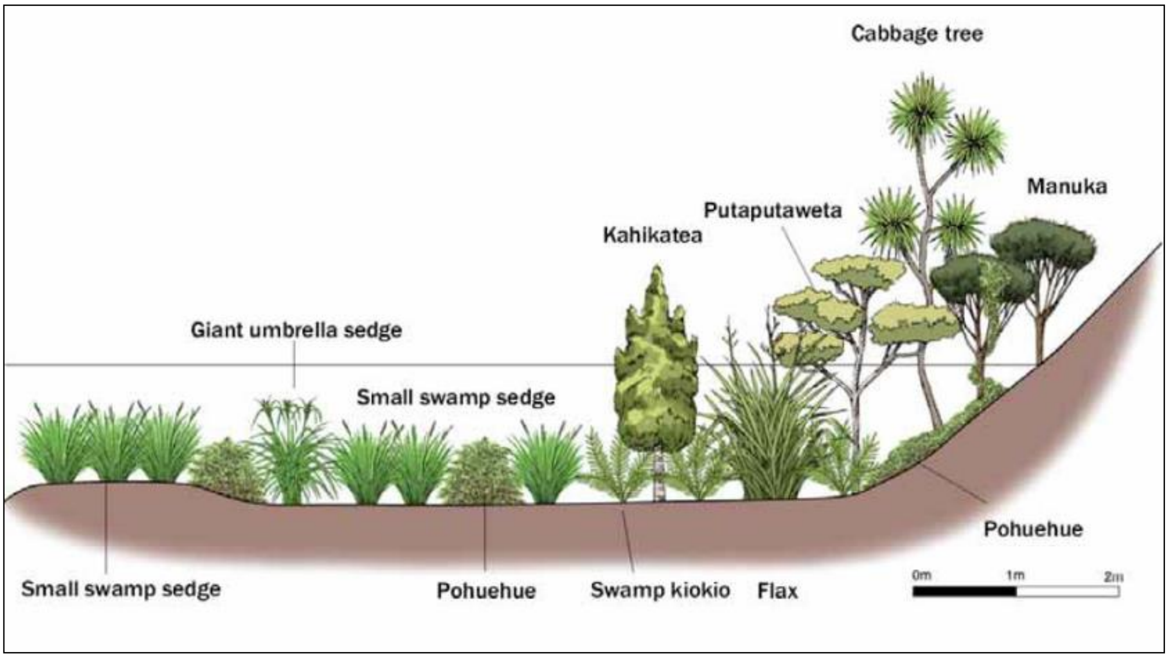

Figure 3 Generalised wetland planting cross-section (Auckland Regional Council, 2001)

Planting schedules and species appropriate for planting in each wetland benchmark community type will be required during detailed design. The planting schedules will need to specify those species that are suitable for initial plantings in each zone and will ensure a relatively fast canopy closure which will assist with weed control. The schedules will also need to include the proportion of the overall mix that each species should contribute to achieving the benchmark wetland communities, along with the recommended grade of plant.

In order to maintain the genetic integrity of the local area all plants used for the wetland project should be grown from seed of naturally occurring species growing in the locality or from other nearby sources within the Auckland Ecological District.

4.3 Maintenance and Pest Control

It is recommended that the wetland is maintained for a minimum period of five years following construction from the date planted to achieve at least 80% cover (over all strata) of indigenous species, with no more than 5% total cover of exotic species in any tier. The species shall be appropriate for all tiers found in a mature habitat, and shall include ground cover, sub canopy and canopy species (where applicable). If monitoring shows that 80% cover has not been achieved after five years of maintenance, the maintenance period shall be extended until that is achieved.

5 References

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6 Limitations

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1 Attachment 1 - Figures

Figure 4 Location and classification of TR-W1 and TR-W4

Figure 5 Indicative location and extent of the proposed offset areas

2 Attachment 2 – Wetland Condition Assessment

Table 3 Wetland condition scores for impact indicators and indicator components for TR-W1 (impact site and offset site)

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
Hydrological integrity	Impact due to manmade structures/drains /changes in water budget and changes to runoff characteristics	4	4	0	4	4	The hydrological integrity of TR-W1 remains largely intact with no observable changes to abstraction, impoundments, changes in hydroperiod (timing, duration, frequency), volumes, inundation of wetland habitats or groundwater changes to the wetland. A small change hydrology due to increased runoff from agricultural land and existing road is reflected in the impact score. Under the potential scenario (fencing and stock exclusion) no material improvement in wetland hydrology is expected. A very high degree of modification to hydrology is expected for post-impact scenario as the wetland will be occupied by the new road embankment. A small extent (<10%) of the offset wetland is affected by a farm pond but overall hydrological integrity remains similar to the impact wetland. The post-offset hydrological integrity expected to improve slightly due to increased surface roughness associated with buffer planting but likely to remain in the same score range.
	Water table depth	-	-	-	-	-	-
	Dryland plant invasion	-	-	-	-	-	-
Mean Score		**4.0**	**4.0**	**0.0**	**4.0**	**4.0**	-
Physico-chemical parameters	Fire damage	-	-	-	-	-	-
	Degree of sedimentation	-	-	-	-	-	-
	Nutrient levels	2	3	0	2	4	Point and diffuse sources of nutrients from agricultural landuse and road runoff. The potential wetland health can improve through stock exclusion.

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
							Nutrient levels for the offset wetland is similar to the impact wetland as it drains the same catchment. The post-offset nutrient levels are expected to improve notably due to stock exclusion and additional filtration through buffer planting.
	Von Post index	-	-	-	-	-	-
Mean Score		**2.0**	**3.0**	**0.0**	**2.0**	**4.0**	-
Change in ecosystem intactness	Loss in area of original wetland	3	3	0	3	3	Moderate increase in runoff due to surface roughness changes associated with agriculture likely resulted in some reduction in wetland extent relative to benchmark. No notable increase in wetland extent is considered achievable under the potential scenario (fencing of the wetland). Changes in wetland extent for the offset wetland (prior to actual offset) is similar to that of the impact wetland (prior to impact) as the offset wetland is an extension of the impact wetland. Offset action will not result in a notable increase in wetland extent and is therefore allocated the same impact score.
	Connectivity barriers	-	-	-	-	-	-
Mean Score		**3.0**	**3.0**	**0.0**	**3.0**	**3.0**	-
Change in browsing, predation, and harvesting regimes	Damage by domestic or feral animals	1	4	4	1	5	Baseline wetland condition notably affected by grazing pressure. Stock exclusion through fencing under the potential scenario will improve wetland condition (although fencing alone will not prevent grazing by introduced pests such as possum, rabid and hare). Grazing pressure (under the impact scenario) scored the same for the pre-impact wetland as impact will not increase grazing pressure (therefore further deteriorating wetland habitat quality).

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
	Introduced predator impacts on wildlife	-	-	-	-	-	-
	Harvesting levels	-	-	-	-	-	-
Mean Score		**1.0**	**4.0**	**4.0**	**1.0**	**5.0**	-
Change in dominance of native plants	Introduced plants	1	2	0	1	4	The baseline cover for the wetland to be impacted is exotic grasses and shrubs with no native species contingent. Therefore, the highest (most severe) impact score is allocated). The wetland potential scenario presumes fencing which by itself will not increase the representation of native species. However, some native recruitment is likely through stock exclusion alone and a slightly higher category impact score is allocated for the potential wetland. The impact is not going to increase the representation of introduced species and is therefore allocated the same impact score as the baseline for the impact wetland. The offset wetland (prior to offset) have the same dominance of introduced plants as the impact wetland. Successful implementation of the restoration plan will result in native plant dominance. The Impact score reflects some contingency for resilient introduced plants.
	Introduced plant understorey cover	-	-	-	-	-	-
Mean Score		**1.0**	**2.0**	**0.0**	**1.0**	**4.0**	-
Total Wetland Condition Index/25		**11.0**	**16.0**	**2.0**	**11.0**	**20.0**	-
Condition Index (%)		**44.00%**	**64.00%**	**16.00%**	**44.00%**	**80.00%**	-
Condition Index Category		**Largely**	**Moderately**	**Critically**	**Largely**	**Largely natural**	-

Table 4 BOAM input summary for TR-W1

Impact Indicator	Impact Site TR-W1: Before Impact (0.1 ha)	Impact Site TR-W1: Potential	Impact Site TR-W1: Before Impact (0.1 ha)	Impact Site TR-W1: Potential	Impact Site TR-W1: Before Impact (0.1 ha)
Hydrological integrity	4	4	0	4	4
Physico-chemical parameters	2	3	0	2	4
Ecosystem intactness retained	3	3	0	3	3
Browsing, predation and harvesting regimes	1	4	4	1	5
Dominance of native plants	1	2	0	1	4

Table 5 Wetland condition scores for impact indicators and indicator components for TR-W4 (impact site and offset site)

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
Hydrological integrity	Impact due to manmade structures/drains /changes in water budget and changes to runoff characteristics	4	4	0	4	4	The hydrological integrity of TR-W4 remains largely intact with no observable changes to abstraction, impoundments, changes in hydroperiod (timing, duration, frequency), volumes, inundation of wetland habitats or groundwater changes to the wetland. A small change hydrology due to increased runoff from agricultural land and existing road is reflected in the impact score. Under the potential scenario (fencing and stock exclusion) no material improvement in wetland hydrology is expected. A very high degree of modification to hydrology is expected for post-impact scenario as the wetland will be occupied by the new road embankment. A small extent (<10%) of the offset wetland affected by a farm pond but overall hydrological integrity similar to the impact wetland. The post-offset hydrological integrity expected to improve slightly due to increased surface roughness associated with buffer planting but likely to remain in the same score range.

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
	Water table depth	-	-	-	-	-	-
	Dryland plant invasion	-	-	-	-	-	-
Mean Score		**4.0**	**4.0**	**0.0**	**4.0**	**4.0**	-
Physico-chemical parameters	Fire damage	-	-	-	-	-	-
	Degree of sedimentation	-	-	-	-	-	-
	Nutrient levels	2	3	0	2	4	Point and diffuse sources of nutrients from agricultural landuse and road runoff. The potential wetland health can improve through stock exclusion. Nutrient levels for the offset wetland is similar to the impact wetland as it drains the same catchment. The post-offset nutrient levels are expected to improve notably due to stock exclusion and additional filtration through buffer planting.
	Von Post index	-	-	-	-	-	-
Mean Score		**2.0**	**3.0**	**0.0**	**2.0**	**4.0**	-
Change in ecosystem intactness	Loss in area of original wetland	3	3	0	3	3	Moderate increase in runoff due to surface roughness changes associated with agriculture likely resulted in some reduction in wetland extent relative to benchmark. No notable increase in wetland extent is considered achievable under the potential scenario (fencing of the wetland). Changes in wetland extent for the offset wetland (prior to actual offset) is similar to that of the impact wetland (prior to impact) as the offset wetland is an extension of the impact wetland.

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
							Offset action will not result in a notable increase in wetland extent and is therefore allocated the same impact score.
	Connectivity barriers	-	-	-	-	-	-
Mean Score		**3.0**	**3.0**	**0.0**	**3.0**	**3.0**	-
Change in browsing, predation, and harvesting regimes	Damage by domestic or feral animals	1	4	4	1	5	Baseline wetland condition notably affected by grazing pressure. Stock exclusion through fencing under the potential scenario will improve wetland condition (although fencing alone will not prevent grazing by introduced pests such as possum, rabid and hare). Grazing pressure (under the impact scenario) scored the same for the pre-impact wetland as impact will not increase grazing pressure (therefore further deteriorating wetland habitat quality).
	Introduced predator impacts on wildlife	-	-	-	-	-	-
	Harvesting levels	-	-	-	-	-	-
Mean Score		**1.0**	**4.0**	**4.0**	**1.0**	**5.0**	-
Change in dominance of native plants	Introduced plants	1	2	0	1	4	The baseline cover for the wetland to be impacted is exotic grasses and shrubs with no native species contingent. Therefore, the highest (most severe) impact score is allocated). The wetland potential scenario presumes fencing which by itself will not increase the representation of native species. However, some native recruitment is likely through stock exclusion alone and a slightly higher category impact score is allocated for the potential wetland. The impact is not going to increase the representation of introduced species and is therefore allocated the same impact score as the baseline for the impact wetland.

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
							The offset wetland (prior to offset) have the same dominance of introduced plants as the impact wetland. Successful implementation of the restoration plan will result in native plant dominance. The Impact score reflects some contingency for resilient introduced plants.
	Introduced plant understorey cover	-	-	-	-	-	-
Mean Score		**1.0**	**2.0**	**0.0**	**1.0**	**4.0**	-
Total Wetland Condition Index/25		**11.0**	**16.0**	**2.0**	**11.0**	**20.0**	-
Condition Index (%)		**44.00%**	**64.00%**	**16.00%**	**44.00%**	**80.00%**	-
Condition Index Category		**Largely**	**Moderately**	**Critically**	**Largely**	**Largely natural**	-

Table 6 BOAM input summary for TR-W4

Impact Indicator	Impact Site TR-W4: Before Impact (0.078 ha)	Impact Site TR-W4: Potential (0.078 ha)	Impact Site TR-W4: After Impact (0.078 ha)	Offset Site TR-W4: Before Offset (0.1 ha)	Offset Site TR-W4: After Offset (0.1 ha)
Hydrological integrity	4	4	0	4	4
Physico-chemical parameters	2	3	0	2	4
Ecosystem intactness retained	3	3	0	3	3

Impact Indicator	Impact Site TR-W4: Before Impact (0.078 ha)	Impact Site TR-W4: Potential (0.078 ha)	Impact Site TR-W4: After Impact (0.078 ha)	Offset Site TR-W4: Before Offset (0.1 ha)	Offset Site TR-W4: After Offset (0.1 ha)
Browsing, predation and harvesting regimes	1	4	4	1	5
Dominance of native plants	1	2	0	1	4

Table 7 BOAM input summary for combined extent and averaged scores for TR-W1 and TR-W4

Impact Indicator	Impact Site TR-W1 & TR-W2	Impact Site TR-W1 & TR-W4: Potential (0.178 ha)	Impact Site TR-W1 & TR-W4: After Impact (0.178 ha)	Offset Site TR-W1 & TR-W4: Before Offset (0.37 ha)	Offset Site TR-W1 & TR-W4: After Offset (0.37)
Hydrological integrity	4	4	0	4	4
Physico-chemical parameters	2	3	0	2	4
Ecosystem intactness retained	3	3	0	3	3
Browsing, predation and harvesting regimes	1	4	4	1	5
Dominance of native plants	1	2	0	1	4

3 Attachment 3 - Definition and attribute justifications for the Biodiversity Accounting Model

Table 8 Impact Model - data inputs used to determine an overall biodiversity loss score at the impact site

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
Biodiversity Type	*Biodiversity Type describes the key biodiversity features of concern found at the Impact Site and can include ecosystems, habitats, or species. Examples include: Lowland podocarp-hardwood forest, or a river and riparian ecosystem. Threatened and iconic species and rare or special features may also be listed as Biodiversity Types.*	Palustrine wetland has been used as our biodiversity type, as this is the overarching hydro system classification of the wetlands.
Biodiversity Component	*Identify and input Biodiversity Components to help describe what makes up the Biodiversity Type. Examples of components include: vegetation tiers, habitat types, related groups of indigenous species, or functional roles (insectivore/predator, nectarivore/pollinator and frugivore/seed disperser).*	Wetland habitat quality has been used as the biodiversity component. Habitat quality is based on attribute categories that are aligned at both the impact and offset sites (Clarkson et al., 2003).
Biodiversity Attribute	*Identify and input Biodiversity Attributes as measures of the condition or the quantity of the Biodiversity Component. The Biodiversity Attributes are the measures balanced in this accounting system to demonstrate no net loss.*	Attribute categories (based on Clarkson et al., 2003) included: – Change in hydrological integrity. – Change in physicochemical parameters. – Change in ecosystem intactness. – Change in browsing, predation and harvesting regimes. – Change in dominance of native plants. These index scores have been directly inserted in the Input Model of the BOAM as suitable "Biodiversity Attributes" which are measures of the condition and the quantity of the wetlands Biodiversity Attributes.
Measurement Unit	*Enter measurement Units for each Biodiversity Attribute. For example, if the Attribute is 'number of adults' the Measurement Unit would be a count. If the Attribute is 'spatial extent of a vegetation tier', the Measurement Unit might be percent. For each attribute, the same measurement units must be used in the Impact and Offset Models.*	Impact scores for each attribute were as per Clarkson et al. (2004): Degree of modification in wetland: **Descriptor** – **Score** Very High – 1 High – 2 Medium – 3 Low – 4 Very Low – 5
Area of Impact (ha)	*Measure and input the extent of habitat or area (ha) supporting the Biodiversity Type and over which the Biodiversity Attribute*	Area of impact assumes the permanent loss of a portion of wetlands TR-W1 (0.1 ha) and TR-W4 (0.078 ha). Embedded

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
	will be impacted by the proposal. For example, if the Biodiversity Type is a threatened plant species, the area of Impact is the total area (ha) of the vegetation community supporting that species that will be affected by the proposed impact, not just the summed area occupied by individual plants.	controls for stormwater management and erosion and sediment control during construction and operation mitigate for the 'indirect' effects associated with potential hydrology and water quality effects. Similarly, embedded controls also compensate for the loss of functional wetland services related to flood attenuation, sediment control and water purification. The area of impact is therefore limited to the permanent loss of wetland habitat directly associated with the construction footprint.
Benchmark	*Input Benchmark values specific to each Biodiversity Attribute. Measurements of ecological condition or quality require reference to a benchmark state that reflects a 'natural' or 'pristine' or other desirable condition.Benchmarks are ideally measured, from a real site of the same vegetation community type of the Impact and Offset Site, and be a site that has been under sustained conservation management or be of the highest possible condition value.*	Benchmark state equates to best possible examples of wetland ecosystem types currently present and the restoration potential of the site, e.g., a future state of mature indigenous wetland ecosystem types with the full potential complement of indigenous species. To be consistent with the Clarkson et al. (2003) wetland impact score, a benchmark score of 5 has been applied and represents a Very Low impact state.
Measure prior to Impact	*Measure and input the measured value of the Biodiversity Attribute at the Impact Site prior to the proposed Impact occurring. This is the measure of biodiversity loss in the loss/gain calculation. The value is expressed in the stated Measurement Unit (Column F), using the same method of measurement as for the Benchmark. If the Impact to the Attribute is total loss, enter a value of zero.*	Assessment of **potential** wetland habitat condition against the benchmark condition. This is a theoretical condition assessment based on expected improvements in wetland condition if stock is excluded from the wetland through fencing.
Measure after Impact	Estimate and input the predicted value of the Attribute at the Impact Site following the proposed Impact. The value is expressed in the stated Measurement Unit (Column F), using the same method of measurement as for the Benchmark. The quantum of Impact may be derived from the Assessment of Environmental Effects, or predictive models may be needed to inform this value. Experts with expertise relevant to each Biodiversity Attribute may be able to confidently estimate post Impact values.	Assumes the value of each condition attribute within the development footprint will be reduced to zero with total removal in the impact footprint. Attributes that will not be affected by the road construction (for example 'Browsing pressure' and 'Dominance of native plants' in the wetland have the same post impact scores).
Biodiversity value	This is the calculated value of the Biodiversity Attribute at the Impact Site following the Impact. Attribute biodiversity value is the measure of the Attribute after the Impact, relative to the measure prior to the Impact, and adjusted in proportion to the Benchmark. Any Attribute value greater than the Benchmark value is truncated to 1 within the equation. This	As per the output of the model's calculation.

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
	change in biodiversity value is then multiplied across the area of proposed Impact.	

Table 9 Offset Model - data inputs used to determine an overall biodiversity gain at the restoration site

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
Biodiversity Type	*The Offsets Model will auto populate this cell with the text entered the Impact Model.*	No deviation from model explanation.
Discount Rate	*Enter a discrete discount rate before any other values are entered into the Offset Model. The same discount rate applies to all Biodiversity Types, Components, and Attributes in the Offset Model. For more discussion on discount rates see the Good Practice Guidance.*	A discount rate of 3% has been applied. This rate is considered appropriate given the risk and uncertainty associated with this specific offset.
Biodiversity Component	The Offsets Model will auto populate this cell within the text entered in the Impact Model.	No deviation from model explanation.
Biodiversity Attribute		
Measurement Unit		
Benchmark		
Proposed Offset Actions	*Define and Input brief detail of the action(s) (management intervention) proposed to Offset Impact. Further detail can be provided in supporting documentation.*	Broad restoration measures are presented in the memo and will be detailed in a WREP as part of the NoR/resource consent condition requirements. However, it is assumed that proposed offset actions include but are not limited to stock exclusion through fencing, native revegetation, or native enrichment plantings, weed pest control for five years (limited to invasive weeds and shrubs in accordance with commonly applied targets) and 10 m buffer planting around each wetland where practicable to do so.
Offset area (ha)	Input the area (in hectares) over which the Offset activity related to this Biodiversity Attribute will be implemented. The same Offset activity, and therefore the same area over which the Offset activity is to be implemented, can apply to more than one Attribute.	Offset reach: TR-W1 - 0.27 ha Offset reach: TR-W4 - 0.1 ha Combined area applied in the BOAM - 0.37 ha
Confidence in Offset Actions	*Estimate and input the likelihood that the proposed Offset Action (Column H) will be successful within the specified time estimate (Column O). This reflects that even with proven management techniques some uncertainty around*	Confidence levels were congruent with the likely success of the proposed offset and the time till endpoint: The following confidence levels were applied:

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
	outcomes is always present e.g., restoration plantings may fail due to unanticipated drought or pest pressures, or possum control targets may not be met due to bait interference by an unexpectedly high rat population. This confidence level does not include risk of default or failing to implement the proposed Offset Actions. *Choose a confidence rating from the dropdown list, as follows:* ***Low confidence**: The proposed Offset Action uses methods that have either been successfully implemented in New Zealand or in the situation and context relevant to the Offset Site but infrequently, or the outcomes of the proposed Offset Action are not well proven or documented, or success rates elsewhere have been shown to be variable. Likelihood of success is > 50% but < 75%.* ***Confident**: The proposed Offset Action uses well known and often implemented methods which have been proven to succeed greater than 75% of the time although enough complicating factors and/or expert opinion exists to not have greater confidence in this Offset Action. Likelihood of success is greater than 75% but less than 90%.* ***Very confident**: The proposed Offset Action uses methods that are well tested and repeatedly proven to be very reliable for the situation and context relevant to the Offset Site; evidence-based expert opinion is that success is very likely. Likelihood of success is > 90%.*	Confidence 75-90% assigned to hydrological integrity, physico-chemical improvements and browsing pressure within five years. Residual uncertainty relates to other browsing pressure other than stock and the wetland vegetation response to stock exclusion Confidence >90% assigned to ecosystem intactness as it is relatively certain the the existing extent of the wetland will remain approximately the same. Confidence >50<75% assigned to dominance of native plants within a five year period.
Time period over which to calculate NPBV	Decide whether to run calculations across five yearly time-steps for 35 years, or at a finite, user defined end point. The time-step calculation is limited to 35 years to reflect the maximum life of a resource consent. The finite end point is not time restricted. It is important to consider that management required to maintain the Offset over the long-term may be necessary beyond the time taken to demonstrate no net loss.	Finite end point.
Measure prior to Offset	*Measure and input the value of the Biodiversity Attribute at the Offset Site prior to the proposed Offset Action being implemented, expressed in the Measurement Unit (Column F). The methods/models used to measure the Attribute at the Offset Site need to be identical to those used to measure the same Attribute at the Impact Site.*	Based on the average attribute condition scores (baseline) for the offset wetlands as per the condition assessment for each attribute.

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
Measure after the Offset	*Estimate and input the value of the Biodiversity Attribute at the Offset Site following the proposed Offset Action at the finite end point — the time at which the Offset Action is anticipated to have achieved the stated objective (Column O), expressed in the Measurement Unit (Column F). Predictive models may be needed to inform this measure. Experts with expertise relevant to each Biodiversity Attribute may be able to estimate future measures.*	Based on the theoretical condition assessment for each of the attributes give the implementation of the proposed restoration plan.
Time till end point (years)	*Predict and input the anticipated number of years (from the time of implementing the Offset Action) until the Offset Action is expected to achieve the Offset goal.*	Time till endpoint (time between restoration action and biodiversity value realized) was allocated as five years.
Biodiversity Value at Offset Site	*This is the difference between the future value of the Attribute after the Offset action (Column N) and the current value of the Attribute at the Offset Site prior to the Offset being implemented (Column M). This change in Attribute value is calculated as a proportion of the Benchmark (Column G). Any Attribute value greater than the Benchmark is truncated to 1. The proportional raw gain is adjusted to the level of confidence in the Offset Actions succeeding, by multiplying the raw gain by the midpoint of the confidence range (Column J). This calculation also incorporates the time preference discount rate (cell E11) and the time taken to reach the stated objective for the Offset Action (Column O). The gain in value is multiplied across the Offset Area (Column I) to give a final Attribute value.*	No deviation in approach from model explanation.
Biodiversity Value at Impact Site	*This value is imported from the corresponding Impact Model and feeds into the Offset Model spreadsheet (Column R).*	
Attribute Net Present Biodiversity Value	*The Net Present Biodiversity Value (NPBV) is determined for each Attribute by calculating the difference between the Attribute biodiversity value at the Offset Site and at the Impact Site to give the net change in biodiversity value over time. A no net loss biodiversity exchange is demonstrated when this value is equal to or greater than zero. Negative values demonstrate a net loss, positive values demonstrate a net gain.* *Where the five yearly time-step option is chosen (Offset Model_5 yearly), this cell is populated with the Attribute NPBV value at the point that is equal or greater than zero or, when a equal or greater than*	

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
	zero NPBV is not reached, the NPBV at Year 35.	
Component Net Present Biodiversity Value	*The NPBV for each component is calculated by averaging the NPBV of all the Attributes used to account for the Biodiversity Component (whether they were calculated using a finite end point or a five yearly time-step). All Biodiversity Attributes are equally weighted.*	

ATTACHMENT 19

TRIG ROAD CORRIDOR UPGRADE
ASSESSMENT OF STORMWATER EFFECTS

Supporting Growth

Trig Road Corridor Upgrade

Assessment of Stormwater Effects

Version 1.0

December 2022

TE TUPU NGĀTAHI Supporting Growth

WAKA KOTAHI NZ TRANSPORT AGENCY

Document Status

Version no.	Responsibility	Name
2020 Draft	Author	Nadine Wolfaardt
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	Reviewer	Mike Summerhays
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1.0	December 2022	Final for Lodgement

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Acronyms

Acronym/Term	Description
AEE	Assessment of Effects on the Environment
AEP	Annual Exceedance Probability
ARI	Annual Recurrence Interval = average period between exceedances of a given flow or rainfall
AT	Auckland Transport
AUP: OP	Auckland Unitary Plan Operative in Part 2016
CoP	Code of Practice
GD01	Stormwater Management Devices in the Auckland Region - Guideline Document 2017/001
HIRDS	High Intensity Rainfall Design System
MPD	Maximum Probable Development
NoR	Notice of Requirement
RMA	Resource Management Act 1991
SH18	State Highway 18
SMAF 1	Stormwater Management Area – Flow 1
SMAF 2	Stormwater Management Area – Flow 2
TDM	Transport Design Manual
TP108	Technical Publication 108: Guidelines for Stormwater Runoff Modelling in the Auckland Region
W3P	Whenuapai 3 Precinct

1 Introduction

1.1 Background

Auckland's population is growing rapidly; driven by both natural growth (more births than deaths) and migration from overseas and other parts of New Zealand. The Auckland Plan 2050 anticipates that this growth will generate demand for an additional 313,000 dwellings and require land for approximately 263,000 additional employment opportunities.

In response to this demand, the Auckland Unitary Plan Operative in Part 2016 (**AUP: OP**) identifies 15,000 hectares of predominantly rural land for future urbanisation. To enable the urban development of greenfield land, appropriate bulk infrastructure needs to be planned and delivered.

The Supporting Growth Programme is a collaboration between Auckland Transport (**AT**) and Waka Kotahi NZ Transport Agency, to investigate, plan and deliver the transport networks needed to support Auckland's future urban growth areas over the next 30 years.

1.2 Purpose of this Report

This report has been prepared to support AT's notice of requirement (**NoR**) and application for resource consents for the Trig Road Corridor Upgrade (the **Project**). The NoR under the Resource Management Act 1991 (**RMA**) is to designate land for the construction, operation and maintenance of the Project.

Trig Road, Whenuapai has been identified in the Supporting Growth Programme as a future arterial corridor that is needed to support the urban development of Whenuapai.

Funding for the upgrade of Trig Road between Hobsonville Road and State Highway 18 (**SH18**) has been made available through the Housing Infrastructure Fund (HIF)[1]. As there is funding available for construction, AT are also applying for the necessary resource consents under the RMA, concurrently with the NoR process.

This report provides an assessment of stormwater effects associated with the construction, operation and maintenance of the Project. This assessment has been prepared to inform the Assessment of Environmental Effects (**AEE**) for the NoR and regional resource consent applications.

The key matters addressed in this report are as follows:

(a) Identify and describe the existing stormwater environment;
(b) Describe the actual and potential adverse stormwater effects of operation of the Project;
(c) Describe the actual and potential adverse stormwater effects of construction of the Project;
(d) Recommend measures as appropriate to avoid, remedy or mitigate potential adverse stormwater effects (including any conditions/management plan required); and
(e) Present an overall conclusion of the level of potential adverse stormwater effects of the Project after recommended measures are implemented.

[1] See North West Housing Infrastructure Fund Assessment of Environmental Effects for further detail regarding the Housing Infrastructure Fund.

2 Project Description

2.1 Project Location

Trig Road is located in Whenuapai, a suburb in the North West area of Auckland. The full length of Trig Road is approximately 2.28km starting from the urban fringe of West Harbour, at the intersection on Hobsonville Road to the south, crossing SH18, and extending towards Brigham Creek Road intersection to the north.

The project area is shown in Figure 1 below, it covers the southern portion of Trig Road between Hobsonville Road and SH18 and a portion of Hobsonville Road between the intersection between Trig Road and Luckens Road.

Figure 1: Locality Plan

2.2 Project Description

The Project consists of the widening and upgrade of Trig Road transport corridor between the SH18 off-ramps and Hobsonville Road. The widening has capacity to provide for a two-lane arterial standard corridor including new footpaths on both sides of the road and a cycleway which is indicatively shown as a bi-direction cycleway on the eastern side of the corridor. The Project will upgrade the current rural standard corridor, currently 20m wide, to an urban standard, proposed to be approximately 22.4 to 24.8m wide, which is appropriate to support the soon to be urban environment on either side of Trig Road.

To safely tie into the existing road network, the Project also includes the signalisation of the intersections at Trig Road / Hobsonville Road and Luckens Road / Hobsonville Road and upgrade of Hobsonville Road between these intersections. This will require some localised widening of the road corridor along Hobsonville Road. The SH18 over-bridge will also be reconfigured to provide for a cycleway, and additional tie in works to the north of the over-bridge within the existing road reserve.

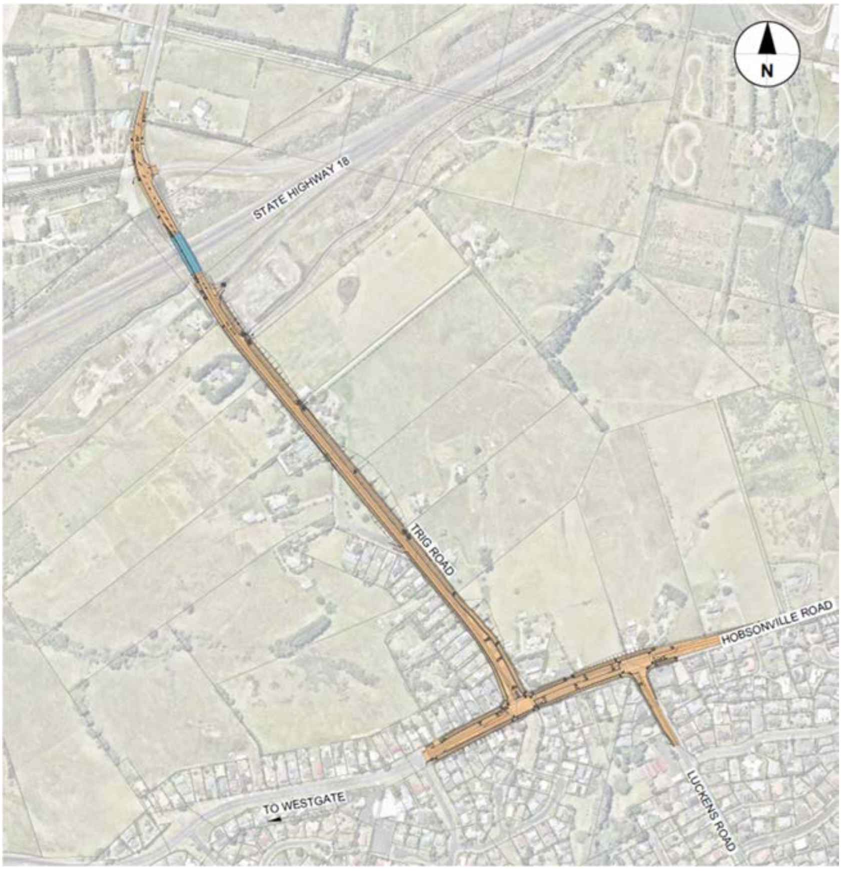


Figure 2: Whenuapai – Trig Road Corridor Upgrade

2.3 Project Features

2.3.1 Cross-Section

The indicative existing Trig Road corridor consists of a ±7m wide two-lane road and 1.5m footpath along the majority of the western side of the road length. While the final layout of the upgraded corridor will be confirmed as part of detailed design, a typical 24m wide cross-section has been developed for the corridor. Refer to Figure 3.

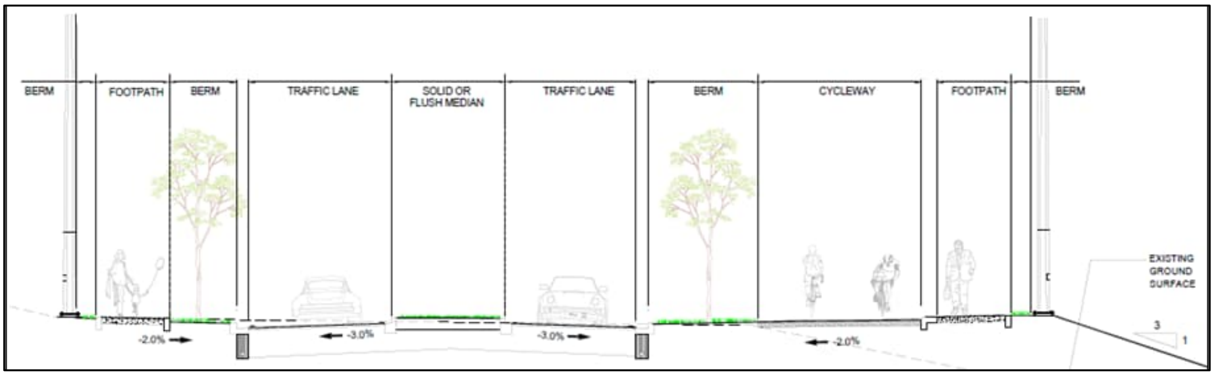


Figure 3: Indicative Trig Road Cross Section

2.3.2 Stormwater Infrastructure

The upgrades to Trig Road will induce necessary upgrades to the existing stormwater infrastructure, allowing for upgrades to accommodate future urban development, and new stormwater management devices. In summary, the specific stormwater infrastructure elements associated with the upgrade of Trig Road will include the following:

- Replacement and upgrading of three existing stormwater culverts under Trig Road, including energy dissipating outfalls
- Construction of new primary stormwater network within the new Trig Road corridor, as well as for portions of Hobsonville Road to be widened
- Installation of new stormwater treatment devices
- Construction of a new dry attenuation pond with energy dissipating outfall to Trig Stream (wetland)

These elements will be discussed in further detail in chapters to follow and are shown in Appendix 2 Stormwater Drawings.

2.4 Indicative Construction Methodology

An indicative construction methodology has been prepared to inform the assessment of the Project and, while subject to change, assists in determining the envelope of effects. An overview of the construction methodology is set out in the AEE. The final construction methodology for the Project will be confirmed during the detailed design phase and finalised once a contractor has been engaged for the work.

A summary of the key components of the indicative construction methodology relevant for this report is outlined in the sub-sections below.

2.4.1 General Construction Overview

The total construction phase of the Project is expected to take approximately 18 to 24 months. It is anticipated that the works will be broken down into separate construction zones based on the type of works required and the nature of the work environment. These anticipated zones are:

- **Zone 1:** Trig Road North of the SH18 bridge
- **Zone 2:** Trig Road South including the SH18 bridge
- **Zone 3:** Hobsonville Road.

2.4.1.1 Construction Methodology

Each zone has different construction activities depending on the type of work to be done and the surrounding environment. In all cases the general sequence of construction is likely to be:

1. Divert or remove services
2. Construct permanent stormwater drainage crossings and environmental controls
3. Move traffic away from works longitudinally
4. Construct earthworks and retaining structures

5. Construct new longitudinal drainage
6. Construct new pavement to half of the road
7. Move traffic onto newly constructed pavement
8. Complete longitudinal drainage
9. Complete pavement and median
10. Move traffic to new alignment
11. Complete footpath and cycleway

3 Assessment Criteria

3.1 Statutory Context

3.1.1 Notice of Requirement

This assessment has been prepared to support the NoR process for the Project. Section 171 of the RMA sets out the matters that must be considered by a territorial authority in making a recommendation on a NoR. This includes consideration of the actual or potential effects (including positive effects) on the environment of allowing the requirement.

3.1.2 Regional Resource Consent Application

AT are also seeking regional resource consents under the AUP: OP and resource consent under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health and National Environmental Standard for Freshwater. The required consents are set out in Section 3.5 of the AEE.

Overall, the application is a Discretionary Activity, therefore in accordance with section 104B of the RMA, Council is not restricted in its discretion when assessing the actual or potential effects associated with the Project.

Notwithstanding Council's unrestricted discretion, the relevant matters of discretion, matters of control, and assessment criteria have been used as a guideline to direct the assessment of effects associated with each trigger for consent.

3.2 Relevant Standards and Guidelines

The following standard documents, guidelines and codes of practice were utilised in the stormwater design development process for the Project:

- AUP: OP – Particularly with regard to:
    - Chapter E1: Water Quality and Integrated Management
    - Chapter E3: Lakes, Rivers, Streams and Wetlands
    - Chapter E8: Stormwater – Discharge and Diversion
    - Chapter E9: Stormwater Quality – High Contaminant Generating Car Parks and High Use Roads
    - Chapter E10: Stormwater Management Area – Flow 1 and Flow 2 (**SMAF 1** and **SMAF 2**)
    - Chapter E26: Infrastructure
    - Chapter E36: Natural Hazards and Flooding
- Auckland Council Stormwater Bylaw 2015
- Auckland Stormwater Network Discharge Consent
- Region-Wide Network Discharge Consent and Associated Catchment Plans
- Auckland Council Code of Practice (**CoP**) for Land Development and Subdivision, Chapter 1- General Requirement and Procedures
- Auckland Council CoP for Land Development and Subdivision, Chapter 4 – Stormwater

- Auckland Council CoP for Land Development and Subdivision, Chapter 7 – Green Infrastructure
- AT CoP for Land Development and Subdivision, Chapter 3 – Transportation
- Transport Design Manual (**TDM**): Road Drainage and Surface Water Control
- Austroads: Guide to Road Design Part 5A: Drainage – Road Surface, Networks, Basins and Subsurface
- Technical Publication No. 108: Guidelines for Stormwater Runoff Modelling in the Auckland Region
- Stormwater Management Devices in the Auckland Region - Guideline Document 2017/001 (**GD01**)

4 Receiving Environment

4.1 Approach to Receiving Environment

A key objective of the Supporting Growth Programme is to protect land now to ensure that the transport networks required to support growth areas in the future, around Auckland, can be provided in an efficient and co-ordinated manner. This Project supports the development of housing in the immediate vicinity of Trig Road and has funding to be constructed in the near future.

In the context of an RMA assessment process, considering the environment as it exists today will not be a true reflection of the real-world environment in which the transport corridor will operate. Accordingly, when considering the environment within which the effects of the construction and operation of the transport corridor are likely to occur, this assessment considers both the existing environment and the likely future environment for the Project area.

Within the Project area there are a range of zones under the AUP: OP which influence the existing and likely future land use patterns for assessment purposes. The Whenuapai Structure Plan signals that the Future Urban zoned land adjacent to Trig Road is likely to contain new medium density and higher density housing. A large suburban park (between 3-5 hectares in size) is proposed on the Western side of Trig Road. Table 1 below provides a summary of the existing and likely future environment as it relates to the Project area.

Table 1: Existing and Future Environment Likelihood of Change

Project area	Environment today	Current Zoning	Likelihood of Change	Likely Future Environment
Context A	Rural	Future Urban	High	Urban
Context B	Urban – Low Density	Future Urban	High	Urban
Context C	Urban – Medium Density	Urban	Moderate	Urban
Context D	Urban	Urban	Moderate	Urban

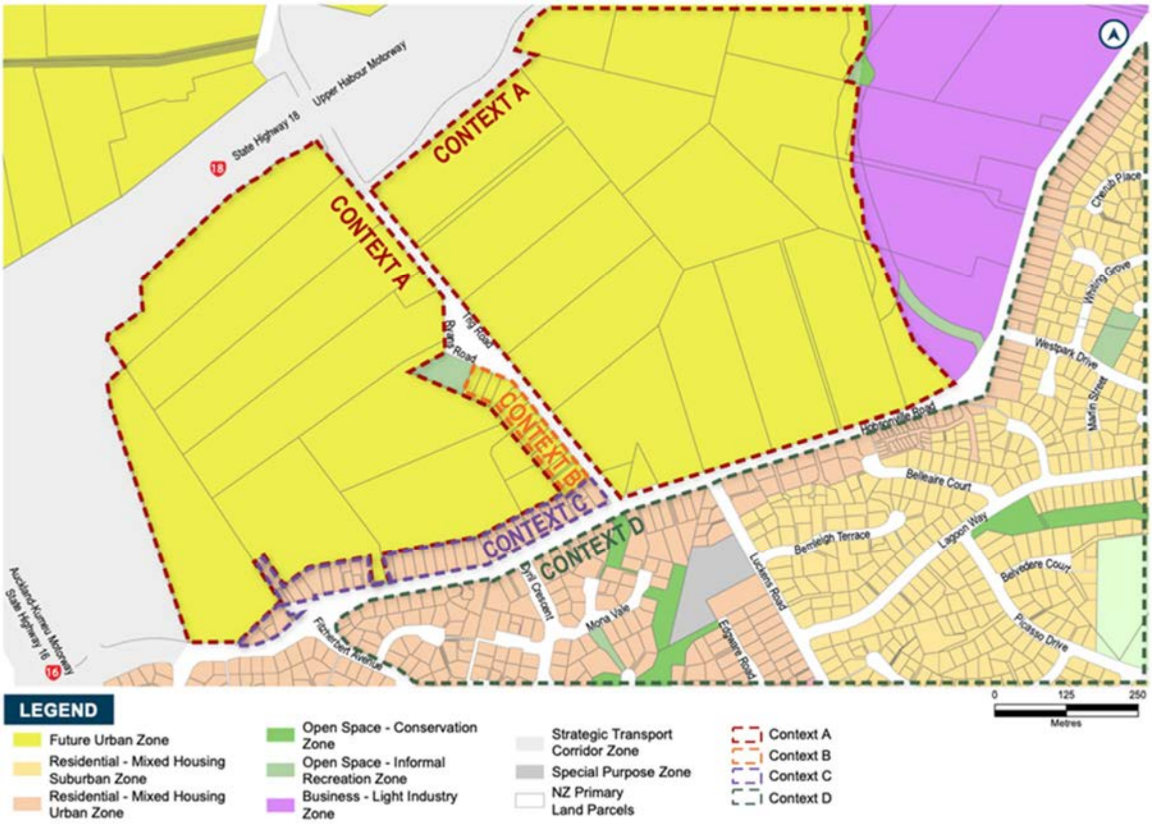


Figure 4: Existing / Future Zoning Scenarios

4.2 Existing Stormwater Management

The stormwater design for Trig Rd aimed at achieving the Healthy Waters Regionwide Network Discharge Consent (NDC) requirements for quality (treatment) and quantity (attenuation). Treatment and attenuation have been allowed for the full proposed road carriageway to meet the NDC requirements.

This section of the report will identify the existing stormwater environment of Trig Road and surrounds and identify:

- existing catchment receiving environments;
- existing stormwater management issues; and
- existing stormwater infrastructure.

4.2.1 Existing Ground Conditions

Soil classifications obtained from the New Zealand Geology Maps indicated two main soil groups in the Trig Road area. The two main soil groups are as follows (GNS Science, 2018):

- East Coast Bays Formation (Waitemata Group) forming in the steeper slopes. This group consists of a variation of interbedded, graded sandstone and siltstone, or mudstone and sandstone, as well as local intercalated volcanic grit.
- Puketoka Formation forming in the gentle slopes and low-lying areas. Undifferentiated alluvium can be found in gullies and within flood plains around streams.

These soils comprise of areas of both low permeability as well as pockets with high soakage potential.

4.2.2 Topography, Catchments, Drainage and Receiving Environments

The Whenuapai catchment topography has been identified as a predominately low-lying catchment, with mostly flat to rolling landscapes, with localised areas of steeper terrain mainly to the south. Figures 5 and 6 below indicate the contours, typical topographical flow paths and major receiving waterbodies for the Project area and its surrounding catchment areas with Trig Road highlighted in Figure 5 below.

Figure 5: Whenuapai Catchment Boundary

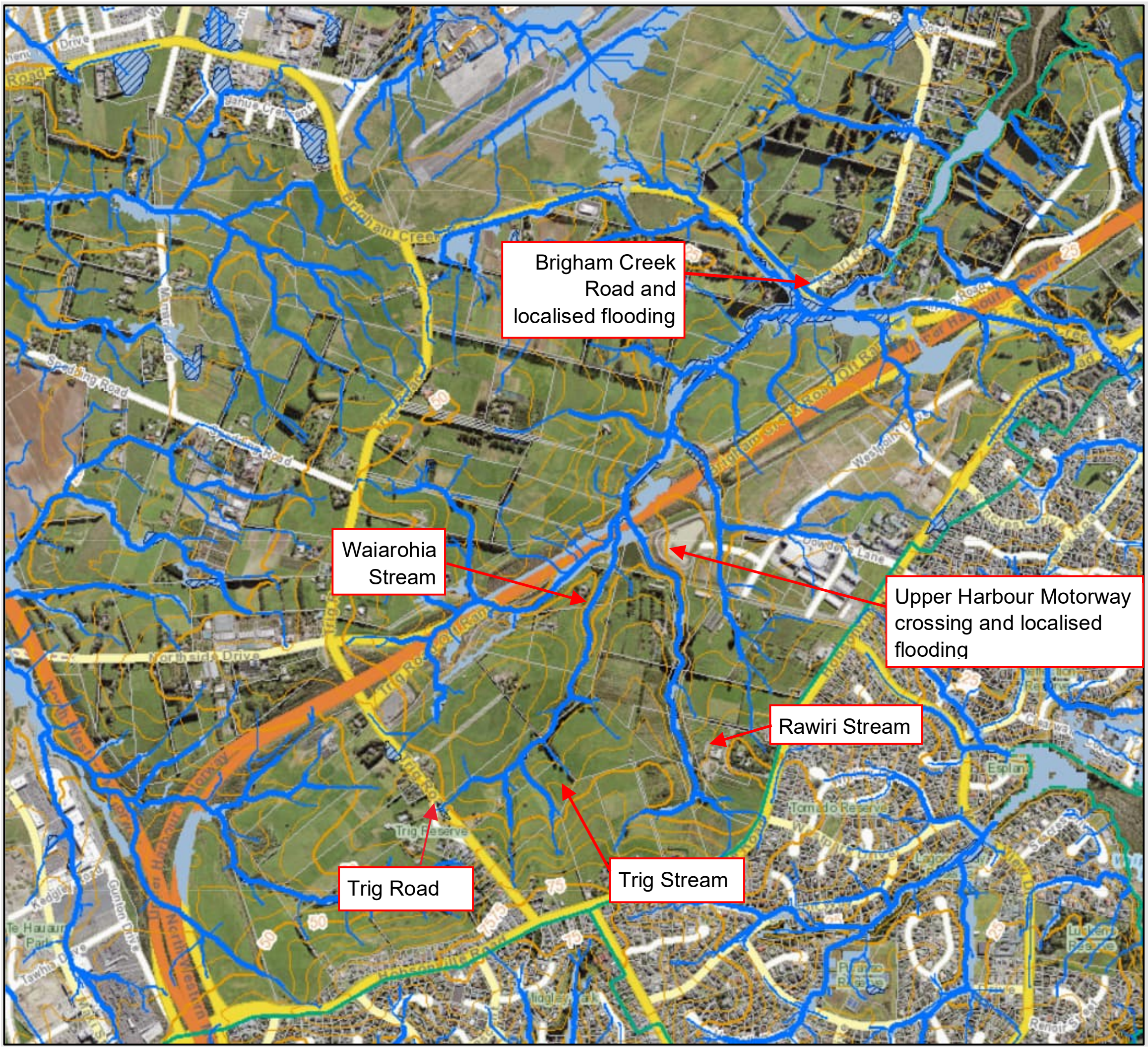


Figure 6: Trig Road surrounding overland flow paths, flood plains and receiving waterbodies

As depicted from the contours, the existing Trig Road alignment is predominately located on a ridge line with the surrounding catchment areas falling away from the road. Trig Road comprises of a steep fall from south-east to north west just off Hobsonville intersection (±8%) for ±300m, with the remaining road length towards the SH18 comprises flatter grades and localised low points.

The catchment area west of Trig Road has a general fall to the west, with two main sub-catchments draining into/forming into a head branch of Totara Creek, which subsequently drains to Brigham Creek.

The catchment area east of Trig Road (and those which form in smaller sub-catchments of localised low points along Trig Road) has a general fall to the east, with three main sub-catchments draining into/forming into head branches of predominately Trig Stream and Rawiri Stream, followed by Waiarohia Stream, all of which subsequently drain towards the Waiarohia Inlet.

Both Brigham Creek and Waiarohia Inlet discharge to the headwaters of the Waitemata Harbour.

A geotechnical study was carried out within the Project area and identified a highwater table and groundwater seepage at the south eastern branch head of Trig Stream (wetland), adjacent to Trig Road, with water encountered at ±800mm below ground level.

4.2.3 Stormwater Quality

The following summary of stream quality for the existing Waiarohia Catchment as shown in Table 2 below.

Table 2: Catchment Stream Quality

Stream Name	Condition	Water Quality	Biological Quality (Stream Ecological Valuation)	Native Fish
Waiarohia Stream	Modified with fine sediment loading Poor quality habitat	Low dissolved oxygen Elevated heavy metals	SEV Moderate	Observed
Trig Stream (wetland)	Slow flowing intermittent in places	Poor	SEV Moderate	No information

Detailed information on stream quality, health and ecological value can be found in the Assessment of Ecological Effects.

4.2.4 Existing Infrastructure

Trig Road drainage (as identified on Auckland Council GEOMAPS data) currently consists of minimal underground stormwater infrastructure, with drainage accommodation requirements limited to the road corridor runoff, localised low-lying catchment along the alignment and drainage from residential properties at the south-eastern end of Trig Road. Surrounding catchment areas currently drain away from the road corridor towards the streams identified above.

Stormwater runoff is collected by open channel drains parallel to Trig Road, diverted through culverts under Trig Road and subsequently discharged into Trig Stream (wetland) and Waiarohia Stream. A portion of underground stormwater network on the southernmost end of Trig Road (closest to Hobsonville Road intersection) discharges into the south eastern branch head of Trig Stream (wetland), where a high watertable has been identified.

Stormwater from the portions of Hobsonville Road included in the Project currently drains to the south via separate Ø225mm underground systems with eventual discharge into Waipateira Stream and Manutewha Stream. Figure 7 shows the existing stormwater layout.

4.2.5 Flooding Hazards and Existing Issues

Figure 7 below (as identified on Auckland Council GEOMAPS data) shows the predicted 1% AEP flood plain and flood prone areas. As depicted in Figure 7 there is generally a low risk for flooding within Trig Road and the surrounding catchments, with no significant identifiable hazard for future development within the surrounding areas.

AC flood prone areas are GIS created areas that allow for the low spot or depression area outlet to be blocked with the upstream flood prone area defined by the overtopping crest level of the surrounding ground.

Notably, there are two flood prone areas at the localised low points along Trig Road which are currently serviced to cater for the drainage requirements of the current land use. The existing drainage crossings will be upgraded as part of the Project, to better cater for these low-lying areas and mitigate any extended negative effects of flooding these areas might have on future urban development as a result of the road widening. This will still not remove the flood prone status but reduce the risk of flooding.

4.2.6 Stormwater Summary

The streams and coastal waters are of poor quality, degraded and sensitive to changes in land use and the consequential change to stormwater flows as a result of urbanisation. As such, according to the AUP: OP, stormwater treatment requirements and SMAF 1 has been applied to the precinct, and consideration for this control has been taken during the design process.

In summary, the following considerations for planning and development within the catchment are required:

Design Approach:

An integrated stormwater management/water sensitive design approach is essential for enabling the development of higher density greenfield sites. The integrated design approach is led by policies E1.3(8) – (10) of the AUP: OP. The integrated design should aim to mitigate or reduce the adverse effects (particularly in regard to increased flows and changes in water quality) of greenfield development on the receiving environment and where possible use the opportunity to enhance existing/degraded receiving environments.

Flood Hazards:

The approach for future development should be to ensure no new flood risks are created, and where possible use the opportunity to reduce the risk of existing flood prone areas through upgraded infrastructure and stormwater diversion.

Two dwellings at risk of flooding around Brigham Creek Road, along with a pump station within the flood plain were identified in previous studies and Geomaps. The stream passes through culverts under SH18 and then crosses Brigham Creek Road where the culverts are insufficient to pass the 100year event. Discussions with Healthy Waters have not yet confirmed whether or not 100year flow attenuation is required. At this stage, 100year attenuation is allowed for within the proposed dry pond to the east of Trig Road.

Stormwater Management Devices:

Various structural devices (i.e. provision of treatment, retention and detention devices, as well as outfalls or erosion mitigation measures) and non-structural management methods (i.e. stream protection/enhancement, retention/infiltration, application of SMAF principles etc.) can be used for an integrated/water sensitive design approach. A combination of the two should be considered for maximum efficiency, protection of the receiving environment and to allow for enhancement of current systems.

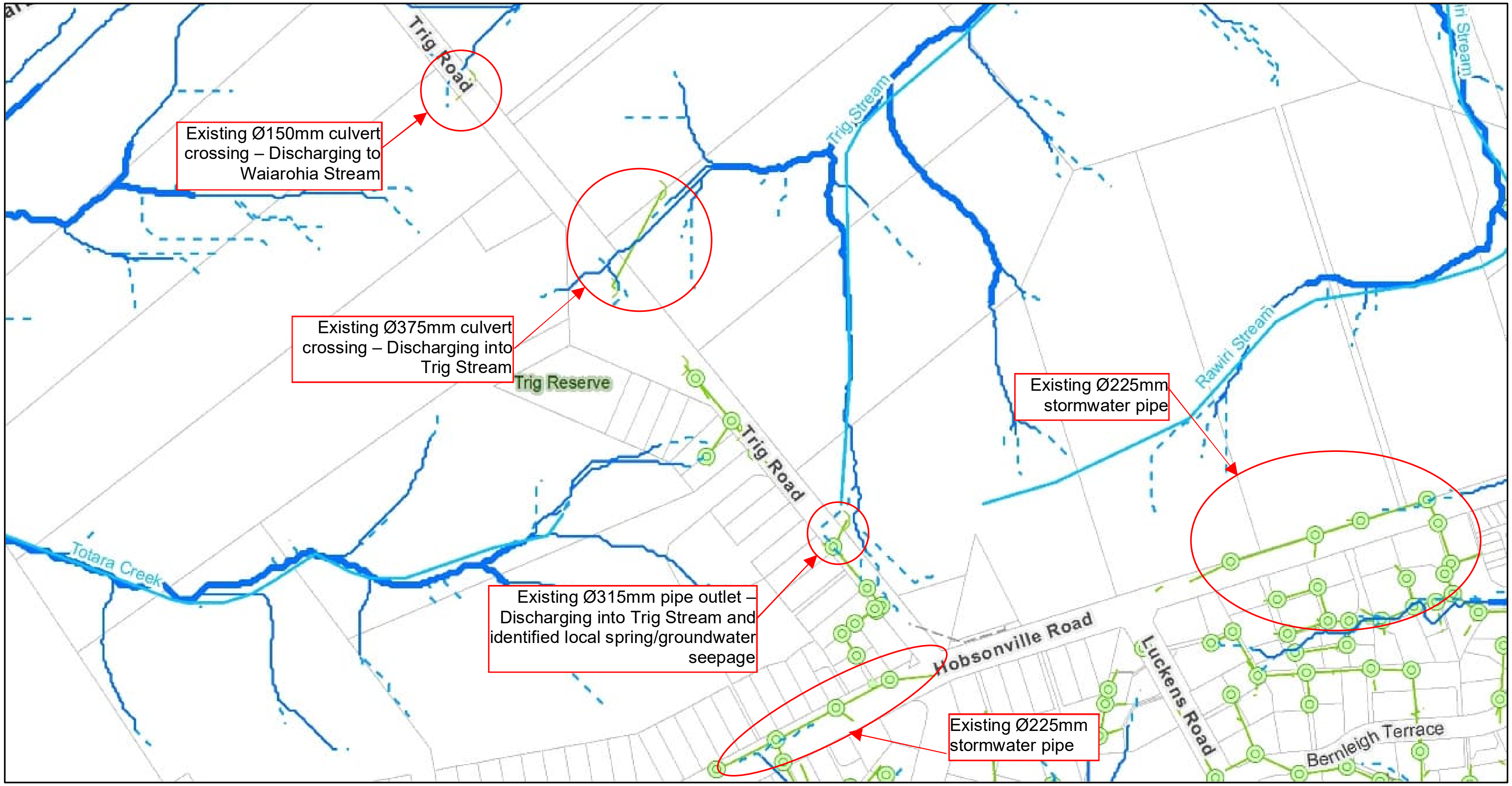


Figure 7: Existing Trig Road Corridor/Hobsonville Road Stormwater Infrastructure (AC – Geomaps 2022)

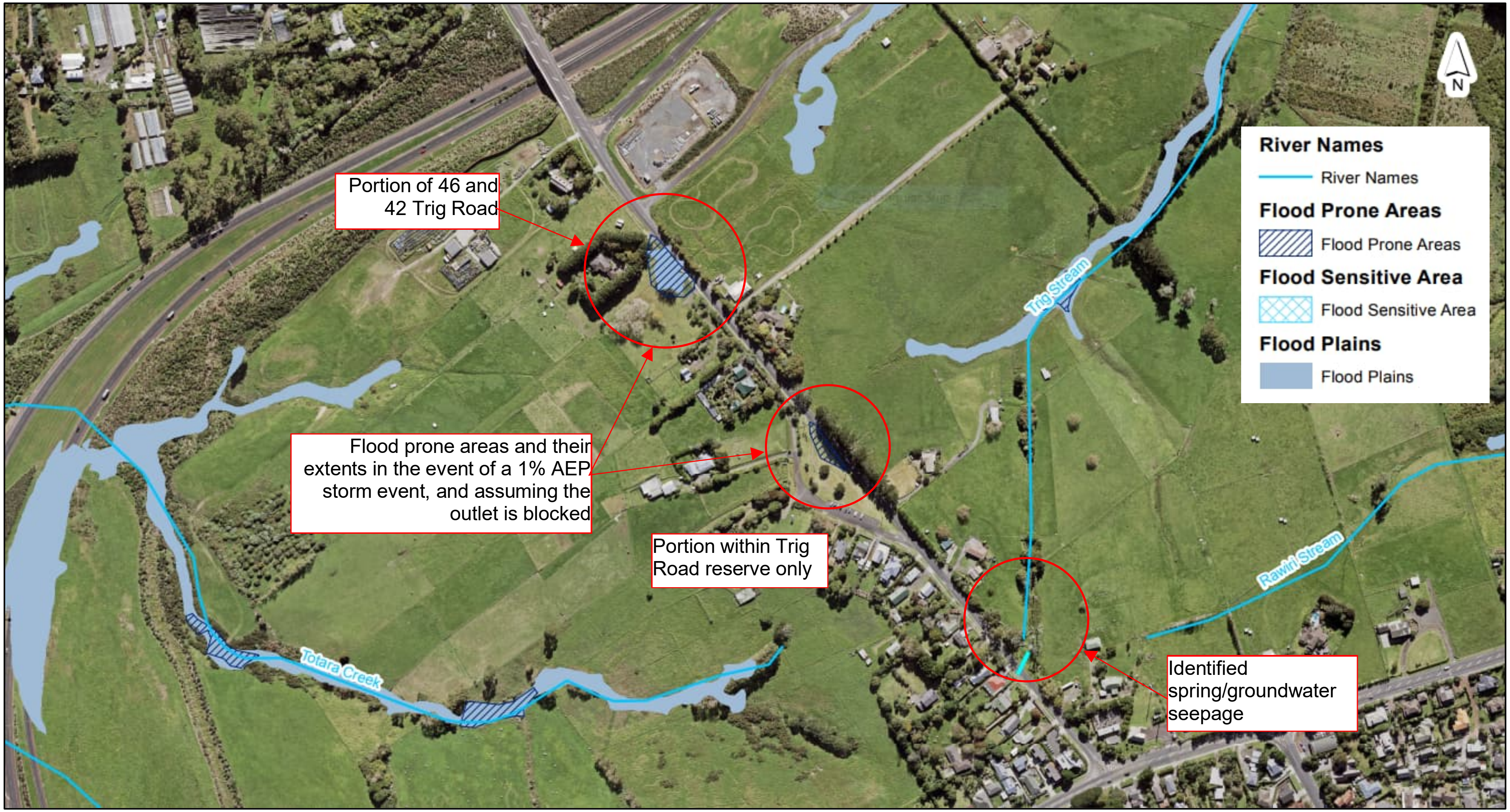


Figure 8: Existing flood plain and flood prone areas along Trig Road (AC – Geomaps 2022)

5 Methodology and Analysis

Chapter Summary

This chapter provides a description of the methodology/approach used in the assessment of the stormwater effects associated with the Project, the details of the design criteria/philosophy followed and the relevant statutory requirements, and the stormwater management methods evaluated under the regulatory guidelines.

In summary the methodology includes evaluation of existing standards and regulatory documents of the AUP: OP pertaining to stormwater and future development, assessment of existing conditions within the Project area, changes to arise through development in terms of impervious area change, subsequent increased runoff rates and water quality changes, followed by selection and design of methods and devices to mitigate the potential identified adverse effects thereof on the environment.

5.1 Assessment Methodology

The methodology used to assess the Project stormwater effects on the receiving environment can be summarised into the following key elements:

a. Evaluation of existing stormwater receiving environments
b. Evaluation of existing catchments and existing stormwater infrastructure
c. Calculation of existing runoff and changes to runoff due to redevelopment of the road corridor
d. Evaluation of water quality due to redevelopment
e. Selection and design of attenuation to mitigate increased discharge effects on the receiving environment
f. Selection of treatment devices to mitigate increase in contaminants entering the receiving environment
g. Design of appropriate primary stormwater system to convey runoff from redevelopment of road corridor
h. Identification of erosion and sediment control issues and determining the approach for mitigating the potential adverse effect thereof
i. Summarising the potential adverse effects to the receiving environment and the proposed mitigation methods of each.

Through the above methodology the stormwater effects of the corridor redevelopment are determined, and appropriate mitigation of these effects are recommended.

5.1.1 Design Software

HEC-HMS Version 4.9 was used for the hydrological modelling for sizing the proposed dry pond in accordance with Auckland Council's Technical Publication 108 (TP108): Guidelines for Stormwater Runoff Modelling in the Auckland and AC's Stormwater Design CoP.

5.2 Design Criteria

The design criteria below were used for the stormwater runoff modelling and management device design, with the objective of satisfying the controlled, restricted discretionary and discretionary standards for resource consent.

Diversion and Discharge:

- A Water Sensitive Design approach has been adopted and application of SMAF 1 requirements.
- Post-development design flows for sub-catchments upstream of culvert crossings have been modelled to accommodate for the Maximum Probable Development (**MPD**) for the zones being urban.
- Peak flow control for specific works is achieved with the utilisation of an on-site detention pond, to enable mitigation of adverse effects on streams and major overland flows during discharge.
- The primary stormwater system collecting runoff from Trig Road has been designed to cater for the 10% AEP rainfall event, and from bridges the 20% AEP rainfall event.
- The secondary stormwater system has been designed to cater for the 1% AEP. The primary system has been used to convey the 1% AEP rainfall event where 1% AEP is diverted away from the road low point towards the dry pond for attenuation.
- TDM: Road Drainage and Surface Water Control was utilised as a guide to risk assessment for a system blockage of 50%.
- Energy dissipation/erosion control measures have been incorporated at pipe outfalls to mitigate scouring and erosion of receiving streams.
- Climate change of 2.1° temperature increase has been accommodated in all calculations.
- Stormwater devices incorporate a flow bypass to prevent overloading during larger storm events, whilst allowing for continued operation and maintenance.
- All stormwater infrastructure has been designed according to the standard requirements as per Auckland Council CoP, AT CoP, TDM: Road Drainage and Surface Water Control, and Austroads: Guide to Road Design Part 5A: Drainage.

Stormwater Quality:

- Stormwater treatment has been incorporated into the stormwater system at the source to cater for the increased runoff contaminants, mitigating the adverse effects to the receiving environment.
- GD01 has been used as the priority for the design and selection of stormwater devices for Trig Road. It provides guides to stormwater choice and design specific to the requirements of the AUP: OP.

Flooding Hazards:

With reference to the General Standards (E8.6.1) for compliance of stormwater diversion and discharge as highlighted in E8 of the AUP:OP (Stormwater – Discharge and Diversion), as well as that Trig Road is in the uppermost reaches of a mainly greenfield receiving environment, and the current zoning plan indicates higher density housing developments proposed for areas surrounding the receiving Trig Stream (wetland) and its associated flood plain, the following criteria have been accounted for in the design and assessment:

- No new/additional habitable floor areas are affected by flooding in the 1% AEP storm event
- No adverse effects on operation and structural integrity of infrastructure in the 1% AEP storm event
- No increase in inundation affecting upstream or downstream properties in the 1% AEP storm event

5.3 Stormwater Management Methods/Infrastructure

Stormwater management device selection and sizing was evaluated in terms of the guidelines laid out in Auckland Council Guidance Document 01 (GD01). A Water Sensitive Design approach has been applied as well as the SMAF 1 requirements. While the Project area is not shown in the AUP: OP as being subject to the SMAF 1 overlay SMAF 1 was adopted for the purposes of this assessment.

Device selection was based on the evaluation of the suggested considerations and devices within GD01 and the characteristic and constraints related to Trig Road.

For higher mitigation within greenfield developments as applicable to the Project area, GD01 suggests the following aspects to be considered (in the order of preference):

- Retention (infiltration) and detention
- Retention (water reuse) and detention
- Detention only

The GD01 suggested devices for retention and detention to satisfy SMAF 1 requirements (with the aim of protection of streams and recharge ground water) are as follows:

- Rainwater tanks (with reuse)
- Bioretention devices (unlined)
- Living roofs
- Pervious paving (unlined)
- Infiltration devices
- Wetlands
- Ponds (dry and wet)

Evaluation of the suggested retention devices against the nature of the Project:

- Rainwater tanks (with reuse) will be uneconomical and are not considered an effective stormwater management tool for the Project.
- Living roofs are not relevant for transport projects.
- Pervious pavement will not comply with the pavement and structural requirements of the Project as it is not suitable for traffic areas of high acceleration, decelerating or turning.
- Swales are not suitable due to the steep road grades, and lack of space due to adjacent residential driveways and future local roads expected off Trig Road.
- Due to potential low permeability of soils around Trig Road as mentioned in section 4.2.1, as well as the large fill embankments expected along the redeveloped corridor, sufficient infiltration rates through unlined devices may not be achievable and could, conceptually, pose stability risks along the embankments due to lateral seepage. The suitability of bioretention devices for achieving SMAF 1 retention requirements will be subject to further geotechnical study at detailed design stage, once these risks have been assessed.
- Permanent waterbodies pose the risk of bird strike within the airspace for Whenuapai Airbase, and as such, stormwater management devices (attenuation ponds) should be designed to optimise full drain down (i.e. dry for the majority of the time). In order to satisfy this requirement an unplanted dry pond has been selected as the most appropriate post-development runoff attenuation method to mitigate the adverse effects on the additional peak

flows on the receiving streams. A dry pond however does not meet the retention or water quality treatment requirements of the AUP: OP and will therefore need to be supplemented with additional stormwater treatment.

- Raingardens for water treatment will be suitable for the majority of Trig Road with appropriate utilisable space and depth available within the proposed berm area on both sides of Trig Road (for varying portions) and within the undeveloped road reserve area west of the carriageway. No berm space is available within the Hobsonville Road portion of the development (east or west), as such, space outside the proposed corridor is considered for treatment devices, as well as redirecting of stormwater into Trig Road for treatment. Limitations and design considerations to accommodate for specific catchment conditions will be detailed in section 6 below. SMAF 1 retention could be incorporated into the raingardens but the suitability thereof would be subject to further geotechnical investigation as described above.
- The use of proprietary devices for treatment/detention/retention is a less economical approach for the Project, with likely increased maintenance costs and frequency, and is therefore not considered.

Selected stormwater management methods based on the above evaluation:

- Dry pond for attenuation for flood mitigation.
- Detention for SMAF 1 will be incorporated into the dry pond attenuation volume.
- Due to suitability of retention through infiltration being subject to further geotechnical investigation at detailed design stage, the 5mm runoff depth will be incorporated into the detention volume for the purpose of this assessment.
- Raingardens for water treatment.

6 Assessment of Stormwater Effects

Chapter Summary

This chapter details the physical changes to stormwater generation over the site as a result of redevelopment of Trig Road as well as the MPD expected to occur as a result of future zoning. Expected post-development impervious areas are calculated, compared with the existing conditions, and used to compute changes to the water quality flows and runoff conditions, and the level of effects on existing stormwater infrastructure and the receiving environment.

In summary of the assessment, flood modelling of upstream catchments for existing and future MPD land use indicate insufficient capacity in the existing crossings and subsequently redevelopment and upgrading of these pipe crossings will enhance current drainage as well as catering for future drainage. The extent of works and changes to the Trig Road and Hobsonville Road cross section result in a combined increase in impervious area of 45.5% and impervious area equating to >50% of the total site which dictates the method for runoff volume calculations as per the GD01.

6.1 Design Parameters

The Whenuapai rainfall depths utilised in the stormwater runoff modelling and stormwater infrastructure design were referenced from the Auckland Council Technical Publication 108: Guidelines for Stormwater Runoff Modelling in the Auckland Region (**TP108)**.

As per the Auckland Council Stormwater CoP (2015), climate change is expected to alter the frequency and intensity of significant rainfall events, and as such rainfall depth are adjusted accordingly to cater for a 2.1° future temperature increase. Table 3 below depicts the selected rainfall depths and the applied climate factors:

Table 3: 24hour rainfall depths and the applied climate change factors

ARI (years)	AEP (%)	TP108 24hr Rainfall Depth (mm)	Climate Change Increase (%)	Adjusted 24hr Rainfall Depth (mm)
10year	10%	135	13.2%	153
50year	2%	180	16.8%	210
100year	1%	200	16.8%	234

Runoff volumes were calculated based on the adjusted 24hr rainfall depths in accordance with Auckland Council Technical Publication 108: Guidelines for Stormwater Runoff Modelling in the Auckland Region (**TP108**).

6.2 Changes to Catchment Runoff

6.2.1 Surrounding Catchments

A flood modelling study was completed as part of this Project for the surrounding catchments adjacent to Trig Road. The assessment evaluated existing development flows and the post-development flows considering the MPD including climate changes. Table 4 below indicates the maximum impervious areas utilised for the post-development runoff, with reference to the possible future zoning (signalled in the Whenuapai Structure Plan) around Trig Road, as discussed in section 4.1.

Table 4: Maximum Impervious Area for Trig Road surrounding catchments

Development Type/Zone	Maximum Impervious Area (as a % of site)
Residential – Terrace Housing and Apartment Building Zone	70
Residential – Mixed Housing Urban Zone	60
Open Space – Informal Recreation Zone	10

As discussed in section 4.2.4 and shown in Figure 7, there are two existing culverts crossings and one pipe outlet which was used in the assessment for the 1% AEP (100 Year ARI) rainfall event. The culverts convey runoff from upstream catchments, under Trig Road, and discharge into the overland flow paths east of Trig Road. The pipe outlet discharges the stormwater conveyed in the existing underground pipe network. The upstream catchments areas are indicated in Figure 9 (pre-development) and Figure 10 (post-development) below. The flood modelling results for the existing development indicated that the existing culverts are of insufficient size to cater for even pre-development flows, which is a probable cause for the flooding potential as highlighted in Figure 8. Using high level LIDAR information and invert levels derived from Auckland Council GEOMAPS, it was also determined that there is currently insufficient cover over the culverts.

The flood modelling for post-development (MPD impervious surfaces) concluded that there will be a minor increase in the 1% AEP flow rates, and appropriately sized pipes have been designed to cater for these flows. It should be noted that the existing cross section of Trig Road is cambered with half the road draining to swales and catering to the pipe crossing flows, whereas the upgraded corridor will drain to a new primary system and flows will not form part of the pipe flows, thus the catchment areas have been slightly reduced.

Table 5 below indicates the pre and post-development flows for each pipe and the existing and proposed pipe sizes. Upgrading of these pipes during the upgrade of Trig Road will essentially reduce the risk of flooding the flood prone areas. Due to the existing steep grades, there are currently higher than desirable velocities at the outfalls. Appropriately designed energy dissipation with the use of riprap and baffles is proposed and will mitigate downstream erosion and scouring, which will be further discussed in Chapter 7.

Table 5: Culvert Size Upgrades

	Pre 1% AEP Flow Rate (m^3/s)	Existing Pipe Size	Post 1% AEP Flow Rate (m^3/s)	Existing Pipe Grade (%)	Proposed Pipe Size
Pipe 1	0.242	1 x Ø150mm	0.375	2.5	1 x Ø525mm
Pipe 2	0.433	1 x Ø375mm	0.691	7.65	1 x Ø600mm
Pipe 3	0.122	1 x Ø315mm	0.118	17	1 x Ø300mm

Figure 9: Pre-development catchments for culvert/pipe flows

Figure 10: Post-development catchments for culvert/pipe flows

6.2.2 Road Corridor Catchments

The Project cross-section indicates an increase to the impervious areas within the corridor (applicable to Trig Road and the upgrades on Hobsonville Road). Through catchment delineation based on topographical information and the proposed vertical alignment of the roads, four major drainage catchments and their drainage low points were identified for calculation of post-development runoff and comparison to pre-development runoff.

Figure 11 shows the post-development catchments, and Table 6 below provides an overview of the catchment extents, catchment sizes and description of discharge location.

Table 6: Catchment Overview

Catchment Description	Total Area (m²)	Discharge Location
Catchment 1: Hobsonville Road (West)	1,764	Tie into existing underground stormwater network
Catchment 2.A: Hobsonville Road (East)	3,383	Piped stormwater runoff diverted into raingarden/detention pond for treatment and attenuation north of Hobsonville Road, prior to discharge into Rawiri Stream overland flow path
Catchment 2.B: Hobsonville Road (East)	2,013	Tie into existing underground stormwater network
Catchment 3: Portion of Hobsonville Road Trig Road (South)	15,596	Portion of Hobsonville Road's (west) piped stormwater runoff to be diverted into Trig Road underground stormwater network. Underground stormwater network to discharge into raingarden at low point west of Trig Road (unless treated within berm raingarden) and into Dry-Pond east of Trig Road for attenuation, prior to discharge into a tributary to Trig Stream
Catchment 4: Trig Road (North) *(Minor works beyond SH18 bridge to be handled as discussed at the end of section 6.2)*	8,489	Piped stormwater runoff, post treatment by raingardens within the berm, diverted to Catchment 3 low point for discharge into Dry-Pond for attenuation, prior to discharge into a tributary to Trig Stream

Based on the intended scope of physical works depicted in the Project cross-section, changes to impervious area have been calculated based on the increased width of corridor, inclusion of footpaths, cycleways, medians and vehicle stacking lanes. Table 7 below provides an overview of the increase in impervious area for each catchment, used in the calculations for pre- and post-development runoff.

Table 7: Changes to Impervious Area

	Catchment Area (m²)	Pre-Development			Post-Development		
		Pervious (m²)	Impervious (m²)	% Imperviousness	Pervious (m²)	Impervious (m²)	% Imperviousness
Catchment 1: Hobson-ville Road (West)	1,764	756	1,008	57%	378	1,386	79%
Catchment (2.A):	3,385	2,290	3,105	58%	258	3,125	92%
(2.B):	2,010				110	1,902	95%
Catchment 3: Trig Road (South)	15,596	8,436	7,160	40%	4,806	10,790	65%
Catchment 4: Trig Road (North)	8,490	5,070	3,420	40%	3,010	5,480	65%
Total	31,245	16,550	14,695	47%	8,564	22,680	73%

The total redeveloped site area equates to 31,245m², with the percent of imperviousness increase from 47% in pre-development condition to 73% in post-development condition. The 22,680m² post-development impervious area equates to >50% of the total catchment area and dictates the method for runoff volume calculations as per the GD01.

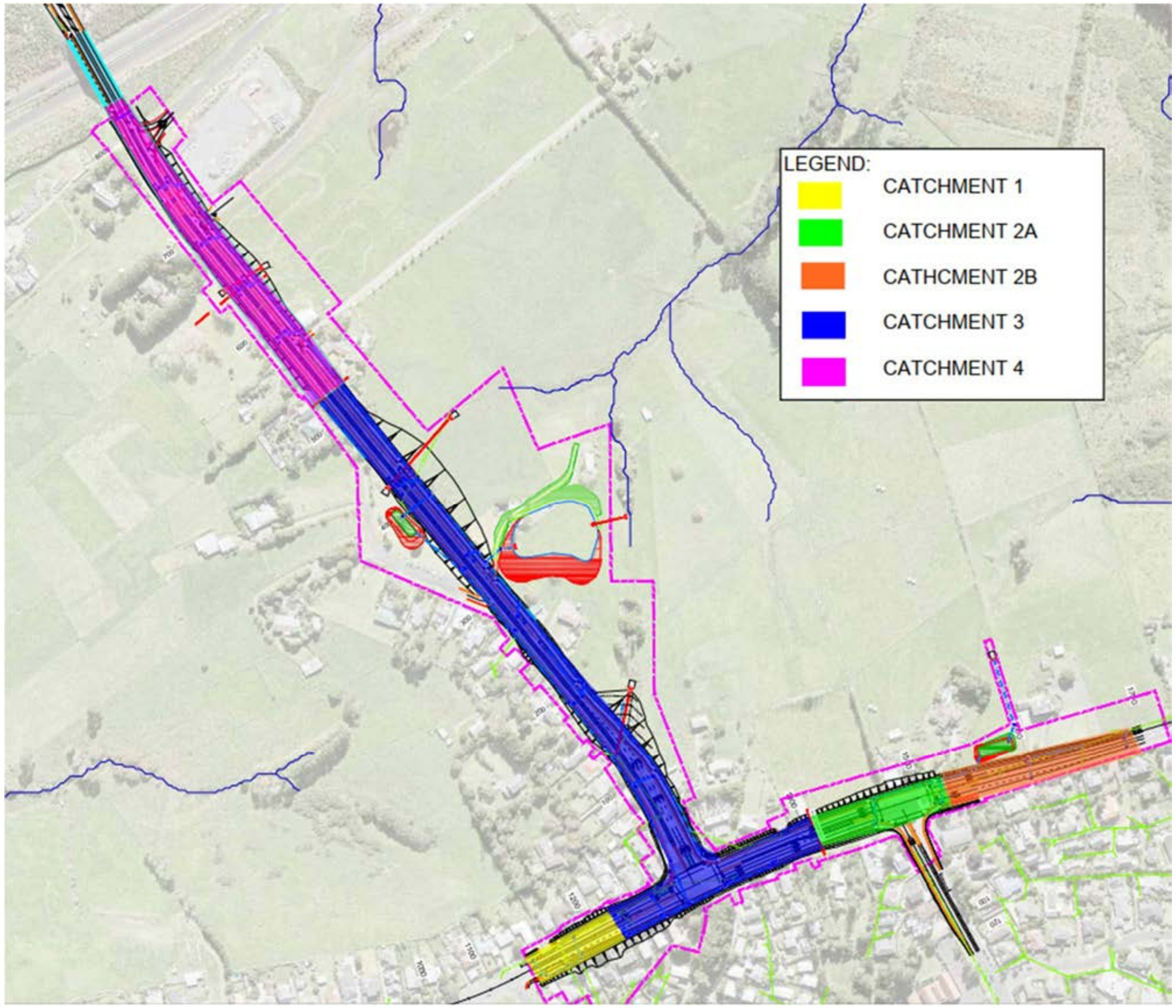


Figure 11: Post-development catchment plan

Pre and post-development runoff has been calculated based on the above pervious and impervious areas, as well as based on proposed discharge locations and areas where flows have been diverted to join other catchments. Volumes are calculated in accordance with TP108. Table 8 provides an overview of the pre- and post-development peak flow rates and runoff volumes for the 1% and 10% AEP storms, 95th percentile storm for stream protection, and water quality volumes for each catchment.

Based on the identified soil description in section 4.2.1 and the TP108 Hydrological Soil Classification, a Group C SCS Soil Group was selected for pre-development runoff modelling purposes. Whenuapai is located in a pasture area with good grass cover, and thus the curve number selected for typical Auckland conditions is 74 (Table 3.3-TP108).

Table 8: Pre and Post Development Runoff Data

	Pre-Development		Post-Development		Post less Pre-Development	
	Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Peak Flow Rate (m^3/s)	Runoff Volume (m^3)
Catchment 2A (Hobsonville Road east)						
WQV	0.008	45	0.011	65	0.003	20
SP (95th)	0.012	70	0.016	97	0.004	27
10% AEP	0.071	417	0.079	483	0.008	66
2% AEP	0.101	601	0.110	678	0.009	77
1% AEP	0.114	677	0.123	752	0.009	75
Catchment 3 (Trig Road South)						
WQV	0.03	178	0.04	239	0.01	61
SP (95th)	0.047	280	0.061	363	0.014	83
10% AEP	0.311	1824	0.339	2025	0.028	201
2% AEP	0.453	2658	0.481	2901	0.028	243
1% AEP	0.512	3004	0.539	3236	0.027	232
Catchment 4 (Trig Road North)						
WQV	0.015	89	0.021	124	0.006	35
SP (95th)	0.024	141	0.032	188	0.008	47
10% AEP	0.166	966	0.181	1080	0.015	114
2% AEP	0.243	1418	0.258	1554	0.015	136
1% AEP	0.275	1605	0.290	1735	0.015	130

Catchments 1 and 2B (which is tying into existing stormwater systems to the south of Hobsonville Road) have been excluded from Table 8 as the resultant post-development impervious and pervious catchment areas draining into the existing system are significantly less than the predevelopment areas.

As indicated on Preliminary Layout 1 of the attached stormwater drawings in Appendix 2, minor works and amendments to Trig Road continue along SH18 bridge and approximately 210m north of the bridge. These changes include realignment of lanes and road markings within the area of the existing bridge resulting in no change to existing impervious area. The works also involves reconfiguring an existing footpath to incorporate an adjacent cycle path on the western road edge, and an additional stretch of cycle/foot path adjacent the eastern road edge.

The existing road alignment, lanes and kerb and channel configuration will remain predominantly the same, with the addition of ±430m² of impervious area change as a result of the addition of cycle paths. Cycle/foot paths are not considered a high contaminant generating activity and therefore do not contribute adversely to runoff quality nor require treatment.

Runoff from SH18 bridge and the ±210m length of corridor north of the bridge beyond does not contribute towards catchment 4 as above, and the existing drainage (contained within kerbs, discharge into roadside swales) can remain unchanged. Additional runoff volumes generated by the impervious cycle/foot paths are minor and can be discharged into the road and existing system without adverse effects.

6.3 Runoff Quality

As per E9 of the AUP: OP: Stormwater Quality – High Contaminant Generating Activity, stormwater runoff from Trig Road is required to be treated by stormwater management devices, in accordance with GD01 or similarly approved methods.

The Water Quality Volume is typically designed as a function of the "first flush", with the concept that the initial runoff from a surface during a flood event will contain the highest level of contaminant when compared to later periods of the storm. This provides the most practical and cost-effective approach for treatment, focusing on treatment device design for the high-level contaminants flows, as opposed to treating the entire storm event volume of diluted/low contaminants. As per GD01 the following parameters are utilised as a function of the Water Quality Volume/Flow calculations:

Water Quality Volume (WQV):	90th Percentile of the 24-hour storm event (±25mm)
Water Quality Flow:	10mm/hr
Water Quality Management:	Design performance based
Water Quality Target Areas:	High Contaminant Generating Car Parks and Roads

The rational method was used in the determination of the peak discharge for a 10mm/hr constant rainfall intensity (equivalent to ±90% of the annual rainfall), and for sizing of the water quality device. Table 9 below indicates the calculated water quality flow per catchment for contaminant treatment and device selection.

Table 9: Water Quality Characteristics per Catchment

	Catchment 2A	Catchment 3	Catchment 4
High use road area only	2160m²	6720m²	2400m²
WQV	45	139	50
Water Quality Flow (m^3/s)	0.0057	0.0165	0.0063

7 Mitigation

Chapter Summary

This chapter provides solutions to mitigating the potential effects induced by the changes to the stormwater conditions, such as stormwater attenuation for peak flow control prior to discharging into the receiving Trig Stream (wetland), stormwater treatment to mitigate the effects of increased contaminants entering the receiving environment and primary stormwater system pipe requirements for conveyance of the new stormwater flows.

In summary of solutions, a dry pond was selected in order to satisfy the design constraints relating to potential bird strike at the nearby Whenuapai Airbase and peak flow control, catering for detention up to 1% AEP rainfall and subsequently mitigating downstream flood potential. Raingardens were selected as an effective means for stormwater treatment within the Project area considering road geometry, available space within the corridor and a water sensitive design approach. Stormwater runoff will be contained within the road reserve, collected in standard catchpits or dropped kerb inlets into raingardens, before being conveyed within an underground pipe system for discharge into the dry pond. There is allowance for overland escape during larger storms at low points along Trig Road.

7.1 Attenuation

Two buildings within the catchment have been identified in previous studies as being susceptible to habitable floor flooding during a 1% AEP rainfall event, located in the vicinity of Brigham Creek Road near Waiarohia Stream into which Trig Stream (wetland) feeds. It also highlights the reduction of stormwater runoff from increased impervious areas, by retention and detention as essential to minimising further erosion to the Waiarohia Stream and its tributaries.

To mitigate the contribution to additional downstream flooding of properties at Brigham Creek Road, as well as for protection of the existing Waiarohia stream, stormwater runoff from the redeveloped Trig Road up to the 1% AEP rainfall event will be attenuated. Due to the infiltration constraints described in section 5.3 and only water quality treatment being provided for in the raingardens, retention and detention of the 95th percentile storm (for stream protection) will be incorporated into the dry pond for attenuation.

As mentioned previously, in accordance with the stormwater pond design restrictions relate to potential bird strike at the Whenuapai airfield. Consequently, a dry pond has been selected for attenuation of additional post-development peak flows and meeting the water sensitive design requirements. The minimum design requirements for the dry pond reduces the attractiveness of the area to birds thus mitigating against the risk of bird strike. The minimum design requirements are as follows:

- fully drain down within 48 hours of a 2% AEP storm event; and
- have side slopes at least as steep as 4 vertical to 1 horizontal (4:1) except for:
    - any side slope treated with rock armouring; or
    - any area required for vehicle access, provided that such vehicle access has a gradient of at least 1 vertical to 8 horizontal (1:8)

To satisfy the requirements to minimise bird roosting and mitigate bird strike risk, the pond has been sized to meet the full drawdown requirements. The pond base will also be shaped and graded to fall from the inlet through to intake manhole outlet. This will facilitate in concentrating frequent storm low flows towards the outlet, preventing runoff spread and subsequent frequent wetting of the full pond base which is likely to encourage unwanted plant growth.

The pond has been designed with 1V:5H internal side slopes for maintenance purposes and to allow for mowing of grass. The steep 4V:1H slopes suggested are not practical for the Project environment and would require retaining walls/reinforced earth in order to construct, presenting a considerable cost increase over the engineered earthworks embankment of a 1V:5H slope. With the overall objective of the specific design requirements aiming to minimise bird roosting, the adopted design achieves this through easily maintainable, unplanted grass slopes and the concentrating of frequent storm low flows to ensure a drier pond base to minimise natural plant growth and bird attraction.

The dry pond was designed using HEC-HMS Version 4.9. Please refer to Appendix 3 for details of HEC-HMS model. The HEC-HMS model may be refined at detailed design stage.

The storage volume includes catchments 3 and 4 into the sizing, catering for a total peak storage volume for the post development less pre-development 1% AEP rainfall event, with a discharge allowance at the outfall to match pre-development peak flows into the existing Trig Stream (wetland) overland flow path. The treated water quality flows from all the raingardens in catchment 4 will be discharged into the overland flow path at the low point of catchment 4, and thus only overflows from the raingardens will be directed to the dry pond. Only catchment 3's existing pre-development peak flow was used as the discharge requirement from the dry pond given that catchment 4's overflow runoff from the raingardens will be redirected from its original overland flow path towards the dry pond for attenuation. That is, flows from both catchment 3 and 4 will be directed to the dry pond with the allowable peak outflow rate set at the catchment 3 pre-development peak outflow rate. Table 10 below provides summary of dry pond design, including the pond post-development peak inflow volumes, allowable peak discharge rates, post-development peak discharge rates, inflow volume and peak storage volumes for the 95th Percentile, 10%, 2% and 1% AEP design rainfall events.

Table 10: Dry pond design summary

	95th Percentile (SP)	10% AEP	2% AEP	1% AEP	Remarks
Post-Development Peak Inflow (m^3/s)	0.092	0.52	0.74	0.83	
Allowable Peak Discharge (m^3/s)	0.047	0.31	0.453	0.51	See Note 1
Post-Development Peak Discharge (m^3/s)	0.013	0.16	0.26	0.29	See Note 2
Post-Development Inflow Volume (m^3)	551	3105	4455	4971	
Post-Development Peak Storage (m^3)	276	1259	1654	1807	
Pond Emptying Duration (Hr:min)	27hr:30min	38hr:10	40hr:10min	40hr:20min	See Note 3

Notes:

1. Allowable peak discharge rate is set at the catchment 3 pre-development peak outflow rate.

2. The post-development peak discharge rate is less than the allowable peak discharge rates.
3. Pond emptying duration is the duration to fully drain down the dry pond from the start of the storm event. The dry pond meets the design criteria that it can be fully drained down within 48 hours of a 2% AEP storm event. Please refer to Appendix 3 for more details on dry pond flow charts.

The dry pond has been designed using HEC-HMS model with following parameters and key design elements:

Dimensions:

- Total catchment: 24,085m³
- Total peak storage volume for 1% AEP: ±1,807m³
- Total peak storage water depth: 0.91m
  Side slopes: 1V:5H
- Total pond depth: 1.8m (including freeboard)
- Selected freeboard: 300mm

Inlet Pipe into Dry Pond (from primary system):

- Post developed Flow (100year ARI): 0.83m³/s (100yr post-dev.)
- Selected slope: 0.5%
- 750mm Dia. RCRRJ. with an appropriate wingwall outfall structure complete with baffle blocks, safety grate and downstream riprap protection

Outlet Pipe from Dry Pond (Into Trig Stream (wetland)):

- Allowable discharge flow (100year ARI): 0.51m³/s (100yr pre-dev.)
- Selected slope: 2%
- 600mm Dia. RCRRJ. with an appropriate wingwall outfall structure complete with baffle blocks, safety grate and downstream riprap protection

The dry pond will include a scruffy dome type intake tower/manhole with throttled discharge from the dry pond to match outflows to the 95th percentile (SP), 10% AEP and 1% AEP pre-development flows discharging into a tributary of Trig Stream. The primary stormwater system (discussed in section 7.3) collecting catchment 3 and 4 road drainage has been designed for discharge into the dry pond.

The dry pond will be located at 7 Trig Road, which is approximately 90m south of the lowest point of Trig-Road, between chainage 280 to 340, to ensure total catchment drainage into the pond mitigating upstream flooding potential, as well as allowing for an overland flow bypass from Trig Road to the attenuation pond during storms greater than that which can be contained within the road reserve, minimising flood risk within the road and accompanying vehicle hazard and damage to infrastructure. The dry pond will be discharged into the tributary to Trig Stream, as indicated in Figure 12 below.

Due to lack of available capacity within the stormwater network south of Hobsonville Road, Catchment 2A will discharge north of Hobsonville Road into the Rawiri overland flow path. Attenuation prior to discharge will be allowed for with the storage volume catered for within the proposed raingarden area. This will be discussed in section 7.2 below.

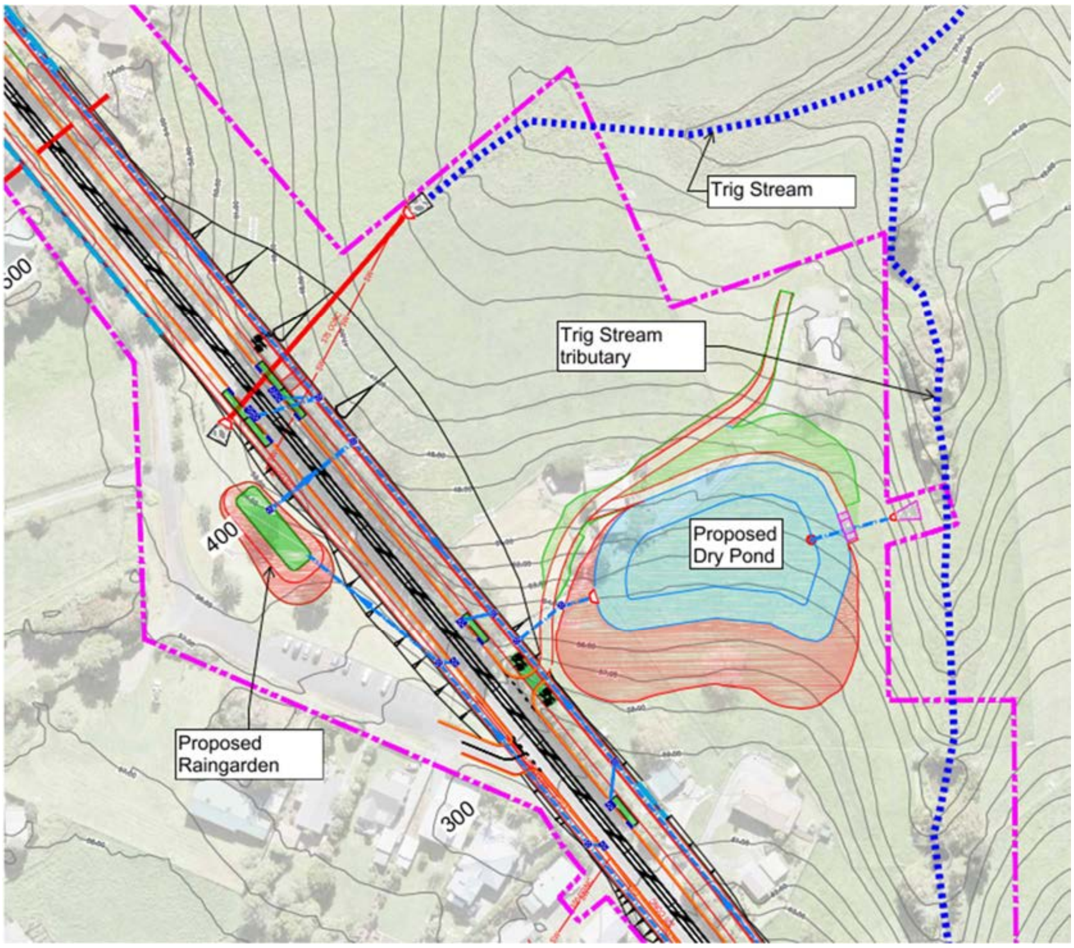


Figure 12: Dry Pond location

7.2 Stormwater Treatment

From guidelines followed in GD01, raingardens were selected as the primary treatment device throughout the Project. Due to topographical, road vertical alignment and space limitations on site, various raingarden configurations were utilised to suit.

7.2.1 Design parameters

As per GD01, the following methodology was used in sizing the raingarden footprint for treatment:

- WQF of 10mm/hr was determined based on the high use road impervious area, as indicated in Table 9, section 6.3.
- Treatment footprint area was determined by the following equation:

$$A = \frac{WQF}{(0.5 \times K(media))}$$

based on the WQF of 10mm/hr passing through a specialised filter media with a standard depth of 500mm and an infiltration rate of max. 1m/hr;

where A - Area of bioretention media bed

WQF	- Water Quality Flow (m^3/hr)
$K_{(media)}$	- Infiltration rate of bioretention media (m/hr)
Safety factor for clogging	- 0.5

- Calculated footprint area was compared with the minimum footprint of 2% of total impervious catchment suggested for raingardens to operate efficiently in terms of maintenance requirements, to ensure sufficient sizing.

Table 11 below indicates the calculated footprint for each catchment using the equation above against the minimum required footprint of 2% of total impervious catchment. For all catchments, the calculated footprint was below the recommended value, therefore the 2% sizing was utilised. If confirmed through geotechnical study that both retention and detention is suitable for incorporation into the raingardens, a minimum footprint of 5% of total impervious catchment would be expected as indicated in the table.

Table 11: Raingarden Sizing per Catchment

	Calculated Treatment Footprint	Min. 2% of Total Impervious Catchment (Treatment Only)	Min. 5% of Total Impervious Catchment (Treatment, Retention and Detention)
C (2A)	43m²	63m²	156m²
C (3)	138m²	216m²	540m²
C (4)	59m²	110m²	274m²

7.2.2 Raingarden configurations

Catchments 2A, 3 and 4 will require treatment prior to discharging into the receiving environment. Each catchment presented various constraints/limitations for sizing and location selection for raingardens, as described in Table 12 below. Refer to the stormwater layouts in Appendix 2 for size and locations described in this section. Required footprint is derived from Table 11 above.

Table 12: Catchment Design Constraints

	Design constraints	Design solution	Raingarden sizing
C (2.A)	• Corridor design width constraints resulted in either small berms or no available berm space either side of carriageway to cater for required raingarden footprint requirements • Catchment area requires attenuation prior to discharge into receiving Rawiri stream overland flow path	• One larger raingarden will be located northeast of the catchment and will allow for a deeper ponding depth to cater for attenuation prior to discharging into the overland flow path	Required footprint = 63m² Design size to accommodate for treatment and 100 Year ARI attenuation (peak storage of 71m³) = 248m² Pond base 1:4 Internal slopes 1:3 External slopes 0.6m Deep
C (3)	• More than 50% of Catchment 3's vertical	• A series of stepped raingardens will be used along the steeper	Required footprint = 216 m²

	alignment is >4% and up to 8%, which does not allow for sufficient infiltration time across raingardens thus ineffective in providing treatment at grade • Residential properties are located on the southwestern side of Trig Road with direct driveway access, therefore berm length along this side of road will be too short and impractical for raingardens. Stormwater will be piped and require treatment further downstream at depth • Hobsonville Road has insufficient berm space for treatment requirements. Stormwater drains into Trig Road via an underground system and will require treatment further downstream at depth where pipe can daylight.	grade of the south eastern road edge • A larger raingarden will be located at the low point of catchment 3 in the available space west of Trig Road, and will cater for piped stormwater runoff from the portion of Hobsonville Road and from the southwestern side carriageway • Raingardens can be utilised both sides of the carriageway for the northern side of catchment 3	*Hobsonville Road portion (to larger raingarden) = 82m²* *Trig Road South portion = 134m²* • Minimum raingarden area each side of road = 134/2 = 67m² • Raingarden area per inlet (6 inlets per road side) 67/6 = 11m² • Selected raingarden size in berm: 6m long x 2m wide = 12m² or 12m long x 1m wide = 12m² <u>Proposed raingarden footprint</u> • Eastern road edge: o (5 raingarden inlets) = 12 x 5 = 60m² • Western road edge: o (2 raingarden inlets) = 12 x 2 = 24m² • Larger raingarden on west side: o (1 inlet from east side + 4 inlet from west side) = 12 x 5 = 60m² o Hobsonville Road raingarden requirement = 82m² o Minimum area of larger raingarden = 60+82= 142m² Total proposed raingarden footprint =60+24+142 = 226m²
C (4)	• No significant design constraints	• Raingardens can be utilised both sides of the carriageway	<u>Footprint required= 110m²</u> • Minimum raingarden area each side of road = 110/2 = 55m² • Raingarden area per inlet (5 inlets per road side) = 55/5 = 11m² • Selected raingarden size in berm: • 6m long x 2m wide = 12m²

Dropped kerb inlets to raingardens will be included along the kerb line on each side of the road. Raingardens will receive a dropped kerb outlet to cater for overflow from raingardens, discharging back into the road. This overflow will be collected in standard catchpits and conveyed via the stormwater pipe network to the dry pond for attenuation. Treated flows from the raingardens in Catchment 3 will be conveyed to discharge into the dry pond. Treated flows from the raingardens in Catchment 4 will be conveyed to discharge into the existing overland flow path at Catchment 4's low point.

Where stepped raingardens are required due to steeper road grades, widths are limited to 2m within the berm to allow for sufficient width for the height transition between the raingarden and adjacent cycle path.

7.3 Primary Stormwater System

The primary stormwater system is designed to accommodate for the 10% AEP rainfall event, and all system elements have been designed to cater for each specific delineated catchment 10% AEP post less pre-development flows as tabulated in the section 6.2.2. Relevant CoP's as stipulated in section 3.2 were used in the design process. The system elements have been designed based on a preliminary approach and will be subject to further detailed design prior to construction.

The following critical assumptions were made for preliminary design of the primary underground system:

Inlets/Catchpits:

- Longitudinal gutter slope for entire catchment taken as equal to the minimum alignment slope for that specific catchment
- Maximum gutter spread = 1.00m
- Manning's n Value = 0.015
- Road Crossfall = 3%
- Gutter Crossfall = 10%
- Gutter Width = 0.3m

Pipe sizing:

- Longitudinal pipe slope for entire catchment taken as equal to the minimum alignment slope for that specific catchment
- Manning's Value for concrete pipes = 0.012
- Pipes designed to be in parallel to the road centreline
- Pipes are reinforced concrete rubber ring joint type (RCRRJ) with 1050mm manholes

Based on the assumptions a maximum flow of 17l/s correlates to a spread width of 1.25m based on Manning's law. According to AT CoP, a standard 460mm by 675mm catchpit should be able to accommodate a nominal inlet capacity of 28l/s when installed on a gradient. Therefore, a standard 460mm by 675mm catchpit installed in accordance with the AT CoP/TDM will be sufficient to provide drainage required for the proposed road upgrades.

The proposed stormwater network will consist of standard catchpit inlets along the kerb line, collecting either road surface runoff or overflow from raingardens, and discharging into the piped underground system for conveyance to the attenuation devices. Each catchment's proposed primary system configuration is described below and should be read in conjunction with the attached stormwater layouts in Appendix 2 and catchment diagram in Figure 11.

7.3.1 Catchment 1

Catchment 1 consists of the remainder of Hobsonville Road west that won't be diverted into Trig Road's stormwater system and will include standard 460mm by 675mm catchpits installed either side of the carriageway, discharging into new stormwater pipes on the southern road edge, tying into the existing stormwater network.

- 10 Year ARI post-development flow = 0.145m³/s (0.073m³/s each side of road)
- Min. road longitudinal slope = 1.4%
- Max. pipe size required = Ø300mm
- Approximate catchpit spacing for max. gutter spread = ±40m

Post-development flow contribution to the existing system will be significantly less due to diversion of a portion of runoff into Trig Road stormwater system, thus sufficient capacity in the existing system is assumed.

7.3.2 Catchment 2A

Catchment 2A consists of the upper portion of Hobsonville Road east. Due to insufficient capacity in the existing downstream network to cater for the full redeveloped impervious area of Hobsonville Road east and lack of space within the corridor for treatment devices/attenuation, a portion of the catchment runoff will be diverted outside of the corridor for treatment, attenuation and discharge. The stormwater system will have double catchpits installed on the southern side of the road only, discharging into a stormwater pipe on the northern road edge for conveyance to the proposed raingarden/attenuation device north of Hobsonville Road.

- 10 Year ARI post-development flow = 0.079m³
- 10 Year ARI pre-development flow = 0.071m³
- Min. road longitudinal slope = 2.3%
- Max. pipe size required = Ø300mm
- Storage volume allowed for = 200m³
- Approximate double catchpit spacing max. gutter spread = ±50m

The raingarden/attenuation device will include a scruffy dome overflow manhole with piped outlet to the Rawiri Stream overland flow path.

7.3.3 Catchment 2B

Similar to Catchment 1, Catchment 2B consists of the remainder of Hobsonville Road east that won't be diverted to discharge outside of the road corridor and will include standard 460mm by 675mm catchpits installed either side of the carriageway, discharging into new stormwater pipes on the northern road edge, tying into the existing stormwater network.

- 10 Year ARI post-development flow = 0.042m³ (0.021m³ each side of road)
- Min. road longitudinal slope = 5.3%
- Max. pipe size required = Ø300mm
- Approximate catchpit spacing each side of road for max. gutter spread = ±80m

Post-development flow contribution to the existing system will be significantly less due to diversion of a portion of runoff outside of the corridor, thus it is concluded there is sufficient capacity in the existing system.

7.3.4 Catchment 3

Catchment 3 includes a combination of treatment at source via raingardens within the berm space (where space is available) as well as treatment downstream in a larger raingarden at the end of pipe run (where treatment within the road corridor is not possible).

Dropped kerb inlets will be used to discharge channel runoff into the berm raingardens, with dropped kerb outlets to cater for overflow above the required 200mm ponding depth. Treated runoff from the raingarden drainage layer will discharge into the new stormwater pipe network. Raingarden overflow will discharge back into the road where it will be collected in catchpits and conveyed via the new stormwater pipe network for subsequent discharge into the proposed dry pond for attenuation.

The portion of Hobsonville Road contributing to Catchment 3 will include catchpit inlets discharging into a stormwater pipe along the south western edge of Trig Road, conveying runoff to the larger raingarden located downstream, west of Trig Road low point. All stormwater runoff along the south western carriageway (as well as the upper portion of Trig Road near the intersection) will also be collected via catchpit inlets and discharged into the larger raingarden downstream.

- 10 Year ARI post-development flow = 0.34m³/s (0.17m³/s each side of road)
- Min. road longitudinal slope (northern side of low point) = 1.1%
- Max. road longitudinal slope (southern side of low point) = 8%
- Max. pipe size discharging into larger raingarden = Ø450mm
- Max. pipe size discharging into dry pond (combined flow for entire catchment) = Ø750mm
- Approximate catchpit spacing road for max. gutter spread (Trig Road) = Varies (see layouts)
- Approximate catchpit spacing road for max. gutter spread (Hobsonville Road) = ±45m
- Dropped kerbed inlets and raingarden locations as indicated on layout to suit available berm space.

7.3.5 Catchment 4

Catchment 4 includes treatment via raingardens within the berm space at source, on both sides of the road. Dropped kerbed inlets will be used to discharge channel runoff into these raingardens, with dropped kerb outlets to cater for overflow above the required 200mm ponding depth. Treated runoff from the raingarden drainage layer will discharge directly into the existing overland flow path at the Catchment 4 low point. Raingarden overflow will discharge back into the road where it will be collected in catchpits and conveyed via the new stormwater pipe network for subsequent discharge into the proposed dry pond for attenuation.

A low point is located at the centre of catchment 4, however road surface runoff (excluding raingarden treated flows) will be diverted towards the dry pond for attenuation. As such, the stormwater pipes from the low point will be upsized to cater for 1% AEP flows.

- 10 Year ARI post-development flow = 0.18m³/s (0.09m³/s each side of road)
- Min. road longitudinal slope = 1%
- Max. pipe size required = Ø450mm (for 100 Year ARI post-dev. Flow, combined both sides)
- Dropped kerbed inlets as indicated on layout to suit available berm space

7.4 Groundwater

As mentioned in section 4.2.2, groundwater seepage was encountered just off the eastern side of Trig Road at the upper branch of Trig Stream (wetland) overland flow path and discharge point for the underground stormwater system near the intersection to Hobsonville Road.

The Project results in a large fill embankment over this seepage area, and appropriate groundwater management will be required to capture and convey the constant groundwater feed out of the fill embankment footprint. This will typically be achieved by the following, to be designed at detailed design stage and approved by the geotechnical engineer:

- In-situ slope drainage using herringbone counterfort drains, daylighting at proposed new headwall
- Mid-height lateral sand drainage blanket laid within fill new fill embankment

The general counterfort drain configuration is shown on Layout 3 of Appendix 2.

7.5 Operation and Maintenance

7.5.1 Dry Pond

Structural elements to facilitate safety and ease of maintenance of the dry pond will be confirmed during detailed design stage and will incorporate at a minimum a 3.0m wide vehicle access no steeper that 1:8, as well as safe access for maintenance workers to inlets and outlets.

Inlets and outfalls should be inspected regularly, as well as specifically after major storm events to clear excess debris build-up or obstructions, and for scour protection maintenance to ensure functional stormwater conveyance and protection of the receiving streams.

Grass should be mowed to maintain aesthetics, and any plant species should be maintained to ensure ecological function.

7.5.2 Raingardens

Raingardens are located within the berm adjacent foot paths, cycle ways or outside of the road corridor where safe access should be achievable. Planting of raingardens should consider on-going maintenance requirements such as weeding/grass cutting frequency and potential of plant growth encroaching into the adjacent footpaths and cycle ways. Raingardens should be regularly inspected, as well as specifically after large storm events to clear excess debris, check for blockages, maintain vegetation and media layers.

7.5.3 Manholes, Inlets and Outfalls

Inlets/catchpits will be provided with a sump to trap heavier/faster settling sediments and debris before connecting the stormwater pipeline and should be regularly maintained by means of a vacuum loading truck (or similar) to remove sediment and debris build up.

Pipes, inlets and outlets should be inspected regularly, as well as specifically after major storm events to clear excess debris build-up or obstructions, and for scour protection maintenance to ensure functional stormwater conveyance and protection of the receiving streams.

Manholes (designed to regulatory standards) will be located where possible outside of trafficable lanes to ensure safe access during maintenance works.

7.6 Summary of Effects and Recommended Mitigation

The table below provides a summary of the stormwater related effects the Project will have on the receiving environment, and how these effects are mitigated and satisfy the requirements under the AUP: OP.

Table 13: Summary of Effects and Methods of Mitigation

Works Activity/Trigger for Resource Consent	Potential Effect on Receiving Environment	Mitigation Method	Conclusion
E8 of the AUP: OP: Stormwater - Discharge and Diversion ***"(A5) Diversion and discharge of stormwater runoff from additional impervious areas greater than 5000m² of road":*** **Redevelopment of Trig Road and the new impervious area to accommodate the new traffic lanes, foot paths and cycleways exceeds 5,000m² of impervious area post-development)**	The 45% increase in impervious area has resulted in a significant peak runoff flow increase across the development, which will be discharged into the downstream receiving Trig Stream (wetland). The receiving environment and surroundings are zoned for mixed-housing development in future. Given the location of the Project in the upper reaches of a greenfield area and the uncertainty of the future developments to be implemented, the increase in discharge may in the future development scenario have the potential to cause: • an increase in scouring or erosion at the discharge point and downstream thereof • adverse effects to stream health and biodiversity as a result of increased cumulative flows • flooding of properties in storm events up to 10% AEP • inundation of buildings on properties in storm events up to the 1% AEP • damage to properties or other infrastructure	• On-site stormwater attenuation is included for peak flow control to ensure discharge of post-development runoff into the receiving environment at a maximum that matches that of pre-development runoff • Stream protection flow has been accounted for and allowed for within the attenuation pond discharge outlet • Outfall structure of attenuation pond will include baffle blocks and rip-rap energy dissipation for ensuring acceptable, non-scouring velocities • The primary stormwater system has been designed to effectively convey the 10% AEP storm event • The 1% AEP storm event will be contained within the road reserve with appropriate bypass allowance from the road low point to the attenuation pond • The existing secondary system/overland flow paths and crossings under Trig Road will be maintained	An on-site attenuation pond for up to the 1% AEP storm event and the appropriately designed outfall structure allows for stream protection flow release, stream protection by energy dissipation at outfall to minimise scouring and erosion, and controlled discharge into the stream during large storm events to prevent downstream flooding. Damage to properties and other infrastructure is avoided by collection and conveyance of runoff within the road and via underground pipe systems, and by ensuring pipe crossings have sufficient capacity for effectively draining upstream catchments for future MPD.

		• The upgrading/upsizing of the crossings for the MPD during the new Trig Road upgrade will allow for enhanced flood control, minimising the potential for flooding as indicated in the flood prone areas	
E9 of the AUP: OP: Stormwater Quality – High Contaminant Generating Activity ***"(A7) Development of a new or redevelopment of an existing high use road greater than 5,000m²":*** **Redevelopment area of Trig Road to accommodate the new traffic lanes, foot paths and cycleways exceeds 5,000m²**	The 45% increase in impervious area (as a redevelopment of high use road) has the potential to increase the concentration of contaminants with the potential to cause: • oils, grease, suspended materials or floating objects to enter the receiving stream • change in colour or visual clarity of receiving stream • release odour generating contaminants into the receiving stream These may result in rendering the water source unfit for consumption by fauna and flora, or have adverse effects on aquatic life and the general ecology of the receiving environment.	• Water treatment has been designed and selected with consideration of GD01 • Raingardens were selected for "at source" treatment within the berms along the carriageway as well as "end of pipe" treatment in larger raingardens, and meet equivalent treatment requirements as per GD01	Raingardens effectively deal with water quality volumes from high contaminant generating roads, removing contaminants from runoff to regulatory requirements prior to discharging into the environment, with ease of incorporation within the project area and its specific constraints.
Minimise bird strike risk through the design of stormwater ponds/wetlands	• Permanent waterbodies attract bird life and present risk of bird strike within the New Zealand Defence Force Airspace Restriction Designation Overlay, and the need for stormwater attenuation within the overlay has the potential to increase the attraction of bird life due to large stored water volumes	• Dry pond design selected over wet pond for attenuation of additional post development run-off ensuring no additional permanent waterbody is allocated within the risk zone • Designed for 1% AEP storm event, fully draining within 24 hours of storm event, resulting in no free-standing water for potential habitation and attraction of bird life.	A fully draining pond will result in no free-standing water for prolonged periods, thus reducing habitability by bird life.

E26 of the AUP:OP: Infrastructure ***"(A55) Stormwater detention/retention ponds/wetlands":*** **A new stormwater detention pond is proposed for attenuation of post-development runoff, to be located at 19 Trig Road.** ***(Not applicable as a trigger for resource consent. Used as a guideline for design)***	• Interference with public use and enjoyment of open space • Potential safety hazard during maintenance works and/or with lack of appropriate access • Potential health and safety effects on public	• Dry pond is not located on existing recreational open space • Dry pond design choice over wet-pond provides aesthetic and amenity potential, with potential for open green space usage during storm events / dry periods • Dry pond provides easier maintenance opportunities and safe access between storm events to structure inlets and outlets • Safe access will be provided into dry pond area • No permanent standing water in dry pond minimises drowning hazard risks • No permanent standing water in dry pond ensures lesser potential for pests, mosquitos and vermin • Dry pond side slopes graded at flatter 1:5 slope to reduce the risk of getting stuck and minimising the need for a dedicated perimeter fence	A fully draining pond, designed with flatter graded internal embankments and vehicle access allowance provides for public safety and safety during maintenance works, as well as providing a potentially multi-purpose use and aesthetically pleasing planted green space during dry periods.

8 Conclusions

The stormwater design approach, elements/infrastructure and concept network layout have been developed to satisfy the regulatory standards and water sensitive design requirements. While subject to refinement in detailed design stage the indicative design demonstrates the stormwater needs of the Project can be met, whilst catering to both current land use and for the expected future development upstream and downstream of the Project area.

The stormwater system will allow for enhancement of the drainage of the upstream catchments along Trig Road and will reduce potential flood effects up to the 100year rainfall event in future development scenarios as well associated with the Trig Rd development. The downstream receiving environment will be protected from additional flood risk by attenuation and by water quality improvement devices. Attenuation will also reduce flood risk to future development downstream of Trig Road.

Through this assessment, the triggers for resource consent have been identified and the potential effects evaluated, and the most well-suited methods and design elements have been selected for mitigation of these effects.

Appendix 1. Relevant Matters of Discretion, Matters of Control, and Assessment Criteria

From the Auckland Unitary Plan

E3. LAKES, RIVERS, STREAMS AND WETLANDS

(A48) Extension of an existing lawful reclamation or drained area.

Activity Status: Non-complying

Assessment Matters: N/A

E8. STORMWATER – DISCHARGE AND DIVERSION

(A5) Diversion and discharge of stormwater runoff from additional impervious areas greater than 5,000m2 of road (which include road ancillary areas that are part of a road, motorway or state highway operated by a road controlling authority) or rail corridor that complies with Standard E8.6.1 and Standard E8.6.4.1

Activity Status: Restricted Discretionary

E8.6.4. Restricted discretionary activity standards:

Activities listed as restricted discretionary in Table E8.4.1

Activity table must comply with the following restricted activity standard. E8.6.4.1. Diversion and discharge of stormwater runoff from additional impervious areas greater than 5,000m2 of road (which include road ancillary areas that are part of a road, motorway or state highway operated by a road controlling authority) or rail corridor

(2) Any road ancillary area must not be used for:

> (a) storage of roading and building materials that are not inert for more than 30 days continuously;
>
> (b) works / building yards.

(3) Where stormwater runoff from an impervious area is discharged into a stream receiving environment, it must be managed by a stormwater management device to meet the hydrology mitigation requirements specified in Table E10.6.3.1.1 Hydrology mitigation requirements.

(4) Stormwater management devices must be provided to reduce or remove contaminants from stormwater runoff.

E8.8. Assessment – restricted discretionary activities

E8.8.1. Matters of discretion

The Council will restrict its discretion to all of the following matters when assessing a restricted discretionary resource consent application:

(1) for diversion of stormwater runoff from lawfully established impervious areas directed into an authorised stormwater network or a combined sewer network that does not comply with Standard E8.6.2.1:

> (a) measures to mitigate additional stormwater flows and potential increases in overflows from the combined sewer network, including future connection to a stormwater network should one become available;

(b) alternative methods of disposal;

(c) effects on the operation and management of the combined sewer network;

(d) operations and maintenance requirements;

(e) monitoring and reporting;

(f) the duration of the consent and the timing and nature of reviews of consent conditions.

(2) for diversion and discharge of stormwater runoff from additional impervious areas greater than 5,000m2 of road (which include road ancillary areas that are part of a road, motorway or state highway operated by a road controlling authority) or rail corridor:

(a) the methods proposed for the management of the adverse effects on receiving environments, including cumulative effects, having regard to:

(i) the nature, volume and peak flow of the stormwater runoff discharge;

(ii) the sensitivity of the receiving environment to stormwater runoff contaminants and flows;

(iii) the extent to which opportunities to reduce existing adverse effects and enhance receiving environments have been identified and utilised; Auckland Unitary Plan Operative in part 7 E8 Stormwater – Discharge and diversion

(iv) where stormwater runoff is discharged to a stream receiving environment, the extent to which the diversion and discharge is managed to achieve the following: • maintain baseflow and interflow at the predevelopment conditions; • reduce the duration and intensity of flows which will cause erosion and habitat degradation; • reduce runoff volumes to pre-development conditions; and • utilise natural flow paths and streams to help slow down water flows; and

(v) the extent to which effects on marine sediment quality, are avoided, remedied or mitigated.

(b) the measures proposed for the management of the adverse effects of the stormwater runoff diversion and discharge on receiving environments having regard to best practicable options;

(c) the measures proposed for the implementation of stormwater management devices and other measures and programmes that give effect to the best practicable option;

(d) the methods proposed for the management and mitigation of flood effects and flood risks, including effects on buildings and property;

(e) the likely effectiveness of the proposed methods and measures to avoid land instability, erosion, scour and flood risk to buildings and property;

(f) the likely effectiveness of the proposed location, design and method of the discharge in managing or mitigating potential adverse effects on the environment;

(g) the methods proposed for the management of stormwater flow and contaminants and for the implementation of stormwater management devices and other measures;

(h) the proposed methods for stormwater runoff disposal through soakage, or infiltration having regard to the need for managing water levels in underlying peat soils and for ground stability, where those conditions are relevant;

(i) the extent to which effects on Mana Whenua values are avoided remedied or mitigated;

(j) the likely effectiveness of the proposed operations and maintenance requirements in ensuring the ongoing and long-term management of adverse effects on the environment; Auckland Unitary Plan Operative in part 8 E8 Stormwater – Discharge and diversion

(k) the extent to which proposal for monitoring and reporting are likely to be sufficient to ensure that any performance failures are addressed without undue delay; and

(l) the proposed duration of the consent and the timing and nature of reviews of consent conditions having regard to:

(i) the need to periodically reassess the consent to take account of any changes in the nature of the discharge or the receiving environment; and

(ii) the need to set duration and review periods having regard to efficiency and effectiveness.

E8.8.2. Assessment criteria

The Council will have regard to the following policies when considering the matters listed above:

(1) for diversion of stormwater runoff from lawfully established impervious areas directed into an authorised stormwater network or a combined sewer network that does not comply with Standard E8.6.2.1:

(a) policies E1.3 (8), (9), (10), (11), (13), (14) and (20) in E1 Water quality and integrated management

(2) for diversion and discharge of stormwater runoff from additional impervious areas greater than 5,000m2 of road (which include road ancillary areas that are part of a road, motorway or state highway operated by a road controlling authority) or rail corridor:

(a) policies E1.3(1) to (14) in E1 Water quality and integrated management.

E9. STORMWATER QUALITY – HIGH CONTAMINANT GENERATING CAR PARKS AND HIGH USE ROADS

(A7) Development of a new or redevelopment of an existing high use road greater than 5,000m2

Activity Status: Controlled

E9.6.2. Controlled activity

All controlled activities in Table E9.4.1 Activity table must comply with the following activity specific standards:

E9.6.2.2. Development of a new or redevelopment of an existing high use road greater than 5,000m2

(1) Stormwater runoff from the impervious area is treated by stormwater management device(s).

(2) Stormwater management device(s) must meet the following:

(a) the device or system must be sized and designed in accordance with Auckland Councils Technical Publication 10: Design Guideline Manual for Stormwater Treatment Devices (2003); or

(b) where alternative devices are proposed, the device must demonstrate it is designed to achieve an equivalent level of contaminant or sediment removal performance to that of Technical Publication 10: Design Guideline Manual for Stormwater Treatment Devices (2003).

E9.7. Assessment – controlled activities

E9.7.1. Matters of control

The Council will reserve its control to all of the following matters when assessing a controlled activity resource consent application:

(2) for the development of a new or redevelopment of an existing high use road greater than 5,000m2:

(a) the effectiveness of the stormwater management device(s) in meeting Standard E9.6.2.2(2);

(b) the potential for adverse effects from the discharge of contaminants on the receiving environment;

(c) the proposed methods for operating and maintaining the stormwater treatment processes and devices to ensure their continued and ongoing effectiveness in meeting Standard E9.6.2.2(2);

(d) the proposed methods for monitoring and reporting on the effectiveness of the treatment process;

(e) the duration of the consent and the timing and nature of reviews of consent conditions; and

(f) the treatment of stormwater runoff from existing high use road impervious areas discharging to the same network.

E9.7.2. Assessment criteria

The Council will consider the relevant assessment criteria below for controlled activities:

(2) for the development of a new, or redevelopment of an existing high use road greater than 5,000m2:

(a) the extent to which the proposed stormwater management device minimises adverse effects on the environment having regard to the nature and sensitivity of the receiving environment;

(b) whether the stormwater management device is appropriately designed, sized and operated for the site and contaminants of concern;

(c) whether the stormwater quality device is durable and will achieve the performance requirements in the long term;

(d) the extent to which operation and maintenance plans have been provided to manage the stormwater management device(s);

(e) whether it is practical to treat existing high use road areas discharging to the same drainage network point and being treated by the same treatment device having regard to all of the following:

(i) site and operational constraints;

(ii) requirements to provide for other utility services;

(iii) the function of roads as overland flow paths conveying stormwater runoff from surrounding land uses which the road controlling authority has limited ability to control;

(iv) safety and operational constraints of the road or discharges; and

(v) topographical limitations and geotechnical and structural requirements; and

(f) the extent to which there is a requirement in the Plan to reconstruct the existing drainage network.

E26. INFRASTRUCTURE

(A55) Stormwater detention/retention ponds/wetlands

Activity Status: Controlled

E26.2.6. Assessment – controlled activities

E26.2.6.1. Matters of control

The Council will reserve its control to all the following matters when assessing a controlled activity resource consent application:

(2) stormwater detention and retention ponds and wetlands:

(a) effects on the use of open space;

(b) provision of safe access for maintenance; and

(c) effects on health and safety.

E26.2.6.2. Assessment criteria

The Council will consider the relevant assessment criteria for controlled activities from the list below:

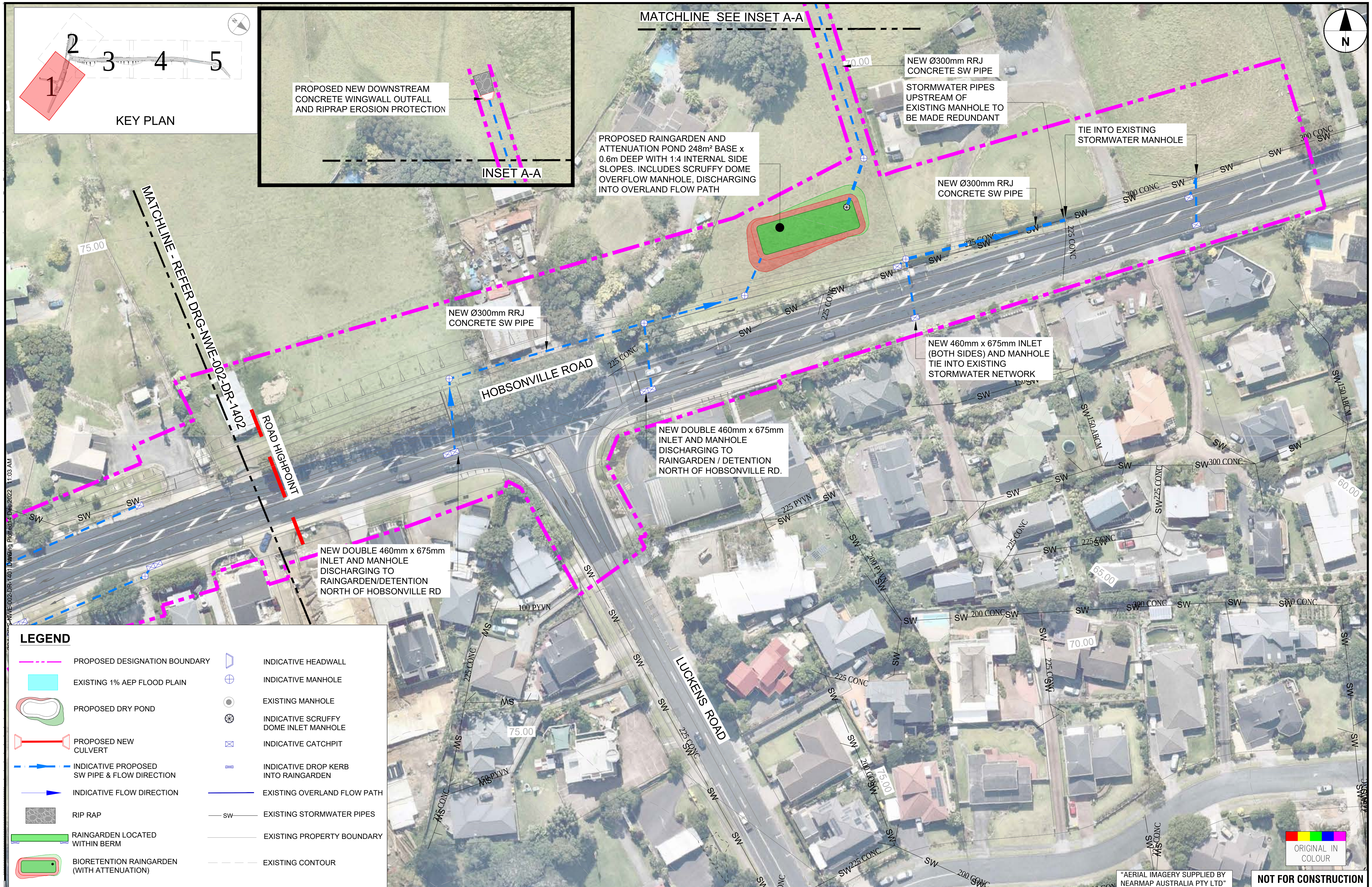
(2) stormwater detention and retention ponds and wetlands:

(a) the extent to which interference with public use and enjoyment of open space is minimised where stormwater detention and retention ponds and wetlands are located in public open space;

(b) whether safe and direct access can be provided to enable the maintenance of stormwater detention and retention ponds and wetlands; and

(c) whether there will be health and safety effects associated with stormwater detention and retention ponds and wetlands and the extent to which these can be mitigated through measures such as fencing.

Appendix 2. Stormwater Drawings



LEGEND

PROPOSED DESIGNATION BOUNDARY	INDICATIVE HEADWALL
EXISTING 1% AEP FLOOD PLAIN	INDICATIVE MANHOLE
PROPOSED DRY POND	EXISTING MANHOLE
	INDICATIVE SCRUFFY DOME INLET MANHOLE
PROPOSED NEW CULVERT	INDICATIVE CATCHPIT
INDICATIVE PROPOSED SW PIPE & FLOW DIRECTION	INDICATIVE DROP KERB INTO RAINGARDEN
INDICATIVE FLOW DIRECTION	EXISTING OVERLAND FLOW PATH
RIP RAP	EXISTING STORMWATER PIPES
RAINGARDEN LOCATED WITHIN BERM	EXISTING PROPERTY BOUNDARY
BIORETENTION RAINGARDEN (WITH ATTENUATION)	EXISTING CONTOUR

REV	REVISIONS	DRAWN	DATE
B	ISSUED FOR NOTICE OF REQUIREMENT LODGEMENT	VDLT	DEC. 2022
A	FOR NOTICE OF REQUIREMENT AND RESOURCE CONSENT	VDLT	AUG. 2020

SURVEYED		
DRAWN	V. DELA TORRE	01.05.20
DRAWING CHECK	J. DELA TORRE	01.05.20
DESIGN	N. WOLFAARDT	20.08.20
DESIGN REVIEW	R. SEYB	20.08.20
APPROVED	B. BUSNARDO	07.12.2022

TE TUPU NGĀTAHI Supporting Growth

WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SUPPORTING GROWTH PROGRAMME
NORTH WEST - HIF TRIG ROAD (SOUTH)

Drawing Title: STORMWATER LAYOUT PLAN
SHEET 1 OF 5

Drawing Status: FOR LODGEMENT
Drawing Date: 07.12.2022
A1 Scales 1:500 | A3 Scales 1:1000
Discipline: STORMWATER
Drawing No. SGA-DRG-NWE-002-DR-1401
Revision: B

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DRAWING CHECK	J. DELA TORRE	01.05.20
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Drawing Title:
STORMWATER LAYOUT PLAN
SHEET 2 OF 5

Drawing Status: **FOR LODGEMENT**
Drawing Date: 07.12.2022
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Discipline: STORMWATER
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Revision: B

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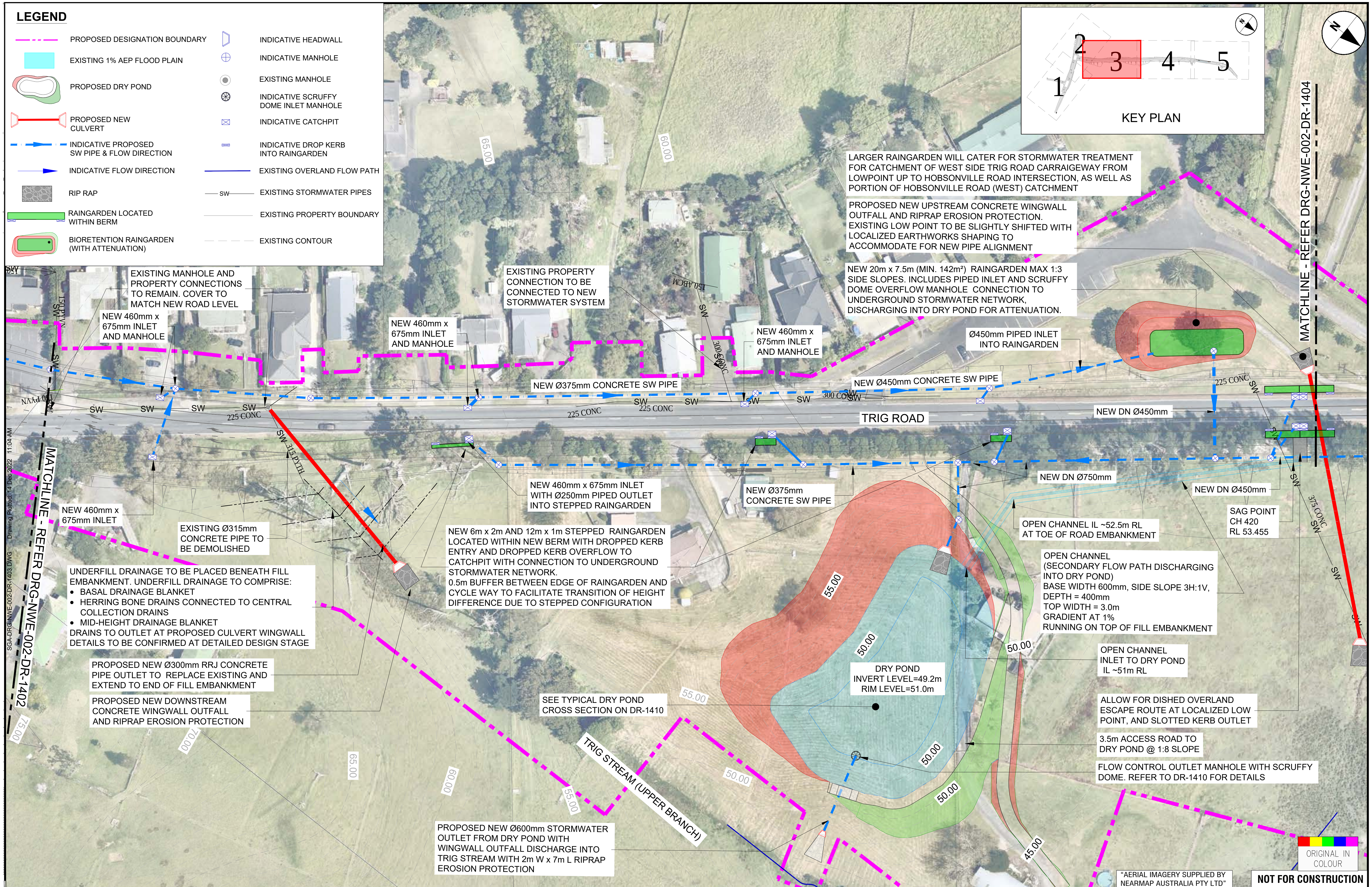

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A	FOR NOTICE OF REQUIREMENT AND RESOURCE CONSENT	VDLT	AUG. 2020

SURVEYED		
DRAWN	V. DELA TORRE	01.05.20
DRAWING CHECK	J. DELA TORRE	01.05.20
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DESIGN REVIEW	R. SEYB	20.08.20
APPROVED	B. BUSNARDO	07.12.2022

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Drawing Title:
STORMWATER LAYOUT PLAN
SHEET 3 OF 5

Drawing Status: **FOR LODGEMENT**
Drawing Date: 07.12.2022
A1 Scales 1:500 | A3 Scales 1:1000
Discipline: STORMWATER
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Revision: B

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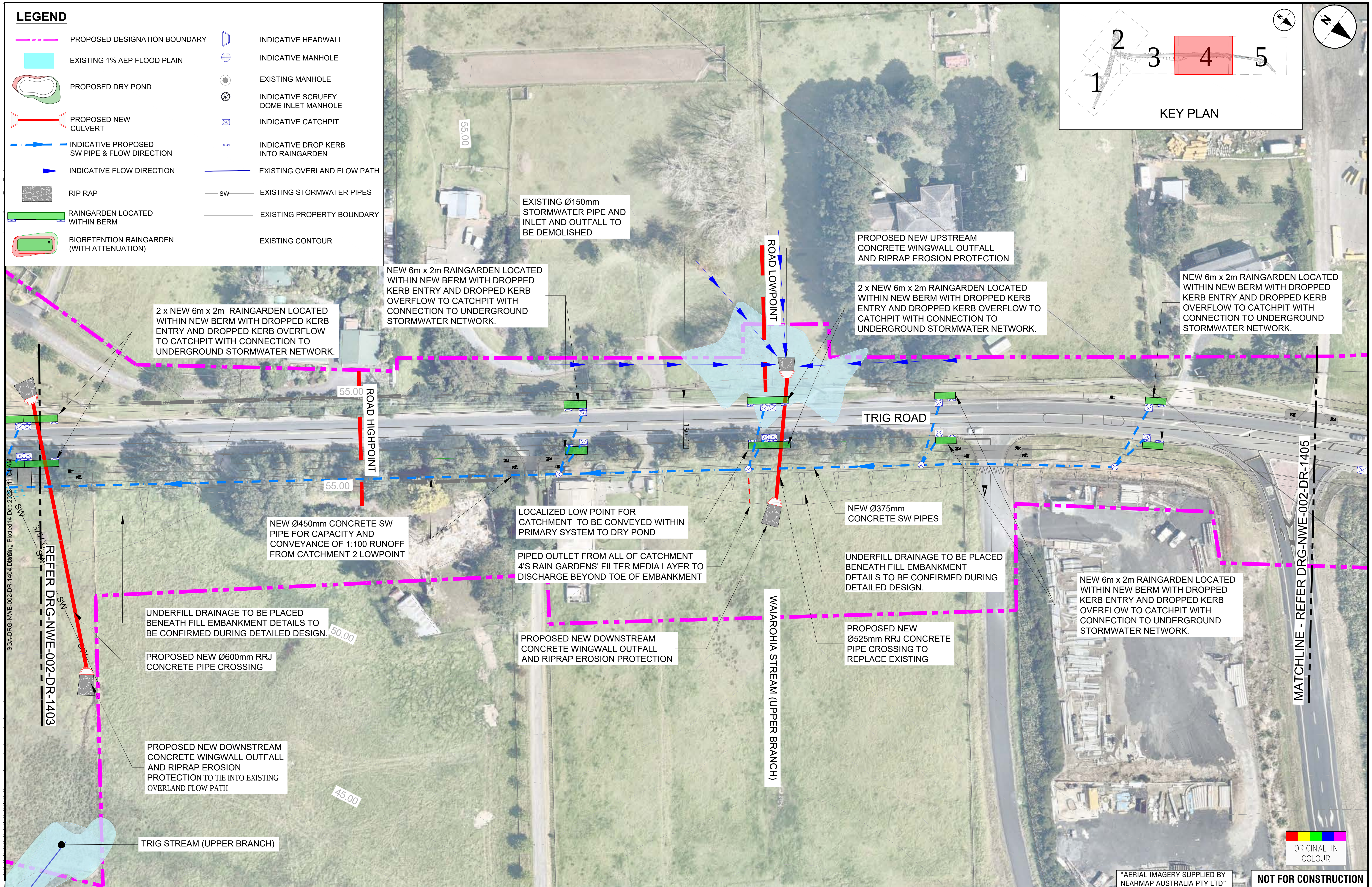

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A	FOR NOTICE OF REQUIREMENT AND RESOURCE CONSENT	VDLT	AUG. 2020

SURVEYED		
DRAWN	V. DELA TORRE	01.05.20
DRAWING CHECK	J. DELA TORRE	01.05.20
DESIGN	N. WOLFAARDT	20.08.20
DESIGN REVIEW	R. SEYB	20.08.20
APPROVED	B. BUSNARDO	07.12.2022

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Drawing Title: STORMWATER LAYOUT PLAN
SHEET 4 OF 5

Drawing Status: FOR LODGEMENT
Drawing Date: 07.12.2022
Scales: A1 1:500 A3 1:1000
Discipline: STORMWATER
Drawing No. SGA-DRG-NWE-002-DR-1404
Revision: B

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DRAWN	V. DELA TORRE	01.05.20
DRAWING CHECK	J. DELA TORRE	01.05.20
DESIGN	N. WOLFAARDT	20.08.20
DESIGN REVIEW	R. SEYB	20.08.20
APPROVED	B. BUSNARDO	07.12.2022

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Project:
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NORTH WEST - HIF TRIG ROAD (SOUTH)

Drawing Title:
STORMWATER LAYOUT PLAN
SHEET 5 OF 5

Drawing Status: **FOR LODGEMENT**
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Discipline: STORMWATER
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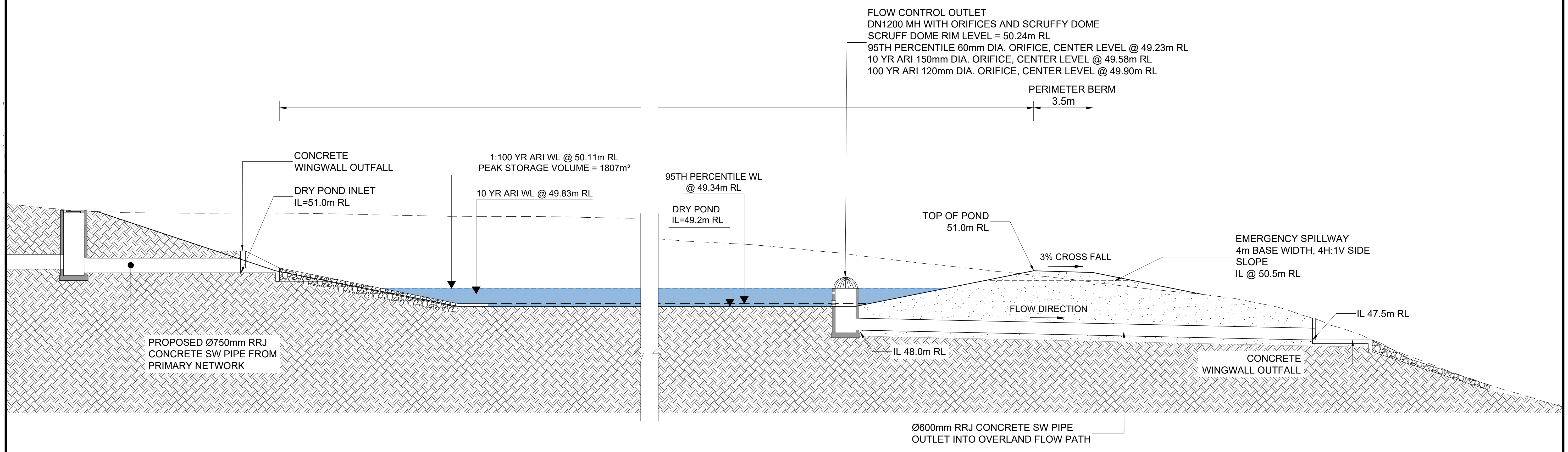
Revision: B



A | TYPICAL DRY POND CROSS SECTION
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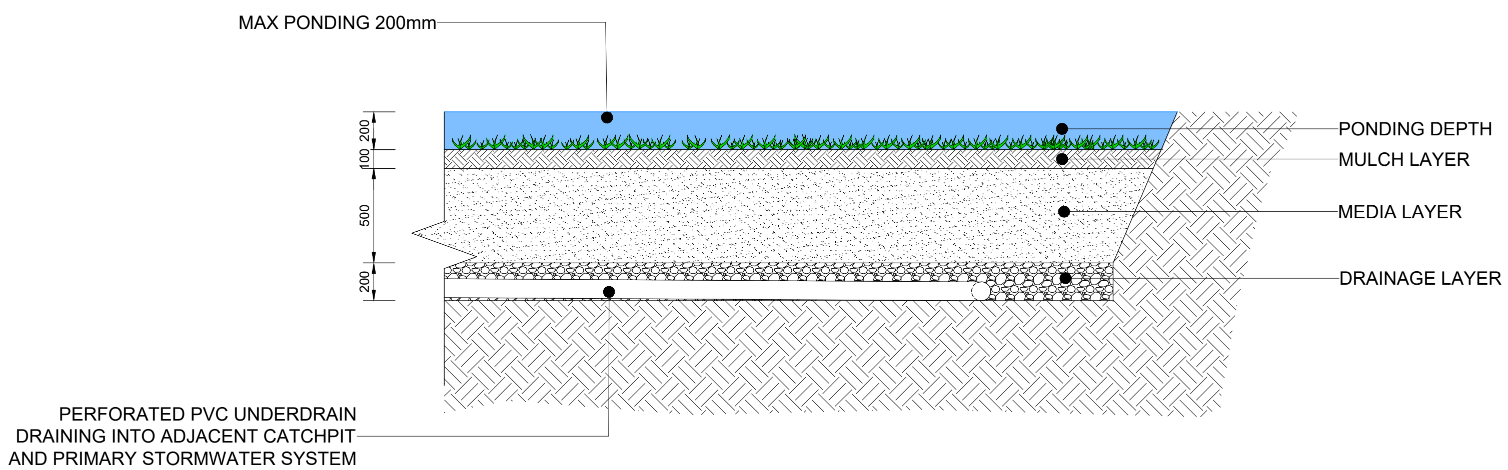
Scale 1:100



B | TYPICAL RAINGARDEN LONG SECTION
-
Scale 1:20

SGA-DRG-NWE-002-DR-1410.Dwg Drawing Plotted14 Dec 2022 11:05 AM

ORIGINAL IN COLOUR

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SURVEYED		
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DRAWING CHECK	J. DELA TORRE	01.05.20
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APPROVED	B. BUSNARDO	07.12.2022

TE TUPU NGĀTAHI Supporting Growth
AT
WAKA KOTAHI NZ TRANSPORT AGENCY

Project:
SUPPORTING GROWTH PROGRAMME
NORTH WEST - HIF TRIG ROAD (SOUTH)

Drawing Title:
STORMWATER
DRY POND AND RAINGARDEN TYPICAL CROSS SECTIONS

Drawing Status: **FOR LODGEMENT**
Drawing Date: 07.12.2022
A1 Scales: AS SHOWN | A3 Scales: HALF SCALE
Discipline: STORMWATER
Drawing No.: SGA-DRG-NWE-002-DR-1410
Revision: B

Appendix 3. HEC-HMS Model

General

The hydrological model was built using HEC-HMS v4.9 to reflect the proposed development and associated imperviousness within the catchment. The modelling was done in accordance with . for sizing the proposed dry pond in accordance with Auckland Council's Technical Publication 108 (TP108): Guidelines for Stormwater Runoff Modelling in the Auckland and AC's Stormwater Design CoP.

The HEC-HMS model may be revised in detailed design phase for optimisation.

Model Inputs

The post-development HEC-HMS basin model is shown in Figure A3-1 below, where Trig Road South is equivalent to Catchment 3 and Trig Road North is equivalent to Catchment 4 in Figure 6-3 in the main report.

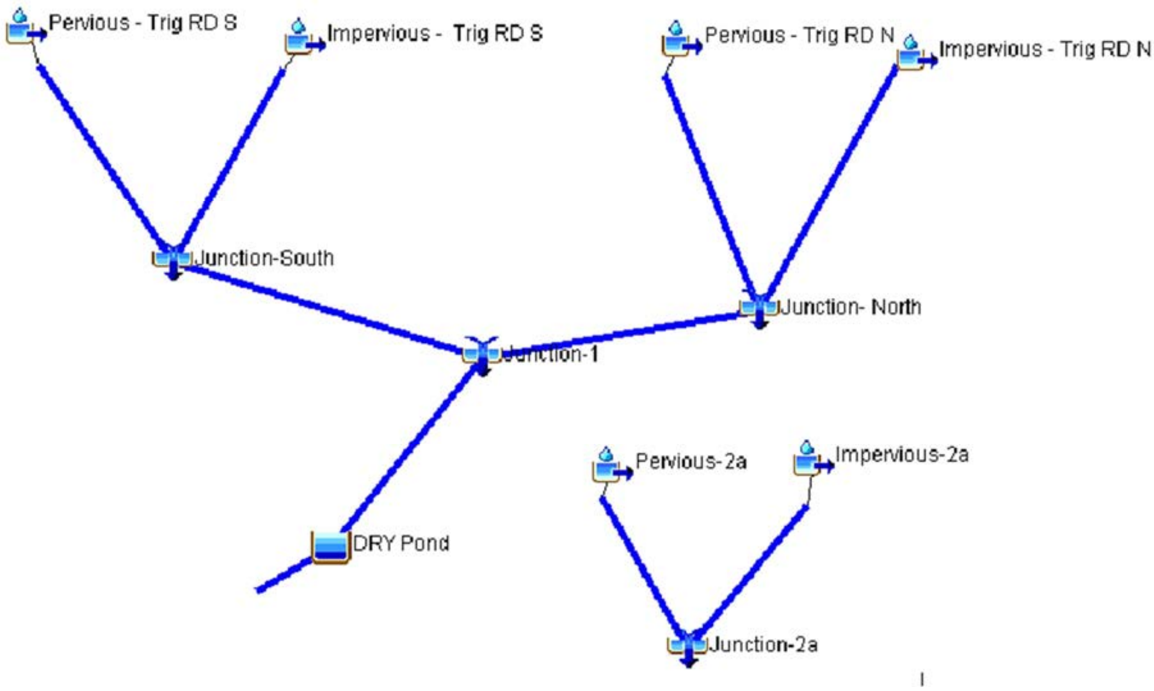

Figure A3-1. HEC-HMS basin model for Trig Road – Post Development

A pre-development basin model was run to estimate pre-development flows.

Design Rainfall

Five design storm events were modelled in HEC-HMS and the following is the design rainfall depth

Design storm Event Description	AEP (%)	24hr Rainfall Depth (mm)	Climate Change Increase (%)	Adjusted 24hr Rainfall Depth (mm)	Reference source
10year ARI	10%	135	13.2%	153	AC TP108
50year ARI	2%	180	16.8%	210	AC TP108
100year ARI	1%	200	16.8%	234	AC TP108
WQV rainfall	N/A	25	N/A	N/A	AC GD01 – 90th percentile rainfall depth
95th Percentile rainfall	N/A	35	N/A	N/A	AC GD01

Rainfall Temporal Pattern

The rainfall temporal pattern was applied in accordance with the *Auckland Code of Practice for Land Development and Subdivision, Chapter 4: Stormwater*, Version 3.0, January 2022. The pattern is shown in Table 2 below for the existing and future rainfall scenarios.

Table 2: TP108 Normalised 24-hour temporal rainfall intensity profile

Time (hrs: mins)	Time interval (min)	TP108 normalised rainfall intensity (I/I24)	
		Existing condition	Future climate change*
0:00 – 6:00	360	0.34	0.33
6:00 – 9:00	180	0.74	0.73
9:00 – 10:00	60	0.96	0.95
10:00 – 11:00	60	1.40	1.40
11:00 – 11:30	30	2.20	2.20
11:30 – 11:40	10	3.80	3.82
11:40 – 11:50	10	4.80	4.86
11:50 – 12:00	10	8.70	8.86
12:00 – 12:10	10	16.20	16.65
12:10 – 12:20	10	5.90	5.95
12:20 – 12:30	10	4.20	4.24
12:30 – 13:00	30	2.90	2.92
13:00 – 14:00	60	1.70	1.70
14:00 – 15:00	60	1.20	1.19
15:00 – 18:00	180	0.75	0.75
18:00 – 24:00	360	0.40	0.39

* Assuming 2.1°C increase in temperature

Dry Pond Storage Capacity

Elevation-area function as shown in table below was used to estimate the storage capacity of the dry pond in HEC-HMS model. Linear interpolation is assumed in elevation between pond invert and rim.

Elevation (m RL)	Area (1000 m^2)	Remarks
49.2	1.243	Pond invert level
51.0	2.863	Pond rim level

The dry pond was designed and 3D-modelled in Civil3D software to obtain cut-fill extent and set invert and rim level. The areas at the pond invert level of 49.2m RL and at the rim level of 51.0m RL were measured from Civil3D.

Model Results

Table below show the HEC-HMS model results for the dry pond's water level, peak discharge rate, peak storage volume, and emptying duration for the five design storm events. Pond emptying duration is the duration to fully drain down the dry pond from the start of the storm event.

Design Storm Event	Water Level (m RL)	Peak Inflow (m^3/s)	Peak Discharge (m^3/s)	Peak Storage Vol (m^3)	Inflow Vol (m^3)	Pond Emptying Duration (Hr:min)
WQV	49.30	0.06	0.01	190	363	25hr:50min
95th Percentile	49.34	0.09	0.01	276	551	27hr:30min
10% AEP	49.83	0.52	0.16	1259	3105	38hr:10min
2% AEP	50.03	0.74	0.26	1654	4455	40hr:10min
1% AEP	50.11	0.83	0.29	1807	4971	40hr:20min

Figures A3-2 and A3-3 below show the inflow and outflow graphs for 2% AEP and 1% AEP design storm event for 48 hours duration.

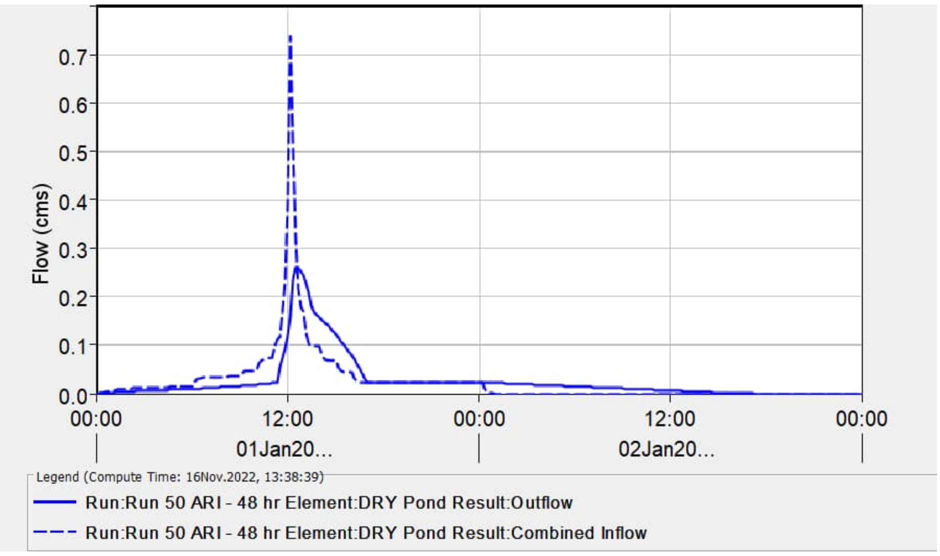

Figure A3-2. Dry Pond – 2% AEP (50yr ARI) Inflow and Outflow Graph (Post-Development)

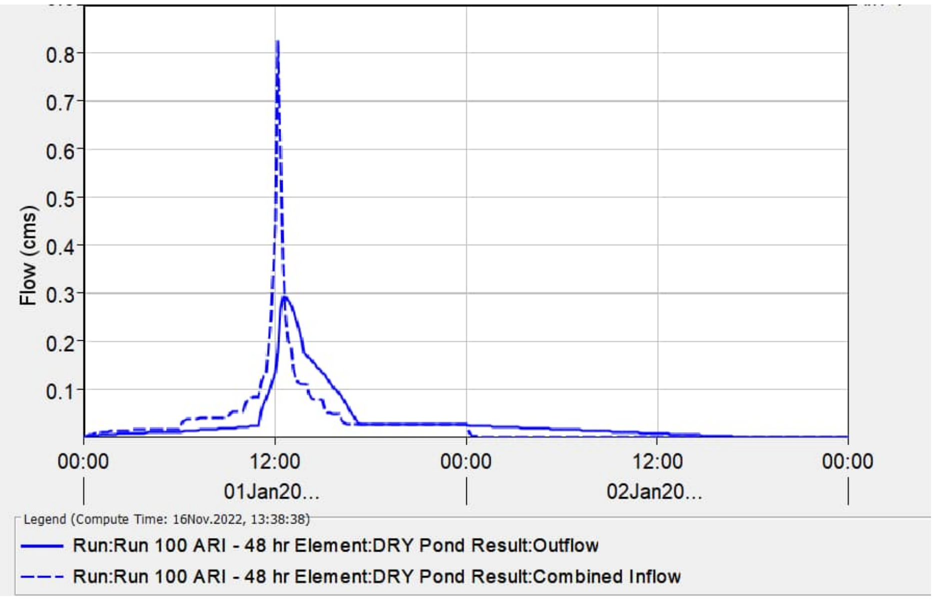

Figure A3-2. Dry Pond – 1% AEP (100yr ARI) Inflow and Outflow Graph (Post-Development)

Conclusions

The HEC-HMS model results indicated that the dry pond meets the attenuation requirements by having the peak post-development discharge rates are less than the allowable peak discharge rates as shown in table below. The dry pond also meets the design criteria that it can be fully drained down within 48 hours of a 2% AEP storm event.

Design Storm Event	Allowable Peak Discharge (m^3/s)	Post-Dev Peak Discharge (m^3/s)
95th Percentile	0.047	0.01
10% AEP	0.31	0.16
2% AEP	0.45	0.26
1% AEP	0.51	0.29

There will be opportunities to optimise the dry pond design in detailed design phase. The current dry pond is likely to be oversized by comparing the attenuated discharge flow rate vs. pre-development allowable peak discharge flow rate.

ATTACHMENT 20

TRIG ROAD CORRIDOR UPGRADE
EROSION AND SEDIMENT CONTROL PLAN

Supporting Growth

Trig Road Corridor Upgrade

Erosion and Sediment Control Plan

Version 1.0

December 2022

TE TUPU NGĀTAHI Supporting Growth

NZ TRANSPORT AGENCY WAKA KOTAHI

Document Status

Version	Responsibility	Name
2020 Draft	Author	Nadine Wolfaardt
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	Reviewer	Mike Summerhays
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1.0	December 2022	Final for issue

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Acronyms

Acronym/Term	Description
AUP:OP	Auckland Unitary Plan Operative in Part 2016
AT	Auckland Transport
AEE	Assessment of Effects on the Environment
GD05	Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region – Guideline Document 2016/005
ESC	Erosion and Sediment Control
NoR	Notice of Requirement
Project	Trig Road Corridor Upgrade
RMA	Resource Management Act 1991
SH18	State Highway 18
SRP	Sediment Retention Pond

1 Introduction

1.1 Background

Auckland's population is growing rapidly; driven by both natural growth (more births than deaths) and migration from overseas and other parts of New Zealand. The Auckland Plan 2050 anticipates that this growth will generate demand for an additional 313,000 dwellings and require land for approximately 263,000 additional employment opportunities.

In response to this demand, the Auckland Unitary Plan Operative in Part 2016 (**AUP:OP**) identifies 15,000 hectares of predominantly rural land for future urbanisation. To enable the urban development of greenfield land, appropriate bulk infrastructure needs to be planned and delivered.

The Supporting Growth Programme is a collaboration between Auckland Transport (**AT**) and Waka Kotahi NZ Transport Agency, to investigate, plan and deliver the transport networks needed to support Auckland's future urban growth areas over the next 30 years.

1.2 Purpose of this Report

Trig Road, Whenuapai has been identified in the Supporting Growth Programme as a future arterial corridor that is needed to support the urban development of Whenuapai.

This report has been prepared to support AT's notice of requirement (**NoR**) and application for resource consents for the Trig Road Corridor Upgrade (the **Project**). The NoR under the Resource Management Act 1991 (**RMA**) is to designate land for the construction, operation and maintenance of the Project.

Funding for the upgrade of Trig Road between Hobsonville Road and State Highway 18 (**SH18**) has been made available through the Housing Infrastructure Fund[1]. As there is funding available for construction, AT are also applying for the necessary resource consents under the RMA, concurrently with the NoR process.

This report outlines the Erosion and Sediment Control (**ESC**) approach for the Project, with regards to reducing and isolating environmental effects associated with the earthworks, construction works and future functioning of the Project on the receiving environment. This report has been prepared in conjunction with the Assessment of Stormwater Effects and the indicative construction methodology, to inform the Assessment of Effects on the Environment (**AEE**).

The report provides the framework for the construction of ESC measures and provides site specific detail. The Report describes the methods and practices to be implemented to ensure the effects of erosion and sediment generation are minimised and managed, and degradation to the receiving environment is avoided.

[1] See North West Housing Infrastructure Fund Assessment of Environmental Effects for further detail regarding the Housing Infrastructure Fund.

The Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region – Guideline Document 2016/005 (**GD05**) was used as a reference for the appropriate methods and practices applied.

This report is a draft report only and will be subject to a contractor preparing a final ESC Plan and obtaining certification from Auckland Council.

2 Project Description

2.1 Project Location

As shown in Figure 1 below, the full length of Trig Road is located in Whenuapai, a suburb in the North West area of Auckland. Trig Road is approximately 2.28km, starting from the urban fringe of West Harbour, at the intersection on Hobsonville Road to the south, crossing SH18, and extending towards Brigham Creek Road intersection to the north.

Figure 1: Locality Plan

2.2 Project Description

The Project consists of the widening and upgrade of Trig Road transport corridor between the SH18 off-ramps and Hobsonville Road. The widening has capacity to provide for a two-lane arterial standard corridor including new footpaths on both sides of the road and a cycleway which is indicatively shown as a bi-direction cycleway on the eastern side of the corridor. The Project will upgrade the current rural standard corridor, currently 20m wide, to an urban standard, proposed to be approximately 22.4 to 24.8m wide, which is appropriate to support the soon to be urban environment on either side of Trig Road.

To safely tie into the existing road network, the Project also includes the signalisation of the intersections at Trig Road / Hobsonville Road and Luckens Road / Hobsonville Road and upgrade of Hobsonville Road between these intersections. This will require some localised widening of the road corridor along Hobsonville Road. The SH18 over-bridge will also be reconfigured to provide for a cycleway, and additional tie in works to the north of the over-bridge within the existing road reserve.

Table 1 below provides a breakdown of the earthworks coverage and cut/fill volumes expected across Trig Road and Hobsonville Road. A hypothetical maximum allowance for site clearance and earthworks remediation for the remaining designation area, outside of the road corridor, has also been provided for as included in the table, although there is a possibility that not all of this area will be disturbed, and these values may be lower.

Table 1: Earthworks volumes and areas

	Approx. Cut	Approx. Fill	Approx. Area
Site Clearance	17,000m³	17,000m³	61,000m²
Corridor Earthworks	3,000m³	35,000m³	45,000m²

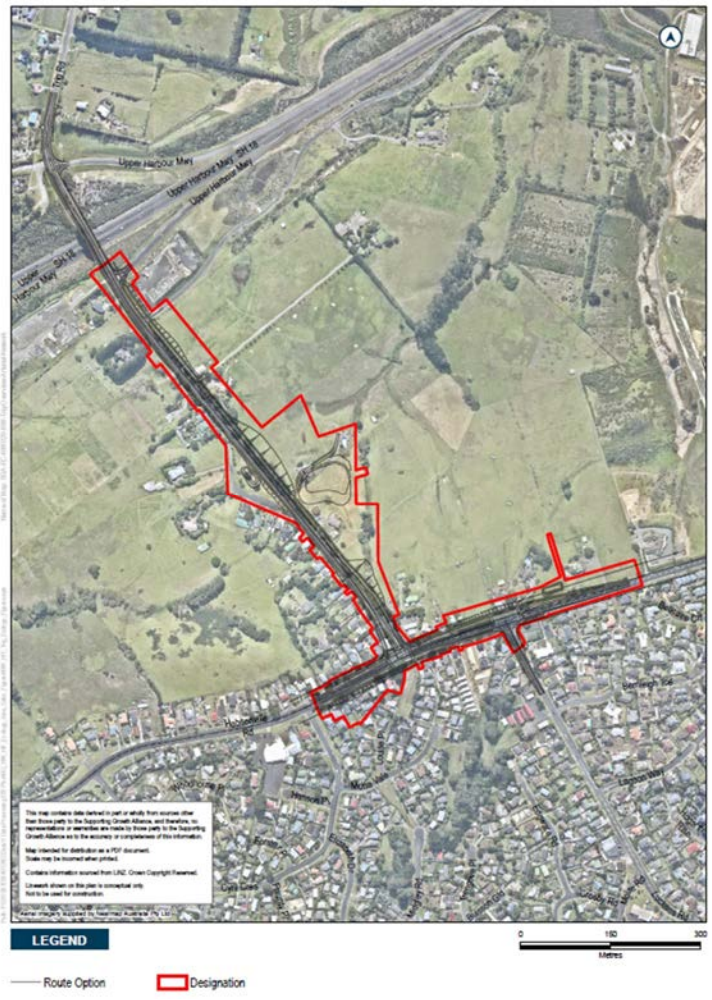

Figure 2: Whenuapai – Trig Road Corridor Upgrade

2.3 Project/Site Features

2.3.1 Cross-Section

The indicative existing Trig Road corridor consists of a ±7m wide two-lane road and 1.5m footpath along the majority of the western side of the road length. While the final layout of the upgraded corridor will be confirmed as part of detailed design, a typical cross-section has been developed for the corridor. The indicative cross section for the road alignment includes:

Trig Road:

- 2 x 3.5m wide traffic lanes divided by a 3m wide median

Trig Road - Adjacent to western road edge:

- 1.5 – 2.7m wide berm containing trees and raingardens
- 1.8m wide footpath
- 0.5m wide berm containing street lighting

Trig Road - Adjacent to eastern road edge:

- 2.7m wide berm containing trees and raingardens
- 4m wide cycleway adjacent to the eastern berm
- 1.8m wide footpath
- 0.5m wide berm containing street lighting

Trig Road – SH18 bridge:

- Provision for a new footpath and cycleway crossings along the existing SH18 bridge crossing (within the corridor of the existing bridge)

Hobsonville Road and Intersections:

- Localised widening around the upgraded intersections at Trig Road/Hobsonville Road and Hobsonville/Luckens Road to accommodate vehicle stacking and tie-ins of new footpaths and cycleways

General

- Batter slopes and retaining walls to tie the corridor into the surrounding ground level.

An indicative cross-section for Trig Road is provided in Figure 3.

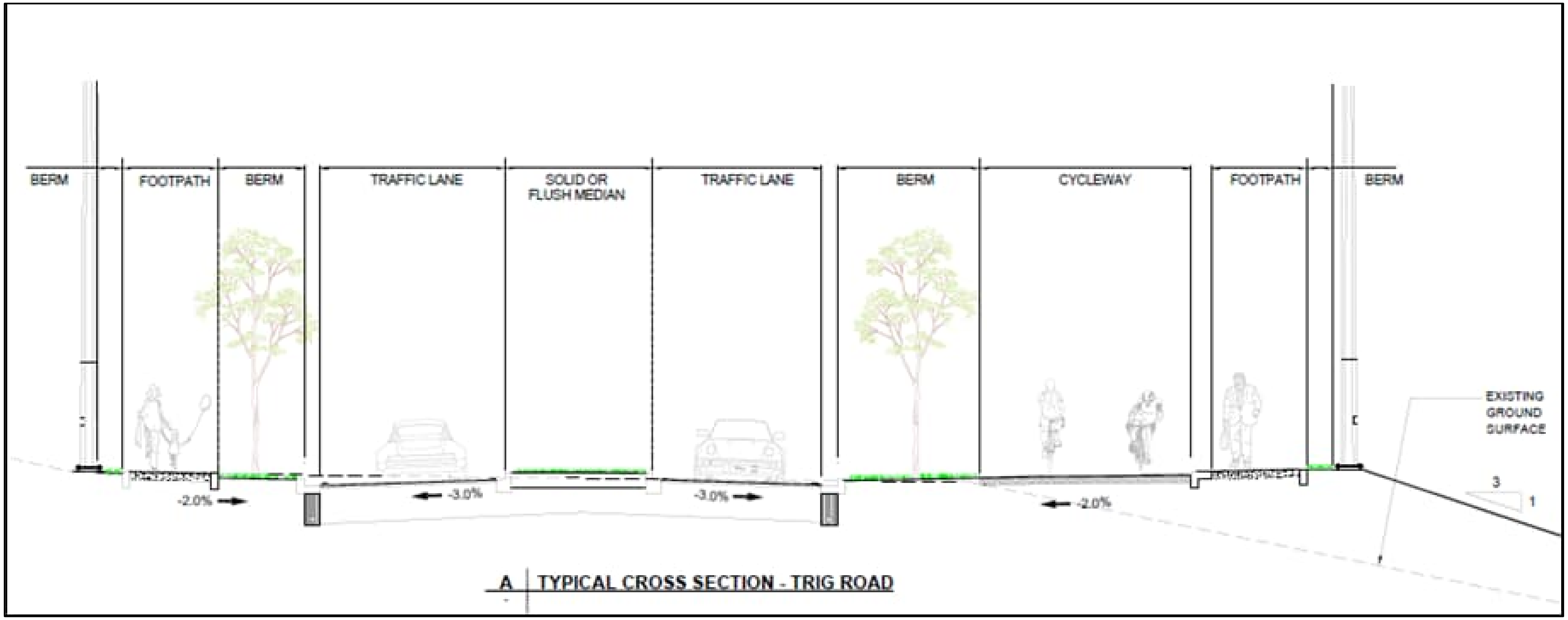

Figure 3: Indicative Trig Road Cross Section

2.3.2 Stormwater Infrastructure

The upgrades to Trig Road will induce necessary upgrades to the existing stormwater infrastructure, allowing for upgrades to accommodate future urban development, and new stormwater management devices. In summary, the specific stormwater infrastructure elements associated with the upgrade of Trig Road will include the following:

- Replacement and upgrading of three existing stormwater culverts under Trig Road, including energy dissipating outfalls
- Construction of new primary stormwater network within the new Trig Road corridor, as well as for portions of Hobsonville Road to be widened
- Installation of new stormwater treatment devices
- Construction of a new detention pond with energy dissipating outfall to Trig Stream (wetland)

Assessment of the construction of these elements will be evaluated in terms of ESC in the sections to follow.

2.3.3 Existing Ground Conditions

Soil classifications obtained from the New Zealand Geology Maps indicated two main soil groups in the Trig Road area. The two main soil groups are as follows (GNS Science, 2018):

- East Coast Bays Formation (Waitemata Group) forming in the steeper slopes. This group consists of a variation of interbedded, graded sandstone and siltstone, or mudstone and sandstone, as well as local intercalated volcanic grit.
- Puketoka Formation forming in the gentle slopes and low-lying areas. Undifferentiated alluvium can be found in gullies and within flood plains around streams.

These soils comprise of areas of both low permeability as well as pockets with high soakage potential.

2.3.4 Topography, Catchments, Drainage and Receiving Environments

The greater Whenuapai 3 precinct topography has been identified as a predominately low-lying catchment, with mostly flat to rolling landscapes, with localised areas of steeper terrain mainly to the south. Figure 4 below indicates the contours, typical topographical flow paths and major receiving waterbodies for the Project area and its surrounding catchment areas.

Figure 4: Trig Road surrounding overland flow paths and receiving waterbodies

As depicted from the contours, the existing Trig Road alignment is predominately located on a ridge line with the surrounding catchment areas falling away from the road. Trig Road comprises of a steep fall from south-east to north west just off Hobsonville intersection (±8%) for ±300m, with the remaining road length towards the SH18 comprises flatter grades and localised low points.

The catchment area west of Trig Road has a general fall to the west, with two main sub-catchments draining into/forming into a head branch of Totara Creek, which subsequently drains out of the Whenuapai 3 Precinct, discharging into Brigham Creek. The catchment area east of Trig Road (and those which form in smaller sub-catchments of localised low points along Trig Road) has a general fall to the east, with three main sub-catchments draining into/forming into head branches of predominately Trig Stream and Rawiri Stream, followed by Waiarohia Stream, all of which subsequently drain towards the Waiarohia Inlet.

A geotechnical study was carried out within the Project area and identified a highwater table and groundwater seepage at the south eastern branch head of Trig Stream (wetland), adjacent to Trig Road, with water encountered at ±800mm below ground level.

Waiarohia Stream and Trig Stream (and related wetlands) will be the most directly affected environmental areas of significance during construction works due to large fill embankments encroaching into the watercourse and the upgrades to the existing stormwater crossing discharging into these streams.

2.3.5 Contaminated Land Assessment

Previous studies and site investigations carried out within the Whenuapai area, as mentioned within the Whenuapai Structure Plan (2016) and Whenuapai 3 Precinct Stormwater Management Plan (a technical document supporting Council’s Proposed Plan Change 5), past applications of pesticides and fertilisers for agricultural activities present the potential for elevated contaminations of soil within the general area, and a historical landfill site has been identified just east of the Whenuapai Air Base which is the only notable/specific land contaminant point of interest near Trig Road.

A Preliminary Site Investigation has been completed for the Project. Contaminated land should be managed in accordance with the recommendations of that report.

3 Statutory Context

3.1 Notice of Requirement

This assessment has been prepared to support the NoR process for the Project. Section 171 of the RMA sets out the matters that must be considered by a territorial authority in making a recommendation on a NoR. This includes consideration of the actual or potential effects (including positive effects) on the environment of allowing the requirement.

3.2 Regional Resource Consent Application

AT are also seeking regional resource consents under the AUP:OP and resource consent under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health. Consents are required to a number of activities including bulk earthworks.

Overall, the application is assessed as a Discretionary Activity.

3.2.1 Relevant Standards and Guidelines

The following standard documents and guidelines were utilised in the development of a suitable ESC Plan for the Project:

- AUP:OP – Particularly with regard to:
    - Chapter E3: Lakes, Rivers, Streams and Wetlands
    - Chapter E11: Land disturbance – Regional
    - Chapter E12: Land disturbance – District
    - Chapter E26: Infrastructure
- GD05
- Technical Publication No. 108: Guidelines for Stormwater Runoff Modelling in the Auckland Region

4 Indicative Construction Methodology

An indicative construction methodology has been prepared to inform the assessment of the Project and, while subject to change, assists in determining the envelope of effects. An overview of the construction methodology is set out in the AEE. The final construction methodology for the Project will be confirmed during the detailed design phase and finalised once a contractor has been engaged for the work.

A summary of the key components of the indicative construction methodology is outlined in the sub-sections below and plays an integral role in the development of a suitable ESC Plan for the Project.

4.1 General Construction Overview

The total construction phase of the Project is expected to take approximately 18 to 24 months. It is anticipated that the works will be broken down into separate construction zones based on the type of works required and the nature of the work environment. These anticipated zones are:

- **Zone 1:** Trig Road North of the SH18 bridge
- **Zone 2:** Trig Road South including the SH18 bridge
- **Zone 3:** Hobsonville Road.

4.2 Construction Methodology

Each zone has different construction activities depending on the type of work to be done and the surrounding environment. In all cases the general sequence of construction is likely to be:

1. Divert or remove services
2. Construct permanent stormwater drainage crossings and environmental controls
3. Move traffic away from works longitudinally
4. Construct earthworks and retaining structures
5. Construct new longitudinal drainage
6. Construct new pavement to half of the road
7. Move traffic onto newly constructed pavement
8. Complete longitudinal drainage
9. Complete pavement and median
10. Move traffic to new alignment
11. Complete footpath and cycleway

The activities for each zone are summarised in Table 2 below.

Table 2: Trig Road Corridor Upgrade Construction Activities Summary

Zone	Construction Activity
1	• Site clearance • Remarking of existing road and bridge deck • New cycleway and footpath on west side • New cycleway crossing
2	• Site clearance • Diversion of overhead services on west of Trig Road • Construction of three new drainage culverts • Construction of new dry pond for stormwater attenuation • Cut/fill earthworks • New retaining walls to the front of properties on the west of Trig Road • Construct new berm and footpath on the west of Trig Road • Construct new berm, footpath and cycleway on the east of Trig Road • New road surface and median • Line marking • Lighting and road furniture
3	• Site clearance • Divert services • Cut/fill earthworks • Construct new stormwater drainage • New retaining walls to the front of existing property • Construct new cycleway and footpath on both sides of Hobsonville Road • New road surface and median • Lighting and road furniture

All three zones consist of works for which ESC measures will be applied with varying magnitude. The construction works in Zone 2 consist of the majority of earthworks and stormwater drainage upgrades and will have the greatest potential impact on the downstream receiving environment and watercourses to be addressed.

The current construction methodology and programme is based on works being constructed concurrently across all 3 zones to achieve the shortest construction period.

Environmental controls will be set up prior to start of site clearance within each zone and be maintained for the duration of works and until such time that any exposed surfaces have been stabilised. General ESC measures to be expected on site as well as specific ESC measures for each zone will be discussed in section 5 and 6 respectively.

4.3 Plant and equipment

Table 3 provides an indicative list of plant and equipment which may be required for the construction across the three zones.

Table 3: Trig Road Corridor Upgrade Plant and Equipment Summary

Construction Type	Construction Activity
Typical across all works	• Site facility • Light vehicles • Hiab truck • Small tools and plant
Clearing	• 20T excavator • Mulcher • Tandem tipper
Overhead line relocation	• Line crew • Elevated work platform or cherry picker • Directional drilling equipment
Bulk Earthworks	• 30T excavator • 20T excavator • Compactor/Sheepsfoot roller • Water cart • Tippers/ADT's
Drainage	• 20T excavator • Trench shields • Tandem tipper • Loader • Plate compactor
Pavement Construction	• Grader • Smooth drum roller • Tandem tippers • Kerbing machine • Plate compactor • Paver

5 Principles of ESC

Erosion and the associated effects of sediment deposition has the potential to cause both physical and ecological disturbance within a watercourse/stream, and control measures both during construction and within the design of permanent structures needs to be considered. This should be in accordance with GD05, which supersedes the previously used Technical Publication 90.

This section outlines the objectives of implementing ESC measures, and describes the typical methods utilised during various construction activities. Section 6 following will provide site specific erosion control measures in order to achieve these objectives.

5.1 Key Objectives

Key objectives of the ESC Plan for the Project and associated works include the following:

- *Construction methodology/staging of works:*

  Selection and implementation of appropriate construction methods to facilitate staged construction works. This allows for more manageable ESC measures by confining works to smaller sections, making it easier to monitor and maintain, particularly when multiple measures are in place. Staging also means that the areas of exposed soils during earthworks is minimised or limited to only the specific area where works are taking place, minimising erosion of loose soils by wind and runoff, and facilitating dust management. Staging earthworks allows for progressive stabilisation during the construction period.

- *Minimising disturbance*

  Minimising disturbance by keeping earthworks and area of works to a minimum during operations, ensuring stability of surrounding slopes and structural integrity of nearby infrastructure is maintained. This is applicable to both vegetation removal, earthworks required to carry out cut/fill operations and works within existing watercourses during stormwater crossing upgrades.

- *Protection of existing watercourses*

  Diversion of clean water away from areas of disturbance and diversion of sediment laden runoff from disturbed areas/exposed soils during earthworks to prevent sediment laden runoff discharging into watercourses and adversely affecting downstream stream health (both ecological and physical).

  Pollutants and debris/construction materials should also be carefully controlled so that these are not deposited within the bed, with the potential to be conveyed downstream along with sediment.

  Minimising earthworks and vegetation removal around and within watercourses to reduce the exposure of soils, and consequential erosion potential from scouring or wind during stormwater crossing upgrades.

  Protection of receiving streams is also applicable for the permanent structures. Outfalls will be designed to ensure stormwater discharges have minimal erosion and scouring impacts.

- *Protection and stabilisation of embankments*

  Protection of steep embankments by means of clean water diversion, contour channels along embankments, and progressive rapid stabilisation with the application of temporary straw mulch, geotextiles or similar, and hydro-seeding/grassing for permanent measure.

Protection of existing watercourse embankments by limiting vegetation removal and earthworks during stormwater crossing upgrades.

- *Retention devices to allow for settlement of suspended solids/sediment laden runoff*

  Allow for sediment laden runoff to be detained and treated to facilitate the settlement of solids prior to discharging back into downstream watercourses.

- *Monitoring and maintenance*

  ESC measures should be monitored and maintain throughout the construction works so that they remain operational and fit for purpose, and modified accordingly to suit changes on site.

5.2 Erosion and Sediment Prevention/Sources Control Measures

Non-structural ESC principles applied from the start of a project can reduce the need for structural controls. Preventing erosion is considered more effective that managing the consequences of it. The following general measures can be taken to facilitate in preventing erosion and sediment generation/transport at its source:

Table 4: Erosion and Sediment Source Control Measures

Source/Activity	Source Control Measure
General site management	• Schedule construction works with wet and dry seasons taken into consideration. Plan according to climate/weather forecast to account for heavy rainfall/wind • Stage earthworks within the construction methodology to allow for more manageable sections of works and keep exposed surfaces to a minimum as far as practically possible • Stabilise work areas with high sediment generation potential by placing geotextile or using other approved methods prior to commencement of works • Provide unobstructed and stabilised overland flow paths prior to rainfall events • Regularly sweep or remove any accumulated sediment associated with the works • Provide stabilised permanent entranceways/exits to the site with aggregate, and optionally incorporate a wheel wash system to provide additional prevention of sediment transfer outside of the construction area • Use water sprinkling from water carts to minimise wind distribution of sediments/dust
Stockpiles	• Stockpiles are to be in construction areas serviced by ESC measures only • Stockpiles should not be located near overland flow paths or within floodplains • Removal and handling of contaminated material must follow a prescribed Soil Management Plan • Stockpiles of fine material are to be wetted to reduce the potential for windblown sediments, or receive temporary coverings such as geotextile fabric during periods of inactivity

Sediment transport due to runoff from external catchments entering the construction site	• Construct cut off channels/diversion bunds to divert clean upstream runoff away from the site, and prevent exposed soils being lifted and washed downstream • Use clean water diversions (e.g. sandbags, compacted earth) where there is steep terrain uphill of the works area to reduce the volume of water requiring management
Works within a watercourse or watercourse/replacement of existing stormwater crossings	• Upstream and downstream sandbag coffer dams to be used to isolate work areas or temporarily divert flow, to allow for dry construction works, or where possible opt for offline construction only, and diversion of flow to new structure after completion • Temporary pipes and culverts to be used to divert flows • Erosion and scour protection (e.g. rip rap or geotextile) to be used at temporary and permanent outlets
Erosion due to runoff over reinstated ground	• Maintain ESC structures in place after completion of works until stabilisation has been established

5.3 General ESC measures

The following general measures can be applied for different types of construction activities in the Project to control erosion and sediment transport, manage sediment deposition and subsequently prevent adverse effects thereof to the receiving environment.

Table 5: General ESC Measures

ESC Measures	Application
Catchpit/ Stormwater inlet protection	Install permeable silt socks/coir logs or small silt fences as a ring around stormwater inlets to act as a barrier for filtering out sediment fines from channel flow runoff. Can also be installed in series upstream of the stormwater inlet to act as check dams. Additionally gratings/inlets can be covered with a geotextile to filter sediment laden runoff before discharging into the stormwater network. These methods are to be used in conjunction with other sediment control measures.
Chemical Treatment	Used to improve the efficiency of sediment retention devices by dosing sediment laden runoff with coagulant reagents to assist in flocculation of particles and faster settlement of sediment fines. This treatment method requires a high level of monitoring and maintenance to ensure safe and effective usage on site, and its viability as a treatment method is dependent on soil type. The two main methods of treatment/dosing are batch dosing and rain activated dosing.

Contour drains	Install/construct across the contours of long and/or steep exposed slopes, as a temporary measure only, during earthworks to break sheet flow by reducing slope length, subsequently reducing flow velocities and the erosive power of thereof. Contour drains should have erosion protected outlets and drain towards diversion channels/bunds.
Decanting earth bund	Smaller than, however similar to, sediment retention ponds (**SRP**) in function, decanting earth bunds are enclosed areas used to collect and retain runoff and allow for sediments to settle out of water before being discharged off site. Used for catchments, <0.3ha, with high concentrations of sediment laden runoff, where runoff treatment is required, and where silt fences cannot be used due to steeper than appropriate slopes.
Diversion channel/bund	Clean water diversion channel/bund: • Install upstream of site of works to prevent clean runoff entering site of works, washing over exposed soils and transporting sediments downstream. Dirty water diversion channel/bund: • Install downstream of the site of works/bottom of catchment/embankment slope to collect sediment laden runoff and transport to appropriate retention site to allow for settlement of solids. Can be used with drop out pits along channel to allow for heavier sediments to settle prior to entering a sediment retention device, reducing the load on the device.
Geotextiles and erosion control blankets	Permeable geotextile blankets or biodegradable fabrics installed as a form of temporary rapid stabilisation on slopes or in channels where permanent vegetation is slow to establish, or where conventional methods such as mulching does not provide sufficient erosion resistance due to high flow velocities. Installed temporarily at inlets/outlets of SRP, within diversion channels or as covers over slopes/batters or stockpiles during periods of inactivity. Plastic covers can also be utilised for covers over stockpiles, stockpiled contaminated soils or material for reuse.
Grass seeding	Temporary or permanent stabilisation by seeding grass to provide vegetative cover for exposed soils, to protect against raindrop impact, reduce runoff velocities and assist in binding of loose soils. Rapid-growing annual grass can provide quicker coverage with rapid establishment for short term stabilisation, and perennial grass can provide for permanent stabilisation.
Hydroseed	Stabilisation method by application of seed and fertiliser mix in the form of a slurry, to allow for seeding and revegetation on steep, inaccessible slopes or in areas with minimal/no existing topsoil to facilitate seeding.
Mulching	Typically, straw applied to the soil surface as a protective layer for short to medium rapid stabilisation to assist in erosion protection from raindrop impact or wind on exposed soils/embankments (not within channels or overland flow paths). Assists in retaining moisture to facilitate vegetation regrow.

Silt fence	A fence of woven geotextile fabric installed along contours, downstream of disturbed areas to intercept and slow down sediment laden sheet flows, temporarily detain the runoff and allow for larger sediment to settle out of water. Best used on sites with flatter grades, in confined areas, areas with smaller contributing catchments, around water courses, bush reserves etc. These are not to be installed across watercourses or in areas of highly concentrated flows.
Silt socks	Tubular socks filled with filter material (compost, wood, straw, bark etc) used to intercept and filter sediment laden runoff, ideal for very small or isolated catchments for short term sediment control (or for stormwater inlet protection as described above). It can also be filled with sand and used to divert runoff or overland flow to allow for works within existing streams.
SRP	Large ponds used as an end of line sediment control structure in order to collect sediment laden runoff from diversion bunds etc, and allow for settlement of sediment through retention and regulated outflow. Ideally combined with chemical treatment for improved settlement efficiency. Most appropriate end of line sediment control method for sites of 0.3ha to 5ha.

5.4 Establishment

ESC mitigation measures will be installed by the contractor prior to the start of any vegetation clearance, site set up or earthworks.

The contractor is responsible for updating the ESC Plan once the construction and traffic management methodology has been confirmed and resubmitting the updated ESC Plan to Auckland Council for certification, prior to the commencement of works.

5.5 Decommissioning

Decommissioning of ESC measures should only be carried out once the site/contributing catchment surface areas are deemed to be stabilised, with a resistance to erosion typically by mulch, geotextile mats, grassing or a combination of the above. Typically for grassing/vegetation stabilisation, 80% coverage established is considered sufficient for allowing decommissioning of temporary controls. Upon removal of controls, any accumulated sediment deposits must be cleared and disposed of appropriately, and any disturbed areas left by the controls themselves after removal should be stabilised.

6 Specific ESC Measures

This section is to be read in conjunction with the indicative ESC Plan Layouts provided in Appendix 1, with a detail of the SRP included. The measures described for each zone are based off the indicative construction methodology at the time of AEE development. The contractor's final methodology may differ based on final design detail changes and future staging requirements, as such, the contractor will be responsible (on behalf of AT) for seeking certification of a revised ESC Plan to reflect the final detailed design and construction works thereof.

All environmental/management controls are to be set up prior to construction works occurring in that zone and to be assessed and certified for its suitability by Auckland Council.

6.1 Zone 1

Zone 1 includes all works on the SH18 bridge crossing and works north of the bridge. The construction activities consist of widening the existing corridor to incorporate a new cycle and footpath extension from the western road edge to ±180m north of the bridge (including crossing), and a new cycle and footpath extension from the eastern edge for a shorter ±60m portion. Works on the SH18 bridge consist only of modifications to the road markings to accommodate a cycle and footpath.

6.1.1 Clean water diversion

Upstream runoff currently flows overland, across the western road edge and into the carriageway. The scale of works within this zone is relatively minor, with minimal earthworks, minimal cut/fill batters and low volumes of adjacent upstream runoff is expected over the site. Diversion of clean upstream runoff can be managed mainly with sand bags/logs, and at worst low level hotmix diversion bunds.

The first ±100m of cycle/foot path works lies adjacent to an existing bund/mound with an existing scruffy dome inlet collecting majority of upstream runoff. Cutting into the existing mound will be required for the width extension and a shallow diversion trench connecting to the existing field inlet can be used to divert minor flows and prevent runoff over new layerworks for the cycle path. Alternatively, if upstream runoff potential is found to be minor, temporary sand bags/logs can be used instead.

Sand bags/logs can be used for the remaining western edge works to divert upstream runoff away from the new layerworks and expected exposed soils, and onto existing impervious driveway surfaces for drainage into the carriageway.

6.1.2 Silt fences/silt socks

Silt socks should be used downstream of and adjacent to the new cycle and footpath extension works along the western road edge to prevent sediment laden runoff entering the carriageway. A silt fence should be used on the eastern road edge, downstream of the ±60m long cycle and footpath extension to capture any runoff from this area of work. Only minor works to the existing berm and kerbs can be expected on the remainder of the eastern edge, for which runoff can be managed with silt socks/coir logs.

Two existing inlets within the Zone 1 carriageway should receive silt sock/coir log rings for additional inlet protection.

6.2 Zone 2

Zone 2 includes all works south of the SH18 bridge crossing up to the intersection of Hobsonville Road. The construction activities in this zone includes redevelopment of Trig Road from an existing 2-lane carriageway to a 2-lane carriageway with centre median, footpath along the western edge and 2-way cycle lane and footpath on the eastern edge.

The majority of the corridor widening occurs on the downstream eastern edge resulting in fill embankments over 5m high. Earthworks of this nature, particularly occurring in and around existing watercourses where diversions are required, needs the construction methodology to be carefully planned and a high level of monitoring carried out during construction so that the control measures are in place and operating correctly prior to them being needed.

The area of works consists of three low points/watercourses downstream, each of which will receive different management and control measures.

6.2.1 Catchment 1

Catchment 1 includes all works and activities upstream of, and with the potential to affect the receiving Waiarohia Stream.

6.2.1.1 Stabilised entranceway

The existing greenfield areas adjacent to the Waiarohia Stream overland flow path will be used for site establishment, with access off the existing service roads. Entranceways from Trig Road into the site establishment and into the adjacent greenfield area will be stabilised in accordance with GD05, with minimum 50mm aggregate placed 150mm thick. Wheel washing may also be incorporated within this area to minimise transfer of sediments between work areas and site establishment.

6.2.1.2 Clean water diversion

Two clean water diversion bunds/channels will be required upstream of Trig Road to direct clean runoff from the upstream catchment (total ±1.3ha) towards the existing inlet and Ø150mm pipe crossing into the gully leading to Waiarohia Stream and prevent runoff towards new fill embankments and over new cut embankments. Initial diversion bunds should be placed so as to divert runoff past the new pipe crossing location to allow for dry, off line construction works. Once the new pipe crossing has been established the diversion bunds should be reconstructed to divert all runoff into the new inlet and allow for offline decommissioning of the existing crossing.

6.2.1.3 Silt fences

A silt fence will be required downstream of the fill embankment on the eastern side of Trig Road, to manage sediment laden runoff expected after these earthworks are completed, constructed behind the new stormwater pipe crossing headwall when crossing upper Waiarohia Stream. The silt fence should incorporate short returns to accommodate for slope grades as well as a minimum 5m grass buffer either end at Waiarohia Stream discharge. The initial placement of the silt fence should be further downstream to allow for vehicle access during embankment construction, shifted up on completion of earthworks and stabilisation. A perimeter silt fence should also be installed along the downstream boundaries of the site establishment yard to manage sediment laden runoff from construction vehicles and stockpiling sources, preventing washing off into the overland flow path.

6.2.2 Catchment 2

Catchment 2 includes all works and activities upstream of, and with the potential to affect the receiving Trig Stream.

6.2.2.1 SRP and chemical treatment

The stormwater drainage system for Trig Road incorporates a dry pond for on-site attenuation. This pond will be utilised temporarily as a SRP for the duration of the construction works, allowing for collection of runoff from dirty water diversion bunds, runoff retention, treatment and settlement of fines for a portion of catchment 2 earthworks.

All piped stormwater flow is designed to drain into the dry pond from various catchments, thus any sediment laden runoff collected from the carriageway during the construction period will be diverted to the pond for retention and settlement of fines. All catchpit inlets and dropped kerb inlets into raingardens should receive protection by use of silt socks regardless.

The dry pond has been designed to accommodate a peak attenuation volume of 1220m^3, fully draining. As per GD05 requirements the SRP will cater for minimum 3% of the contributing catchment volume which equates to ±205m^3 for the immediate bunded earthworks area catchment and a maximum total of ±1075m^3 for the catchment including runoff from the carriageway directed to the pond through the piped network.

The SRP will be designed to allow for level spreading of sediment laden runoff entering in from the dirty water diversion bunds, and the intake manhole will be designed to allow for 30% retention volume. Upon decommissioning of the SRP, modifications will be made to restore dry pond functionality as per detail design.

Appendix 1 includes details for the SRP components in accordance with GD05 standards. The SRP design is to be finalised once detailed design for the Project has been completed in future and the final dry pond location/size is clarified. The SRP pond is to incorporate GD05 standards while making use of the proposed dry pond structure. All final SRP details must be outlined in a revised ESC Plan for certification by council prior to commencement of works.

The SRP will include chemical treatment (typically by the rainfall activated method) in its process to assist with settlement of sediment and improve its efficiency. Bench testing will be carried out and details of the selected reagents and dosing procedures must be specified in a separate flocculation management plan to be required under conditions of consent for certification by Auckland Council.

The SRP must be constructed prior to all works commence, along with the construction of its own required sediment control measures.

6.2.2.2 Clean water diversion

Similarly to catchment 1, two diversion bunds/channels will be required upstream of Trig Road to direct clean runoff from the upstream catchment (total ±1.95ha) towards the existing inlet and Ø375mm pipe crossing into Trig Stream and prevent runoff into the proposed raingarden excavation area, towards new fill embankments and over new cut embankments. Initial diversion bunds should be placed to divert runoff past the new pipe crossing location to allow for dry, offline construction works.

Once the new pipe crossing has been established the diversion bunds should be reconstructed to divert all runoff into the new inlet and allow for offline decommissioning of the existing crossing. This diversion bund should extend along the boundary of the proposed raingarden excavation to allow for dry works area. A clean water diversion bund should also be incorporated south east of the SRP, upstream of the pond cut embankment.

6.2.2.3 Dirty water diversion

Dirty water diversion bunds/channels will be utilised for transporting sediment laden runoff from the fill embankment on the eastern side of Trig Road towards the SRP to allow for treatment and settlement of fines prior to discharge.

Dirty water diversion bunds will also be required along the toe of the SRP fill embankment, these will drain towards a decanting earth bund for settlement of fines prior to discharge.

6.2.2.4 Decanting earth bund

A decanting earth bund will be placed at the base of the SRP, adjacent to the SRP outlet, for collection and retention of only the runoff from the pond fill embankment, sized to accommodate a minimum 2% of the contributing catchment volume (±30m³) and constructed in accordance with GD05 requirements.

6.2.2.5 Silt fences/silt sock

A silt fence will be required along the downstream side of the proposed fill embankment off the western road edge to prevent sediment laden runoff entering the existing adjacent residential properties.

6.2.3 Catchment 3

Catchment 3 includes all works and activities upstream of, and with the potential to affect the receiving Trig Stream (upper branch).

6.2.3.1 Dirty water diversion

Dirty water diversion bunds will be utilised for the collection and transport of sediment laden runoff from the large fill embankment within the upper branch of Trig Stream, and discharge into a decanting earth bund adjacent to the new stormwater pipe outlet. The diversion bund will cut across the embankment above the new headwall outlet.

Given the long slope length, a temporary cut-off drain should be used mid-way of the slope when high rainfall is expected, to intercept sheet flow. A silt fence should be incorporated at the base of the embankment adjacent to the stream for additional protection.

6.2.3.2 Decanting earth bund

A decanting earth bund will be placed at the base of the fill embankment for collection and retention of runoff from the fill embankment, sized to accommodate a minimum 2% of the contributing catchment volume (±60m³) and constructed in accordance with GD05 requirements.

6.2.3.3 Silt fences/silt sock

A silt fence will be required along the downstream side of the proposed fill embankment off the western road edge to prevent sediment laden runoff entering the existing adjacent residential properties.

6.3 Zone 3

Zone 3 includes all works within Hobsonville Road associated with corridor widening to accommodate for new cycleways and footpaths, new turning lanes to accommodate for the Trig Road intersection, new raingarden and temporary laydown yard north of Hobsonville Road, and an additional lane for a portion of Luckens Road. Construction activities in this area are to be to be managed to reduce the effects on adjacent residential properties, on the downstream piped stormwater network and Rawiri overland flow paths north of Hobsonville Road.

6.3.1 Silt socks/silt fences/sand logs

Erosion and sediment will mainly arise from activities during corridor extension and associated cut /fill operations for new road layerworks, and trench excavations for stormwater pipe installation.

A combination of silt fences and/or sand logs are to be used to divert clean runoff from properties away from site excavations, discharging into the carriageway downstream outside out the area of works, or to prevent sediment laden runoff from the site entering onto adjacent properties. These measures are to be utilised either side of Hobsonville Road and along the western edge of Luckens Road.

A perimeter silt fence should be installed around the proposed raingarden excavation area and outlet piped down to Rawiri overland flow path. The silt fence should also extend east to incorporate the proposed temporary laydown area north of Hobsonville Road.

Silt sock rings must be installed around all existing stormwater inlets within Hobsonville Road and Luckens Road area of works, as well as further downstream to ensure no sediment laden runoff from the site enters the existing stormwater network.

6.3.2 Decanting earth bund

The proposed new raingarden includes a 600mm deep, $200m^3$ attenuation capacity which can be utilised as a temporary treatment device for settlement of sediment laden runoff from the nearby works.

6.4 Dewatering

Dewatering will be applicable across all three zones for a combination of works including trench excavations for stormwater pipes, excavations for manhole and catchpit construction, and dewatering of sediment control devices for maintenance or decommissioning, with water originating from either surface runoff after rainfall events or ground water or a combination.

Minimal dewatering is expected in Zone 1. Dewatering in Zone 2 from stormwater structure excavations can be pumped to silt fenced areas downstream for small volumes, or into dirty water bunds/channels for subsequent drainage into decanting earth bunds or the SRP for larger volumes.

Dewatering from excavations in Zone 3 can be pumped to localised devices such as turkey nests for treatment prior to discharge or pumped through dewatering bags or pipe socks for smaller volumes. All water discharged off site should have a minimum water clarity of 100mm. Minimising long runs of open trenches and ensuring trenches/excavations are backfilled as soon as practicable will decrease the volume of dewatering required.

As noted in section 2.3.4, a continuous groundwater feed should be expected within the large fill embankment area on the south eastern side of Trig Road. In-situ counterfort drains and drainage layers will be installed as part of these construction works to cater for groundwater flows and subsequently, a constant sediment laden runoff should be expected to be managed during the in-situ drainage installation.

6.5 Stream protection

Construction works within Zone 2 consists of activities directly within the upper gullies leading to existing watercourses (catchment 1 – Waiarohia Stream, catchment 2 – Trig Stream/wetland, catchment 3 – Trig Stream/wetland upper branch) with potential to cause adverse effects to ecological health of the streams.

All three stormwater culvert crossing upgrades/extensions under Trig Road can be completed offline given their realignment, therefore typical control measures such as bunds/silt/sand logs should be used to prevent loose soil runoff into the adjacent watercourse.

Outlets will be constructed in approximately similar positions downstream as existing structures and some water diversion from existing outlets with the use of sandbags may be required to allow for dry working space while the existing outlets remain functional. Silt fences should be used around the downstream perimeter of outlet construction areas. Water diversion and sediment control measures are to be used progressively as required and adapted to suit changes to conditions on site.

The earthworks operations will be handled with controls as described above. Tree removal will be required on Trig Stream upper branch to accommodate for the embankment fill, and measures should be taken to minimise disturbance to surrounding vegetation and soils, followed up with compaction and temporary stabilisation of the area to cater for the period prior to continuance of earthworks.

6.6 Stockpiling

Stockpiles consisting of spoil or materials to be used in the construction activities will for the most part be located in the allocated construction yards (indicatively identified at 19 Trig Road and 80 Hobsonville Road), alternatively small stockpiles can be located adjacent to immediate areas of work. As far as practical, measures should be taken to ensure materials are only stockpiled for short periods of time and are located clear of overland flow paths, watercourses and construction vehicle traffic. Stockpile height should be kept to a minimum and placed in areas sheltered from wind.

Cut/fill material should receive immediate cover once stockpiled for extended periods by use of plastic covers or geotextiles blankets. Larger stockpiles should receive bunds/perimeter silt fencing if high rainfall is expected.

6.7 Stabilisation

All cut/fill embankments will be progressively stabilised by mulching or geotextiles/biodegradable fabric covers upon completion of individual sections of work or during periods of inactivity for short term stabilisation. Grass seeding will be required for long term/permanent stabilisation, for which hydroseeding can be utilised for more inaccessible slopes. All sediment control measures are to be kept in place until vegetation coverage has been 80% established.

6.8 Specific Controls Summary

Table 6 and 7 below provide a summary of the larger/significant environmental/sediment control methods, catchment sizes and expected flow rates for clean and dirty water respectively.

Table 6: Clean water controls

Zone	Catchment Size	Control/Method	Size	5% AEP Storm Flow Rate (m^3/s)	1% AEP Storm Flow Rate (m^3/s)
2 (Catchment 1)	9500m^2	Diversion bund	See typical detail	0.175m^3/s	0.240m^3/s
2 (Catchment 2)	17560m^3	Diversion bund	See typical detail	0.323m^3/s	0.445m^3/s
2 (Catchment 2)	2255m^3	Diversion bund	See typical detail	0.041m^3/s	0.057m^3/s

Table 7: Dirty water controls

Zone	Catchment Size	Control/Method	Size	5% AEP Storm Flow Rate (m^3/s)	1% AEP Storm Flow Rate (m^3/s)
2 (Catchment 1)	1950m^3	Silt Fence	See typical detail	0.046m^3/s	0.062m^3/s
2 (Catchment 2)	6800m^3	Diversion bund/channel	See typical detail	0.160m^3/s	0.215m^3/s
	6800m^3 + 28700m^3 (Including new road footprint)	SRP	1075m^3 (new dry pond structure to be used as temporary SRP including baffles to achieve desired length to width ratio)	0.160m^3/s + 0.625m^3/s	0.215m^3/s +0.824m^3/s
2 (Catchment 2 - SRP Embankment)	1430m^3	Diversion bund/channel	See typical detail	0.034m^3/s	0.045m^3/s
	1430m^3	Decanting earth bund	±30m^3	0.034m^3/s	0.045m^3/s
2 (Catchment 3)	2825m^3	Diversion bund/channel	See typical detail	0.066m^3/s	0.089m^3/s
	2825m^3	Decanting earth bund	±60m^3	0.066m^3/s	0.089m^3/s

7 Monitoring and Maintenance

The contractor will identify the person on site responsible for the ESC measures (most likely the Site Supervisor or Specialist Environmental/ ESC Manager). The contractor will keep daily records of site inspections and any erosion or sediment issues that may arise. The records will be included with other site information required under the contract and will be available for inspection by the Engineer to the contract. These records will be retained for the duration of the contract.

All silt fences, bunds, dewatering mechanisms and site specific measures constructed for the purpose of ESC will be inspected on a daily to weekly basis and after rainfall events. Details of the inspection schedule will include, but not be limited to, the following as described in Table 8 below.

Table 8: Monitoring and Maintenance Requirements

ESC	Inspection/Maintenance Requirements	Frequency
Chemical Treatment	• Rainfall activated treatment system will require on-going adjustments to suit runoff and site characteristics. • To be serviced as outlined in an approved management plan.	Weekly & before and after rainfall
Clean & Dirty Water Diversion Bunds and Channels	• Check for scour and areas where a breach may or has occurred – repair immediately. • Remove sediment build up deposited in the channel. • Check inlets/outlets to ensure they are free from scour and erosion. • Check for low spots, formation of gullies or debris – repair immediately.	Weekly & after rainfall
Dewatering Devices	• Check for a minimum of 100mm water clarity before pumping treated water directly offsite. It can be measured using a black target (e.g. black disc). • Ensure that outlet of any pumped water pipes is not creating erosion issues. • Ensure dosing rates and batch dosing methodology is accurate for flocculant treatment.	Daily, before & after rainfall
SRP	• Remove accumulated sediment deposits once volume reaches 20% of total pond volume using high capacity sludge pumps. • Clean out forebay area after each rainfall event if sediment is present. • Dispose of pumped sediment in a contained location away from overland flow paths and watercourses. • Check for and repair any damages to the SRP caused by construction activities or erosion. • Check inlets and outlets for obstructions and erosion.	Daily, before & after rainfall

Silt Fence	• Check geotextile material for tears, broken support wires, undercutting and other damages – repair immediately. • Silt build up removal required when bulges in the fabric occur, overtopping or when sediment accumulation reaches 20% of fabric height. • Dispose of cleared sediment in a location away from overland flow paths and watercourses.	Weekly & after rainfall
Silt Sock	• Check to ensure sediment control efficiency is maintained. • Accumulated sediment greater than 20% of the silt sock height should be removed, or another silt sock can be placed on top of existing. • Check integrity of silt sock and media prior to reuse elsewhere on site.	Regularly & after rainfall
Stabilised areas	*Varies with stabilisation method:* Hydroseeding/grass seeding: • Apply fertilisers as required after initial hydroseeding. • Water regularly to promote growth. • Protect from being washed away by heavy rainfall or reseed where necessary. Mulching: • Replace mulch in areas of damaged cover, particularly after heavy rainfall or strong winds. Geotextiles/covers/blankets: • Check for tears, damage or displacement and repair, replace or reapply and secure as required.	Daily & after rainfall
Stabilised Entranceway	• Check quantity of aggregate and geotextile for sediment build up and deterioration – apply more aggregate as required to ensure ability of entranceway to prevent sediment leaving the site is maintained. • Ensure structures used to trap runoff are cleaned out regularly as required. • Where additional flows from wheel wash are generated, ensure sediment retention devices can accommodate additional flows. • Regularly sweep or vacuum sealed pavements to removed sediment.	Weekly & after rainfall
Stormwater Inlet Protection	• Check for damage, blockages and leaks – repair immediately. Remove accumulated sediment immediately.	Daily, before & after rainfall
Weather forecast	• Check weather and rainfall forecast. • Set up site stabilisation and prepare controls for high rainfall suitability.	Daily

8 Conclusion

The ESC measures outlined in this report satisfy the regulatory standards and effectively implement the guidelines specified in GD05 for minimising impact to the receiving environment, addressing the triggers for resource consent.

This report has been development for preliminary design stage and to support the AEE as part of the NoR and resource consent application process. A finalised ESC Plan must be compiled and submitted for certification to Auckland Council prior to construction commencement, amended to suit the final detailed design and the contractor's final construction methodology.

Appendix 1. Indicative Erosion Control Plans

LEGEND

PROPOSED DESIGNATION BOUNDARY	INDICATIVE HEADWALL
EXISTING 1% AEP FLOOD PLAIN	INDICATIVE MANHOLE
PROPOSED DRY POND	EXISTING MANHOLE
	INDICATIVE SCRUFFY DOME INLET MANHOLE
PROPOSED NEW CULVERT	INDICATIVE CATCHPIT
INDICATIVE PROPOSED SW PIPE & FLOW DIRECTION	INDICATIVE DROP KERB INTO RAINGARDEN
INDICATIVE FLOW DIRECTION	EXISTING OVERLAND FLOW PATH
RIP RAP	SW EXISTING STORMWATER PIPES
RAINGARDEN LOCATED WITHIN BERM	EXISTING PROPERTY BOUNDARY
BIORETENTION RAINGARDEN (WITH ATTENUATION)	EXISTING CONTOUR

ESCM LEGEND

- EXISTING SWALE
- CLEAN WATER DIVERSION BUND
- 'DIRTY' WATER DIVERSION BUND
- SILT FENCE
- SAND BAG/LOG
- SILT SOCK
- CONTOUR DRAIN
- SILT STABILIZED ENTRANCEWAY
- DECANTING EARTH BUND
- EXTEND SURFACING/LAYERWORKS (DISTURBED AREAS). APPLIES TO FULL LENGTH OF TRIG ROAD AND HOBSONVILLE ROAD AS INDICATED

GENERAL NOTES (APPLICABLE TO ALL LAYOUTS):

1. ALL ENVIRONMENTAL CONTROLS TO BE SET UP PRIOR TO COMMENCEMENT OF WORKS AND APPROVED FOR SUITABILITY BY ENGINEER.
2. CLEAN WATER DIVERSION BUNDS TO DIRECT RUNOFF TO EXISTING CROSSINGS UNTIL OFFLINE CONSTRUCTION OF NEW STORMWATER CROSSINGS HAVE BEEN COMPLETED, INCLUDING OUTFALL AND EROSION PROTECTION, AFTER WHICH CLEAN RUNOFF WILL BE DIVERTED TO NEW STORMWATER CROSSINGS.
3. STORMWATER CROSSINGS UNDER TRIG ROAD TO BE CONSTRUCTED OFFLINE ALONG NEW ALIGNMENT. DOWNSTREAM DISCHARGE FROM EXISTING CROSSINGS TO BE TEMPORARILY DIVERTED TO ALLOW FOR DRY WORKS AREA AT NEW OUTFALL POSITION.
4. WHERE EXISTING STORMWATER PIPES TIE INTO NEW NETWORK, ENSURE DOWNSTREAM STORMWATER PIPES AND OUTFALLS ARE COMPLETED PRIOR TO CONNECTION.
5. TRAFFIC MANAGEMENT PLAN TO BE SUPPLIED BY CONTRACTOR FOR ZONE 2 AND 3 OF WORKS FOR WHICH FULL ROAD RECONSTRUCTION IS EXPECTED WITH DETAILS OF PROGRESSIVE CHANGES TO SEDIMENT CONTROL METHODS WITHIN THE CARRIAGEWAY.
6. WORKS AND ASSOCIATED EROSION AND SEDIMENT CONTROL MEASURES TO BE STAGED TO MAINTAIN ACCESS TO EXISTING PROPERTIES THROUGHOUT.
7. USE CUT AND COVER METHOD FOR OPEN TRENCH INSTALLATION.
8. ALL STOCKPILES TO BE COVERED DURING PERIODS OF INACTIVITY.
9. ALL EXISTING STORMWATER INLETS AND NEW INLETS DRAINING INTO EXISTING STORMWATER SYSTEMS, TO RECEIVE SEDIMENT PROTECTION.
10. ALL SEDIMENT CONTROL MEASURES TO REMAIN IN PLACE POST CONSTRUCTION UNTIL >80% STABILIZED SURFACES HAVE BEEN ESTABLISHED.
11. ANY SEDIMENT LADEN RUNOFF COLLECTED OFF THE TRIG ROAD SURFACE AREA WILL BE COLLECTED VIA THE NEW STORMWATER PIPE NETWORK AND DISCHARGED INTO THE SEDIMENT RETENTION POND FOR TREATMENT.
12. ANY SEDIMENT LADEN RUNOFF COLLECTED OFF THE ROAD SURFACE OF HOBSONVILLE ROAD, JUST EAST OF THE INTERSECTION, WILL BE COLLECTED VIA THE NEW STORMWATER PIPE NETWORK AND DISCHARGED INTO THE PROPOSED ATTENUATION POND / RAINGARDEN (TO USED AS A TEMPORARY TREATMENT DEVICE DURING CONSTRUCTION) FOR TREATMENT.
13. NEW SLOTTED KERB ENTRY INTO AND OUT OF THE PROPOSED RAINGARDENS WITHIN THE BERM ARE TO BE ADDED ONLY AFTER FULL SITE STABILIZATION IS ACHIEVED AND ROAD SURFACE RUNOFF IS NO LONGER SEDIMENT LADEN. RAINGARDENS ARE TO RECIEVE PERIMETER SEDIMENT PROTECTION MEASURES AND TEMPORARY COVERS DURING THIS PERIOD UNTIL OPEN FOR USE.

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REV	REVISIONS	DRAWN	DATE
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TE TUPU NGĀTAHI Supporting Growth

WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SUPPORTING GROWTH PROGRAMME
NORTH WEST - HIF TRIG ROAD (SOUTH)

Drawing Title: EROSION & SEDIMENT CONTROL
LEGEND AND GENERAL NOTES

Drawing Status: FOR LODGEMENT
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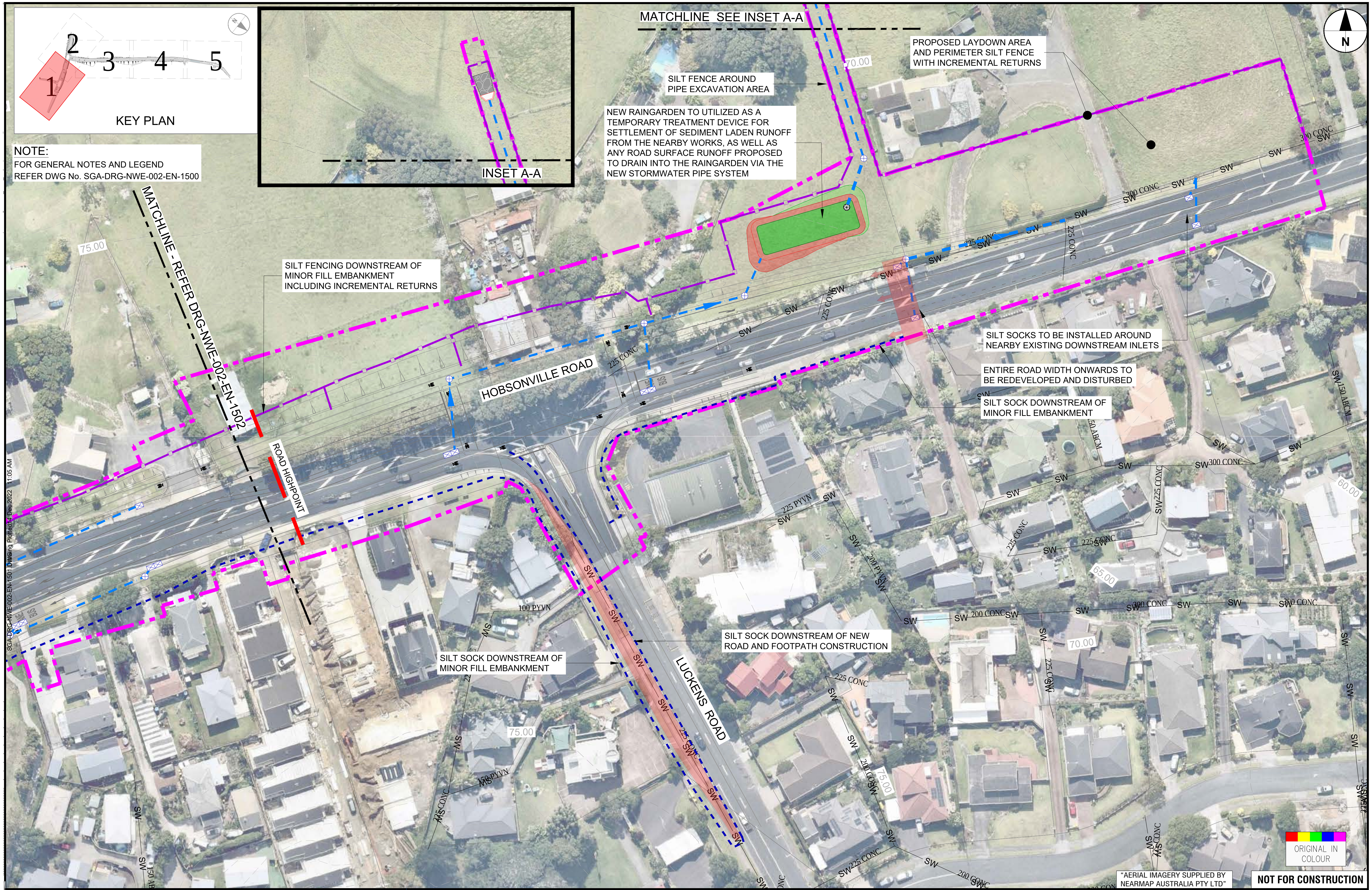

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Project:
SUPPORTING GROWTH PROGRAMME
NORTH WEST - HIF TRIG ROAD (SOUTH)

Drawing Title:
EROSION & SEDIMENT CONTROL PLAN
SHEET 1 OF 5

Drawing Status: **FOR LODGEMENT**
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Project:
SUPPORTING GROWTH PROGRAMME
NORTH WEST - HIF TRIG ROAD (SOUTH)

Drawing Title:
EROSION & SEDIMENT CONTROL PLAN
SHEET 2 OF 5

Drawing Status: FOR LODGEMENT
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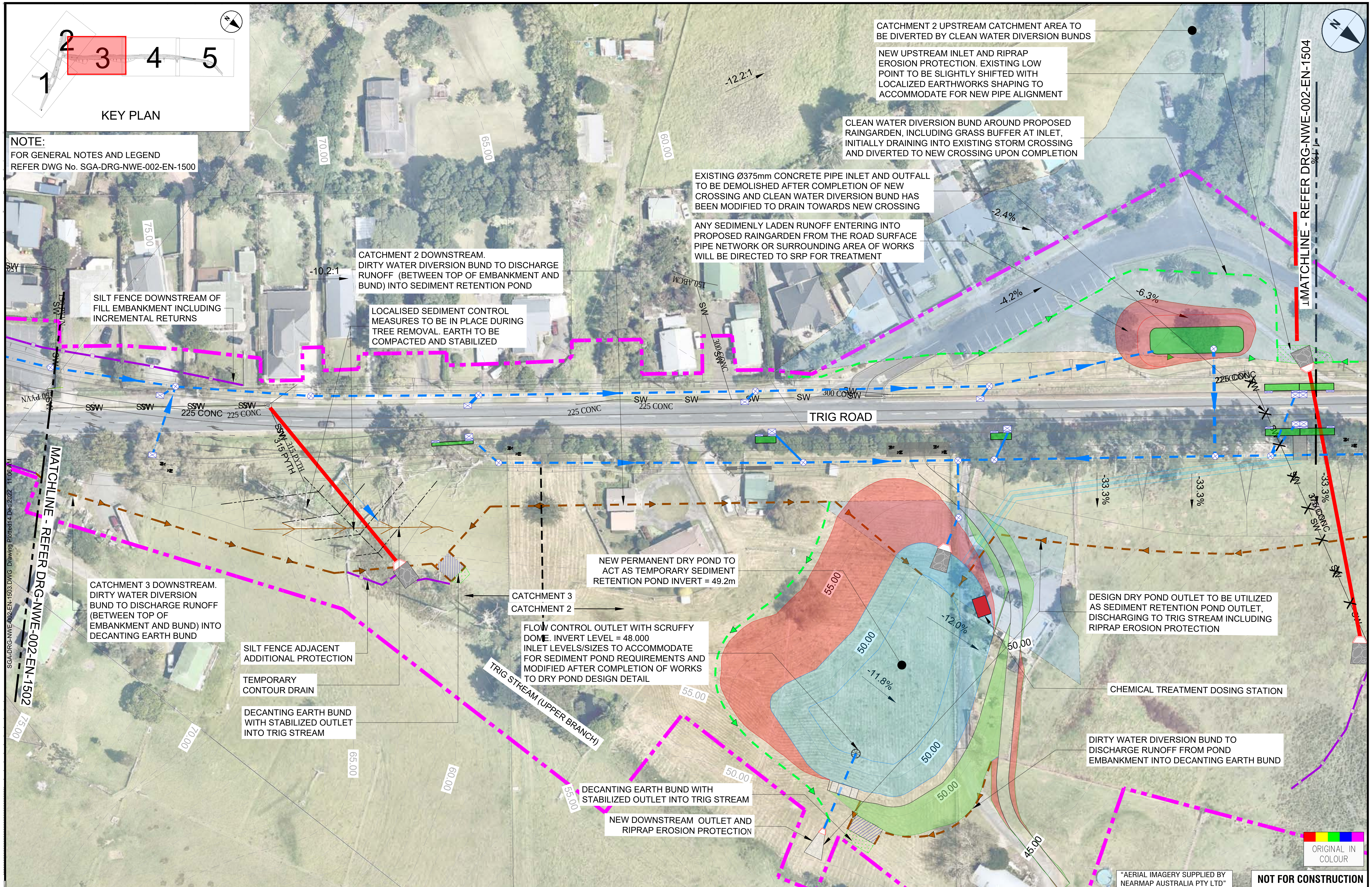

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DRAWN	V. DELA TORRE	20.08.20
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DESIGN REVIEW	R. SEYB	20.08.20
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TE TUPU NGĀTAHI Supporting Growth
WAKA KOTAHI NZ TRANSPORT AGENCY

Project:
SUPPORTING GROWTH PROGRAMME
NORTH WEST - HIF TRIG ROAD (SOUTH)

Drawing Title:
EROSION & SEDIMENT CONTROL PLAN
SHEET 3 OF 5

Drawing Status: **FOR LODGEMENT**
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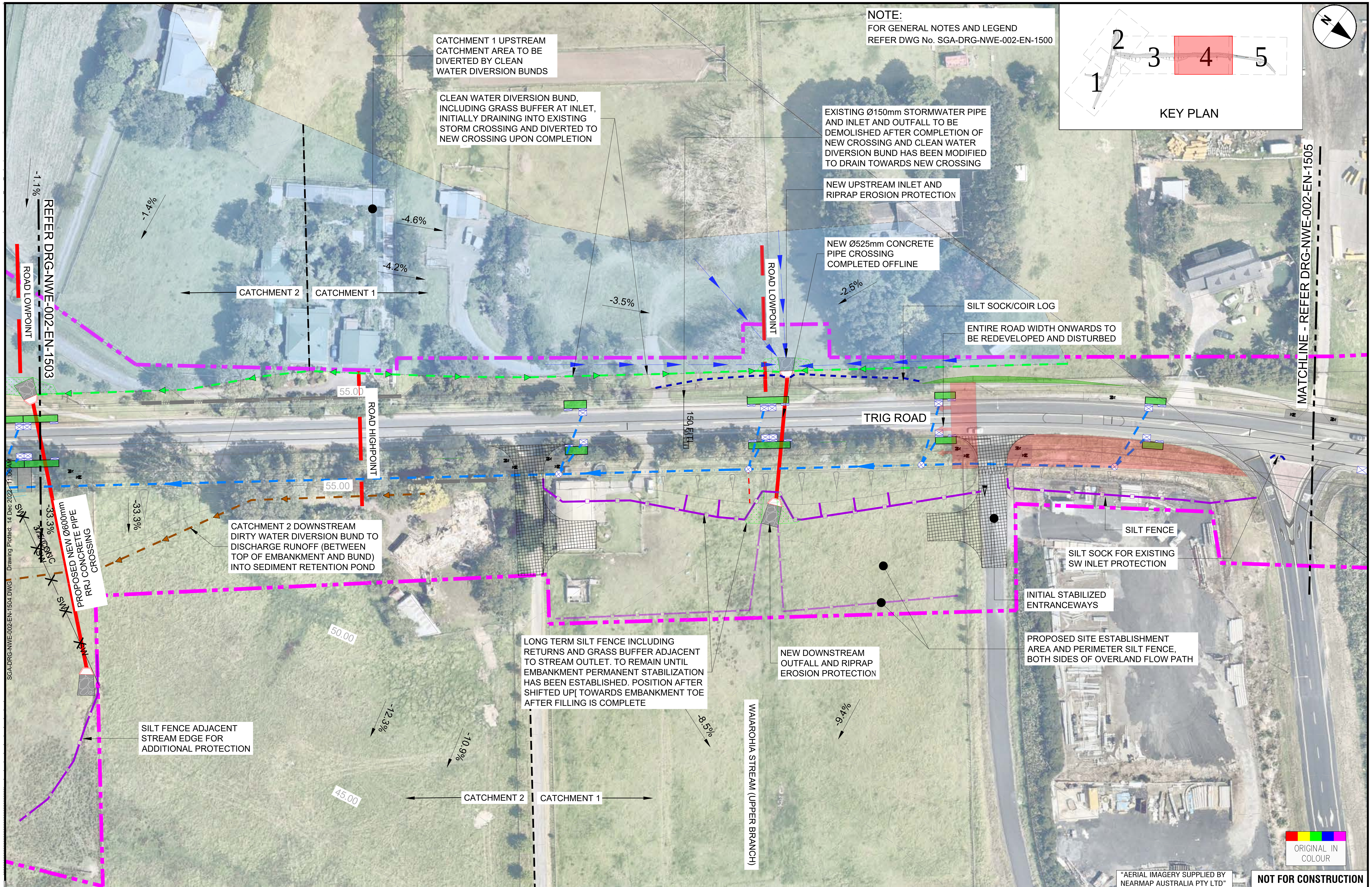
Revision: B



NOT FOR CONSTRUCTION

SURVEYED			
DRAWN	V. DELA TORRE	20.08.20	
DRAWING CHECK	J. DELA TORRE	20.08.20	
DESIGN	N. WOLFAARDT	20.08.20	
DESIGN REVIEW	R. SEYB	20.08.20	
APPROVED	B. BUSNARDO	07.12.2022	

REV	REVISIONS	DRAWN	DATE
B	ISSUED FOR NOTICE OF REQUIREMENT LODGEMENT	VDLT	DEC. 2022
A	FOR NOTICE OF REQUIREMENT AND RESOURCE CONSENT	VDLT	AUG. 2020

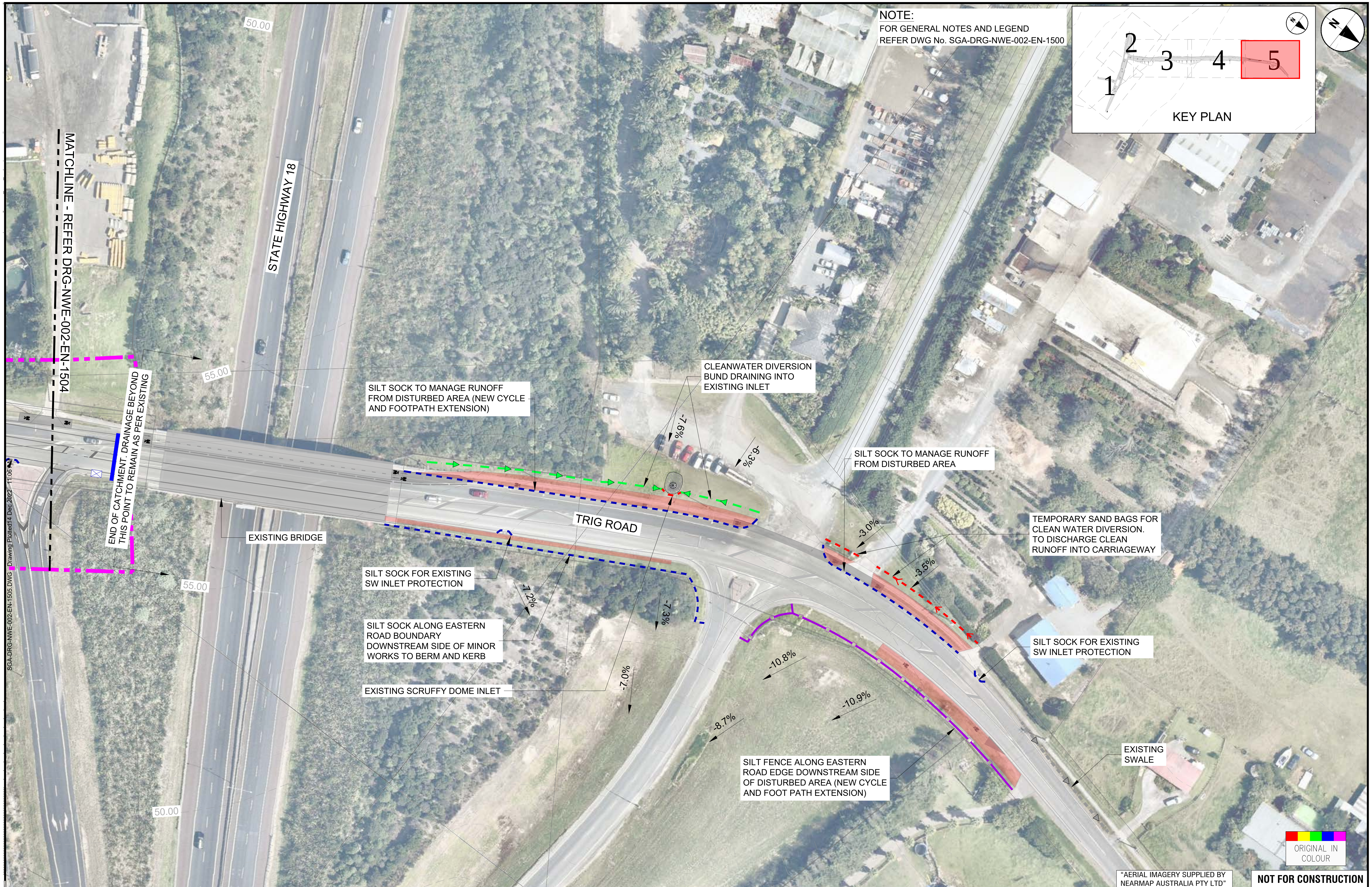
TE TUPU NGĀTAHI Supporting Growth

WAKA KOTAHI NZ TRANSPORT AGENCY

Project:
SUPPORTING GROWTH PROGRAMME
NORTH WEST - HIF TRIG ROAD (SOUTH)

Drawing Title:
EROSION & SEDIMENT CONTROL PLAN
SHEET 4 OF 5

Drawing Status: FOR LODGEMENT
Drawing Date: 07.12.2022
Scales: A1 1:500 A3 1:1000
Discipline: ENVIRONMENTAL
Drawing No. SGA-DRG-NWE-002-EN-1504
Revision: B



NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	DATE
B	ISSUED FOR NOTICE OF REQUIREMENT LODGEMENT	VDLT	DEC. 2022
A	FOR NOTICE OF REQUIREMENT AND RESOURCE CONSENT	VDLT	AUG. 2020

SURVEYED		
DRAWN	V. DELA TORRE	20.08.20
DRAWING CHECK	J. DELA TORRE	20.08.20
DESIGN	N. WOLFAARDT	20.08.20
DESIGN REVIEW	R. SEYB	20.08.20
APPROVED	B. BUSNARDO	07.12.2022

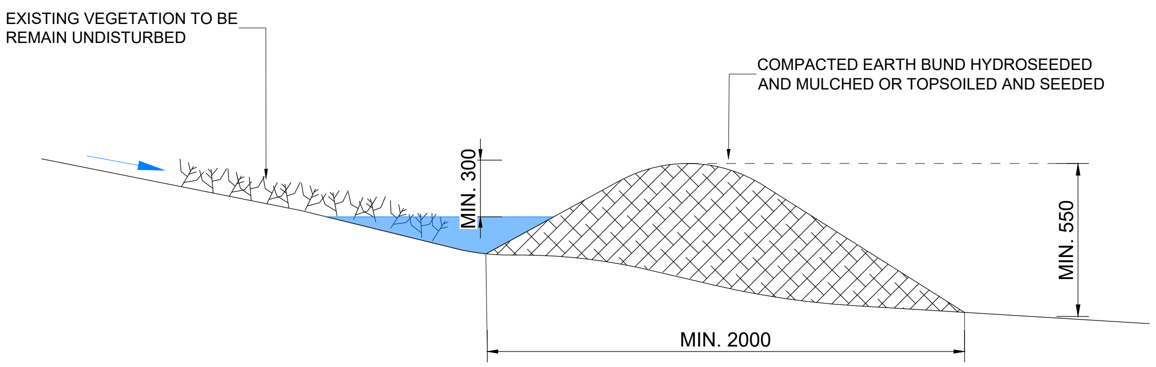
TE TUPU NGĀTAHI Supporting Growth

WAKA KOTAHI NZ TRANSPORT AGENCY

Project:
SUPPORTING GROWTH PROGRAMME
NORTH WEST - HIF TRIG ROAD (SOUTH)

Drawing Title:
EROSION & SEDIMENT CONTROL PLAN
SHEET 5 OF 5

Drawing Status: FOR LODGEMENT
Drawing Date: 07.12.2022
A1 Scales 1:500 | A3 Scales 1:1000
Discipline ENVIRONMENTAL
Drawing No. SGA-DRG-NWE-002-EN-1505
Revision B



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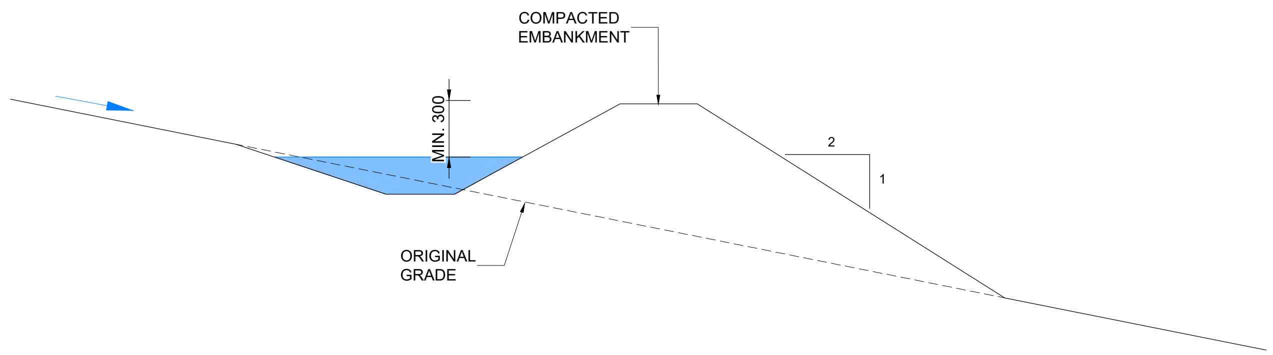
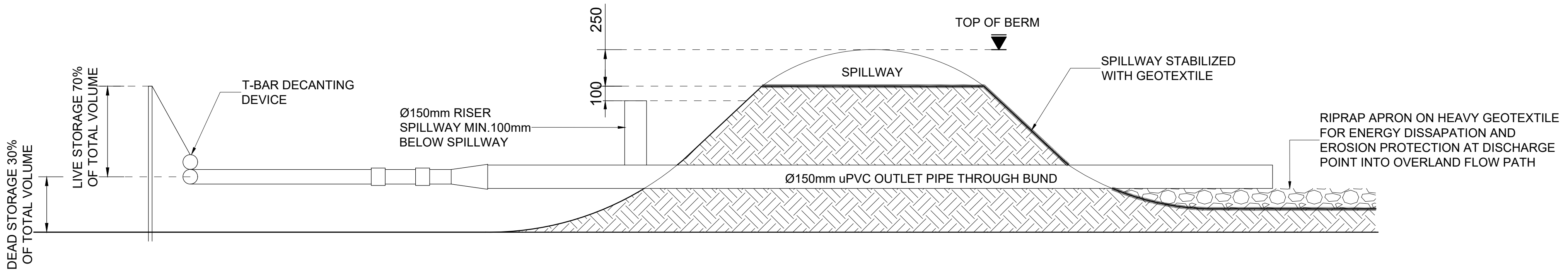
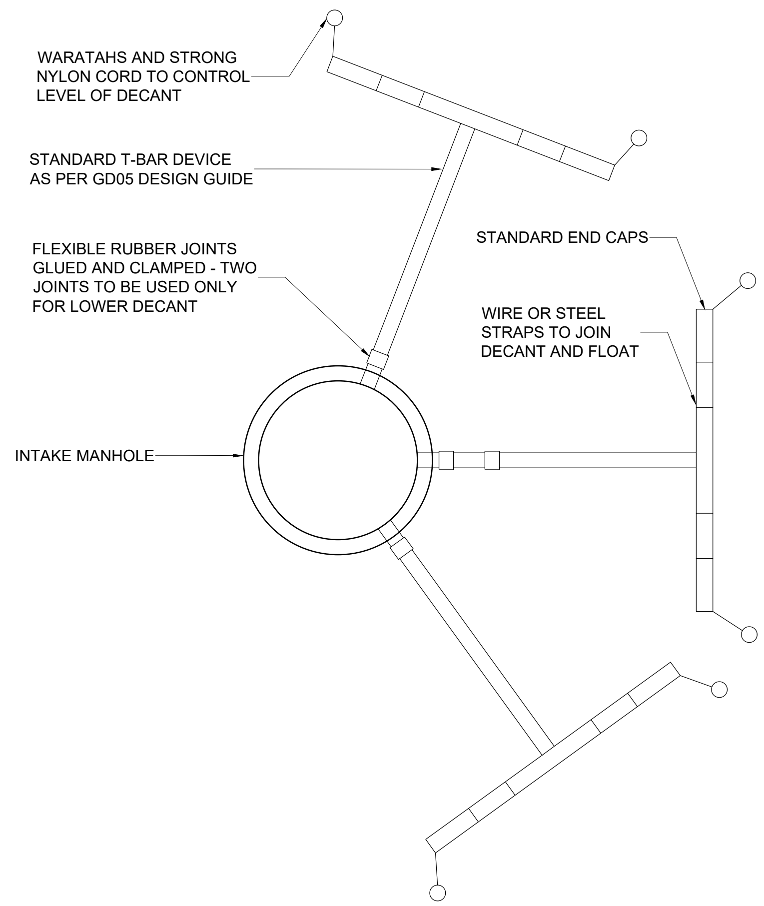


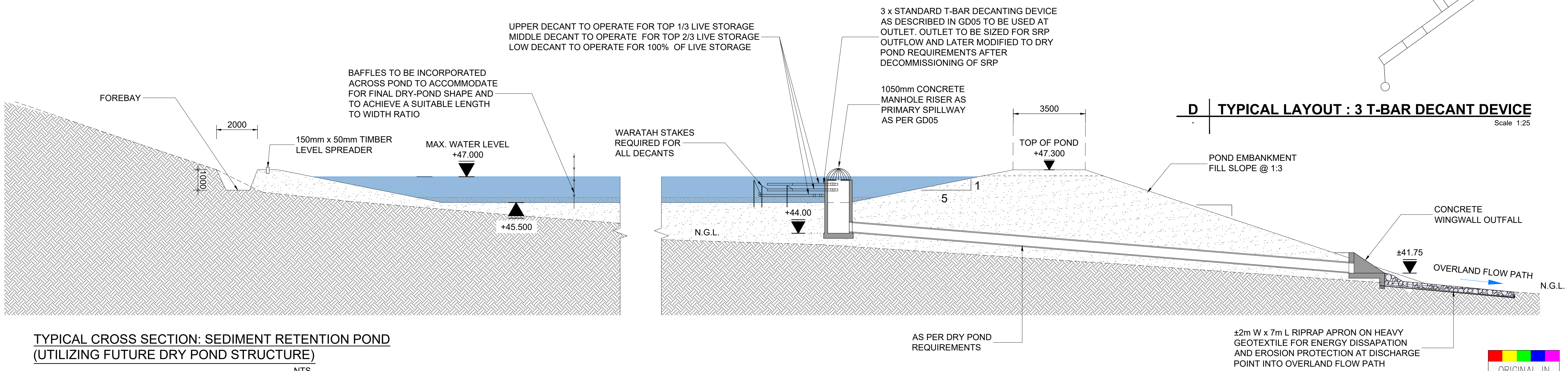
C | TYPICAL CROSS SECTION : DIRTY WATER DIVERSION BUND
Scale 1:20



A | TYPICAL CROSS SECTION : DECANTING EARTH BUND
Scale 1:20



D | TYPICAL LAYOUT : 3 T-BAR DECANT DEVICE
Scale 1:25



TYPICAL CROSS SECTION: SEDIMENT RETENTION POND (UTILIZING FUTURE DRY POND STRUCTURE)
NTS

ORIGINAL IN COLOUR

NOT FOR CONSTRUCTION

SGA-DRG-NWE-002-EN-1510.DWG Drawing Plotted: 14 Dec 2022 11:07 AM

REV	REVISIONS	DRAWN	DATE
B	ISSUED FOR NOTICE OF REQUIREMENT LODGEMENT	VDLT	DEC. 2022
A	FOR NOTICE OF REQUIREMENT AND RESOURCE CONSENT	VDLT	AUG. 2020

SURVEYED		
DRAWN	V. DELA TORRE	20.08.20
DRAWING CHECK	J. DELA TORRE	20.08.20
DESIGN	N. WOLFAARDT	20.08.20
DESIGN REVIEW	R. SEYB	20.08.20
APPROVED	B. BUSNARDO	07.12.2022

TE TUPU NGĀTAHI Supporting Growth
WAKA KOTAHI NZ TRANSPORT AGENCY

Project: **SUPPORTING GROWTH PROGRAMME**
NORTH WEST - HIF TRIG ROAD (SOUTH)
Drawing Title: EROSION & SEDIMENT CONTROL
SEDIMENT RETENTION DEVICES

Drawing Status: **FOR LODGEMENT**
Drawing Date: 07.12.2022
Scales: A1 AS SHOWN | A3 HALF SCALE
Discipline: ENVIRONMENTAL
Drawing No. SGA-DRG-NWE-002-EN-1510
Revision: B

ATTACHMENT 21

TRIG ROAD CORRIDOR UPGRADE PRELIMINARY SITE INVESTIGATION

Supporting Growth

Trig Road Corridor Upgrade

Preliminary Site Investigation

Version 1.0

August 2020

TE TUPU NGĀTAHI Supporting Growth

WAKA KOTAHI NZ TRANSPORT AGENCY

Document Status

Version no.	Responsibility	Name
1.0	Author	Zoe Lightfoot (2020)
	Reviewer	Emma Trembath (2020) Matthew Kerr-Ridge (2020)
	This report was authored in 2020 by Zoe Lightfoot and reviewed by Emma Trembath and Matthew Kerr Ridge. It has been assessed for issue in 2022 by Phillip Ware. Some aspects of the investigation require updating and additional content in line with the updated MFE Contaminated Land Guidelines. The matters requiring update are not considered to change the overall assessment of risk or approach to further investigation and management and can be addressed during the proposed Detailed Site Investigation.	
	Reviewer	Phillip Ware (2022)
	Approver	Bridget O'Leary (2022)

Revision Status

Version	Date	Reason for Issue
1.0	August 2020	Final

Table of Contents

Tables

Acronyms

Acronym/Term	Description
AT	Auckland Transport
AUP:OP	Auckland Unitary Plan Operative in Part 2016
DSI	Detailed Site Investigation (contaminated land)
HAIL	Hazardous Activities and Industries List
MfE	Ministry for the Environment
PSI	Preliminary Site Investigation (contaminated land)
SH18	State Highway 18

1 Introduction

1.1 Project Background

Auckland's population is growing rapidly; driven by both natural growth (more births than deaths) and migration from overseas and other parts of New Zealand. The Auckland Plan 2050 anticipates that this growth will generate demand for an additional 313,000 dwellings and require land for approximately 263,000 additional employment opportunities.

In response to this demand, the Auckland Unitary Plan Operative in Part (**AUP:OP**) identifies 15,000 hectares of predominantly rural land for future urbanisation. To enable the urban development of greenfield land, appropriate bulk infrastructure needs to be planned and delivered.

The Supporting Growth Programme is a collaboration between Auckland Transport (**AT**) and Waka Kotahi NZ Transport Agency to investigate, plan and deliver the transport network needed to support Auckland's future urban growth areas over the next 30 years.

1.2 Project Area

Trig Road, Whenuapai has been identified in the Supporting Growth Programme as a future arterial corridor which is needed to support the urban development of Whenuapai. AT is progressing a Notice of Requirement to provide route protection for the Trig Road Corridor Upgrade (hereinafter referred to as the Project or Project area).

The Project consists of the widening and upgrade of Trig Road between the State Highway 18 (**SH18**) off-ramps and Hobsonville Road. The Project area extends along the southern extent of Trig Road starting adjacent to the property located at 82 Trig Road down to the intersection with Hobsonville Road to the south. The Project area also extends along a section of Hobsonville Road between adjacent properties 60 and 78 Hobsonville Road and the northern extent of Luckens Road down to the adjacent property at 5 Luckens Road. Refer to Figure 1 for plan illustrating the extent of the Project area.

The Project is currently in preliminary phases and the final extent of land disturbance activities is yet to be defined. For the purposes of this Preliminary Site Investigation (**PSI**) we have assumed land disturbance to the extent as illustrated in black on Figure 1.

Figure 1: Project Area Plan

1.3 Purpose of this Report

The purpose of this PSI (contaminated land) is to:

- Provide a preliminary understanding of the nature and extent of historical and current landuse activities, and whether such activities may have adversely impacted soil contaminant conditions within the Project area.
- Provide recommendations with respect to any potential contaminated land issues or constraints.
- Provide an understanding of the contaminated land resource consents required to be sought in support of the Project.

1.4 Scope

In order to meet the purpose, the following scope has been undertaken:

- Review of available environmental and geotechnical records for the Project area.
- Completion of a Project area walkover.
- Review of historical aerial photographs for the period 1940 through to present day as made available through public information sources.

Property files, certificates of title, and review of Auckland Council groundwater records were not included in scope of the PSI. The exclusion of this information is not considered to materially impact upon the recommendations or conclusions of this report.

1.5 Terms of Reference

This PSI has been completed in general accordance with the following guidelines:

- Ministry for the Environment (**MfE**). Contaminated Land Management Guidelines No. 1: Reporting on Contaminated Site in New Zealand, revised 2011 (hereinafter referred to as MFE Guideline 1).
- Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (hereinafter referred to as the NES).

2 Environmental Setting

2.1 Topography

Topography across the study corridor is at its highest elevation along Hobsonville and Luckens Roads, decreasing in elevation towards the north-west along Trig Road. In summary:

- The section along Luckens Road has an elevation ranging between 76 and 78 m above sea level.
- The section along Hobsonville Road has an elevation ranging between 73 and 79 m above sea level.
- The section along Trig Road has an average elevation of 55 m above sea level, decreasing to approximately 50 m above sea level at the centre of the Trig Road.

2.2 Sensitive Ecological Receptors

A number of streams are located within a 1 kilometre radius of the Project area including, Pikau Stream and Waiarohia Stream to the north, Trig Stream and Rawiri Stream to the east, Waipateira Stream and an unknown tributary of Manutewhau Stream to the south and Totara Creek to the west. The nearest surface water body to the Project area is Trig Stream located on the eastern side of Trig Road.

2.3 Geology

The key geologic unit recorded within the study corridor is Tauranga Group material (GNS, 2001). The Tauranga Group deposits are noted on the map to form the majority of the study area and are part of the Puketoka Formation. This is described as pumiceous mud, sand and gravel interbedded with muddy peat and lignite, rhyolite pumice, including non-welded ignimbrite, tephra and alluvial pumice deposits.

There is a geological boundary at the southern end of the proposed arterial upgrade on Luckens Road. The key geologic unit at this location is Waitemata Group material comprising deposits from the East Coast Bays Formation. This is described as alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grit beds.

Geological borelogs for historical investigations completed within the Project area, as well as a map indicating the locations is included in Appendix A.

2.4 Hydrogeology

Boreholes advanced in the area have recorded groundwater between 3 and 4 m below ground level (refer Appendix A). Locally groundwater may flow north east towards areas of lower elevation and the Trig Stream located on the eastern side of Trig Road. Regional groundwater flow is likely south towards the Waitemata Harbour.

3 Summary of Current Landuse Activity

3.1 Current Aerial Photography

Table 1 presents a summary of landuse activity adjacent to the Project area as derived from the review of current aerial photographs (2019) provided in the Auckland Council GIS platform.

Table 1: Current Aerial Photograph Review

Direction	Summary of Observations
North	Pastoral landuse is visible to the north east and a mixture of horticultural and pastoral landuse is visible to the north west.
East	Trig Road section of the Project: Pastoral landuse is predominant with some residential properties.
South	Hobsonville Road beyond which is residential landuse.
West	Predominantly pastoral landuse with horticultural activities visible directly west of the northern extent of the Project area. A number of residential properties are visible adjacent to the south west section of Trig Road.

3.2 Walkover Observations

A walkover of the Project area was completed on 14 January 2020. A photographic log is included in Appendix B. A summary of key observations is as follows:

- Horticultural nurseries were observed at 62 and 82 Trig Road.
- An electrical substation was observed at 1 Trig Road.
- Electrical transformers were observed on the grass verges outside 12 and 40 Trig Road.
- A Watercare pump station for potable water is located at 74 Hobsonville Road.

3.3 Summary

The review of current landuse activity within the Project area has identified that activities classified on the MfE Hazardous Activities and Industries List (**HAIL**) are being undertaken i.e., horticultural nurseries, electrical substation, and electrical transformers. Refer to Appendix C for a copy of the HAIL.

4 Summary of Historical Aerial Photographs

4.1 Historical Aerial Photography

Table 2 presents a summary of observations derived from the review of historical aerial photographs made available by Retrolens and Auckland Council via their GIS platform. Copies of historical aerials are provided in Appendix D.

Table 2: Historical Aerial Photograph Review

Year	Summary of Observations
1940	The alignment of Trig, Hobsonville and Luckens Roads appear as they do at present day. Land surrounding the Project area is largely cleared and appears to have been used for pastoral activities. Hedgerows are present along the eastern side of Trig Road and both sides of Hobsonville and Luckens Road within the Project area. Several houses associated with farming activities are visible along Trig and Luckens Road. A water tank is visible on the corner of Trig and Hobsonville Roads. Properties on the eastern side of Luckens Road and western side of Trig Road appear subject to horticultural landuse (orchard or market gardening).
1950	The 1950 aerial photograph appears similar to the 1940 aerial photograph. Properties on the western side of Luckens Roads and the northern extent of Trig Road (western side) are now also subject to horticultural landuse (orchard or market gardening).
1963	A number of residential properties are visible along the south-western side of Trig Road, northern and southern sides of Hobsonville Road and southern end of Luckens Road. Horticultural landuse activities (orchard or market gardening) remain visible near the intersection of Luckens Road and Hobsonville Road.
1972	The 1972 aerial photograph appears similar to the 1963 aerial photograph.
1988	Residential landuse activity within the Project area has intensified since the 1972 aerial photograph. Two commercial nurseries including glasshouses (still present today refer Section 3) have been established on the western side of Trig Road (northern extent of Project area). An electrical substation (still present today refer Section 3) has been established on the corner or Trig and Hobsonville Roads. Horticultural activity (market gardening) appears to have been established on the northern side of Hobsonville Road. The horticultural activity formally observed at the corner of Luckens Road appears to have ceased.
2000	Residential landuse activity within the Project area has intensified since the 1988 aerial photograph. The former horticultural properties on the corner of Luckens Road have been redeveloped for residential lanudse purposes. A commercial nursery including glasshouses has been established on the eastern side of Trig Road. Horticultural activity (orchard) is visible on the western side of Trig Road.
2008	The 2008 aerial photograph appears similar to the 2000 aerial photograph. The commercial nursery established on the eastern side of Trig Road appears to have ceased operation. The water tank formerly observed near the corner of Trig and Hobsonville Roads has been removed. The horticultural activity formally on the northern side of Hobsonville Road appears to have ceased.

2010	The 2010 aerial photograph appears similar to the 2008 aerial photograph. SH18 is under construction.

4.2 Summary

The review of historical landuse activity within the Project area has identified that activities classified on the MfE HAIL were historically undertaken i.e., horticulture and market gardening.

5 Summary of PSI Findings

The PSI has identified that activities classified on the MFE HAIL have historically been completed or are currently being undertaken on properties within the Project area. Refer to Table 3 for a summary of these key findings.

Table 3: Summary of PSI Findings

HAIL Activity	HAIL Classification	Contaminants of Concern associated with the HAIL Activity	HAIL Activity Inside or Outside of Project Area	Likely Extent of Soil Impact & Associated Risk
Horticultural Nursery Orchard Market Gardening	A10 Persistent pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds.	Heavy metals including arsenic, lead, copper, and mercury. Wide range of organic compounds including acidic herbicides, organophosphate and organochlorines. Asbestos containing materials (associated with building structures).	Inside. Former and current horticultural properties located on both Trig and Hobsonville Roads are within the current extent of the proposed road widening activities.	Direct application of hazardous substances to ground as part of operations. Impact likely restricted to shallow soil profile but may have been tilled to greater depth as part of crop preparation. Spray drift of chemicals across property boundaries as part of operations. Impact likely limited to surficial soils. The risk profile to human health and the environment is low, however this has not yet been assessed by way of soil sampling.
Electrical Substation	B4 Power stations, substations or switchyards.	Polychlorinated biphenyls. Hydrocarbons. Heavy metals including boron and arsenic. Asbestos containing materials (associated with building structures and other electrical equipment).	Inside. The front of the property is within the current extent of the proposed road widening activities.	Accidental discharge or leakage of hazardous substances to ground as part of operations. Impact likely limited to shallow soil profile. As only the front of the property is within the current extent of the proposed road widening activities it is unlikely that

				soil impact will be encountered. The risk profile to human health and the environment is low, however this has not yet been assessed by way of soil sampling.
Electrical Transformers	B2 Electrical transformers including the manufacturing, repairing, or disposing of electrical transformers or other heavy electrical equipment.	Polychlorinated biphenyls. Hydrocarbons. Heavy metals including boron and arsenic. Asbestos containing materials (associated with building structures and other electrical equipment).	Inside. The electrical transformers may need to be relocated as they are within the proposed area of road widening.	Accidental discharge or leakage of hazardous substances to ground as part of operations. Impact likely limited to shallow soil profile. The risk profile to human health and the environment is low, however this has not yet been assessed by way of soil sampling.

6 Recommendations

The PSI has identified that activities classified on the HAIL have historically been completed or are currently being undertaken on properties that are within the proposed road widening area of the Project. It is therefore recommended that a Detailed Site investigation (**DSI**) (contaminated land) be completed. Through the completion of a soil sampling exercise, the DSI would act to provide an understanding of actual soil contaminant conditions within the Project area. The results of the DSI would inform:

- Contaminated land resource consent requirements.
- Human health and environmental controls for implementation during land disturbance activities associated with the Project.
- Soil reuse and off-site disposal requirements i.e., classification status as cleanfill, managed fill or landfill.

7 Contaminated Land Regulatory Assessment

Based on the results of this PSI, and as soil samples have not been analysed which would indicate whether soil contaminant conditions (the DSI results, refer section 6) meet the Permitted Activity criteria of the AUP:OP or NES; Table 4 presents a current assessment of contaminated land regulatory requirements.

Table 4: Summary of Required Consents Relating to Contaminated Land

Regulation	Regulation / Rule	Activity	Status
Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011	11(1)	This regulation applies to an activity described in any regulation 5(2) to (6) on a piece of land described in regulations 5(7) or (8) that is not a permitted activity, controlled activity, or restricted discretionary activity.	Discretionary
	11(2)	This activity is a discretionary activity.	
Auckland Unitary Plan Operative in Part	E30.4.1(A7)	Discharges of Contaminants into air, or into water, or onto or into land not meeting controlled activity standard E30.6.2.1.	Discretionary

It is recommended that the above consents are applied for, and conditions imposed requiring a DSI to be undertaken and for a Contaminated Soil Management Plan to be prepared for the management and monitoring of any contaminated soil confirmed by the DSI.

8 Conclusions

Trig Road, Whenuapai has been identified in the Supporting Growth Programme as a future arterial corridor which is needed to support the urban development of Whenuapai. The Project consists of the widening and upgrade of Trig Road between the SH18 off-ramps and Hobsonville Road.

A PSI (contaminated land) was completed in support of the Project. As part of the PSI the following tasks were undertaken:

- Review of available environmental and geotechnical records for the Project area.
- Completion of a Project area walkover.
- Review of historical aerial photographs for the period 1940 through to present day as made available through public information sources.

The PSI identified that activities classified on the MFE HAIL have historically been completed or are currently being undertaken on properties within the proposed road widening area. These activities include:

1. Category A10: persistent pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds.
2. Category B2: electrical transformers including the manufacturing, repairing, or disposing of electrical transformers or other heavy electrical equipment.
3. Category B4: power stations, substations or switchyards.

Based on the findings of the PSI, the completion of a DSI (contaminated land) is recommended. Through the completion of a soil sampling exercise, the DSI would act to provide an understanding of actual soil contaminant conditions within the Project area. The results of the DSI would inform:

- Contaminated land resource consent requirements.
- Human health and environmental controls for implementation during land disturbance activities associated with the Project.
- Soil reuse and off-site disposal requirements i.e., classification status as cleanfill, managed fill or landfill.

Given the findings of the PSI and the fact that a DSI has not yet been undertaken for the Project, it is recommended that the following contaminated land resource consents are required to be sought in support of this Project:

- Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011: Discretionary Activity consent under Regulation 11(2).
- AUP:OP: Discretionary Activity consent under Rule E30.4.1(A7).

9 References

Auckland Council, 2016 (Updated 15 November 2019). The Auckland Unitary Plan Operative in Part.

Institute of Geological & Nuclear Sciences Limited, 2001. 1:250,000 Geological Map 3.

Ministry for the Environment, April 2012. National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health.

Ministry for the Environment, 2004. Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils. Revised 2011.

Ministry for the Environment, 2001. Contaminated Land Management Guidelines No. 1. Reporting on Contaminated Sites in New Zealand. Revised 2011.

Appendix 1. Geological Information

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH-T56**

SHEET: 1 OF 8

PROJECT: NI - Phase 2-6	CO-ORDINATES (NZTM): 5924976.76 N, 1744441.61 E
JOB No.: 28773.213	DIRECTION: 0°
LOCATION: 52 Trig Road, Hobsonville	ANGLE FROM HORIZ.: -90°
R.L. GROUND: 54.60m	DRILLED BY: McMillan Drilling
R.L. COLLAR: 54.60m	LOGGED BY: PRMM
DATUM: AUCKLAND 1946	CHECKED: JWY
SURVEY: Handheld GPS	START DATE: 23/11/2015
	FINISH DATE: 24/11/2015
	CONTRACTOR: McMillan Drilling

DESCRIPTION OF CORE

SOIL: Classification, colour, consistency / density, moisture, plasticity

ROCK: Weathering, colour, fabric, name, strength, cementation

Geological Unit	Description of Core	Sampling Method	Core Recovery (%)	Testing	Rock Defects: Description & Additional Observations
Fill	Organic SILT; dark brown. Stiff, dry, non-plastic.[Topsoil]	HAND AUGER	100		
Fill	SILT, with some clay, trace rootlets; dark brown and orange brown. Very stiff, moist, low plasticity.	HAND AUGER	100		
Tauranga Group	Clayey SILT; light grey mottled orange brown, streaked red. Very stiff, moist, low plasticity.	HAND AUGER / HQ3	100 / 23		
Tauranga Group	1.85-3m: CORE LOSS.	HQ3	23		
Tauranga Group	3-3.5m: Push Tube.	PUSH TUBE	100		3.00m: , Atterberg & Consol Test
Tauranga Group	Clayey SILT, trace pumiceous coarse sand; light grey, streaked red and orange brown. Soft, moist, moderate plasticity.	SPT / HQ3	100 / 100	0/0 0/0 0/0 N=0	3.50 - 3.95m: , SPT sample slipped out. Recovered in following core run. 3.55m: , Drilling with no water and rotation.
Tauranga Group	4.5-5m: Push Tube.	PUSH TUBE	100		

Graphic Log: TS

Water Level: 23/11/2015

Core Box: Box 1, 0.0-3.0m

COMMENTS: Standpipe piezometer installed with screened intervals at 4.5-5.5m and 32-34m below ground level. See standpipe piezometer record for further details

Hole Depth 35.3m

Scale 1:25

General Log - 3/05/2016 5:24:10 p.m. - Produced with Core-GS by GeRoc

NZGD ID: BH_100368

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH-T56

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED: JWY
START DATE: 23/11/2015
FINISH DATE: 24/11/2015
CONTRACTOR: McMillan Drilling

PROJECT: NI - Phase 2-6
JOB No.: 28773.213
LOCATION: 52 Trig Road, Hobsonville

CO-ORDINATES (NZTM): 5924976.76 N 1744441.61 E
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 54.60m
R.L. COLLAR: 54.60m
DATUM: AUCKLAND 1946
SURVEY: Handheld GPS

Geological Unit	Description of Core (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Rock Defects Description & Additional Observations	Water Level	Core Box
Tauranga Group	Clayey SILT, with trace coarse pumiceous sand; light grey streaked orange brown and red. Soft, moist, moderate plasticity.	SPT	100	0/0 1/1 1/1 N=4					Box 2, 3.0-5.5m
		HQ3	100		49				
Weathered East Coast Bays Formation	Clayey SILT; grey. Firm to stiff, moist, high plasticity.								
	Clayey SILT, with some fine sand; grey, streaked orange brown. Firm, moist, low plasticity.								
	6-6.5m: Push Tube.	PUSH TUBE	100			6			
	Clayey SILT; grey streaked orange brown. Firm, moist, moderate plasticity.	SPT	100	0/0 1/1 1/1 N=4	48				
	Interbedded sandy SILT; grey. Stiff, moist, non-plastic; moderately thinly bedded with SILT, with minor clay; grey. Very stiff, moist, low plasticity. Thinly bedded.	HQ3	100			7			
		SPT	100	1/1 1/2 2/2 N=7	47		7.50m: , Drilling with water and rotation.		
	SILT, with minor clay; grey. Very stiff, moist, low plasticity. Thin sub-horizontally bedded.	HQ3	52			8		24/11/2015	Box 3, 5.5-8.2m
	8.5-9m: CORE LOSS.				46				
	Interbedded sandy SILT; grey. Stiff, moist, non-plastic; moderately thinly bedded with SILT, with minor clay; grey. Very stiff, moist, low plasticity. Thinly bedded.	SPT	100	1/1 2/2 2/4 N=10		9			
	9.50m: SILT, with minor clay, grades moderately thinly bedded, sandy silt is thinly bedded with carbonaceous laminations throughout.	HQ3	76		45				

COMMENTS: Standpipe piezometer installed with screened intervals at 4.5-5.5m and 32-34m below ground level. See standpipe piezometer record for further details

Hole Depth 35.3m
Scale 1:25

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH-T56

SHEET: 3 OF 8

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED: JWY
START DATE: 23/11/2015
FINISH DATE: 24/11/2015
CONTRACTOR: McMillan Drilling

PROJECT: NI - Phase 2-6
JOB No.: 28773.213
LOCATION: 52 Trig Road, Hobsonville

CO-ORDINATES: (NZTM) 5924976.76 N 1744441.61 E
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 54.60m
R.L. COLLAR: 54.60m
DATUM: AUCKLAND 1946
SURVEY: Handheld GPS

Geological Unit	Description of Core (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Core Box
Weathered East Coast Bays Formation	Interbedded sandy SILT; grey. Stiff, moist, non-plastic; thinly bedded with carbonaceous laminations throughout. With moderately thinly bedded SILT, with minor clay; grey. Very stiff to moist, low plasticity.	HQ3	76				Box 4, 10.0-11.9m
	10.25-10.5m: CORE LOSS.						
	Silty, fine SAND; grey. Medium dense, moist. Moderately thinly bedded with thin to moderately thin interbeds of grey hard SILT. Sub-horizontally bedded with carbonaceous laminations throughout.	SPT	100	2/2 2/3 4/4 N=13	44		
		HQ3	100		43	11	
	12.00m: Silty, fine SAND, moderately thickly bedded.	SPT	100	2/2 4/4 4/5 N=17		12	
	12.50m: Silty, fine SAND and SILT, thinly bedded.	HQ3	100		42	13	Box 5, 11.9-14.7m
		SPT	100	3/3 4/4 5/6 N=19	41		
	14.55m: Silty, fine SAND, moderately thinly bedded.	HQ3	100		40	14	

ROCK DEFECTS: Defect Log | Fracture Spacing (mm) | RQD (%) | Description & Additional Observations

COMMENTS: Standpipe piezometer installed with screened intervals at 4.5-5.5m and 32-34m below ground level. See standpipe piezometer record for further details

Hole Depth 35.3m

Scale 1:25

General Log - 3/05/2016 5:24:10 p.m. - Produced with Core-GS by GeRoc

NZGD ID: BH_100368

NZGD ID: BH_100368

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH-T56

SHEET: 4 OF 8

PROJECT: NI - Phase 2-6	CO-ORDINATES: (NZTM) 5924976.76 N 1744441.61 E	R.L. GROUND: 54.60m	DRILLED BY: McMillan Drilling
JOB No.: 28773.213		R.L. COLLAR: 54.60m	LOGGED BY: PRMM
LOCATION: 52 Trig Road, Hobsonville	DIRECTION: 0°	DATUM: AUCKLAND 1946	CHECKED: JWY
	ANGLE FROM HORIZ.: -90°	SURVEY: Handheld GPS	START DATE: 23/11/2015
			FINISH DATE: 24/11/2015
			CONTRACTOR: McMillan Drilling

Columns: GEOLOGICAL UNIT | DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation) | Rock Weathering (UW SW MW HW CW) | Rock Strength (ES VS S MS W VW EW) | Sampling Method | Core Recovery (%) | Testing | RL (m) | Depth (m) | Graphic Log | ROCK DEFECTS: Defect Log, Fracture Spacing (mm) (2000 600 200 60 20), RQD (%), Description & Additional Observations | Water Loss (%) (25 50 75) | Water Level | Casing | Installation | Core Box

GEOLOGICAL UNIT: Weathered East Coast Bays Formation

Silty, fine SAND; grey. Medium dense, moist. Moderately thinly bedded with thin to moderately thin interbeds of grey hard SILT. Sub-horizontally bedded with carbonaceous laminations throughout.

Silty, fine SAND; grey. Medium dense, moist.

15.50 - 15.65m: high carbonaceous content.

16.25 - 16.33m: high carbonaceous content.

16.88m: 20mm thick grey, very stiff SILT bed. Sub-horizontal.

17.00m: 20mm thick grey, hard SILT bed. Sub-horizontal.

18.30m: 40mm thick grey, hard, SILT bed. Sub-horizontal.

19.25m: 10mm thick grey, hard SILT bed. Sub-horizontal.

19.50m: - grades dense.

19.75 - 19.77m: high carbonaceous content, very closely spaced laminations.

Sampling Method	Core Recovery (%)	Testing
SPT	100	3/4 4/5 5/8 N=22
HQ3	100	
SPT	100	2/4 4/4 5/5 N=18
HQ3	100	
SPT	100	2/4 5/5 8/9 N=27
HQ3	100	
SPT	100	4/6 8/9 11/11 N=39

RL (m): 39, 38, 37, 36, 35

Depth (m): 16, 17, 18, 19

Core Box: Box 6, 15.0-17.6m

COMMENTS: Standpipe piezometer installed with screened intervals at 4.5-5.5m and 32-34m below ground level. See standpipe piezometer record for further details

Hole Depth 35.3m

Scale 1:25

General Log - 3/05/2016 5:24:10 p.m. - Produced with Core-GS by GeRoc

NZGD ID: BH_100368

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH-T56**

PROJECT: NI - Phase 2-6	CO-ORDINATES (NZTM): 5924976.76 N, 1744441.61 E
JOB No.: 28773.213	DIRECTION: 0°
LOCATION: 52 Trig Road, Hobsonville	ANGLE FROM HORIZ.: -90°
R.L. GROUND: 54.60m	DRILLED BY: McMillan Drilling
R.L. COLLAR: 54.60m	LOGGED BY: PRMM
DATUM: AUCKLAND 1946	CHECKED: JWY
SURVEY: Handheld GPS	START DATE: 23/11/2015
	FINISH DATE: 24/11/2015
	CONTRACTOR: McMillan Drilling

DESCRIPTION OF CORE

SOIL: Classification, colour, consistency / density, moisture, plasticity
ROCK: Weathering, colour, fabric, name, strength, cementation

Geological Unit	Description of Core	Sampling Method	Core Recovery (%)	Testing	RQD (%)	Defect Description & Additional Observations	Core Box
Weathered East Coast Bays Formation	20.05m: 20mm thick grey, hard SILT bed 20.10 - 20.15m: high carbonaceous content.	HQ3	100				Box 7, 17.6-20.3m
	Moderately weathered, grey SANDSTONE. Extremely weak, dense, sub-horizontally bedded. 20.55m: high carbonaceous content. 20.75m: 50mm thick SILTSTONE bed. Extremely weak to very weak.	SPT (SC)	100	6/9 11/11 11/11 N=44			
	21.85m: To 21.88m, high carbonaceous content. 22.22m: 40mm thick SILTSTONE bed.	HQ3	100		100		
		SPT (SC)	100	5/10 10/11 12/11 N=44			
		HQ3	100		0	22.95 - 24.00m: , Drilling breaks 50mm apart filled with drilling mud.	Box 8, 20.3-24.0m
East Coast Bays Formation Rock	24-24.35m: CORE LOSS.	SPT (SC)	0	7/18 25/22 3 -10mm N>=50			
	Unweathered, grey streaked black silty fine grained SANDSTONE. Very weak, with black carbonaceous specks throughout. 24.70m: Extremely weak, uncemented, no carbonaceous content.	HQ3	65		65		

Depth (m): 21, 22, 23, 24
RL (m): 34, 33, 32, 31, 30

COMMENTS: Standpipe piezometer installed with screened intervals at 4.5-5.5m and 32-34m below ground level. See standpipe piezometer record for further details

Hole Depth 35.3m

Scale 1:25

NZGD ID: BH_100368

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH-T56**

PROJECT: NI - Phase 2-6	CO-ORDINATES: (NZTM) 5924976.76 N 1744441.61 E	R.L. GROUND: 54.60m	DRILLED BY: McMillan Drilling
JOB No.: 28773.213		R.L. COLLAR: 54.60m	LOGGED BY: PRMM
LOCATION: 52 Trig Road, Hobsonville	DIRECTION: 0°	DATUM: AUCKLAND 1946	CHECKED: JWY
	ANGLE FROM HORIZ.: -90°	SURVEY: Handheld GPS	START DATE: 23/11/2015
			FINISH DATE: 24/11/2015
			CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT: East Coast Bays Formation Rock

DESCRIPTION OF CORE
SOIL: Classification, colour, consistency / density, moisture, plasticity
ROCK: Weathering, colour, fabric, name, strength, cementation

Description of Core	Sampling Method	Core Recovery (%)	Testing	RQD (%)
25.05-25.5m: CORE LOSS.	HQ3	65		65
Unweathered, grey, silty, fine grained SANDSTONE. Very weak.	SPT (SC)	100	7/15 15/16 17/2 -5mm N>=50	
25.95m: 10mm thick grey, very weak SILTSTONE bed. 26.00m: - grades extremely weak, uncemented, fine to medium SANDSTONE, with trace coarse grains. 26.55m: - grades very weak SANDSTONE. 26.70m: - grades fine to medium SANDSTONE. 26.7 - 26.74m: high carbonaceous content.	HQ3	100		100
27.20m: 10mm thick grey, very weak SILTSTONE bed. 27.25m: - grades fine to medium SANDSTONE. 27.40m: To 27.55m, convoluted siltstone beds and carbonaceous laminations.	SPT (SC)	100	7/23 24/20 6 -20mm N>=50	
	HQ3	53		53
27.8-28.5m: CORE LOSS.				
Unweathered, silty, fine to medium grained SANDSTONE, with trace coarse sand grains. Very weak	HQ3	100		100
Unweathered, grey, silty, fine grained SANDSTONE. Very weak, moderately thinly bedded, with thin interbeds of grey, very weak SILTSTONE. Sub-horizontally bedded.				

Depth (m): 26, 27, 28, 29
RL (m): 29, 28, 27, 26, 25

Core Box: Box 9, 24.0-27.5m

COMMENTS: Standpipe piezometer installed with screened intervals at 4.5-5.5m and 32-34m below ground level. See standpipe piezometer record for further details

Hole Depth 35.3m

Scale 1:25

NZGD ID: BH_100368

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: **BH-T56**

SHEET: 7 OF 8

PROJECT: NI - Phase 2-6	DRILLED BY: McMillan Drilling
JOB No.: 28773.213	LOGGED BY: PRMM
LOCATION: 52 Trig Road, Hobsonville	CHECKED: JWY
CO-ORDINATES (NZTM): 5924976.76 N, 1744441.61 E	START DATE: 23/11/2015
DIRECTION: 0°	FINISH DATE: 24/11/2015
ANGLE FROM HORIZ.: -90°	CONTRACTOR: McMillan Drilling
R.L. GROUND: 54.60m	
R.L. COLLAR: 54.60m	
DATUM: AUCKLAND 1946	
SURVEY: Handheld GPS	

GEOLOGICAL UNIT: East Coast Bays Formation Rock

DESCRIPTION OF CORE
SOIL: Classification, colour, consistency / density, moisture, plasticity
ROCK: Weathering, colour, fabric, name, strength, cementation

Depth (m)	Description of Core	Sampling Method	Core Recovery (%)	RQD (%)	Rock Defects: Description & Additional Observations	Core Box
to 30.9	Unweathered, medium to coarse grained SANDSTONE, trace fine gravel sized siltstone lithics. Very weak. 30.70m: - grades silty, fine to medium SANDSTONE. 31.65m: fine to medium SANDSTONE, with trace coarse sand and fine gravel sized siltstone lithics.	HQ3	100	60		Box 10, 27.5-31.8m
30.9-31.5	30.9-31.5m: CORE LOSS.					
31.5-33.45	Unweathered, grey, silty, fine to medium grained SANDSTONE. Extremely weak. 33.35m: - grades very weak.	HQ3	100	100	*32.40m:* UCS 0.23	
33.45-33.6	Unweathered, grey SILTSTONE. Very weak. Sub-horizontally bedded, with carbonaceous laminations, very closely spaced.	HQ3	100	100		
33.6-35.3	Unweathered, grey, silty, fine to medium grained SANDSTONE. Very weak. 34.10m: - grades medium to coarse grained SANDSTONE. 34.20m: - grades fine to medium grained SANDSTONE. Extremely weak, uncemented. 34.30m: - grades very weak. 34.55m: - grades extremely weak, uncemented. 34.90m: - grades fine to medium SANDSTONE. Very weak.	HQ3	100	100	34.10m: , Stopped run due to hard ground. Possibility of becoming core bound *34.30m:* UCS 1.74 MPa	Box 11, 31.8-34.3m

RL (m): 24, 23, 22, 21, 20
Depth (m): 31, 32, 33, 34

COMMENTS: Standpipe piezometer installed with screened intervals at 4.5-5.5m and 32-34m below ground level. See standpipe piezometer record for further details

Hole Depth 35.3m

Scale 1:25

General Log - 3/05/2016 5:24:11 p.m. - Produced with Core-GS by GeRoc

NZGD ID: BH_100368

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH-T56

SHEET: 8 OF 8

PROJECT: NI - Phase 2-6	CO-ORDINATES (NZTM): 5924976.76 N, 1744441.61 E
JOB No.: 28773.213	DIRECTION: 0°
LOCATION: 52 Trig Road, Hobsonville	ANGLE FROM HORIZ.: -90°
R.L. GROUND: 54.60m	DRILLED BY: McMillan Drilling
R.L. COLLAR: 54.60m	LOGGED BY: PRMM
DATUM: AUCKLAND 1946	CHECKED: JWY
SURVEY: Handheld GPS	START DATE: 23/11/2015
	FINISH DATE: 24/11/2015
	CONTRACTOR: McMillan Drilling

DESCRIPTION OF CORE: SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation

ROCK DEFECTS: Description & Additional Observations

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm) (2000 600 200 60 20)	RQD (%)	Description & Additional Observations	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
East Coast Bays Formation Rock				HQ3	100							100						Box 12, 34.3-35.3m
	35.3m: END OF BOREHOLE						19, 18, 17, 16, 15	36, 37, 38, 39										

COMMENTS: Standpipe piezometer installed with screened intervals at 4.5-5.5m and 32-34m below ground level. See standpipe piezometer record for further details

Hole Depth 35.3m

Scale 1:25

General Log - 3/05/2016 5:24:11 p.m. - Produced with Core-GS by GeRoc

HA CH 11930/130L MA0709

Sheet 1 of 1

Job No:	60025015
Project:	Upper Harbour Highway
Borehole Location:	see site plan
Chainage: 11930	Offset: 130L
Coordinates: 707571.57 N 287225.59 E	RL: 45.48
Surface Conditions:	Gentle slope, Grass

Lithologic Key: FILL, TOP SOIL, SAND, CLAY, SILT, SILT clayey, SILT sandy, ORGANIC soils

Columns: Geol. Unit | Depth (m) | Graphic Log | Description | Depth (m) | Groundwater | Vane Shear Strength (KPa) Corrected (Per NZGS Guideline)

Geol. Unit: PUKETOKA FORMATION

TOPSOIL

SILT, very stiff, moist, non plastic, orange, mottled brown

SILT, very stiff, moist, non plastic, orange, mottled brown

Clayey, very stiff, moist, mod to highly plastic, light grey, mottled orange

Slightly clayey, very stiff, moist, slightly plastic, light grey, mottled orange

Clayey, very stiff, moist, mod plastic, light grey/purple, mottled brown, orange

CLAY, silty, very stiff, moist, highly plastic, light grey, mottled orange

Light grey, mottled orange and red

Mod to highly plastic, light grey, mottled orange and red

SILT, clayey, very stiff, moist, slight to mod plastic, light grey, mottled orange

Slightly clayey, very stiff, moist to wet, non to slightly plastic, light grey, mottled orange

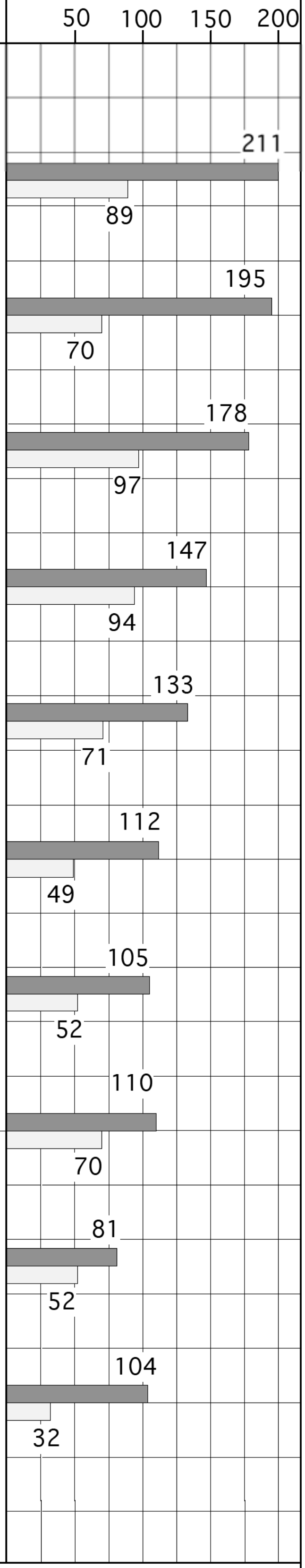
Clayey, stiff, moist, slight to mod plastic, light grey, mottled orange

Very stiff, mod to highly plastic, light grey, mottled orange

End of Borehole 5.0m (Target Depth)

Note: Logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' Dec 2005 as outlined by The NZ Geotechnical Society Inc.
Note: The subsurface data described above has been determined at this specific borehole location. Such data will not identify any variations away from this location

Groundwater: 3rd September 2007 (water level at approx. 4.0 m)



Drill Method: Hand Auger
Date Drilled: 3 Sept 2007
Drilled By: DTM
Shear Vane No.: DR 4529

Observations
Shearvane Correction Value for DR 4529 is 1. 623

Maunsell Ltd
47 George St, Newmarket
PO Box 4241 Auckland

NZGD ID	Type	Reference	Date	X (NZTM)	Y (NZTM)	RL	Vertical datum	Total depth	GW measured	GW depth	GW date
63712	Borehole	State Highway 16 & 18 - (AGD7506)	15/01/2000	1744375.7	5925051.1	55.4	Ellipsoidal (GPS)	22.5	No	-	-
65478	Borehole	Upper Harbor Cooridor - (AGD1891)	1/12/2001	1744434.7	5925010.8	55.6	Ellipsoidal (GPS)	19.5	No	-	-
65479	Borehole	Upper Harbor Cooridor - (AGD1892)	1/12/2001	1744408.7	5925042.8	55	Ellipsoidal (GPS)	20	No	-	-
67590	HandAuger	Waitakere #2 Upgrade - (AGD518)	21/07/2004	1744979.1	5924390.5	78	Auckland 1946 (MSL)	4	No	-	-
67591	HandAuger	Waitakere #2 upgrade - (AGD519)	9/07/2004	1744986.4	5924408.3	78	Auckland 1946 (MSL)	4	No	-	-
67592	HandAuger	Waitakere #2 Upgrade - (AGD520)	9/07/2004	1744988.8	5924415.3	78	Auckland 1946 (MSL)	1.2	No	-	-
67593	HandAuger	Waitakere #2 Upgrade - (AGD521)	9/07/2004	1744990.5	5924421.8	78	Auckland 1946 (MSL)	4	No	-	-
96780	CPT	A-CPT17	9/05/1999	1744431.4	5924972.9	0	Auckland 1946 (MSL)	15.3	No	-	-
96781	CPT	D-CPT16	26/07/2001	1744395.3	5925056.8	55.4	Auckland 1946 (MSL)	18	No	-	-
96785	CPT	F-CPT22	30/11/2005	1744406.4	5925079.9	54.88	Auckland 1946 (MSL)	16.5	No	-	-
96786	CPT	F-CPT23	30/11/2005	1744430.7	5925038.4	55.62	Auckland 1946 (MSL)	18.5	No	-	-
96787	CPT	F-CPT24	30/11/2005	1744457.6	5924992.5	55.11	Auckland 1946 (MSL)	23	No	-	-
96891	Borehole	A-BH4	14/04/1999	1744375.6	5925051.5	55.427	Auckland 1946 (MSL)	22.5	No	-	-
96892	Borehole	D-BH21	4/07/2001	1744433.8	5925010.6	56.26	Auckland 1946 (MSL)	19.5	No	-	-
96893	Borehole	D-BH22	26/06/2001	1744407.5	5925041	55.79	Auckland 1946 (MSL)	20	No	-	-
96897	Borehole	F-12120 50L	1/12/2005	1744441.4	5924985	55.01	Auckland 1946 (MSL)	18.44	No	-	-
96898	Borehole	F-12120 50R	29/11/2005	1744389.3	5925070.2	55.85	Auckland 1946 (MSL)	19.6	No	-	-
97058	HandAuger	H-11930 130L	2/09/2007	1744625.6	5925006.3	45.48	Auckland 1946 (MSL)	5	Yes	4	3/09/2007
100368	Borehole	BH-T56	24/11/2015	1744441.6	5924976.8	54.6	Auckland 1946 (MSL)	35.3	Yes	3	23/11/2015
110816	HandAuger	5122	10/07/2003	1745229	5924294		Not Available	5	No	-	-

Legend

- Borehole
- CPT
- Hand Auger
- Other

Appendix 2. Photographic Log

PHOTOGRAPHIC LOG

Client Name: Auckland Transport	**Project:** Trig Road PSI	**Project No.** 60558831

<table>
<tr><td>Photo No.
1</td><td>Date:
14/01/2020</td><td rowspan="2"></td></tr>
<tr><td colspan="2">Address:
82 Trig Road,
Whenuapai, Auckland
0618

Description:
Lyndale Nursery, facing north-west.</td></tr>
<tr><td>Photo No.
2</td><td>Date:
14/01/2020</td><td rowspan="2"></td></tr>
<tr><td colspan="2">Address:
62 Trig Road,
Whenuapai, Auckland
0618

Description:
Touch of the Tropics Nursery, facing south-west.</td></tr>
</table>

		PHOTOGRAPHIC LOG
Client Name: Auckland Transport	**Project:** Trig Road PSI	**Project No.** 60558831

Photo No. 3	**Date:** 14/01/2020

Address:
23-25 Trig Road, Whenuapai, Auckland 0618

Description:
Highway equipment laydown area adjacent to the southern side of SH18, facing north-east.

Photo No. 4	**Date:** 14/01/2020

Address:
19-21 Trig Road, Whenuapai, Auckland 0618

Description:
Pond (potentially associated with former nursey), facing north-east.

PHOTOGRAPHIC LOG

Client Name: Auckland Transport	**Project:** Trig Road PSI	**Project No.** 60558831

Photo No. 5	**Date:** 14/01/2020

Address:
Grass verge outside 40 Trig Road, Whenuapai, Auckland 0618

Description:
Transformer, facing south-east.

Photo No. 6	**Date:** 14/01/2020

Address:
Grass verge outside 12 Trig Road, Whenuapai, Auckland 0618

Description:
Transformer, facing south-east.

PHOTOGRAPHIC LOG			
Client Name: Auckland Transport	**Project:** Trig Road PSI	**Project No.** 60558831	

Photo No. 7	**Date:** 14/01/2020	
Address: Outside 12 Trig Road, Whenuapai, Auckland 0618 **Description:** Trig Road, facing north-west.		
Photo No. 8	**Date:** 14/01/2020	
Address: 1 Trig Road, Whenuapai, Auckland 0618 **Description:** Hobsonville Substation, facing east.		

PHOTOGRAPHIC LOG		
Client Name: Auckland Transport	**Project:** Trig Road PSI	**Project No.** 60558831

Photo No. 9	**Date:** 14/01/2020	
Address: 74 Hobsonville Road, West Harbour, Auckland 0618 **Description:** Watercare pump station (potable water).		
Photo No. 10	**Date:** 14/01/2020	
Address: 6 Luckens Road, West Harbour, Auckland 0618 **Description:** Dental Specialists Limited, facing east.		

PHOTOGRAPHIC LOG			
Client Name: Auckland Transport		**Project:** Trig Road PSI	**Project No.** 60558831
Photo No. 11	**Date:** 14/01/2020		
Address: Outside 16 Luckens Road, West Harbour, Auckland 0618 **Description:** Luckens Road, facing north-west.			

Appendix 3. Ministry for the Environment Hazardous Activities and Industries List and Summary of Likely Contaminants

Ministry for the Environment
Manatū Mō Te Taiao

Hazardous Activities and Industries List (HAIL)

October 2011

A Chemical manufacture, application and bulk storage

1. Agrichemicals including commercial premises used by spray contractors for filling, storing or washing out tanks for agrichemical application
2. Chemical manufacture, formulation or bulk storage
3. Commercial analytical laboratory sites
4. Corrosives including formulation or bulk storage
5. Dry-cleaning plants including dry-cleaning premises or the bulk storage of dry-cleaning solvents
6. Fertiliser manufacture or bulk storage
7. Gasworks including the manufacture of gas from coal or oil feedstocks
8. Livestock dip or spray race operations
9. Paint manufacture or formulation (excluding retail paint stores)
10. Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds
11. Pest control including the premises of commercial pest control operators or any authorities that carry out pest control where bulk storage or preparation of pesticide occurs, including preparation of poisoned baits or filling or washing of tanks for pesticide application
12. Pesticide manufacture (including animal poisons, insecticides, fungicides or herbicides) including the commercial manufacturing, blending, mixing or formulating of pesticides
13. Petroleum or petrochemical industries including a petroleum depot, terminal, blending plant or refinery, or facilities for recovery, reprocessing or recycling petroleum-based materials, or bulk storage of petroleum or petrochemicals above or below ground
14. Pharmaceutical manufacture including the commercial manufacture, blending, mixing or formulation of pharmaceuticals, including animal remedies or the manufacturing of illicit drugs with the potential for environmental discharges
15. Printing including commercial printing using metal type, inks, dyes, or solvents (excluding photocopy shops)
16. Skin or wool processing including a tannery or fellmongery, or any other commercial facility for hide curing, drying, scouring or finishing or storing wool or leather products
17. Storage tanks or drums for fuel, chemicals or liquid waste
18. Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling, or bulk storage of treated timber outside

B Electrical and electronic works, power generation and transmission

1. Batteries including the commercial assembling, disassembling, manufacturing or recycling of batteries (but excluding retail battery stores)

2. Electrical transformers including the manufacturing, repairing or disposing of electrical transformers or other heavy electrical equipment
3. Electronics including the commercial manufacturing, reconditioning or recycling of computers, televisions and other electronic devices
4. Power stations, substations or switchyards

C **Explosives and ordinances production, storage and use**

1. Explosive or ordinance production, maintenance, dismantling, disposal, bulk storage or re-packaging
2. Gun clubs or rifle ranges, including clay targets clubs that use lead munitions outdoors
3. Training areas set aside exclusively or primarily for the detonation of explosive ammunition

D **Metal extraction, refining and reprocessing, storage and use**

1. Abrasive blasting including abrasive blast cleaning (excluding cleaning carried out in fully enclosed booths) or the disposal of abrasive blasting material
2. Foundry operations including the commercial production of metal products by injecting or pouring molten metal into moulds
3. Metal treatment or coating including polishing, anodising, galvanising, pickling, electroplating, or heat treatment or finishing using cyanide compounds
4. Metalliferous ore processing including the chemical or physical extraction of metals, including smelting, refining, fusing or refining metals
5. Engineering workshops with metal fabrication

E **Mineral extraction, refining and reprocessing, storage and use**

1. Asbestos products manufacture or disposal including sites with buildings containing asbestos products known to be in a deteriorated condition
2. Asphalt or bitumen manufacture or bulk storage (excluding single-use sites used by a mobile asphalt plant)
3. Cement or lime manufacture using a kiln including the storage of wastes from the manufacturing process
4. Commercial concrete manufacture or commercial cement storage
5. Coal or coke yards
6. Hydrocarbon exploration or production including well sites or flare pits
7. Mining industries (excluding gravel extraction) including exposure of faces or release of groundwater containing hazardous contaminants, or the storage of hazardous wastes including waste dumps or dam tailings

F **Vehicle refuelling, service and repair**

1. Airports including fuel storage, workshops, washdown areas, or fire practice areas
2. Brake lining manufacturers, repairers or recyclers
3. Engine reconditioning workshops
4. Motor vehicle workshops
5. Port activities including dry docks or marine vessel maintenance facilities

6. Railway yards including goods-handling yards, workshops, refuelling facilities or maintenance areas
7. Service stations including retail or commercial refuelling facilities
8. Transport depots or yards including areas used for refuelling or the bulk storage of hazardous substances

G Cemeteries and waste recycling, treatment and disposal

1. Cemeteries
2. Drum or tank reconditioning or recycling
3. Landfill sites
4. Scrap yards including automotive dismantling, wrecking or scrap metal yards
5. Waste disposal to land (excluding where biosolids have been used as soil conditioners)
6. Waste recycling or waste or wastewater treatment

H Any land that has been subject to the migration of hazardous substances from adjacent land in sufficient quantity that it could be a risk to human health or the environment

I Any other land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment

HAIL contaminants

The table below lists the kind of hazardous substances that are typically associated with each of the activities and industries listed on the HAIL (Hazardous Activities and Industries List).

The fact that an activity or industry is on the HAIL does not mean that hazardous substances were used or stored everywhere on that land, nor that any hazardous substances that were used or stored there have contaminated the land.

The hazardous substances listed in the table below for each activity or industry are provided as a guide only. The NES for assessing and managing contaminants in soil to protect human health requires a suitably qualified and experienced practitioner to decide which substances to check for in soil samples taken as part of a detailed site investigation.

Activity or industry on the HAIL	Hazardous substances likely to be associated with that activity or industry
Agrichemicals including commercial premises used by spray contractors for filling, storing or washing out tanks for agrichemical application	Arsenic, lead, copper; wide range of organic agrichemicals including organochlorine pesticides, organophosphate pesticides, herbicides, fungicides, carbamates, and synthetic pyrethroids; compounds may be mixed with diesel before spraying
Chemical manufacture, formulation or bulk storage	Wide range of organic and inorganic compounds
Commercial analytical laboratory sites	Wide range of organic and inorganic compounds including solvents, acids, metals, and mercury
Corrosives including formulation or bulk storage	Mercury, sulphuric, phosphoric, hydrochloric and nitric acids, sodium and calcium hydroxide, ammonia and ammonium hydroxide
Dry-cleaning plants including dry-cleaning premises or the bulk storage of dry-cleaning solvents	Volatile hydrocarbons including trichloroethylene 1,1,1-trichloroethane tetrachlorothene (also known as PCE), and carbon tetrachloride
Fertiliser manufacture or bulk storage	Calcium phosphate, calcium sulphate, copper chloride, sulphur, sulphuric and phosphoric acid, molybdenum, selenium, iron, cadmium, nitrates, and ammonia
Gasworks including the manufacture of gas from coal or oil feedstocks	Polycyclic aromatic hydrocarbons (PAHs), benzene, toluene, ethylbenzene and xylenes (BTEX), phenolics, metals (particularly arsenic, lead, copper, chromium), boron, cyanide compounds, sulphides and sulphates, thiocyanates, ammonia, nitrates, and coke
Livestock dip or spray race operations	Arsenic, organochlorines (eg, aldrin, dieldrin, DDT, lindane) and organophosphates, carbamates, and synthetic pyrethroids
Paint manufacture or formulation (excluding retail paint stores)	Solvents, resins, metals including arsenic, cadmium, copper, nickel, lead, zinc, and mercury
Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds	Arsenic, lead, copper, mercury; wide range of organic compounds including acidic herbicides, organophosphates, and organochlorines (eg, endosulfan on golf and bowling greens)
Pest control including the premises of commercial pest control operators or any authorities that carry out pest control where bulk storage or preparation of pesticide occurs, including preparation of poisoned baits or filling or washing of tanks for pesticide application	Arsenic, cyanide, strychnine, mercury, phosphorus, 1080, organochlorines and organophosphates, carbamates, synthetic pyrethroids, and other commercial preparations

Activity or industry on the HAIL	Hazardous substances likely to be associated with that activity or industry
Pesticide manufacture (including animal poisons, insecticides, fungicides or herbicides) including the commercial manufacturing, blending, mixing or formulating of pesticides	Wide range of insecticides, herbicides and fungicides, including arsenic, lead, mercury, copper, tin, chromium, organochlorines, organonitrogens, organophosphates, acid herbicides, and carbamates. Dioxin may be present as an impurity
Petroleum or petrochemical industries including a petroleum depot, terminal, blending plant or refinery, or facilities for recovery, reprocessing or recycling petroleum-based materials, or bulk storage of petroleum or petrochemicals above or below ground	Hydrocarbons including BTEX, PAHs, and solvents; lead and other metals, particularly if waste oil handled
Pharmaceutical manufacture including the commercial manufacture, blending, mixing or formulation of pharmaceuticals, including animal remedies or the manufacturing of illicit drugs with the potential for environmental discharges	Wide range of chemicals and solvents
Printing including commercial printing using metal type, inks, dyes, or solvents (excluding photocopy shops)	Solvents, acids, alkalis, and metals
Skin or wool processing including a tannery or fellmongery, or any other commercial facility for hide curing, drying, scouring or finishing or storing wool or leather products	Chromium (including hexavalent Cr), manganese, copper, ammonia, nitrite, sulphides, acids, sodium hydroxide, lime, formaldehyde, solvents, cyanide, detergents, pesticides, and bleaching agents (eg, hydrogen peroxide)
Storage tanks or drums for fuel, chemicals or liquid waste	Wide range of chemicals (organic and inorganic), and biological hazards
Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling, or bulk storage of treated timber outside	Pentachlorophenol (PCP), copper, arsenic, chromium, boron, PAHs, phenolics (creosote), antisapstain, organochlorine pesticides, fungicides, and tributyltin (TBT)
Batteries including the commercial assembling, disassembling, manufacturing or recycling of batteries (but excluding retail battery stores)	Metals (lead, mercury, zinc, cadmium, nickel, antimony, silver, and manganese), and sulphuric acid
Electrical transformers including the manufacturing, repairing or disposing of electrical transformers or other heavy electrical equipment	Polychlorinated biphenyls (PCBs), hydrocarbons, copper, tin, lead, and mercury
Electronics including the commercial manufacturing, reconditioning or recycling of computers, televisions and other electronic devices	Metals (eg, copper, tin, lead, mercury, cadmium, nickel, silver, zinc, and beryllium), solvents, and PCBs
Power stations, substations or switchyards	PCBs, asbestos, metals including boron, arsenic (in fly ash), water treatment chemicals (thermal stations), and hydrocarbons (eg, diesel in generators)
Explosive or ordinance production, maintenance, dismantling, disposal, bulk storage or re-packaging	Acetone, nitric and sulphuric acid, ammonium nitrate, PCP, nitroglycerine, lead, mercury, copper, aluminium, silver, sodium hydroxide, and explosives; fuel oils, solvents and metals (associated with workshops)
Gun clubs or rifle ranges, including clay targets clubs that use lead munitions outdoors	Metals (lead, antimony, copper, zinc, tin, and nickel)
Training areas set aside exclusively or primarily for the detonation of explosive ammunition	Explosives, lead, copper, arsenic, antimony (firing ranges), and hydrocarbon storage
Abrasive blasting including abrasive blast cleaning (excluding cleaning carried out in fully enclosed booths) or the disposal of abrasive blasting material.	Metals (iron, lead, chromium, aluminium, zinc). Dependent on material being removed and substrate
Foundry operations including the commercial production of metal products by injecting or pouring molten metal into moulds	Metals, particularly iron, aluminium, lead, zinc, copper, tin, nickel, chromium and oxides, chlorides, fluorides and sulphates of these, acids, coke, and fuel oils
Metal treatment or coating including polishing, anodising, galvanising, pickling, electroplating, or heat treatment or finishing using cyanide compounds	Metals (zinc, aluminium, cadmium, chromium, lead, copper, and tin), acids (sulphuric, nitric, hydrochloric, and phosphoric), cyanide; flourine and barium (from Al processing)
Metalliferous ore processing including the chemical or physical extraction of metals, including smelting, refining, fusing or refining metals	Metals and associated oxides, fluorides and chlorides; cyanide compounds
Engineering workshops with metal fabrication	Metals and oxides of iron, nickel, copper, chromium, magnesium and manganese; range of organic compounds used for cleaning including BTEX, solvents

Activity or industry on the HAIL	Hazardous substances likely to be associated with that activity or industry
Asbestos products manufacture or disposal including sites with buildings containing asbestos products known to be in a deteriorated condition	Asbestos
Asphalt or bitumen manufacture or bulk storage (excluding single-use sites used by a mobile asphalt plant)	Petroleum hydrocarbons and PAHs
Cement or lime manufacture using a kiln including the storage of wastes from the manufacturing process	Lime, calcium hydroxide, alkalis; boron and arsenic in fly ash
Commercial concrete manufacture or commercial cement storage	Cement, calcium hydroxide, alkalis, and ammonia
Coal or coke yards	Hydrocarbons (particularly PAHs), boron, and arsenic
Hydrocarbon exploration or production including well sites or flare pits	Hydrocarbons including PAHs, metals (barium, cadmium, zinc, mercury, lead), and vanadium
Mining industries (excluding gravel extraction) including exposure of faces or release of groundwater containing hazardous contaminants, or the storage of hazardous wastes including waste dumps or dam tailings	Arsenic, mercury, cyanides, sulphides, and metals and hydrocarbons associated with fuel storage
Airports including fuel storage, workshops, washdown areas, or fire practice areas	Petroleum hydrocarbons including lube oils; metals and PAHs in fire practice areas, potential for dioxins in fire practice areas
Brake lining manufacturers, repairers or recyclers	Asbestos and copper
Engine reconditioning workshops	Hydrocarbons including solvents, and metals contained in waste oil
Motor vehicle workshops	Hydrocarbons including PAHs, solvents, and metals contained in waste oil
Port activities including dry docks or marine vessel maintenance facilities	Metals, paint residues (tin, and lead), tributyltin (TBT), and hydrocarbons associated with fuel storage
Railway yards including goods-handling yards, workshops, refuelling facilities or maintenance areas	Hydrocarbons including PAHs, solvents, creosote/phenols, and metals
Service stations including retail or commercial refuelling facilities	Petroleum hydrocarbons (BTEX, PAHs) and lead
Transport depots or yards including areas used for refuelling or the bulk storage of hazardous substances	Wide variety of chemicals, dependent on products being transported
Cemeteries	Nitrates, lead, mercury, formaldehyde, and biological hazards
Drum or tank reconditioning or recycling	Wide range of chemicals from drums; hydrocarbons used to wash drums
Landfill sites	Dependent on original waste composition, wide range of hydrocarbons and metals, organic acids, landfill gas, and ammonia
Scrap yards including automotive dismantling, wrecking or scrap metal yards	Metals, petroleum hydrocarbons (particularly lube oils), solvents used for cleaning, and PCBs
Waste disposal to land (excluding where biosolids have been used as soil conditioners)	Depends on type of waste – biological hazards (bacteria, viruses), metals, PAHs, semi- volatile organic compounds, and solvents
Waste recycling or waste or wastewater treatment	Depends on type of waste – biological hazards (bacteria, viruses), metals, PAHs, semi- volatile organic compounds, and solvents.
Any land that has been subject to the migration of hazardous substances from adjacent land in sufficient quantity that it could be a risk to human health or the environment	Dependent on contaminants associated with adjacent property
Any other land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment	Dependent on contaminants associated with spill

The New Zealand Institute of Chemistry (NZIC) has published a series of articles on many industries in New Zealand at http://www.nzic.org.nz/ChemProcesses/chem_processes.html. These articles provide a good chemical background for many of the industries listed on the HAIL.

Appendix 4. Historical Aerial Photographs

Historical Aerial Photograph Review

Year: 1940

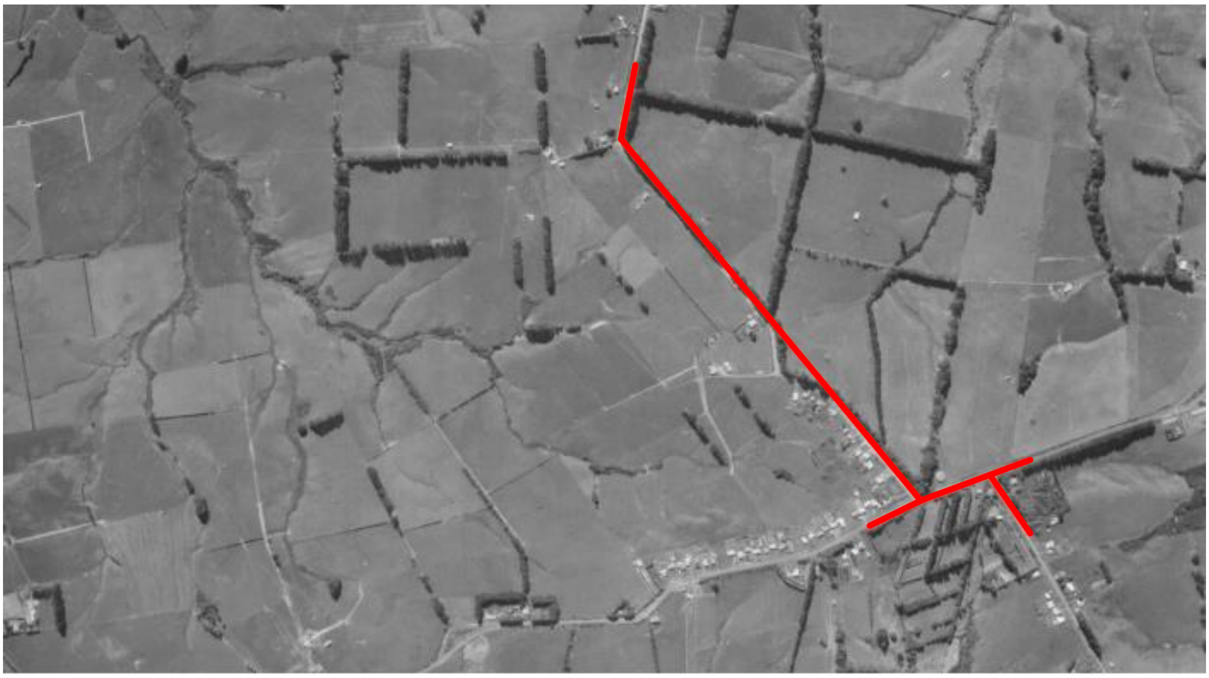
Source: http://retrolens.nz/Map/ - accessed 8 October 2019

Year: 1950

Source: http://retrolens.nz/Map/ - accessed 8 October 2019

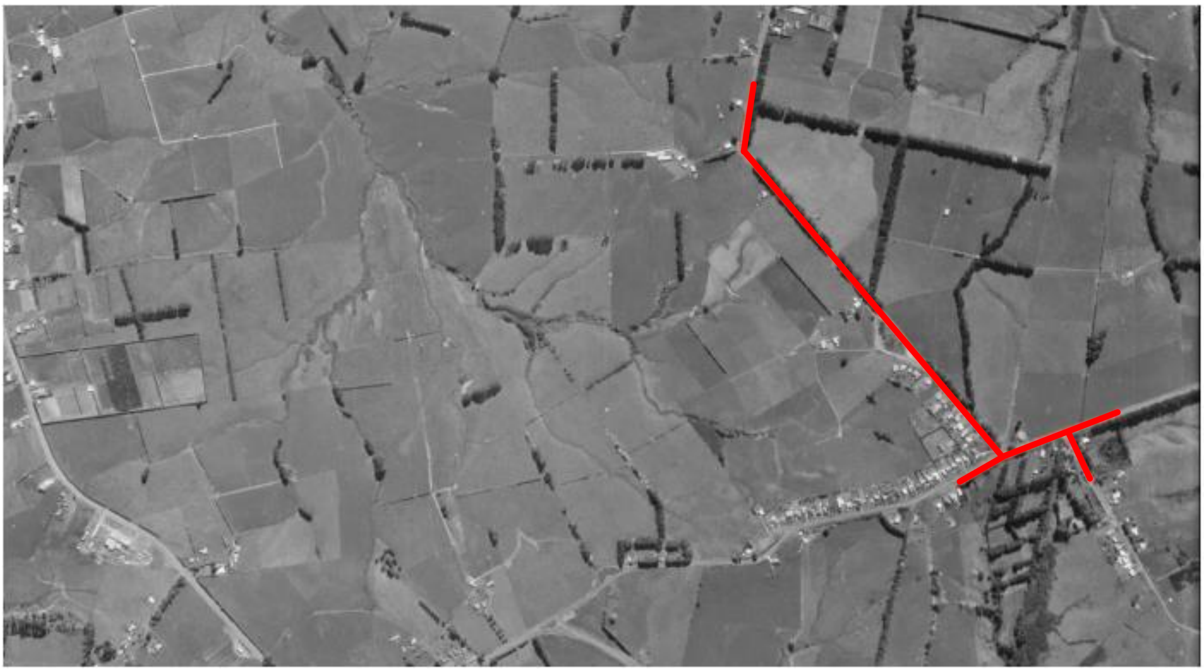
Year: 1963

Source: http://retrolens.nz/Map/ - accessed 8 October 2019



Year: 1972

Source: http://retrolens.nz/Map/ - accessed 8 October 2019



Year: 1988

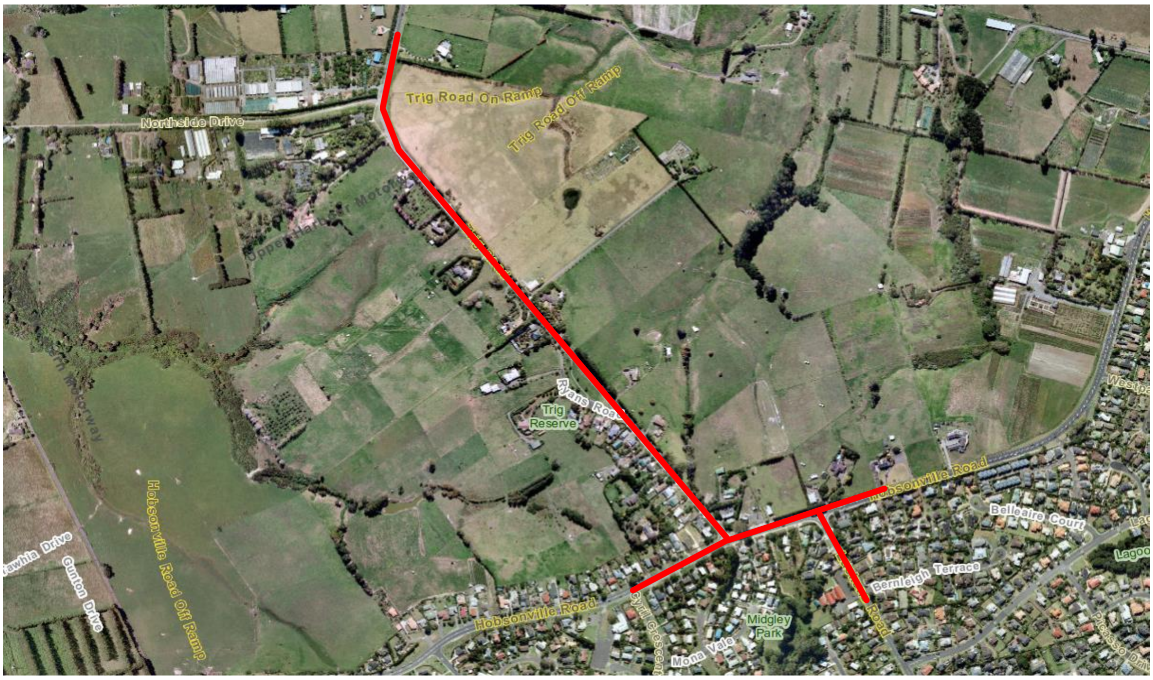
Source: http://retrolens.nz/Map/ - accessed 8 October 2019

Year: 2000

Source: Auckland Council Geomaps – accessed 8 October 2019

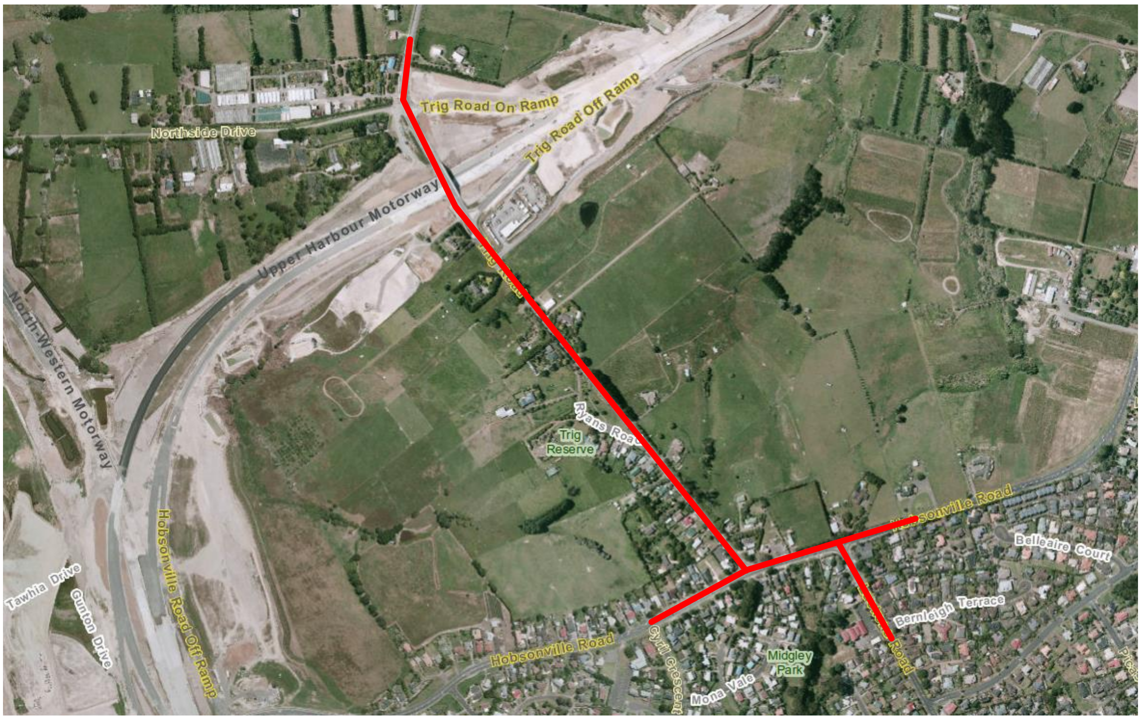
Year: 2008

Source: Auckland Council Geomaps – accessed 8 October 2019



Year: 2010 / 2011

Source: Auckland Council Geomaps – accessed 8 October 2019



Year: 2017

Source: Auckland Council Geomaps – accessed 8 October 2019

Year: 2019

Source: Google Earth Pro– accessed 8 October 2019

ATTACHMENT 22

NORTH-WEST HIF
TRIG ROAD GEOTECHNICAL FACTUAL REPORT

Factual Report

Date Prepared: 24th January 2020

Prepared by: Max Davis

Northwest HIF - Trig Road Geotechnical Factual Report

Purpose

This Factual Report has been prepared in order to present geotechnical information from the preliminary investigation undertaken at Trig Road, Whenuapai.

Document Status

Responsibility	Name	Signature
Author	Max Davis	
Reviewer	James Burr	
Approver	Rob Mason	

Revision Status

Version	Date	Reason for Issue
0.1	24/01/2020	Issue to Client
0.2		
0.3		

Disclaimer

This is a draft document for review by specified persons at Auckland Transport and the New Zealand Transport Agency. This draft will subsequently be updated following consideration of the comments from the persons at Auckland Transport and the New Zealand Transport Agency. This document is therefore still in a draft form and is subject to change. The document should not be disclosed in response to requests under the Official Information Act 1982 or Local Government Official Information and Meetings Act 1987 without seeking legal advice.

Table of Contents

Appendices

1 Introduction

The Supporting Growth project aims to identify the transport networks required to connect Auckland's future growth areas over the next 30 years. A coordinated approach with land use development running in parallel with infrastructure planning is required.

An early indication of the viability of preferred networks is required to identify geotechnical opportunities and constraints to developing land.

The 'preferred networks' require the following criteria to be met:

- Include improved accessibility and transport options,
- Strong focus on public transport, including walking and cycling facilities,
- Connections to the wider strategic transport network, and
- Maximum benefit and value in management of existing network infrastructure

This report provides the factual results of the preliminary geotechnical site investigation for the proposed development of Trig Road in the Northwest area.

1.1 Object and Scope of the Investigation

The initial scope of this preliminary geotechnical investigation comprised two machine boreholes and four test pits along Trig Road. Due to constraints with land owner access along Trig Road, the investigation needed to be separated into stages with the first stage comprising just the machine boreholes, followed later by the test pits and a hand auger, which replaced one of the test pits. The investigation targeted areas along Trig Road where significant cut/fill is proposed.

This report presents the results of both stages of the geotechnical investigations undertaken between 23rd October 2019 and 13th November 2019.

1.2 Site Location and Description

The site is located along Trig Road, which trends in a north-west south-east direction from Hobsonville Road in the south to Brigham Creek Road in the north. The proposed Trig Road upgrade extends approximately 850m from Hobsonville Road in the south to Upper Harbour Highway in the North. The site is bound by residential properties to the south and grass paddocks to the east and west. Refer to the Location Plan shown in Figure 1 below. An overall Site Plan is also shown in Appendix 1.

Trig Road runs along a minor north to south trending ridge with slopes within the area considered flat to gently sloping, at less than 5°. Slopes up to 20° occur in localised areas immediately adjacent to the road alignment. Three streams are present within the site and exist on the eastern and western sides of Trig Road and are named Totara Stream, Trig Stream, and Rawiri Stream with various ephemeral water courses feeding into them. The proposed road alignment upgrade involves various cut and fill operations which will require retaining walls to support adjacent properties. Refer to Geometric Plans attached in Appendix 1.

Figure 1: Trig Road Location Plan

1.3 Site Geology

The published 1:250,000 geological map (QMAP) of the Auckland area (Edbrooke, 2001) indicates that the area comprises two main geological units (Figure 2). Puketoka Formation alluvial deposits belonging to the Tauranga Group and comprising “pumiceous mud, sand and gravel” underly most of the site. Residually weathered soils of the East Coast Bays Formation (ECBF) belonging to the Waitemata Group and comprising “alternating sandstone and mudstone” are shown to the south and southwest of Trig Road.

The nearest mapped active fault in the GNS Active Faults Database is the Wairoa North fault, approximately 39 km south east of the site (GNS Science, 2019).

Figure 2: Trig Road Geology (QMaps, 2019)

1.4 Previous Investigations

Several geotechnical investigations have been carried out along Upper Harbour Highway. A Beca investigation is shown in our reports database, however the locations of the individual investigation points are a long way from this Trig Road site. The New Zealand Geotechnical Database (NZGD) shows several investigation points at the northern end of the site adjacent to the Upper Harbour Highway (Figure 3). These are summarised below:

- Five machine boreholes and five Cone Penetrometer Tests (CPT's) at the northern end of the site
- Machine boreholes encounter varying amounts of fill ranging from 0.5m to 2.5m thick.
- Puketoka Formation alluvials underly the fill to approximately 5.6m below ground level (bgl) to 15mBGL and overly residual ECBF. The ECBF residual soil varies from approximately 5.6mBGL to 24mBGL and overlies ECBF Rock. ECBF rock varies from approximately 12mBGL to 35.3mBGL.
- CPT results indicate soft soils from ground level to around 8 – 13mBGL with cone resistance of 0 – 2 mPa.
- CPT's reach refusal from around 15 – 23mBGL.

Figure 3 – Trig Road NZGD Investigation Points.

2 Site Investigation

As noted previously, the investigation was carried out in two stages, with the Machine Boreholes drilled on 23 and 24 October 2019, and the test pits and hand auger completed on 13 December 2019. The site investigations were observed full-time by a Beca Geotechnical Engineer. Unless otherwise stated, all soil and rock logging has been undertaken by a Beca Geotechnical Engineer. All logs have been verified by a Beca Senior Engineering Geologist.

2.1 Machine Boreholes

Machine boreholes were drilled by Pro Drill using a SLG 2 drilling rig. Drilling was undertaken using both Open Barrel and HQ Triple Tube drilling. A summary of all machine boreholes undertaken are given in Table 1 below.

Table 1: Summary of Boreholes Drilled

BH No.	Location	Easting	Northing	R.L. ground (m)	Total Depth (m)	Borehole Inclination (degrees from horizontal)	Backfill Details
BH101/19	Trig Road Shoulder	1,744,858	5,924,484	68.0	12.95	-90	Gravel
BH102/19	Trig Road Land Reserve	1,744,732	5,924,611	58.0	21.88	-90	Gravel
Notes: All survey coordinates are given in NZTM2000							

Field testing undertaken during drilling of the machine boreholes comprised:

- Standard Penetration Tests were typically carried out at nominal 1.5m centres and the uncorrected N-values are recorded on the borehole logs. SPT hammer efficiencies are presented on the borehole log sheets.
- Hand held shear vane tests were carried out within the end of the core barrel in cohesive soils. The corrected and uncorrected shear vane values are reported on the machine borehole logs.
- Two push tubes were taken within BH101/19 at depths of 3.0 m and 6.0 m

All core samples were logged on site by a Beca Geotechnical Engineer. Machine borehole logs and core photographs are presented in Appendix 2. After the core samples had been logged, they were wrapped in plastic to reduce moisture loss and placed in labelled core boxes before being transferred to the Beca office for storage. Some natural desiccation and degradation of the core samples will occur through time following storage. Upon completion, all boreholes were backfilled with gravel and placed over with a topsoil and grass cover.

2.2 Hand Auger Hole

A hand auger was drilled and logged on site by Beca staff. The hand auger location is shown on the Site Plan in Appendix 1, the log and photographs are shown in Appendix 3.

In-situ testing comprised:

- Down-hole hand held shear vanes, undertaken at 500mm centres;
- Scala penetrometer tests were undertaken from the ground surface to 900mm below ground level (bgl), and from the base of the hand auger hole (3.5m bgl) to 4.4m bgl. The test was undertaken with a maximum of 1 rod length/900mm per test. Scala tests were carried out in general accordance with the methods described in NZS4402

A summary of the hand auger hole undertaken is given in Table 2 below.

Table 2: Summary of Hand Auger Hole

HA No.	Location	Easting	Northing	R.L. ground (m)	Total Depth (m)
HA101/19	40 Trig Road	1,744,643	5,924,720	55.5	3.5
Notes: All survey coordinates are given in NZTM2000					

2.3 Test Pits

Abernethy Contractors Ltd. were contracted to excavate test pits using a 6T excavator. The pits were approximately 800mm wide in plan area and ranged from 2.3m to 3.5m depth. Material excavated from the test pit was logged and sampled by a Beca Engineering Geologist. The test pit logs and photographs are presented in Appendix 4.

In-situ testing comprised:

- Hand-held shear vanes were undertaken using samples excavated from the test pits, at approximately 500mm centres.
- Scala penetrometer testing was carried out from the ground surface to 0.9m and from 1.0m to 1.9m depth.

A summary of the test pits undertaken are given in Table 3 below.

Table 3 - Summary of Test Pits

HA No.	Location	Easting	Northing	R.L. ground (m)	Total Depth (m)
TP101/19	1 Trig Road	1,744,898	5,924,477	64.75	3.5
TP102/19	9 Trig Road	1,744,741	5,924,679	47.2	3.5
TP103/19	19 Trig Road	1,744,588	5,924,899	52.25	2.3
Notes: All survey coordinates are given in NZTM2000					

2.4 Groundwater

Both boreholes were dipped following completion of drilling. At the time of the measurements the boreholes were fully open. Only borehole BH101/19 was able to be left to allow for dissipation of drilling muds or other fluids. Borehole BH102/19 was dipped following completion of drilling. The water level is indicative only and does not allow for the interpretation of water levels or vertical gradients between individual units.

Test pit 101/19 encountered groundwater at approximately 800mm depth. This test pit is located adjacent to an ephemeral watercourse and groundwater will likely be elevated at this location. Groundwater was measured at 3.0m below ground level in borehole BH101/19, and 2.5m below ground level in borehole BH102/19. Table 4 below summarises these observations

Table 4: Groundwater Measurements

Borehole/ Piezometer ID	Date of measurement	Depth to water (mBGL)	Level of water (mRL)	Type of Measurement (Borehole or Piezometer)
BH101/19	24/10/2019	3.0m	65.0 mRL	Borehole
BH102/19	24/10/2019	2.5m	55.5 mRL	Borehole
TP101/19	13/12/2019	0.8m	62.2	-

3 Laboratory Testing

Two undisturbed push tube samples were collected from machine borehole BH101/19 and SPT samples were taken from both boreholes for testing.

Beca carried out testing of these samples. The tests undertaken, and the testing specifications, were as follows:

- Natural Moisture Content: NZS4402, 1986; test 2.1
- Atterberg Limits: NZS4402, 1986; tests 2.2, 2.3 and 2.4
- Hydrometer Grading: NZS4402, 1986, test 2.8.4
- Consolidation Test: NZS4402, 1986; test 7.1

The results of the laboratory testing are given in Appendix 5 together with a summary of the tests carried out.

4 Applicability Statement

This report has been prepared on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which we have not given its prior written consent, is at that person's own risk.

This is a factual report of site investigation and laboratory testing. The site investigation has been undertaken at discrete locations and no inferences about the nature and continuity of ground conditions away from the investigation locations are made. Furthermore, logs are provided presenting description of the soils and geology based on our observation of the samples recovered in the fieldwork and may not be truly representative of the actual underlying conditions.

No interpretation of the investigation results has been made in this report. Should you be in any doubt as to the applicability of this report for the proposed development described herein, it is essential that you carry out independent investigations to satisfy your needs.

5 References

ASTM D 1586-11 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

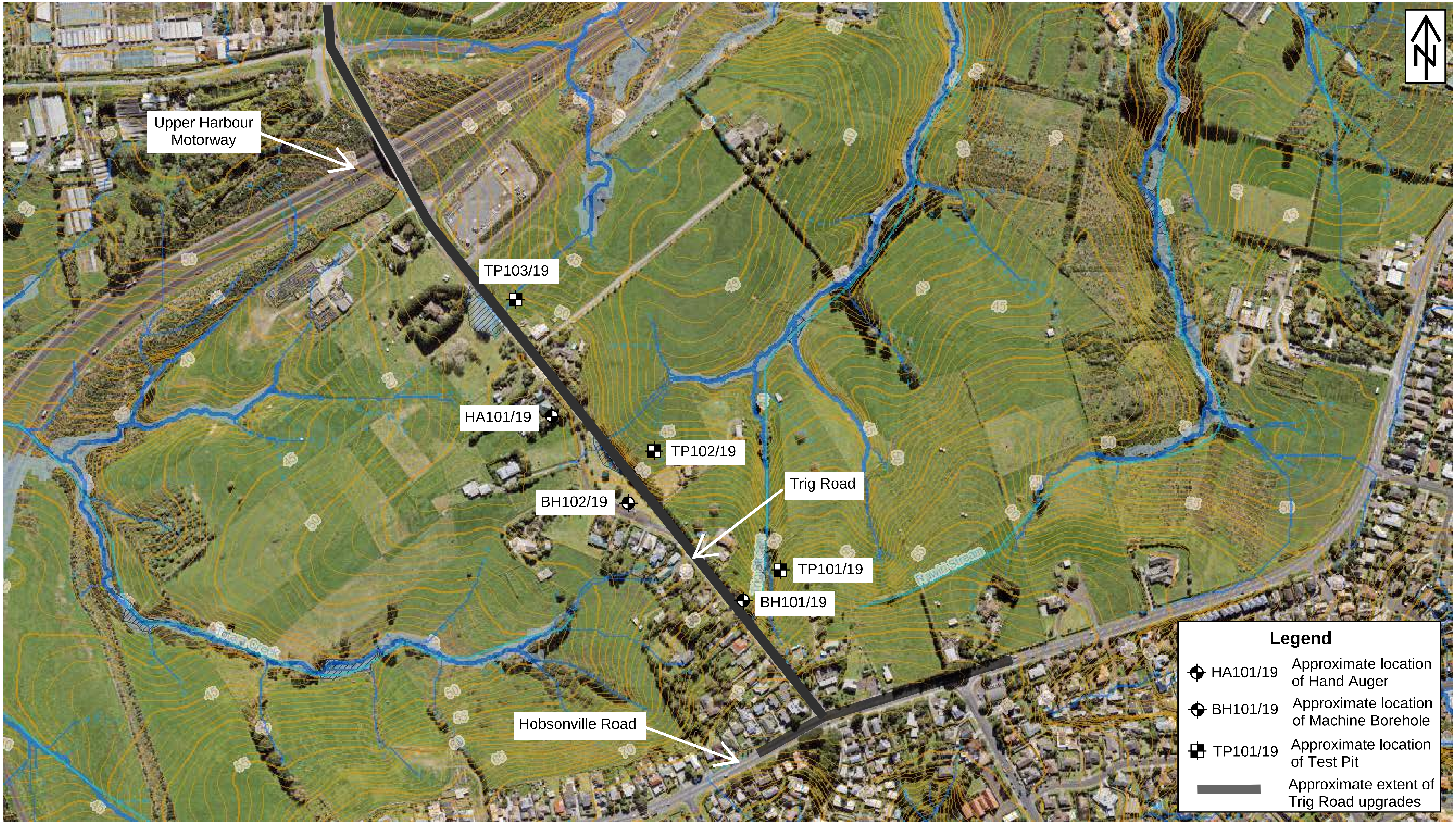
British Standard (BS1377: 1990 Part 9, 4.4) (in situ – geonor vane)

NZ Geotechnical Society, 2005: Field Description for Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes.

NZ Geotechnical Society, 2001: Guidelines for the Hand Held Shear Vane Test

NZ Standard 4402, 1986, Methods of Testing Soils for Civil Engineering Purposes

Appendix 1. Figures



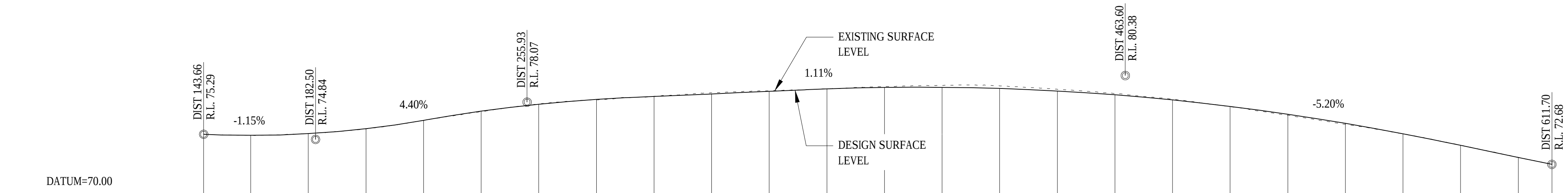
Overall Site Plan

Beca

3810934/100

PLAN VIEW: HOBSONVILLE ROAD

A1 1:1000 / A3 1:2000 — 0 10 20 30 40 50m



DISTANCE	144	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600	612
DESIGN SURFACE LEVELS	75.29	75.19	75.34	75.77	76.49	77.29	77.90	78.31	78.56	78.78	79.01	79.22	79.35	79.36	79.26	79.04	78.71	78.26	77.70	77.03	76.24	75.34	74.32	73.28	72.68
EXISTING SURFACE LEVELS	75.28	75.19	75.33	75.76	76.48	77.25	77.90	78.27	78.58	78.89	79.06	79.24	79.42	79.52	79.48	79.19	78.82	78.33	77.68	76.94	76.15	75.32	74.33	73.29	72.68

VERTICAL SCHEMATIC: 143.66 — K=14.00 L=77.69 — 221.34 — K=-21.00 L=69.18 — 290.52 — P=1.11% L=62.67 — 353.20 — K=-35.00 L=220.81 — 574.01 — P=-5.20% L=37.69 — 611.70

HORIZONTAL SCHEMATIC: 143.66 — D=166.17 — 309.83 — R=220.00 L=42.36 — 352.18 — D=259.52 — 611.70

LONGITUDINAL SECTION ON CONTROL STRING MCH0
SCALE HORIZ=1:1000 VERT=1:250

Rev	Revisions	Drawn	Date
C	FOR DRAFT DETAILED BUSINESS CASE	VDLT	25.07.19
B	FOR AT INTERNAL REVIEW	VDLT	17.04.19
A	FOR SAFETY AUDIT	VDLT	05.04.19

Surveyed	-	-
Drawn	V. DELA TORRE	27.03.19
Drawing Check	P. ISON	27.03.19
Drawing Review		
Design	-	-
Design check	-	-

ORIGINAL SIZE A1

TE TUPU NGĀTAHI Supporting Growth — AT — NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND COUNCIL
NORTHWEST HOUSING INFRASTRUCTURE FUNDING-PROPOSED ARTERIAL ROADS

Drawing Title: PLAN AND LONG SECTION - HOBSONVILLE ROAD
SHEET 1 OF 4

Drawing Status: DRAFT DETAILED BUSINESS CASE
Drawing Date: 25.07.19
Scales: A1 1:1000 A3 1:2000
Contract Number: 0000000
Drawing No. SGA-DRG-NWE-002-CI-1221
Revision C

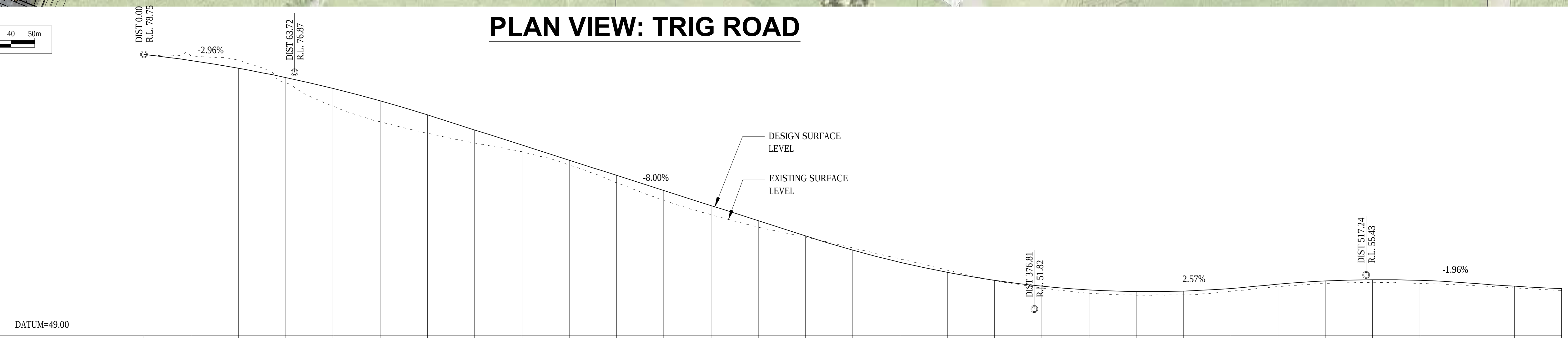
C:\CAD\Auckland Transport\Richard Batty (AT) - Infraworks Data\TFUG\West\Outputs\2018-03-12 2019 Exports_DEE\AT_C3D-Dunlop.dwg

Drawing Plotted: 24 Jul 2019 2:42 PM

SGA-DRG-NWE-002-CI-1222.DWG

PLAN VIEW: TRIG ROAD

A1 1:1000
A3 1:2000
0 10 20 30 40 50m



DISTANCE	DESIGN SURFACE LEVELS	EXISTING SURFACE LEVELS
0	78.75	78.70
20	78.10	78.58
40	77.29	78.14
60	76.30	75.70
80	75.16	73.27
100	73.84	71.63
120	72.36	70.42
140	70.76	69.38
160	69.16	68.46
180	67.56	67.06
200	65.96	65.19
220	64.36	63.31
240	62.76	61.81
260	61.16	60.50
280	59.56	59.42
300	58.06	58.29
320	56.77	57.12
340	55.71	55.93
360	54.87	54.83
380	54.25	54.04
400	53.85	53.49
420	53.68	53.29
440	53.73	53.31
460	54.00	53.71
480	54.45	54.20
500	54.79	54.53
520	54.92	54.64
540	54.85	54.53
560	54.59	54.33
580	54.24	54.05
600	53.98	53.78

VERTICAL SCHEMATIC: P 3.27 K=-24.00 L=120.90 124.17 P=-8.00% L=157.50 281.67 K=18.00 L=190.27 471.94 K=-20.00 L=90.60 562.54 K=40.00 L=151.96

HORIZONTAL SCHEMATIC: 0.00 D=54.60 54.60 R=-498.00 L=106.25 160.85 D=546.25

LONGITUDINAL SECTION ON CONTROL STRING MCT0

SCALE HORIZ=1:1000 VERT=1:250

ORIGINAL SIZE A1

Rev	Revisions	Drawn	Date
C	FOR DRAFT DETAILED BUSINESS CASE	VDLT	25.07.19
B	FOR AT INTERNAL REVIEW	VDLT	17.04.19
A	FOR SAFETY AUDIT	VDLT	05.04.19

Surveyed	-	-
Drawn	V. DELA TORRE	27.03.19
Drawing Check	P. ISON	27.03.19
Drawing Review		
Design	-	-
Design check	-	-

TE TUPU NGĀTAHI Supporting Growth

NZ TRANSPORT AGENCY WAKA KOTAHI

Project: AUCKLAND COUNCIL
NORTHWEST HOUSING INFRASTRUCTURE FUNDING-PROPOSED ARTERIAL ROADS

Drawing Title: PLAN AND LONG SECTION - TRIG ROAD
SHEET 2 OF 4

Drawing Status: DRAFT DETAILED BUSINESS CASE

Drawing Date: 25.07.19

Scales: A1 1:1000 A3 1:2000

Contract Number: 0000000

Drawing No. SGA-DRG-NWE-002-CI-1222

Revision C

Appendix 2. Machine Borehole Logs and Photographs

MACHINE BOREHOLE LOG

PROJECT: Northwest HIF
JOB NUMBER: 3810934
SITE LOCATION: Trig Road, Whenuapai, Auckland
CLIENT: Supporting Growth Alliance

CIRCUIT: NZTM
COORDINATES: N 5,924,484.43 m
E 1,744,858.19 m
BOREHOLE LOCATION: Trig Road RP 0.191 opposite 16 Trig Road
R L: 68 m
DATUM: NZVD2016
COORDINATE ORIGIN: hhGPS
ACCURACY: ±5m

Depth (m)	Core recovery	Method	SV	τ (kPa)	SPT 'N'	Soil / Rock description	Geological unit
0.00–1.50	0 %	VE				0.00 - 1.50m: no recovery - vacuum extracted.	
1.50–1.95	100 %	SPT			0 1 1 1 1 2 N=5	Stiff, clayey SILT, trace organics; orange mottled white; moist, high plasticity. Organics: amorphous and fibrous (rootlets).	Tauranga Group
1.95–3.00	71 %	OB	58/38	84/54		1.95m: no organics; bands of white.	Tauranga Group
3.00–3.50	100 %	PT				3.00 - 3.50m: no recovery - undisturbed tube.	Tauranga Group
3.50–3.95	100 %	SPT			1 0 1 1 1 2 N=5	Stiff, clayey SILT, trace organics; orange with white bands; moist, high plasticity. Organics: fibrous (wood).	Tauranga Group
3.95–4.50	100 %	OB	50/32	72/46		4.40m: orange.	Tauranga Group
4.50–4.95	100 %	SPT			0 1 0 1 1 1 N=3	4.70m: alternating bands of orange and white <5mm. 4.90m: red oxide staining. 4.95m: trace coarse sand, trace fine gravel. Gravel: highly weathered, subangular, SILTSTONE.	Tauranga Group
4.95–6.00	100 %	OB	30/8	43/12		5.50m: red mottled white, flecks of iron oxide. Firm, SILT, some clay, trace fine sand, trace fine gravel; red mottled white; moist, high plasticity. Gravel: highly weathered, subangular, SILTSTONE.	Tauranga Group
6.00–6.50	100 %	PT				6.00 - 6.50m: no recovery - undisturbed tube.	Tauranga Group
6.50–6.95	100 %	SPT			1 1 1 1 1 2 N=5	Firm, clayey SILT, trace fine gravels; grey mottled white; moist, high plasticity. Gravel: slightly weathered, subrounded, greywacke. 6.70m: no gravel; grey.	Tauranga Group
6.95–7.50	100 %	OB	38/20	54/30		7.50m: trace fine sand.	Tauranga Group
7.50–7.95	100 %	SPT			1 1 1 1 2 2 N=6	Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, completely weathered, grey, SILTSTONE].	Waitemata Group
7.95–9.00	100 %	OB					Waitemata Group
9.00–9.45	100 %	SPT			3 3 4 6 7 7 N=24	Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, completely weathered, grey, fine to medium SANDSTONE].	Waitemata Group
9.45–	100 %	TT				9.45m: [moderately weathered].	Waitemata Group

DAILY WATER LEVEL: 24/10/2019 3:15:00 PM (at approx. 2.9 m)

DATE STARTED:	24/10/19	DRILLED BY:	Pro -Drill
DATE FINISHED:	24/10/19	EQUIPMENT:	SLG-02
LOGGED BY:	RLR	DRILL METHOD:	OB/PT/SPT/TT/VE
SHEAR VANE No:	GEO613	DRILL FLUID:	Water
		DIAMETER/INCLINATION:	-/ 90°

COMMENTS:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:50

MACHINE BOREHOLE LOG

PROJECT: Northwest HIF | JOB NUMBER: 3810934

SITE LOCATION: Trig Road, Whenuapai, Auckland | CLIENT: Supporting Growth Alliance

CIRCUIT: NZTM | BOREHOLE LOCATION: Trig Road RP 0.191 opposite 16 Trig Road

COORDINATES: N 5,924,484.43 m, E 1,744,858.19 m | R L: 68 m | COORDINATE ORIGIN: hhGPS

DATUM: NZVD2016 | ACCURACY: ±5m

CORE RECOVERY	METHOD	SPT 'N'	DEPTH (m)	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
100 %	TT			Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, completely weathered, grey, fine to medium SANDSTONE].	Waitemata Group	
				Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, moderately weathered, grey, SILTSTONE.]		
				Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, moderately weathered, grey, fine to medium SANDSTONE].		
0 %	SPT	5, 5, 6, 7, 9, 9, Nc=31	11	11.00 - 11.45m: no recovery - solid SPT.		57
100 %	TT			Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, moderately weathered, grey, fine to coarse SANDSTONE].		
			12	Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, moderately weathered, grey, SILTSTONE].		56
0 %	SPT	6, 8, 8, 12, 12, 15, Nc=47		12.50 - 12.95m: no recovery - solid SPT.		
			13	END OF LOG @ 12.95 m		55
			14			54
			15			53
			16			52
			17			51
			18			50
			19			49

Other columns (FLUID LOSS, DAILY WATER LEVEL, CASING, RQD, IN-SITU TESTS SV, τ (kPa), SAMPLES, GRAPHIC LOG) are empty or graphic only.

DATE STARTED: 24/10/19 | DRILLED BY: Pro -Drill | COMMENTS:

DATE FINISHED: 24/10/19 | EQUIPMENT: SLG-02

LOGGED BY: RLR | DRILL METHOD: OB/PT/SPT/TT/VE

SHEAR VANE No: GEO613 | DRILL FLUID: Water

DIAMETER/INCLINATION: -/ 90°

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:50

Trig Road

BOX: 1 **DEPTH: 0.0 to 4.50m**

BOX: 2 **DEPTH: 4.50 to 7.20m**

BH101/19

Machine Borehole Photos

Trig Road

BOX: 3 **DEPTH: 7.20 to 9.70m**

BOX: 4 **DEPTH: 9.70 to 12.95m**

Beca

MACHINE BOREHOLE LOG

BOREHOLE No: **BH102/19**

PROJECT: Northwest HIF
JOB NUMBER: 3810934
SITE LOCATION: Trig Road, Whenuapai, Auckland
CLIENT: Supporting Growth Alliance

CIRCUIT: NZTM
COORDINATES: N 5,924,611 m
E 1,744,732 m
BOREHOLE LOCATION: Trig Road RP 0.338 Council Reserve on Ryan's Road
R L: 58 m
DATUM: NZVD2016
COORDINATE ORIGIN: hhGPS
ACCURACY: ±5m

DRILLING / IN-SITU TESTS

Depth (m)	Daily water level	Core recovery	Method	SV	τ (kPa)	SPT 'N'
0.00 – 1.50		0 %	VE			
1.50 – 1.95		100 %	SPT			1, 1, 1, 1, 2, 2 N=6
1.95 – 3.00	24/10/2019 8:00:00 AM	52 %	OB	60/40	87/57	
3.00 – 3.45		78 %	SPT			1, 1, 2, 1, 2, 2 N=7
3.45 – 4.50		86 %	OB	45/12	63/18	
4.50 – 4.95		100 %	SPT			1, 1, 1, 1, 1, 2 N=5
4.95 – 6.00		86 %	OB	28/10	40/15	
6.00 – 6.45		100 %	SPT			1, 1, 0, 1, 2, 1 N=4
6.45 – 7.50		91 %	OB	60/22	87/32	
7.50 – 7.95		100 %	SPT			1, 1, 2, 1, 2, 3 N=8
7.95 – 9.00		90 %	OB	UTP	UTP	
9.00 – 9.45		100 %	SPT			2, 2, 2, 3, 4, 4 N=13
9.45 – 10.00		100 %	OB			

SOIL / ROCK DESCRIPTION

Geological unit: Fill

0.00 - 1.50m: vacuum extracted - no recovery.

Stiff, clayey SILT; light orange mottled white; moist, high plasticity.

Geological unit: Tauranga Group

Stiff, clayey SILT; bands of white and streaked orange red; moist, high plasticity.

2.95m: orange mottled white.

2.50 - 3.00m: no recovery.

Stiff, clayey SILT; bands of white and streaked orange red; moist, high plasticity.

3.50m: wet.
3.60m: grey mottled red; moist.
3.70m: orange mottled white.

4.00m: trace fine sand.

Stiff, SILT, minor clay, trace fine sand; orange; moist, low plasticity.
4.50m: some clay, trace fine to medium sand; high plasticity.

Firm, clayey SILT, minor fine to medium sand; orange; moist, high plasticity.

5.95m: trace fine to coarse sand; orange mottled grey.

6.45m: no sand; grey.

7.40m: stiff

8.15m: trace organics. Organics: amorphous.

Hard, SILT, minor clay; grey; moist, low plasticity.

Depth (m)	R L (m)
1	57
2	56
3	55
4	54
5	53
6	52
7	51
8	50
9	49

DATE STARTED: 23/10/19
DATE FINISHED: 23/10/19
LOGGED BY: RLR
SHEAR VANE No: GEO613

DRILLED BY: Pro -Drill
EQUIPMENT: SLG-02
DRILL METHOD: OB/SPT/TT/VE
DRILL FLUID: Water
DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Hole terminated at target depth.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:50

MACHINE BOREHOLE LOG

PROJECT: Northwest HIF	JOB NUMBER: 3810934
SITE LOCATION: Trig Road, Whenuapai, Auckland	CLIENT: Supporting Growth Alliance

CIRCUIT: NZTM
COORDINATES: N 5,924,611 m
E 1,744,732 m

BOREHOLE LOCATION: Trig Road RP 0.338 Council Reserve on Ryan's Road
R L: 58 m
DATUM: NZVD2016
COORDINATE ORIGIN: hhGPS
ACCURACY: ±5m

DRILLING

CORE RECOVERY	METHOD
100 %	OB
100 %	SPT
100 %	OB
100 %	SPT
86 %	TT
100 %	TT
100 %	SPT
90 %	TT
100 %	SPT
100 %	TT
3878 %	SPT
100 %	TT
100 %	SPT
90 %	TT

Columns: FLUID LOSS, DAILY WATER LEVEL, CORE RECOVERY, METHOD, CASING, RQD (FLUID LOSS, DAILY WATER LEVEL, CASING and RQD columns are empty)

IN-SITU TESTS

SV	τ (kPa)	SPT 'N'
UTP	UTP	2, 2, 3, 4, 5, 6 N=18
UTP	UTP	3, 4, 5, 6, 7, 7 N=25
		4, 4, 4, 7, 6, 9 N=26
		5, 4, 6, 9, 11, 12 N=38
		4, 5, 6, 7, 8, 10 N=31
		8, 9, 9, 12, 14, 15 N=50+
		7

SAMPLES: (none)

SOIL / ROCK DESCRIPTION

DEPTH (m)	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
10.0 – 11.8	Hard, clayey SILT, grey, moist, high plasticity. 10.20m: minor fine sand. 11.50m: 50mm bed of black clayey SILT; trace organics.	Waitemata Group	47 (at 11 m)
11.8 – 12.45	Hard, silty fine to medium SAND, some clay; grey, moist, high plasticity. [Extremely weak, grey, SANDSTONE]. 12.00m: closely spaced 10mm thick carbonaceous bands.	Waitemata Group	46 (at 12 m)
12.45 – 12.9	Very stiff, clayey SILT; grey; moist, high plasticity. [Extremely weak, grey, SILTSTONE].	Waitemata Group	
12.9 – 14.0	Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak to very weak, grey, fine SANDSTONE].	Waitemata Group	45 (at 13 m)
14.0 – 14.45	Very stiff, clayey SILT; grey; moist, high plasticity. [Extremely weak, grey, SILTSTONE].	Waitemata Group	44 (at 14 m)
14.45 – 15.95	Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, grey, fine SANDSTONE].	Waitemata Group	43 (at 15 m)
15.95 – 16.3	Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, moderately weathered, SILTSTONE].	Waitemata Group	42 (at 16 m)
16.3 – 16.6	Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, grey, fine SANDSTONE].	Waitemata Group	
16.6 – 16.7	Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, grey, SILTSTONE].	Waitemata Group	
16.7 – 17.0	Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, grey, fine to medium SANDSTONE].	Waitemata Group	41 (at 17 m)
17.0 – 17.45	17.00 - 17.45m: no recovery.	Waitemata Group	
17.45 – 17.9	Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, grey, SILTSTONE].	Waitemata Group	
17.9 – 18.5	Dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, grey, fine SANDSTONE]. 20mm bed of black bands. 18.30m: 50mm bed of SILTSTONE.	Waitemata Group	40 (at 18 m)
18.5 – 18.95	Extremely weak, moderately weathered, grey, SILTSTONE.	Waitemata Group	
18.95 – 19.5	Extremely weak to very weak, moderately weathered, grey, fine to coarse SANDSTONE.	Waitemata Group	39 (at 19 m)
19.5 – 20.0	Extremely weak to very weak, moderately weathered, grey, fine SANDSTONE.	Waitemata Group	

DATE STARTED: 23/10/19	DRILLED BY: Pro -Drill	COMMENTS:
DATE FINISHED: 23/10/19	EQUIPMENT: SLG-02	Hole terminated at target depth.
LOGGED BY: RLR	DRILL METHOD: OB/SPT/TT/VE	
SHEAR VANE No: GEO613	DRILL FLUID: Water	
	DIAMETER/INCLINATION: -/ 90°	

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

PROJECT: Northwest HIF | JOB NUMBER: 3810934
SITE LOCATION: Trig Road, Whenuapai, Auckland | CLIENT: Supporting Growth Alliance

CIRCUIT: NZTM
COORDINATES: N 5,924,611 m
E 1,744,732 m

BOREHOLE LOCATION: Trig Road RP 0.338 Council Reserve on Ryan's Road
R L: 58 m | COORDINATE ORIGIN: hhGPS
DATUM: NZVD2016 | ACCURACY: ±5m

FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	SV	τ (kPa)	SPT 'N'	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
		100 %	SPT					11 10 13 18 9/35mm N=50+				Extremely weak to very weak, moderately weathered, grey, fine SANDSTONE.	Waitemata Group	
		96 %	TT							21		20.41m: slightly to moderately weathered, fine to coarse.		37
		100 %	SPT					8 11 13 16 21 N=50+				21.80m: 50mm bed of SILTSTONE.		
										22		END OF LOG @ 21.88 m		36
										23				35
										24				34
										25				33
										26				32
										27				31
										28				30
										29				29

DATE STARTED: 23/10/19
DATE FINISHED: 23/10/19
LOGGED BY: RLR
SHEAR VANE No: GEO613

DRILLED BY: Pro -Drill
EQUIPMENT: SLG-02
DRILL METHOD: OB/SPT/TT/VE
DRILL FLUID: Water
DIAMETER/INCLINATION: -/ 90°

COMMENTS:
Hole terminated at target depth.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:50

Trig Road

BOX: 1 **DEPTH: 0.0 to 4.95m**

BOX: 2 **DEPTH: 4.95 to 7.95m**

Trig Road

BOX: 3 DEPTH: 7.95 to 10.50m

BOX: 4 DEPTH: 10.5 to 13.95m

Trig Road

BOX: 5 **DEPTH: 13.05 to 16.25m**

BOX: 6 **DEPTH: 16.25 to 20.00**

BH102/19

Machine Borehole Photos

Trig Road

BOX: 7 **DEPTH: 20.0 to 22.375m**

Appendix 3. Hand Auger Logs and Photographs

Beca

HAND AUGER LOG

HAND AUGER No: **HA 101/19**

SHEET 1 of 1

PROJECT:	Trig Road Investigations, Kumeu	JOB NUMBER:	3810934
SITE LOCATION:	Trig Road	CLIENT:	Supporting Growth Alliance

CIRCUIT: NZTM
COORDINATES: N 5,924,720.77 m
E 1,744,643.39 m

AUGER LOCATION: 40 Trig Rd - RP00/0.500
R L: 55.5 m
DATUM: MSL

COORDINATE ORIGIN: AKL Council GIS
ACCURACY: ±5m

DEPTH (m)	SAMPLES	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	Scala (Blows/100mm)	SV	τ (kPa)	WATER LEVEL	R L (m)
0.0–0.15		Stiff fine sandy SILT, some organics; dark brown; dry, low plasticity. Organics: rootlets [Topsoil]	Topsoil	4, 4				
0.15–0.3		Very stiff fine sandy SILT, trace organics; orange-brown; moist, low plasticity. Organics: rootlets	Puketoka Formation	4				
0.3–1.4		Very stiff clayey SILT; orange; moist, high plasticity.	Puketoka Formation	3, 3, 2, 3, 2, 2				
0.5					112/42	154/59		55.0
1.0					90/36	124/51		54.5
1.4–2.3		Very stiff clayey SILT; light brown streaked white and pink; moist, high plasticity; pumiceous texture.	Puketoka Formation					
1.5					104/54	143/75		54.0
2.0					98/50	135/70		53.5
2.3–3.5		Very stiff clayey SILT; light orange-brown speckled white; moist, high plasticity; pumiceous texture.	Puketoka Formation					
2.5					80/40	110/56		53.0
3.0					90/52	124/73		52.5
3.5					84/46	116/64		52.0
3.5		END OF LOG @ 3.5 m		3, 5, 6, 7, 8, 8, 6, 8, 7				
4.0								51.5
4.5								51.0

DATE AUGERED:	13/12/19	DIAMETER:	50 mm
LOGGED BY:	GH	METHOD:	HA
SHEAR VANE No:	GEO1509		

COMMENTS:
No groundwater encountered

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

SGA Trig Rd Geotechnical Investigation. HA101/19

BOX: 1 **Depth: 0.00 m to 3.50 m**

Appendix 4. Test Pit Logs and Photographs

Beca

TEST PIT No: TP 101/19

TEST PIT LOG

SHEET 1 of 1

PROJECT:	Trig Road Investigations, Kumeu	JOB NUMBER:	3810934
SITE LOCATION:	Trig Road	CLIENT:	Supporting Growth Alliance

CIRCUIT:	NZTM	TEST PIT LOCATION:	1 Trig Rd - RP00/0.145		
COORDINATES:	N 5,924,477.75 m	R L:	64.75 m	COORDINATE ORIGIN:	AKL Council GIS
	E 1,744,898.35 m	DATUM:	MSL	ACCURACY:	±5m

DEPTH (m)	SAMPLES	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	Scala (Blows/100mm)	SV	τ (kPa)	WATER LEVEL	R L (m)
			Stiff silty fine SAND, trace clay; dark brown; moist, low plasticity.	Topsoil	1, 2, 3, 4	50/24	70/35		64.5
0.5			Stiff clayey SILT; minor fine sand; light grey; moist, high plasticity; disturbed structure [Colluvium?]	Puketoka Formation	4, 3, 5	67/36	92/51		
1.0			Stiff clayey SILT, light grey; wet, high plasticity; non-disturbed structure [Colluvium?] 1.0m - approximate groundwater level encountered. Seepage into pit	Puketoka Formation	4, 6, 1, 1, 1, 1	49/20	68/29	13/12/2019	64.0, 63.5
1.5, 2.0			Firm clayey SILT; light grey speckled light yellow; wet, high plasticity; disturbed structure [Colluvium?]	Puketoka Formation	2, 2, 2, 3, 5	32/15 30/15	46/22 43/22		63.0, 62.5
2.5, 3.0, 3.5			Firm clayey SILT, minor fine sand, trace organics; dark brown; wet, high plasticity. Organics - semi-decomposed wood, disturbed blocky structure [Colluvium?]	Puketoka Formation		35/12 26/10 15/8	49/19 37/16 22/13		62.0, 61.5
3.5			END OF LOG @ 3.5 m						61.0
4.0, 4.5									60.5, 60.0

DATE EXCAVATED:	13/12/19	CONTRACTOR:	Abernathy	COMMENTS:
LOGGED BY:	GH	EQUIPMENT:	14T Excavator	Shear vanes undertaken within bulk samples from the pits below 1.4m depth
SHEAR VANE No:	GEO1509	METHOD:	E	

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

SGA Trig Rd Geotechnical Investigation TP101/19

Depth: 0.00 m to 3.5 m

Depth: 0.00 m to 3.5 m

Beca

TEST PIT No: TP 102/19

TEST PIT LOG

SHEET 1 of 1

PROJECT: Trig Road Investigations, Kumeu
JOB NUMBER: 3810934
SITE LOCATION: Trig Road
CLIENT: Supporting Growth Alliance

CIRCUIT: NZTM
COORDINATES: N 5,924,679.89 m
E 1,744,741.58 m
TEST PIT LOCATION: 9 Trig Rd - RP00/0.410
R L: 47.2 m
DATUM: MSL
COORDINATE ORIGIN: AKL Council GIS
ACCURACY: ±5m

DEPTH (m)	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT
0.0 – 0.4	Stiff fine SAND; trace clay, trace organics; dark brown; dry, low plasticity. Organics: rootlets [Topsoil]	Topsoil
0.4 – 1.7	Stiff clayey SILT; light grey; moist, high plasticity. Fines content increasing with depth 1.2m - Very stiff	Puketoka Formation
1.7 – 3.5	Very stiff silty CLAY; light grey; moist, high plasticity. 2.5m- Streaked yellow	Puketoka Formation
3.5	END OF LOG @ 3.5 m	

DEPTH (m)	Scala (Blows/100mm)	SV	τ (kPa)	R L (m)
0.0	2	96/35	132/49	
0.1	3			
0.2	4			47.0
0.3	4			
0.4	2			
0.5	1	60/18	83/27	
0.6	2			
0.7	3			46.5
0.8	2			
1.0	3	93/40	128/56	
1.1	4			
1.2	6			46.0
1.3	4			
1.4	4			
1.5	6	88/38	121/54	
1.6	6			
1.7	7			45.5
1.8	7			
2.0		86/25	118/36	
2.2				45.0
2.5		140+	191+	
2.7				44.5
3.0		105/45	144/63	
3.2				44.0
3.5		94/46	129/64	
3.7				43.5
4.2				43.0
4.7				42.5

Column headings: DEPTH (m), SAMPLES, GRAPHIC LOG, SOIL / ROCK DESCRIPTION, GEOLOGICAL UNIT, Scala (Blows/100mm), SV, τ (kPa), WATER LEVEL, R L (m)

DATE EXCAVATED: 13/12/19
CONTRACTOR: Abernathy
LOGGED BY: GH
EQUIPMENT: 14T Excavator
SHEAR VANE No: GEO1509
METHOD: E

COMMENTS:
No groundwater encountered
Shear vanes undertaken within bulk samples from the pits below 1.4m depth

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

SGA Trig Rd Geotechnical Investigation TP102/19

BOX: 1 **Depth: 0.00 m to 3.5 m**

BOX: 2 **Depth: 0.00 m to 3.5 m**

TP102/19

[3810934/1000]

Test Pit Photos

TEST PIT No: TP 103/19

TEST PIT LOG

PROJECT:	Trig Road Investigations, Kumeu	JOB NUMBER:	3810934
SITE LOCATION:	Trig Road	CLIENT:	Supporting Growth Alliance

CIRCUIT:	NZTM	TEST PIT LOCATION:	19 Trig Rd - RP00/0.650		
COORDINATES:	N 5,924,899.03 m	R L:	52.25 m	COORDINATE ORIGIN:	AKL Council GIS
	E 1,744,588.22 m	DATUM:	MSL	ACCURACY:	±5m

DEPTH (m)	SAMPLES	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT
0.0 – 0.2		Stiff silty fine SAND, minor clay, minor organics; dark brown; dry, low plasticity. Organics: rootlets [Topsoil]	Topsoil
0.2 – 0.7		Very stiff silty fine SAND, minor clay, minor fine gravel; redish orange, moist, low plasticity.	Puketoka Formation
0.7 – 2.3		Very stiff clayey SILT, trace organics; light greyish yellow; moist, high plasticity. Organics: rootlets.	Puketoka Formation
2.3		END OF LOG @ 2.3 m	

Scala (Blows/100mm): 1, 2, 2, 2, 2, 2, 3, 2, 3, 3, 2, 2, 3, 6, 4, 5, 3, 8

Depth (m)	SV	τ (kPa)
0.0	52/30	73/43
0.45	112/45	154/63
0.95	140+	191+
1.45	140+	191+
1.95	132/50	181/70

WATER LEVEL: –

R L (m): 52.0, 51.5, 51.0, 50.5, 50.0, 49.5, 49.0, 48.5, 48.0, 47.5

DATE EXCAVATED:	13/12/19	CONTRACTOR:	Abernathy
LOGGED BY:	GH	EQUIPMENT:	14T Excavator
SHEAR VANE No:	GEO1509	METHOD:	E

COMMENTS:
No groundwater encountered
Shear vanes undertaken within bulk samples from the pits below 1.4m depth

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

SGA Trig Rd Geotechnical Investigation TP103/19

BOX: 1 **Depth: 0.00 m to 2.3 m**

BOX: 2 **Depth: 0.00 m to 2.3 m**

Appendix 5. Laboratory Testing

Geotest

21 Pitt Street
P O Box 6345
Auckland 1141
Ph. 300-9380

SUMMARY OF TEST RESULTS

Report: 2057L:01

Job Name: Supporting Group Alliance **Job No:** 3810934/1000

Client: Auckland Transport **Date:** 13 December 2019

Bore hole No.	Sample No.	Depth (m)	Sample Type	Sample Description	Natural		Atterberg Limits		Grading	Pσ t/m³	Clay Index	Consol	CBR	Compaction	Perm k m/s	Triaxial CUPP
					WC%	Bulk Density t/m³	LL/ CPL	PL								
BH101/19	S836	1.5	SD	Fine to medium sandy silty CLAY, trace organics; yellowish brown, speckled dark greyish brown; moist, highly plastic.	43.4		X	X	X							
BH102/19	S837	3.0	SD	Clayey SILT, some fine sand; orange brown, mottled light blueish grey; moist, highly plastic.	47.5		X	X	X							
BH101/19	S846	3.8	PT	Clayey SILT, minor sand; bluish grey mottled orange brown; moist, highly plastic.	43.8							X				
BH101/19	S835	4.5	SD	Clayey SILT, minor sand; orange brown, mottled blueish grey; moist, highly plastic.	56.5											
BH101/19	S847	6.0	PT	Clayey SILT, minor sand, trace fine gravel; reddish brown mottled yellowish grey; moist, highly plastic.	81.5							X				
BH102/19	S838	6.0	SD	Clayey SILT, minor sand; orange brown, mottled blueish grey; moist, highly plastic.	43.1											
BH102/19	S839	7.5-7.95	SD	Fine to medium sandy SILT, some clay; greyish brown, speckled orange brown; moist, highly plastic.	40.7		X	X	X							

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ENVIROLAB GEOTEST IS ACCREDITED BY INTERNATIONAL ACCREDITATION NEW ZEALAND. ALL TESTS REPORTED HEREIN HAVE BEEN PERFORMED IN ACCORDANCE WITH THE LABORATORY'S SCOPE OF ACCREDITATION. THIS REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL
NOTE: IANZ ENDORSEMENT DOES NOT COVER SOIL DESCRIPTIONS.

REPORT RELATES ONLY TO SAMPLES TESTED, SAMPLING WAS UNDERTAKEN BY OTHERS.

X = DATA ATTACHED, UT = UNDISTURBED TUBE SAMPLES, SD = SMALL DISTURBED SAMPLES

TEST STANDARDS:

NZS 4402: 1986; Test 2.1,2.2,2.3,2.4,2.8.4, 7.1

AUTHORISED SIGNATORY

N.Agarkova – Authorised Signatory

Sheet 1 of 9

geotest

21 Pitt Street
PO Box 6345
Auckland 1141
Ph: (09) 300-9380

ATTERBERG LIMITS

Job Name: Supporting Group Alliance

Date: 13 December 2019

Job No: 3810934/1000

Report No: 2057L:01

Client: Auckland Transport

Tested By: S.Shah/B.Alves

Sample Type: Small Disturbed

Checked By: C.Oey

Test Standard: NZS 4402: 1986, Test 2.1,2.2,2.3,2.4

History: As Received

Test Performed On: Sub 425µm

Bore No.	Sample No.	Depth (m)	Sample Description	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
BH101/19	S836	1.5	Fine to medium sandy silty CLAY, trace organics; yellowish brown, speckled dark greyish brown; moist, highly plastic.	43.4	67	30	**37**
BH102/19	S837	3.0	Clayey SILT, some fine sand; orange brown, mottled light blueish grey; moist, highly plastic.	47.5	79	37	**42**
BH102/19	S839	7.5-7.95	Fine to medium sandy SILT, some clay; greyish brown, speckled orange brown; moist, highly plastic.	40.7	71	25	**46**

Comments:

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Authorised Signatory:...
N. Agarkova – Authorised Signatory

Geotest
21 Pitt St
PO Box 6345
Auckland 1141
Ph: (09) 300-9380

PARTICLE SIZE DISTRIBUTION - WET SIEVE/HYDROMETER METHOD

Job Name: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019

Job No.: 3810934/1000 **Tested By:** S.Shah **Checked By:** C.Oey

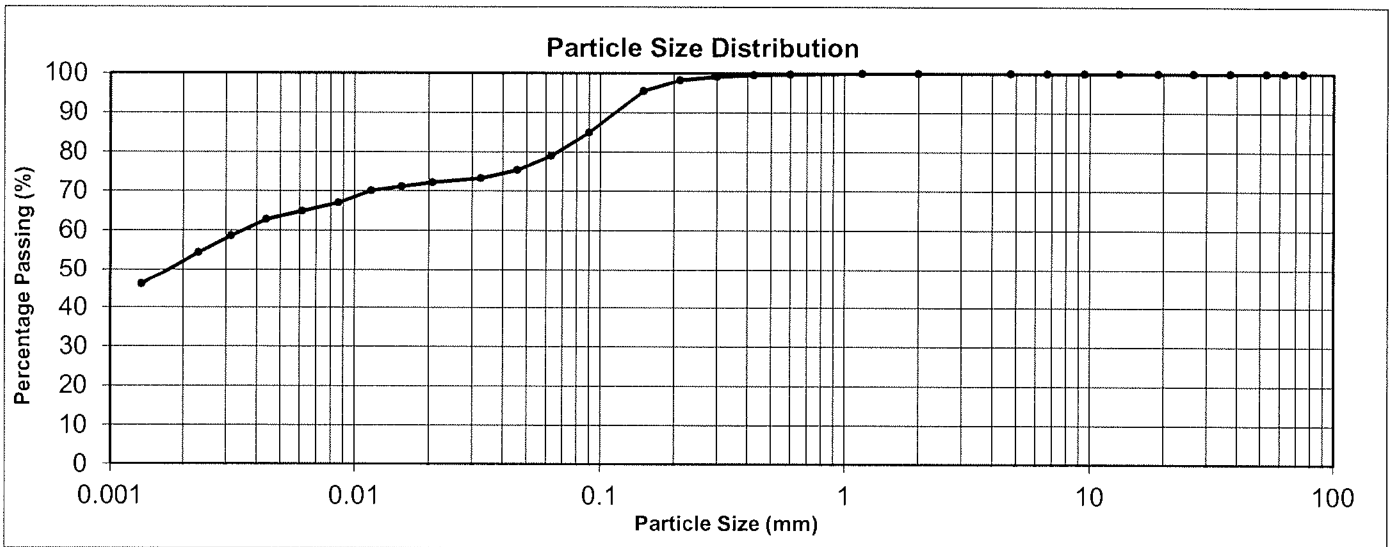
Bore No.: BH101/19 **Sample No.:** S836 **Depth (m):** 1.5

Sample Type: Small Disturbed **History:** As Received **Report No.:** 2057L:01

Sample Description: Fine to medium sandy silty CLAY, trace organics; yellowish brown, speckled dark greyish brown; moist, highly plastic.

Test Standard: NZS4402: 1986, Test 2.8.4 **Dispersion:** Sodium hexametaphosphate, pH = 9.0

Fraction Determined by Sieving				Fraction Determined by Hydrometer			
Sieve Size mm	% Passing	Sieve Size mm	% Passing	Part. Size mm	% Passing	Part. Size mm	% Passing
75	100	2.0	100	0.046	75	0.001	46
63	100	1.18	100	0.033	73		
53	100	0.600	100	0.021	72		
37.5	100	0.425	100	0.015	71		
26.5	100	0.300	99	0.012	70		
19	100	0.212	98	0.009	67		
13.2	100	0.150	96	0.006	65		
9.5	100	0.090	85	0.004	63		
6.7	100	0.063	79	0.003	59		
4.75	100			0.002	54		



% Clay	% Silt	% Sand	% Gravel	Max. size:
52	27	21	0	300µm

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geotest

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PO Box 6345
Auckland 1141
Ph: (09) 300-9380

PARTICLE SIZE DISTRIBUTION - WET SIEVE/HYDROMETER METHOD

Job Name: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019

Job No.: 3810934/1000 **Tested By:** S.Shah **Checked By:** C.Oey

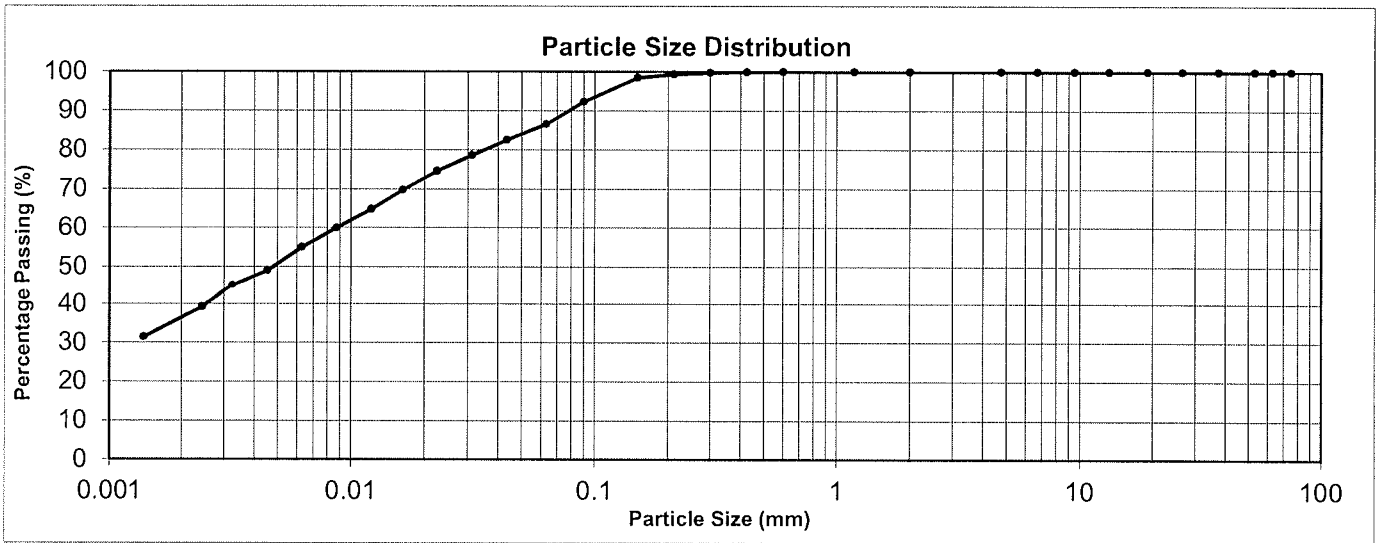
Bore No.: BH102/19 **Sample No.:** S837 **Depth (m):** 3.0

Sample Type: Small Disturbed **History:** As Received **Report No.:** 2057L:01

Sample Description: Clayey SILT, some fine sand; orange brown, mottled light blueish grey; moist, highly plastic.

Test Standard: NZS4402: 1986, Test 2.8.4 **Dispersion:** Sodium hexametaphosphate, pH = 9.0

Fraction Determined by Sieving				Fraction Determined by Hydrometer			
Sieve Size mm	% Passing	Sieve Size mm	% Passing	Part. Size mm	% Passing	Part. Size mm	% Passing
75	100	2.0	100	0.043	82	0.001	31
63	100	1.18	100	0.031	79		
53	100	0.600	100	0.022	75		
37.5	100	0.425	100	0.016	70		
26.5	100	0.300	100	0.012	65		
19	100	0.212	99	0.009	60		
13.2	100	0.150	98	0.006	55		
9.5	100	0.090	92	0.005	49		
6.7	100	0.063	87	0.003	45		
4.75	100			0.002	39		



% Clay	% Silt	% Sand	% Gravel	Max. size:
36	51	13	0	212µm

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Geotest
21 Pitt St
PO Box 6345
Auckland 1141
Ph: (09) 300-9380

PARTICLE SIZE DISTRIBUTION - WET SIEVE/HYDROMETER METHOD

Job Name: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019

Job No.: 3810934/1000 **Tested By:** S.Shah **Checked By:** C.Oey

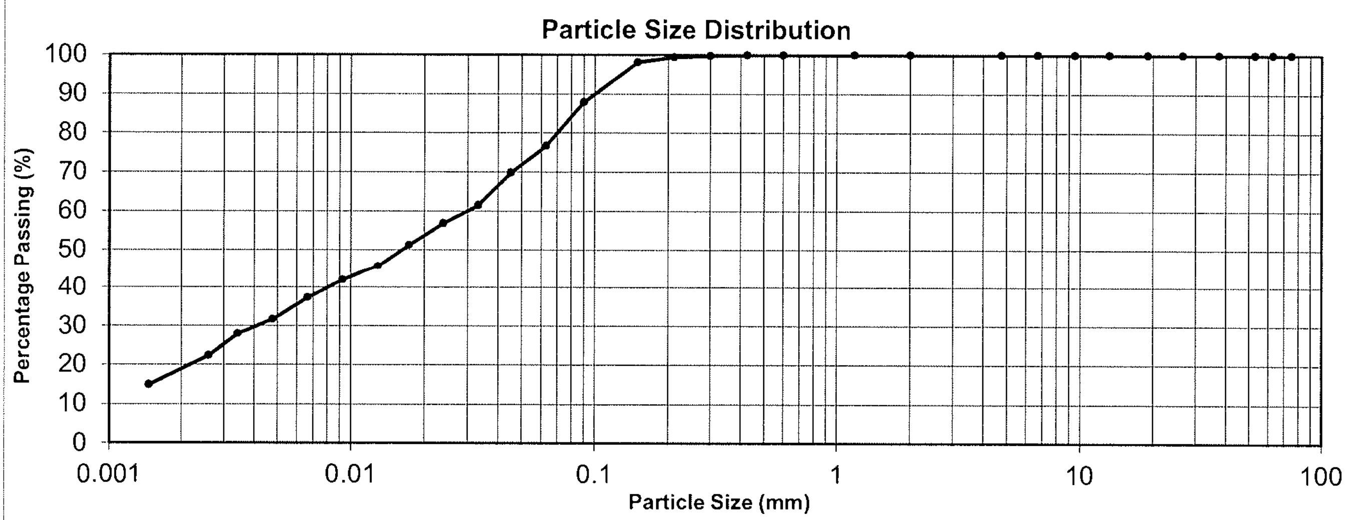
Bore No.: BH102/19 **Sample No.:** S839 **Depth (m):** 7.5-7.95

Sample Type: Small Disturbed **History:** As Received **Report No.:** 2057L:01

Sample Description: Fine to medium sandy SILT, some clay; greyish brown, speckled orange brown; moist, highly plastic.

Test Standard: NZS4402: 1986, Test 2.8.4 **Dispersion:** Sodium hexametaphosphate, pH = 9.0

Fraction Determined by Sieving				Fraction Determined by Hydrometer			
Sieve Size mm	% Passing	Sieve Size mm	% Passing	Part. Size mm	% Passing	Part. Size mm	% Passing
75	100	2.0	100	0.045	70	0.001	15
63	100	1.18	100	0.033	61		
53	100	0.600	100	0.024	57		
37.5	100	0.425	100	0.017	51		
26.5	100	0.300	100	0.013	46		
19	100	0.212	99	0.009	42		
13.2	100	0.150	98	0.007	37		
9.5	100	0.090	88	0.005	32		
6.7	100	0.063	77	0.003	28		
4.75	100			0.003	22		



% Clay	% Silt	% Sand	% Gravel	Max. size:
18	59	23	0	212μm

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geotest

21 Pitt Street
PO Box 6345
Auckland 1141
Ph:(09) 300 9380
Fax:(09) 300 9292

ONE DIMENSIONAL CONSOLIDATION (OEDOMETER) TEST

Project: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019

Job No: 3810934/1000 **Location:** - **Depth (m):** 3.8

Bore/Test Pit No.: BH101/19 **Sample No.:** S846 **Report No:** 2048L:01

Sample Type: Undisturbed Tube **History:** Natural

Sample Description: Clayey SILT, minor sand; bluish grey mottled orange brown; moist, highly plastic.

Test Standard: NZS 4402:1986,Test 7.1 **Tested By:** N.Agarkova **Checked By:** S.Shah

Test Condition: Inundated at 1 minute interval on initial load sequence

Initial Water Content	(%)	43.8	Solid Density (assumed)	(t/m^3)	2.77
Initial Bulk Density	(t/m^3)	1.75	Saturation Ratio (Initial)		0.95
Initial Dry Density	(t/m^3)	1.22	Saturation Ratio (Final)		1.0
Cycle Time (Ave)	(Hrs)	4	Temperature Range	(^0C)	19.5-23
Area of Ring	(mm^2)	1960	Initial Void Ratio	(e)	1.28
Height of Ring	(mm)	14.9	Date Tested	21 - 25 November 2019	

Applied Pressure	(kPa)	6	12.5	25	50	100	200	400	800	200	50
Compression	(%)	0.0	0.0	0.4	1.2	2.7	5.6	9.6	14.4	13.1	11.4
Void Ratio	(e)	1.28	1.28	1.27	1.25	1.22	1.15	1.06	0.95	0.98	1.02
Coefficient of consolidation Cv Log	(m^2/yr)	-	5.1	15	9.5	9.6	7.9	8.1	8.5	-	-
Coefficient of volume compressibility Mv	(m^2/MN)	-	0.05	0.31	0.31	0.31	0.29	0.21	0.13	-	-

***Comment:**

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Geotest

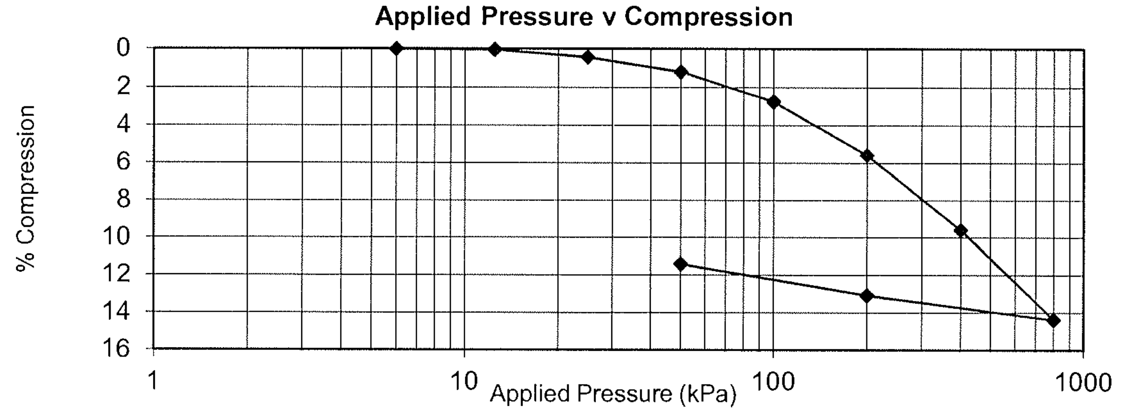
21 Pitt Street
PO Box 6345
Auckland 1141
Ph:(09) 300 9380
Fax:(09) 300 9292

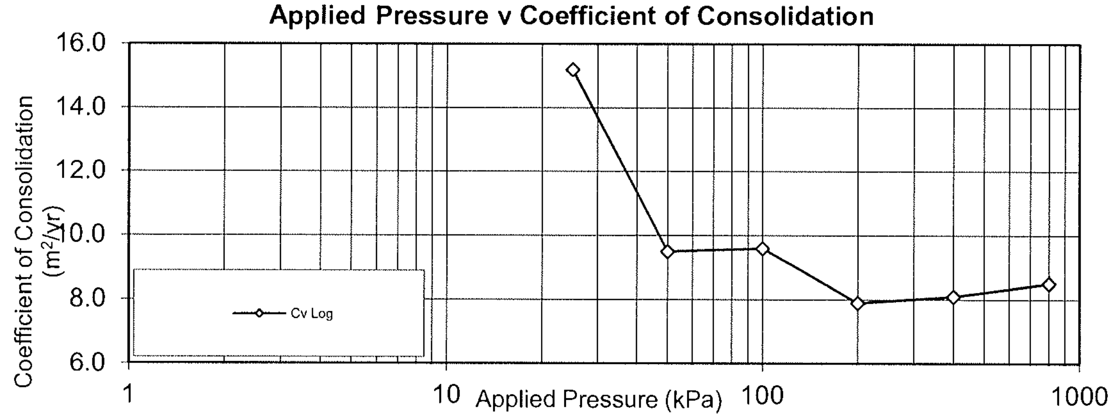
ONE DIMENSIONAL CONSOLIDATION (OEDOMETER) TEST

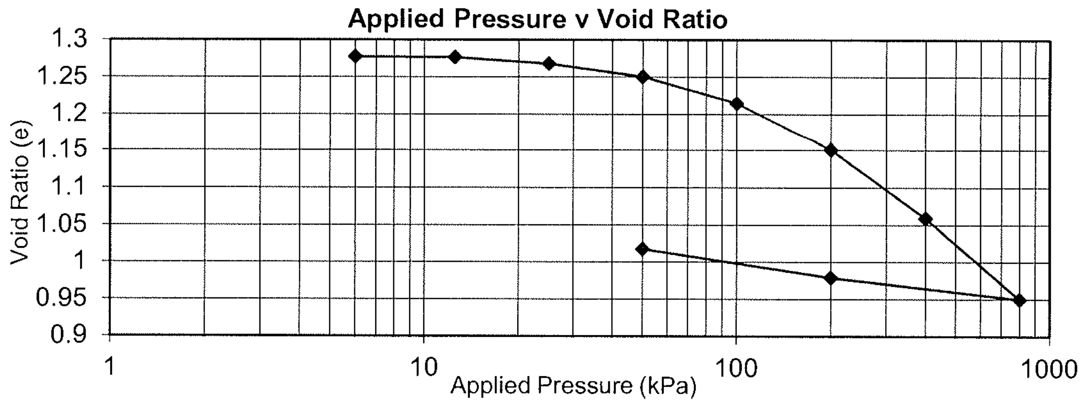
Project: Supporting Group Alliance | **Client:** Auckland Transport | **Date:** 13 December 2019

Job No: 3810934/1000 | **Location:** - | **Depth (m):** 3.8

Bore/Test Pit No.: BH101/19 | **Sample No.:** S846 | **Report No:** 2048L:01







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ONE DIMENSIONAL CONSOLIDATION (OEDOMETER) TEST

Project: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019

Job No: 3810934/1000 **Location:** - **Depth (m):** 6.0

Bore/Test Pit No.: BH101/19 **Sample No.:** S847 **Report No:** 2048L:01

Sample Type: Undisturbed Tube **History:** Natural

Sample Description: Clayey SILT, minor sand, trace fine gravel; reddish brown mottled yellowish grey; moist, highly plastic.

Test Standard: NZS 4402:1986,Test 7.1 **Tested By:** N.Agarkova **Checked By:** S.Shah

Test Condition: Inundated at 1 minute interval on initial load sequence

Initial Water Content	(%)	81.5	Solid Density (assumed)	(t/m^3)	2.77
Initial Bulk Density	(t/m^3)	1.51	Saturation Ratio (Initial)		0.97
Initial Dry Density	(t/m^3)	0.83	Saturation Ratio (Final)		1.0
Cycle Time (Ave)	(Hrs)	4	Temperature Range	(^0C)	19.5-23
Area of Ring	(mm^2)	1960	Initial Void Ratio	(e)	2.32
Height of Ring	(mm)	15	Date Tested	21 - 25 November 2019	

Applied Pressure	(kPa)	6	12.5	25	50	100	200	400	800	200	50
Compression	(%)	0.2	0.5	1.0	1.6	2.7	4.9	10.6	19.5	18.0	16.2
Void Ratio	(e)	2.31	2.30	2.29	2.27	2.23	2.16	1.97	1.67	1.72	1.78
Coefficient of consolidation Cv Log	(m^2/yr)	-	-	28	25	34	30	15	6.1	-	-
Coefficient of volume compressibility Mv	(m^2/MN)	-	0.45	0.41	0.28	0.22	0.22	0.30	0.25	-	-

***Comment:**

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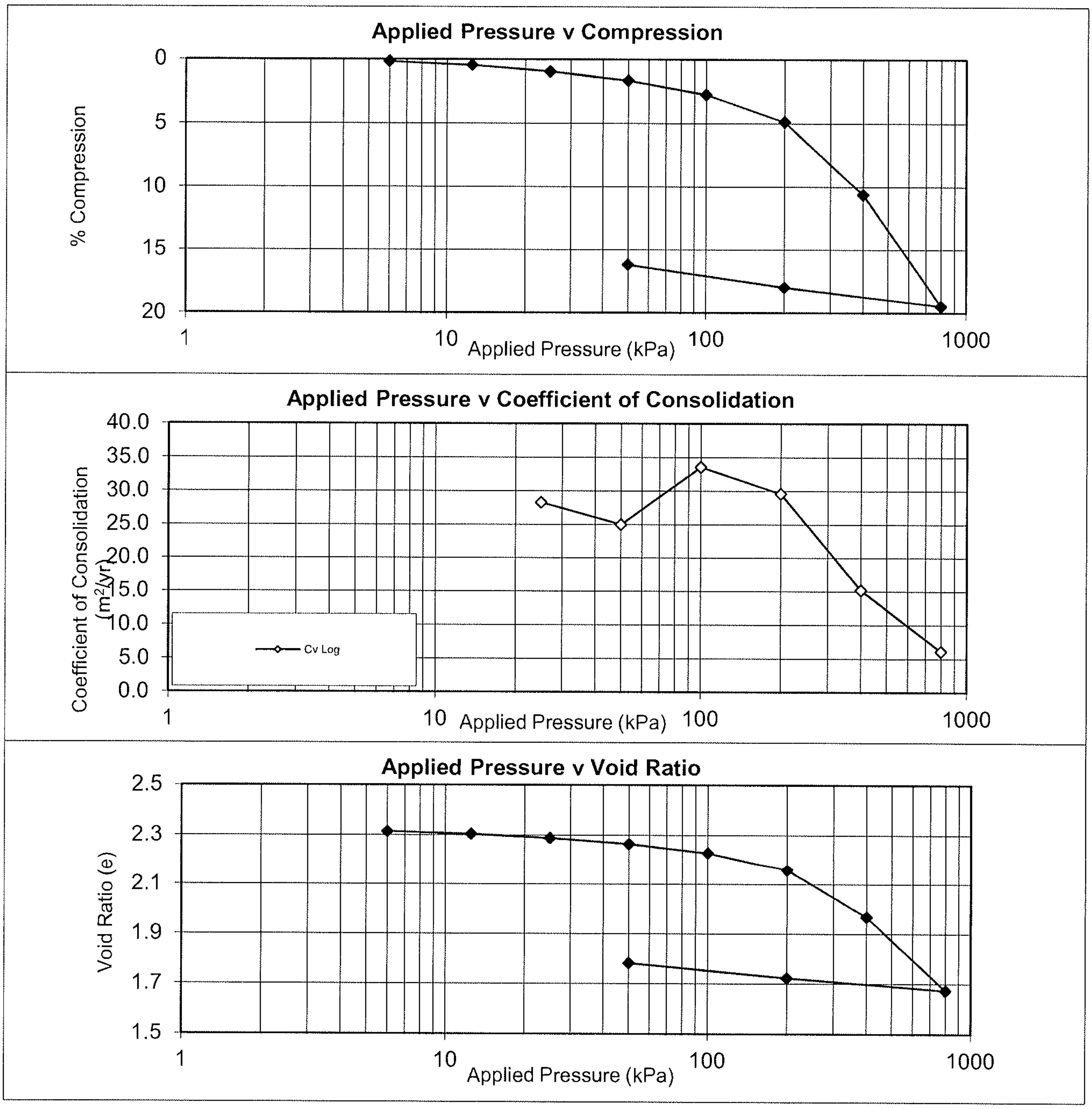
ONE DIMENSIONAL CONSOLIDATION (OEDOMETER) TEST

Project: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019

Job No: 3810934/1000 **Location:** - **Depth (m):** 6.0

Bore/Test Pit No.: BH101/19 **Sample No.:** S847 **Report No:** 2048L:01



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ATTACHMENT 23

NORTH-WEST HIF
TRIG ROAD GEOTECHNICAL
INTERPRETIVE REPORT

Interpretive Report

Date Prepared: 31 January 2020

Prepared by: Ashe Cooper

Northwest HIF – Trig Road Geotechnical Interpretive Report

Purpose

This geotechnical interpretive report has been prepared to present the geotechnical interpretation of the geotechnical factual information retrieved during the ground investigation at Trig Road, Whenuapai. This report also provides recommendations for the proposed development.

Document Status

Responsibility	Name	Signature
Author	Ashe Cooper	
Reviewer	James Burr	
Approver	Rob Mason	

Revision Status

Version	Date	Reason for Issue
0.1	31/01/2020	For Client Comment
0.2	14/02/2020	For issue to Client

Disclaimer

This is a draft document for review by specified persons at Auckland Transport and the New Zealand Transport Agency. This draft will subsequently be updated following consideration of the comments from the persons at Auckland Transport and the New Zealand Transport Agency. This document is therefore still in a draft form and is subject to change. The document should not be disclosed in response to requests under the Official Information Act 1982 or Local Government Official Information and Meetings Act 1987 without seeking legal advice.

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Tables

Figures

Appendices

1. Introduction

The Supporting Growth project aims to identify the transport networks required to connect Auckland's future growth areas over the next 30 years. A coordinated approach with land use development running in parallel with infrastructure planning is required.

An early indication of the viability of preferred networks is required to identify geotechnical opportunities and constraints to developing land.

The 'preferred networks' require the following criteria to be met:

- Include improved accessibility and transport options,
- Strong focus on public transport, including walking and cycling facilities,
- Connections to the wider strategic transport network, and
- Maximum benefit and value in management of existing network infrastructure

As part of the Supporting Growth Alliance (SGA), Beca Limited (Beca) are undertaking the geotechnical investigation and interpretation to inform the preliminary design of the roading upgrades along Trig Road. This report provides high level geotechnical interpretation of the factual ground investigation data and recommendations of design elements which may be considered for the project. Additional investigation and analyses will be required for later stages of the design.

2. Proposed Development

The proposed development along Trig Road is a road widening to accommodate future transportation requirements for the Auckland region. Trig Road is a Level 1, Arterial route road. The Trig Road upgrade would see:

- Two lane road with a flush or scour median
- Berm and footpath on either side of the road
- A cycleway along one side of the road

For the proposed road widening to take place, a combination of cut and fill earthworks along with retaining structures would be required in order to achieve the targeted road width (refer Figure 1).

Figure 1 - Trig Road Proposed Concept Design

3. Site Description

The site is located along Trig Road, which trends in a north-west south-east direction from Hobsonville Road in the south to Brigham Creek Road in the north. An overall Site Plan is also shown in Appendix 1.

Trig Road runs along a minor north to south trending ridge with slopes within the area considered flat to gently sloping, at less than 5°. Slopes up to 20° occur in localised areas immediately adjacent to the road alignment. Three streams are present within the site and exist on the eastern and western sides of Trig Road and are named Totara Stream, Trig Stream, and Rawiri Stream with various ephemeral water courses feeding into them.

4. Geotechnical Information

4.1. Geology

The published 1:250,000 geological map (QMAP) of the Auckland area (Edbrooke, 2001) indicates that the area comprises two main geological units as shown in Figure 2. From the ground investigation, it was found that the site is underlain by Puketoka Formation of the Tauranga Group overlying Waitemata Group material.

Figure 2 - Trig Road Geology (QMaps, 2019)

4.2. Ground Investigation Scope

Ground investigations were undertaken by Beca in November – December 2019. The information from the investigation is presented in the report titled *Northwest HIF – Trig Road Geotechnical Factual Report*

The scope of the investigations carried out is summarised below:

- 2 x Machine Boreholes with Standard Penetration Tests (SPT's) undertaken typically at 1.5m centres, to depths ranging between 13 and 22m
- 3 x Test Pits (TP's) to a maximum of 3.5m depth
- 1 x Hand Auger (HA) to 3.5m depth.

The upper 1.5m of both machine boreholes was vacuum excavated due to services being present in the investigation area.

4.3. Ground Profile

We provide a summary of the soil and rock profile derived from the ground investigation in Table 1 below. Two geological cross sections at the site are presented in Appendix B.

Table 1 – General Ground Profile[1]

Layer	Geological Unit	Soil Description	Thickness (m)	Undrained Shear Strength Range (kPa)	Typical SPT "N" Value Range (Blows/100mm)
1a	Puketoka Formation	Stiff/ Very Stiff Clayey SILT	5 – 10	43 – 191	3 – 5
1b	Puketoka Formation (recent alluvium)	Firm Clayey SILT	3.0+ ?	37 – 43	4 – 13
2a	Weathered Waitemata Group	Interbedded Hard Clayey SILT/Medium dense fine silty SAND	4 - 9	UTP	18 – 47
2b	Waitemata Group	Extremely Weak SANDSTONE/ SILTSTONE	-	-	50+

Unit 1b (recent colluvium) was only encountered in TP101/19 but may be found in other low-lying areas along the alignment.

4.4. Groundwater Conditions

Both boreholes were dipped following completion of drilling. At the time of the measurements the boreholes were fully open. Only borehole BH101/19 was able to be left to allow for dissipation o drilling muds or other fluids. Borehole BH102/19 was dipped following completion of drilling. The water level is indicative only and does not allow for the interpretation of water levels or vertical gradients between individual units.

Test pit 101/19 encountered groundwater at approximately 800mm depth. This test pit is located adjacent to an ephemeral watercourse and groundwater will likely be elevated at this location. Groundwater was measured at 3.0m below ground level in borehole BH101/19, and 2.5m below ground level in borehole BH102/19.

[1] Findings presented above are based on the ground investigation at chainages 140m and 420m. Variation in the ground profile along the length of the road is expected

4.5. Laboratory Testing

The laboratory testing was carried out on collected field samples and was undertaken by Geotest Ltd, an IANZ accredited laboratory. Full results are in the report titled *Northwest HIF – Trig Road Geotechnical Factual Report.*

Laboratory testing results are shown in the tables below.

Table 2 - Natural Moisture Content and Atterberg limits Test Results

Unit	Borehole ID	Sample Depth (m)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
1a	BH101/19	1.5	43.4	67	30	37
1a	BH102/19	3.0	47.5	79	37	42
1b	BH102/19	7.5 – 7.95	40.7	71	25	46

The soils plot as highly plastic clay/silt.

Table 3 - Particle Size Distribution - Wet Sieve/Hydrometer Method Test Results

Unit	Borehole ID	Sample Depth (m)	% Clay	% Silt	% Sand	% Gravel
1a	BH101/19	1.5	52	27	21	0
1a	BH102/19	3.0	36	51	13	0
1b	BH102/19	7.5 – 7.95	18	59	23	0

Table 4 - One Dimensional Consolidation Test Results

Unit	Borehole ID	Sample Depth (m)	Initial Bulk Density (t/m^3)	Initial Void Ratio	Applied Pressure Range (kPa)	Coefficient of Consolidation Range (C_v Log) (m^2/year)	Coefficient of Volume Compressibility Range (M_v) (m^2/MN)
1a	BH101/19	3.8	1.75	1.28	12.5 – 800	5.1 – 8.5	0.05 – 0.13
1b	BH101/19	6.0	1.51	2.32	12.5 – 800	28 – 6.1	0.45 – 0.25

5. Geotechnical Design Parameters

Preliminary material parameters have been assessed from the geotechnical investigations, laboratory testing, and moderated by our experience of similar soils in the Auckland area. These are provided in the Table 5 below.

Table 5 - Geotechnical Design Parameters

Layer	Soil Description	Density (kN/m^3)	Cohesion (kPa)	Friction Angle (degrees) Φ'	Undrained Shear Strength (Su) (kPa)
1a	Stiff Clayey SILT	17	3	28	55
1b	Soft/Firm Clayey SILT	16	1	26	40
2a	Interbedded Hard Clayey SILT/Medium dense silty fine SAND	18	3	30	125
2b	Waitemata Group Rock	18	10	36	500
3	Engineered Fill	18	5	30	100

6. Design Standards and Criteria

6.1. Design Codes and Guidelines

The relevant design codes and standards for the Trig Road upgrade are summarised below:

- AS/NZS 1170 Structural Design Actions
- NZS 1170.5:2004 Structural Design Actions – Part 5: Earthquake Actions – New Zealand, incorporating Amendment 1, September 2016
- Bridge Manual, Manual Number SP/M/22, 3rd Edition, Amendment 3 (BM) (NZTA, 2018)
- MBIE New Zealand Building Code – B1 Structure/ Verification Method 4 Foundations (B1/VM4), incorporating Amendment 15, January 2017
- Auckland Unitary Plan – E25. Noise and Vibration, Auckland Council
- MBIE/NZGS Modules for Earthquake Geotechnical Engineering Practice

6.2. Seismic Design

6.2.1. Site Subsoil Class

The site subsoil class has been determined from the geotechnical site investigations in accordance with New Zealand Standard for Structural Design Actions NZS1170.5:2004.

The site subsoil class is classified as Class C – shallow soil sites.

6.2.2. PGA Design Values

The Peak Ground Acceleration (PGA) values for the earth slopes obtained from NZTA Bridge Manual Version 3.3, are presented in Table 6 below.

A 100-year design life has been assumed for the embankments and they are assumed to be no greater than 6m high.

Table 6 - Input for the Seismic Peak Ground Acceleration Calculation

Importance Level	Design Life (years)	Design Case	Annual Probability of Exceedance	Return Period Factor (Ru)	PGA Design Value (g)
3	100	ULS	1/500	1.0	0.19
3	100	MCE	1/1400	1.0	0.29

The calculation of the Peak Ground Acceleration is attached in Appendix D.

6.3. Liquefaction Susceptibility

Liquefaction is a phenomenon where saturated granular soil temporarily lose strength due to high pore water pressure development during and after significant earthquake shaking. Liquefaction predominantly occurs in loose non-plastic silts, sands and well-graded gravels below the water table.

Liquefaction susceptibility at the site is low due to the cohesive nature of the soils. This is confirmed by the laboratory testing.

7. Design Recommendations

Key geotechnical issues and risks for the Trig Road upgrade are:

- Property boundary constraints
- Geotechnical ground conditions
- Cut fill material balance
- Existing services

The following design recommendations are applicable across the Trig Road upgrade.

7.1. Earthworks

7.1.1. General

Topsoil needs to be stripped from the site before earthworks are undertaken. Tree stumps, old foundations, and any other obstructions or organic materials need to be removed and remediated. The existing road embankment fill may also need to be excavated and replaced, subject to further testing. These locations need to be excavated and backfilled with suitable compacted material to engineering standards. All unsuitable material should be excavated and removed from site and replaced with approved engineered fill (either compacted cohesive or granular hardfill).

Site won soils maybe used as engineered fill. The Unit 1 soils are likely to require drying back before they can be placed and compacted. The Unit 2 soils/rock may be usable without conditioning, but they are encountered at significant depth and so are unlikely to be available based on the earthworks current design.

Lime or cement stabilisation may be used to improve soil strength upon reworking and compacting. Prior to construction, laboratory testing would be required to confirm the suitability of lime and/or cement to provide drying and/or strength improvement. Alternatively, imported cohesive or granular hardfill or cohesive fill could be used for backfilling.

Unsuitable materials may be able to be used as landscape fill or temporary stormwater controls.

7.1.2. Cuts

Small cut slopes are required to widen to the west of Trig Road. These will encroach on existing footpaths, stormwater controls, and property boundaries. Unsupported cut slopes should be cut no steeper than 3H:1V.

It is recommended that cut slopes be dressed in vegetation to avoid frittering and scour from the wetter months. A geosynthetic product would be appropriate to encourage vegetation growth and provide a means for this.

7.1.3. Fills

Once any unsuitable material and existing topsoil has been stripped from the site, embankment construction could commence. Engineered fill embankments should be constructed using good, clean, engineered fill. Imported granular hardfill would also be appropriate for embankment construction. Fill should be compacted in a maximum 200mm lifts and benched into the existing slopes. For preliminary design purposes, embankments compacted using cohesive engineered fill should be no steeper than 3H:1V. and embankments constructed using granular hardfill could be constructed no steeper than 2H:1V.

Consolidation settlements will occur within the soils beneath the proposed concept embankments. Minor settlement of the fill embankment itself may occur if cohesive engineered fill is used. Settlements are expected to be in the order of 25 – 100mm. Further investigation and analysis should be undertaken during detailed design.

Settlement monitoring of fills should be undertaken during construction and for 6 months post-construction to confirm design assumptions. Monitoring beyond this point should be continued should settlements be trending toward greater than expected.

Engineered fill embankment slopes should be adequately dressed in vegetation to avoid local scour or failure of the topsoil layer. A geosynthetic product would be appropriate to encourage vegetation growth and provide a means for this.

7.1.4. Effects on Natural Groundwater Levels

The proposed concept earthworks design has cut slopes no greater than two metres in height and fills no greater than six metres in depth. From the ground investigation information, the observed groundwater levels are lower than the proposed cuts. Embankments will be constructed on top of the existing ground level.

The concept design for the Trig Road works are anticipated to have negligible effects on the natural groundwater level.

This conclusion should be reviewed as the design progresses to confirm that any changes do not result in significant effects to the current groundwater regime.

7.2. Slope Stability

Slope stability analyses have been assessed using GeoSlope Slope/W 2019 to assess, at a conceptual level, the stability of the proposed embankment. Stability cases assessed are:

- Static
- Elevated groundwater level
- Seismic, applying a peak ground acceleration to the stability model

Target factors of safety for each of the design cases are as below:

- Static – FoS > 1.5
- Elevated groundwater level – FoS > 1.3
- Seismic – FoS > 1.0 (or if <1.0, acceptable displacements as per Bridge Manual)

Stability analyses are presented in Appendix 4 and show that, for the conceptual embankment model constructed with engineered fill, target factors of safety are achieved.

7.3. Retaining Walls

Retaining walls may be required for local stability of cuts and fills on both sides of the road widening. Other small retaining structures might be desirable for landscaping and maintaining driveway access to existing properties. Timber pole walls may be an appropriate option to be explored for these applications, should a 50-year design life be acceptable.

Retaining walls may also be considered to support larger areas of the proposed road widening instead of large engineered fill embankments as they will allow a smaller footprint. The walls required for this height of retaining (in the order of 3 – 6m) would likely be MSE walls constructed using hardfill. MSE walls would also need to consider global stability and so may require undercut of the weaker Unit 1b soils.

Wall options could be considered in later stages as part of a costing and environmental impact analysis.

Drainage must be included behind all retaining walls to encourage any water to drain from behind the structure.

7.4. Pavements

For pavement design on in-situ soils, a California Bearing Ratio (CBR) of 3% is recommended. For the engineered fill a CBR of 5% is recommended. Testing of the subgrade is required during construction and minimum Scala Penetrometer results of 3 blows per 150mm and 5 blows per 150mm are required for design subgrades of 3% and 5% respectively.

The subgrade CBR is for insitu soils and will vary, meaning that undercutting of weaker soils and replacement with compacted granular hardfill may be required to achieve this CBR. Alternatively, weaker areas could be potentially be improved with lime and/or cement stabilisation if required, however laboratory testing is required to confirm the reactivity and improvement likely to be achieved.

7.5. Services

At present, services run down both sides of Trig Road. Services should be located and protected prior to beginning construction onsite.

Services should be located in berms and beneath footpaths to reduce traffic disruption during scheduled and unscheduled maintenance.

7.6. Sustainability

Reusing site won material, where suitable would reduce the carbon footprint of this project. Should materials need to be imported for construction, a study into locally available material should be carried out to reduce emissions from vehicles transporting material to the site. Existing chip seal could be recycled and utilised for the new pavement of the road. Alternatively, recycled aggregate products are also readily available for pavement construction.

The long-term maintenance of new assets should also be considered before proceeding into detailed design of any infrastructure.

8. Conclusions and Recommendation

Geotechnical site investigations were undertaken for the to inform the preliminary design of the proposed Trig Road upgrade. Based on the investigation, we provide the following high-level conclusions and recommendations:

- Trig Road is a Level 1 Arterial route road located in Whenuapai, Auckland road. The road runs along a minor north to south ridge. The site is predominately sloping from west to east.
- The 1:250,000 'Geology of the Auckland Area' map indicates the site is underlain by Puketoka Formation (Tauranga Group) soils overlying Waitemata Group soils and rock.

- Geological units across the site comprise firm to very stiff clayey silt from the Puketoka Formation overlying a weathered profile of the Waitemata Group.
- Groundwater has been measured across the site at 1 – 2.5mbgl.
- A seismic site subsoil of class C has been determined for Trig Road.
- The in-situ Unit 1 soils may require conditioning for reuse as engineered fill.
- All soft and/or unsuitable soils (organics, tree roots, and existing fill) should be removed from the site before the placing any fill material or construction of structures.
- Site susceptibility to liquefaction is considered to be low.
- The concept design for the Trig Road works are anticipated to have negligible effects on the natural groundwater level.
- The soils beneath the proposed concept embankments may settle under the embankment load. Settlements are expected to be between 25 – 100mm.
- Specific design such as retaining walls should be undertaken for any cuts >0.5m with adequate drainage provided.
- A design subgrade of CBR 3% for in-situ soils and 5% for engineered fill is recommended. This can vary across the site and some undercut may be required to achieve it.
- Further ground investigations and analyses will be required at detailed design stage.

9. Applicability

This report has been prepared by Beca on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

Should you be in any doubt as to the applicability of this report and/or its recommendations for the proposed development as described herein, and/or encounter materials on site that differ from those described herein, it is essential that you discuss these issues with the authors before proceeding with any work based on this document.

10. References

Beca Ltd, *January* 2020 '*Northwest HIF – Trig Road Geotechnical Factual Report.*

Edbrook, 2001 'Geology of the Auckland Area'

Standards New Zealand, 2004 NZS 1170.5: 2004 Structural Design Actions – Earthquake Actions

NZTA (2018), Bridge Manual 3, Third edition, Amendment 3

Appendix 1. Site Plans

Site Plan

Drawing Status:
DRAFT DETAILED BUSINESS CASE

A1 Scales	1:2000	A3 Scales	1:4000

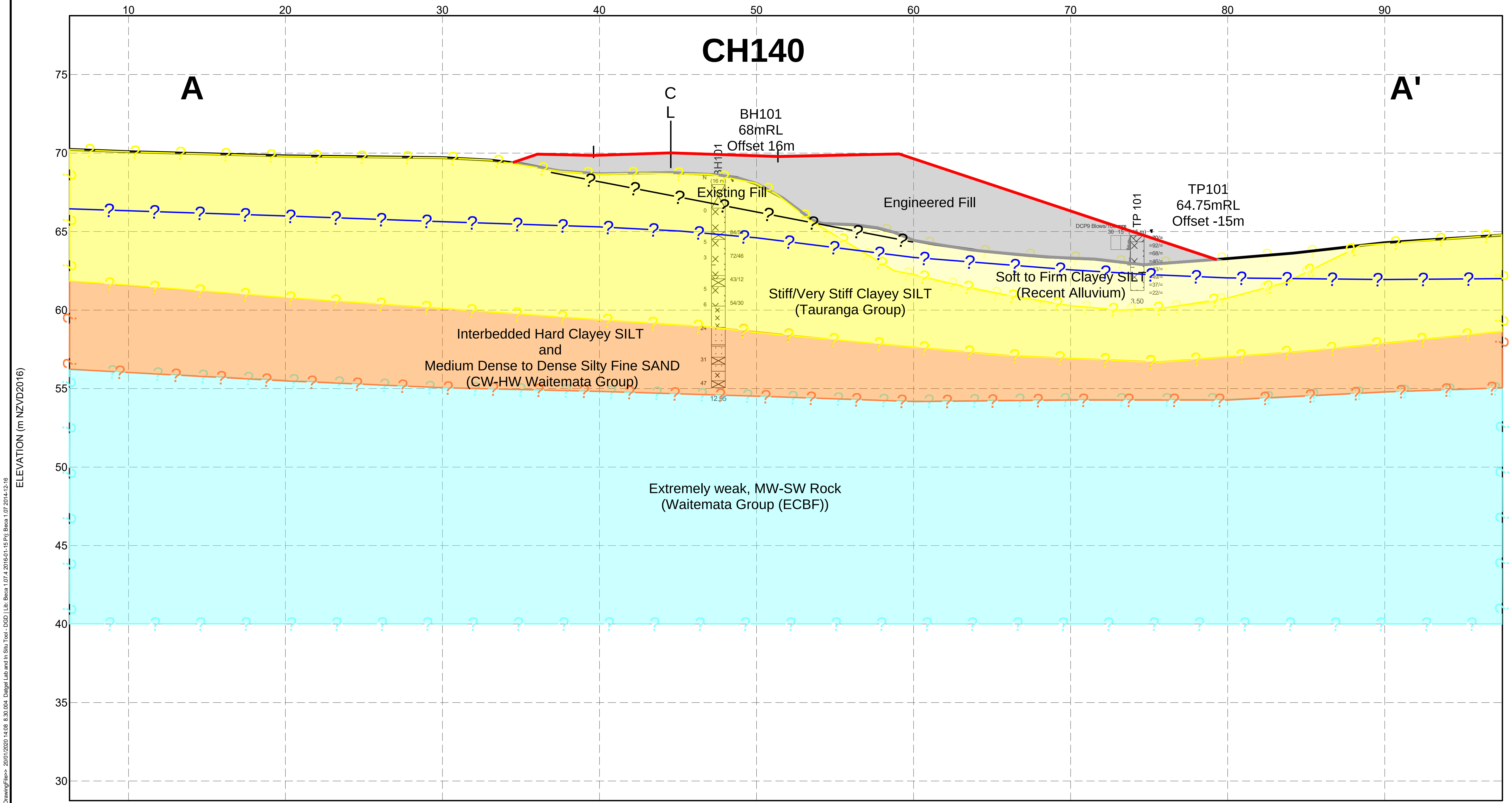
Contract Number: 0000000

ORIGINAL SIZE A1

Drawing Plotted: 24 Jul 2019 2:41 PM

SGA-DRG-NWE-002-CI-1101.DWG

Appendix 2. Geological Cross-sections



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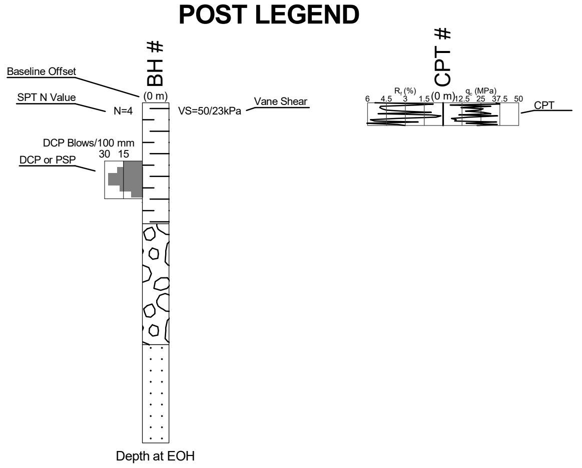


MATERIAL GRAPHIC

- No Core
- Clayey SILT
- SILT
- SILTSTONE
- SANDSTONE
- TOPSOIL

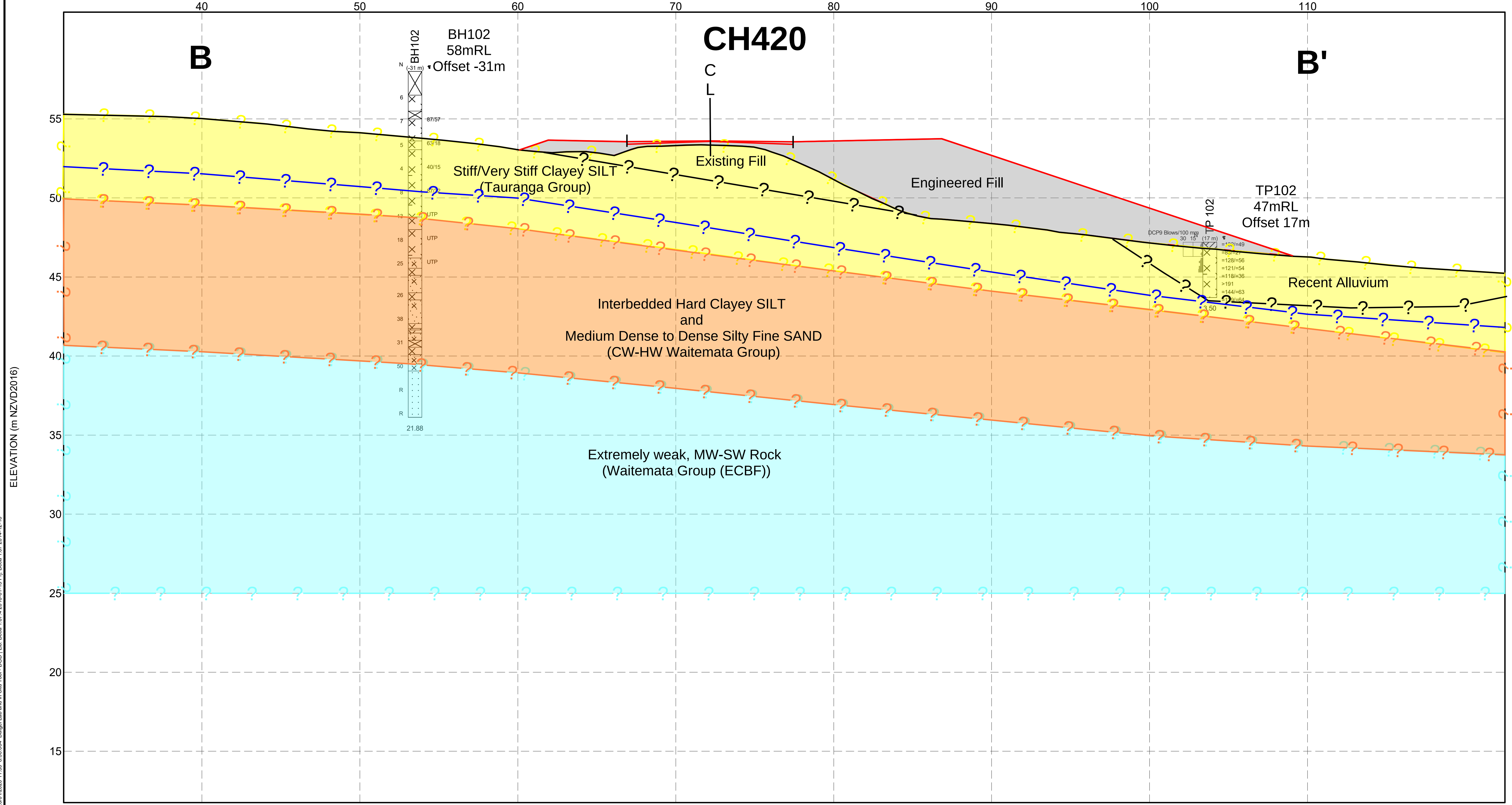
GEOLOGY

- Firm Clayey SILT
- Stiff/Very Stiff Clayey SILT
- Interbedded Hard Clayey SILT and Medium Dense Silty Fine SAND
- Extremely Weak, CW Rock
- Engineered Fill

H 1:250
V 1:250
Coord.System: Height Datum: NZVD2016

Beca

TITLE	DRAWN AC	DATE 20/01/2020
Supporting Growth Alliance Trig Road Trig Road Investigations, Kumeu Subsurface Section A A'	CHECKED JZC	DATE 20/01/2020
	SCALE H 1:250 V 1:250	A3
	PROJECT No 3810934	FIGURE No



POST LEGEND

Baseline Offset
SPT N Value
DCP Blows/100 mm
DCP or PSP
BH #
N=4
VS=50/23kPa
Vane Shear
CPT #
CPT
Depth at EOH

MATERIAL GRAPHIC

- No Core
- Clayey SILT
- SILT
- Silty SAND
- SILTSTONE
- SANDSTONE
- TOPSOIL

GEOLOGY

- Firm Clayey SILT
- Stiff/Very Stiff Clayey SILT
- Interbedded Hard Clayey SILT and Medium Dense Silty Fine SAND
- Extremely Weak, CW Rock
- Engineered Fill

H 1:250

0 2 4 6 8 10m

V 1:250

0 2 4 6 8 10m

Coord.System: Height Datum: NZVD2016

Beca	TITLE: Supporting Growth Alliance Trig Road Trig Road Investigations, Kumeu Subsurface Section B B'	DRAWN: AC	DATE: 20/01/2020	
		CHECKED: JZC	DATE: 20/01/2020	
		SCALE: H 1:250 V 1:250		A3
		PROJECT No: 3810934	FIGURE No	

Appendix 3. Peak Ground Acceleration Calculation

Calculation datasheet

job name	Supporting Growth Alliance		
job no	3810934	by	AC
date	31/01/2020	page	1 of 2

Determination of Peak Ground Accelerations (Major/MCE/CALS, Design/ULS/DCLS, Minor and SLS) with Bridge Manual (BM) SP/M/022 Third addition Amendment 3, Section 6.2.2

6.2 Design Loadings and Analysis

PGA= $C_{0,1000}\frac{R_u}{1.3}fg$

PGA = Peak ground acceleration in combination with a corresponding earthquake magnitude

$C_{0,1000}$ = 1000 year return period PGA coefficient

R_u = return period factor determined from Table 3.5 NZS 1170.5

f = site subsoil class

cl. 3.1.3 site subsoil class

choose a suitable site subsoil class	→	**Class C - Shallow soil sites**
Site subsoil class factor f	→	**1.33**
Town/ City		
Table 6A.1		
choose an area closest to the site in question	→	**Auckland**
1000 year return period PGA coefficient, $C_{0,1000}$, for the area chosen	→	**0.15**

cl. 3.1.5 return period factor, R

1170.0 table 3.2 importance levels for building types - nz structures

refer to 1170.0 table 3.2 for importance level	→	**3**

1170.0 table 3.3 annual probability of exceedance - earthquakes

1170.5 table 3.5 return period factor, R

anticipated design working life of structure	→	**100 years or more**
Annual probability of exceedance for **Design/ULS/DCLS** refer BM Table 2.1 to 2.3	→	**1/500**
Return period factor based on **Design/ULS,** R_u =	→	**1**
Annual probability of exceedance for **SLS2** refer BM Table 2.1 to 2.3 for earth retaining or slopes; refer BM Section 6.1.2b for Road operational continuity requirements	→	**1/50**
Return period factor based on **SLS2**, R_s =	→	**0.35**
Annual probability of exceedance for minor event/**SLS1** see BM Table 5.1	→	1/25
Return period factor based on **Minor Event/SLS1 (Ru/4)**, R_{minor} =	→	**0.25**
Approximate annual probability of exceedance for Major/MCE/CALS event see BM Table 5.1	→	1/1400
Return period factor based on **Major/MCE/CALS Event**, $R_{MCE/CALS}$ =	→	**1.5**

Determination of Peak Ground Accelerations (Major/MCE/CALS, Design/ULS/DCLS, Minor and SLS) with Bridge Manual (BM) SP/M/022 Third addition Amendment 3, Section 6.2.2

Summary
A Class C - Shallow soil sites is selected to evaluate the PGA for this Auckland project.
An importance level of 3 has been allocated to the structure.
Design working life of structure is 100 years or more.
As such, the PGA has been evaluated based on MCE/CALS, ULS/DCLS and SLS1.

Limit State	Annual Propability of Exceedance	Earthquake Magnitude, M_w	Return Period Factor	Unweighted PGAs C(0) = PGHA
Major/MCE/CALS	1/1400	6.50	1.5	0.285g
Design/ULS/DCLS	1/500	6.50	1	0.19g
Minor/SLS1	1/25	5.90	0.75	0.115g
SLS2	1/50	5.90	0.35	0.054g

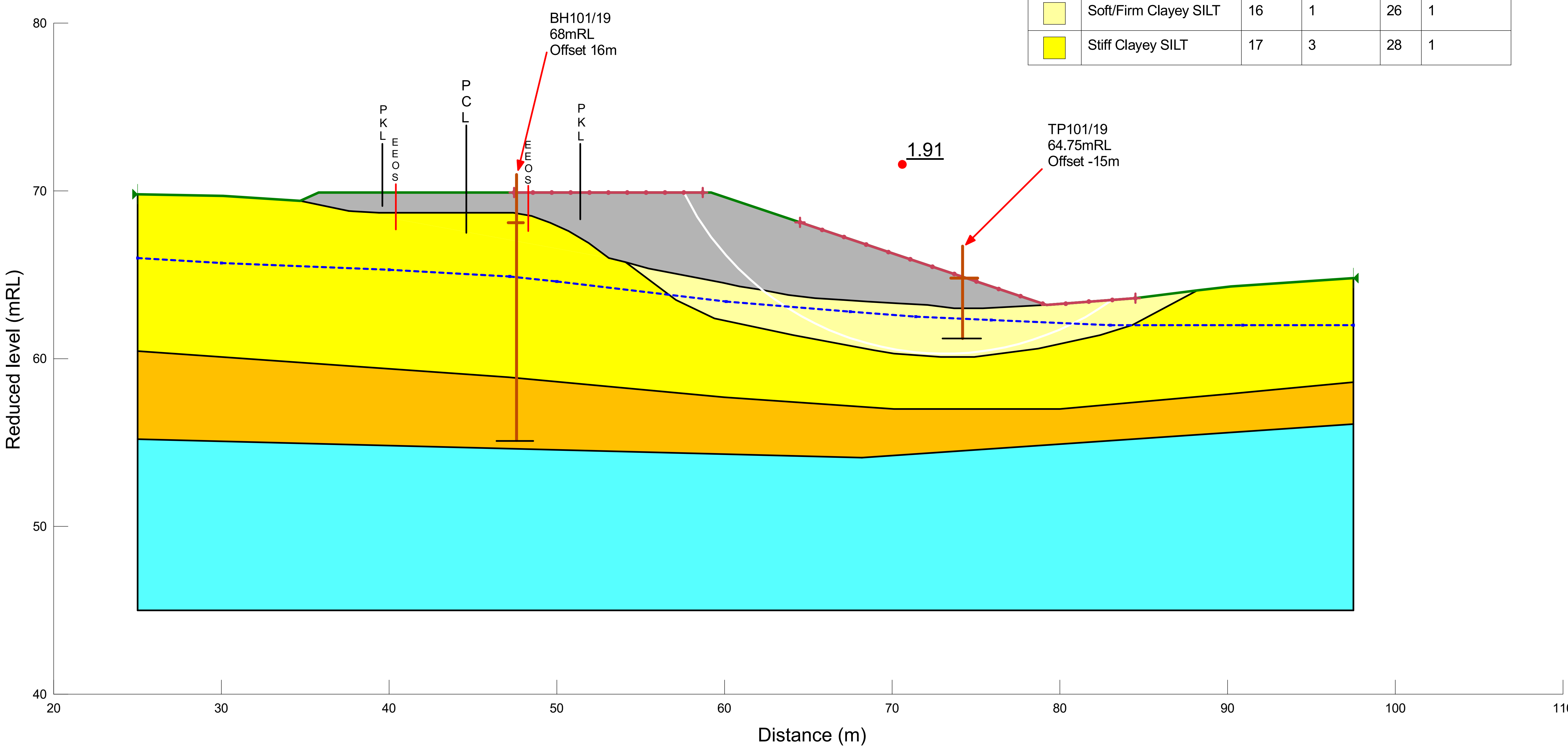
Appendix 4. Slope Stability Analysis

Horz Seismic Coef.:
Staged Pseudo Static Analysis Option: (none)

Method: Morgenstern-Price

Trig Road - CH140

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	ECBF ROCK	18	10	36	1
	Engineered Fill	18	5	30	1
	Interbeded Hard Clayey SILT/Medium Dense Silty Fine SAND	18	3	30	1
	Soft/Firm Clayey SILT	16	1	26	1
	Stiff Clayey SILT	17	3	28	1



Beca

Supporting Growth Alliance
Trig Road

Supporting Growth Alliance - Trig Road.gsz
1.0 Static

Job Number: 3810934	Date: 30/01/2020
Scale: 1:250	Figure 4.1

Version: 10.0.1.17733

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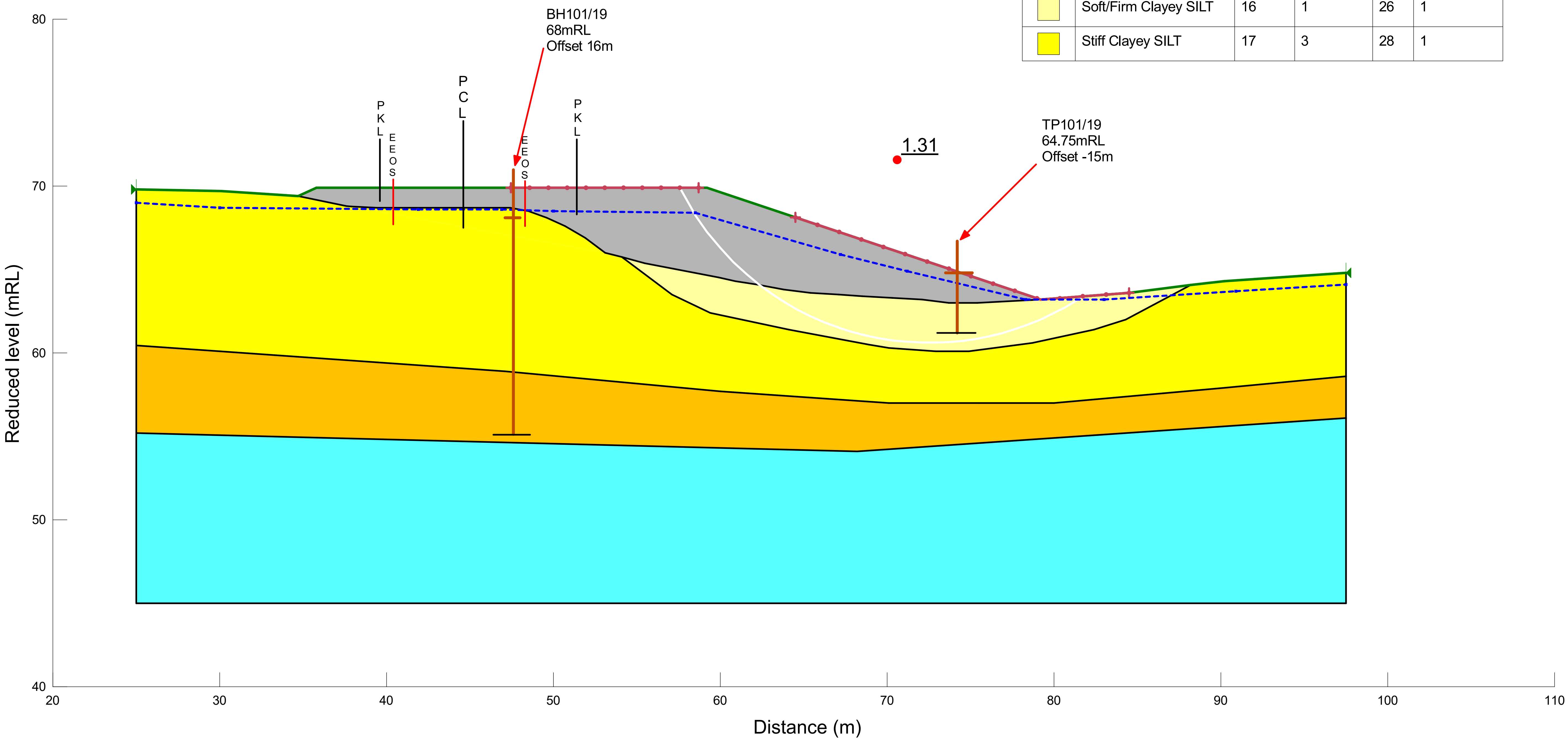
DO NOT SCALE

Horz Seismic Coef.:
Staged Pseudo Static Analysis Option: (none)

Method: Morgenstern-Price

Trig Road - CH140

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	ECBF ROCK	18	10	36	1
	Engineered Fill	18	5	30	1
	Interbeded Hard Clayey SILT/Medium Dense Silty Fine SAND	18	3	30	1
	Soft/Firm Clayey SILT	16	1	26	1
	Stiff Clayey SILT	17	3	28	1



Beca

Supporting Growth Alliance
Trig Road

Supporting Growth Alliance - Trig Road.gsz
2.0 Elevated Water Level

Job Number: 3810934	Date: 30/01/2020
Scale: 1:250	Figure 4.2

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DO NOT SCALE

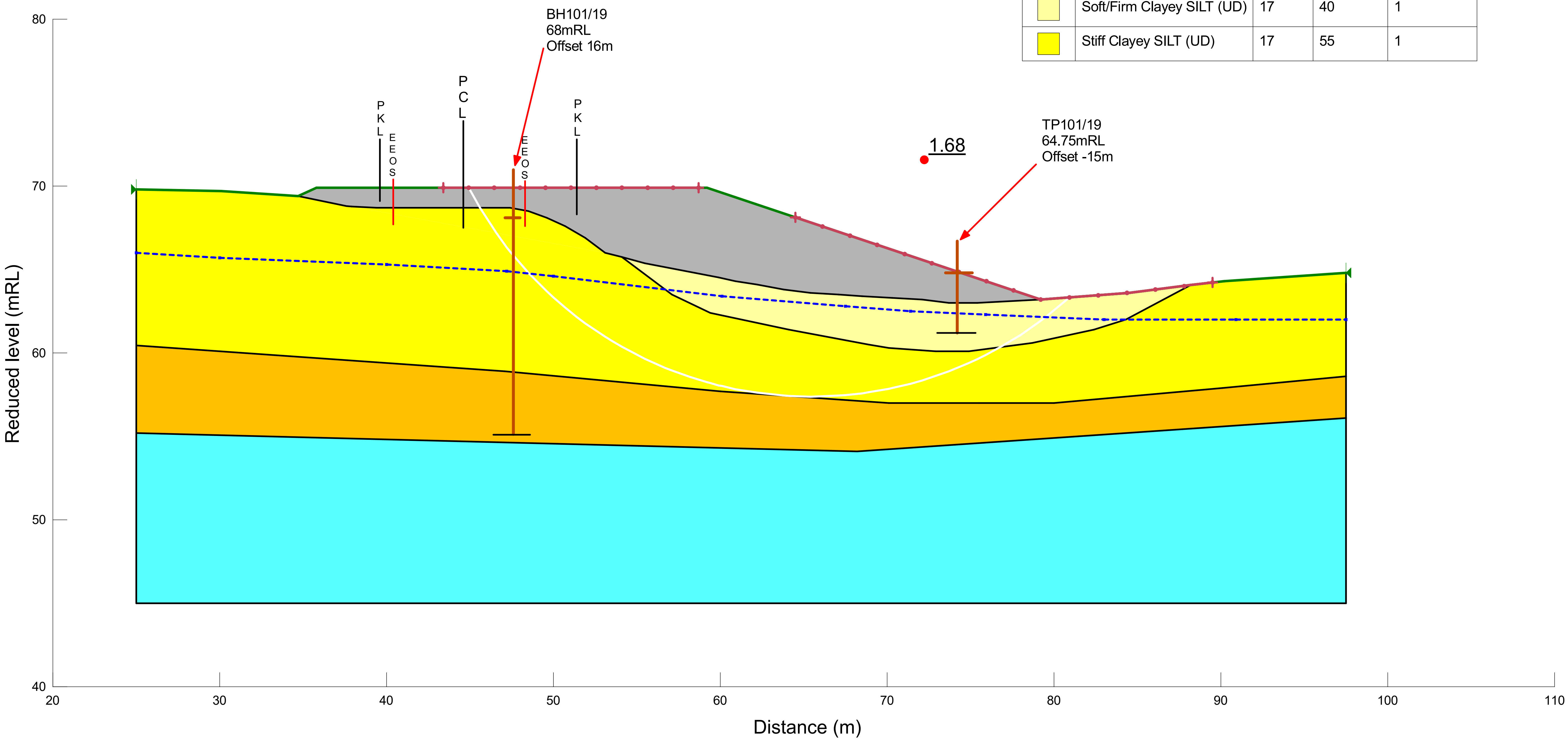
Version: 10.0.1.17733

Horz Seismic Coef.: 0.19
Staged Pseudo Static Analysis Option: (none)

Method: Morgenstern-Price

Trig Road - CH140

Color	Name	Unit Weight (kN/m³)	Cohesion (kPa)	Piezometric Line
	ECBF ROCK (UD)	18	500	1
	Engineered Fill (UD)	18	100	1
	Interbeded Hard Clayey SILT/Medium Dense Silty Fine SAND (UD)	18	125	1
	Soft/Firm Clayey SILT (UD)	17	40	1
	Stiff Clayey SILT (UD)	17	55	1



Supporting Growth Alliance
Trig Road

Supporting Growth Alliance - Trig Road.gsz
3.0 Seismic ULS

Job Number: 3810934	Date: 30/01/2020
Scale: 1:250	Figure 4.3

Version: 10.0.1.17733

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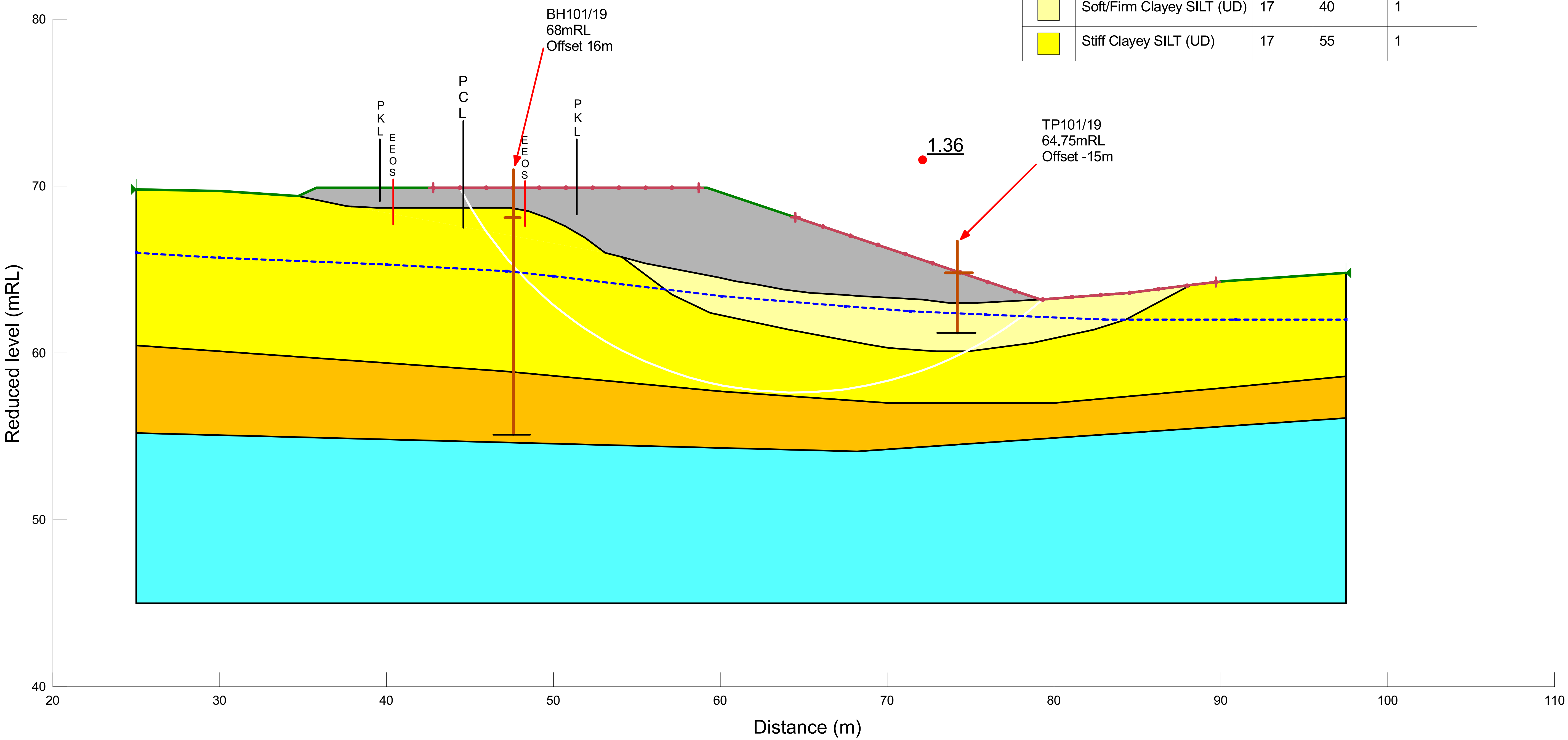
DO NOT SCALE

Horz Seismic Coef.: 0.29
Staged Pseudo Static Analysis Option: (none)

Method: Morgenstern-Price

Trig Road - CH140

Color	Name	Unit Weight (kN/m³)	Cohesion (kPa)	Piezometric Line
	ECBF ROCK (UD)	18	500	1
	Engineered Fill (UD)	18	100	1
	Interbeded Hard Clayey SILT/Medium Dense Silty Fine SAND (UD)	18	125	1
	Soft/Firm Clayey SILT (UD)	17	40	1
	Stiff Clayey SILT (UD)	17	55	1



Beca	Supporting Growth Alliance Trig Road	Supporting Growth Alliance - Trig Road.gsz 3.1 Seismic MCE	Job Number: 3810934	Date: 30/01/2020
			Scale: 1:250	Figure 4.4

Version: 10.0.1.17733

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DO NOT SCALE

ATTACHMENT 24

RECORD OF TITLE

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier 376597
Land Registration District North Auckland
Date Issued 18 November 2011

Prior References
110147

Estate	Fee Simple
Area	356 square metres more or less
Legal Description	Lot 2 Deposited Plan 394135

Registered Owners
Zhongdong Yang

Estate	Fee Simple - 1/4 share
Area	108 square metres more or less
Legal Description	Lot 5 Deposited Plan 394135

Registered Owners
Zhongdong Yang

Interests

C428346.1 Certificate pursuant to Section 94C Transit New Zealand Act 1989 declaring that part of State Highway 18 known as Hobsonville Road, commencing at its junction with State Highway 16 and proceeding in an eastern direction to Upper Harbour Drive to be a limited access road - 5.11.1992 at 2.01 pm

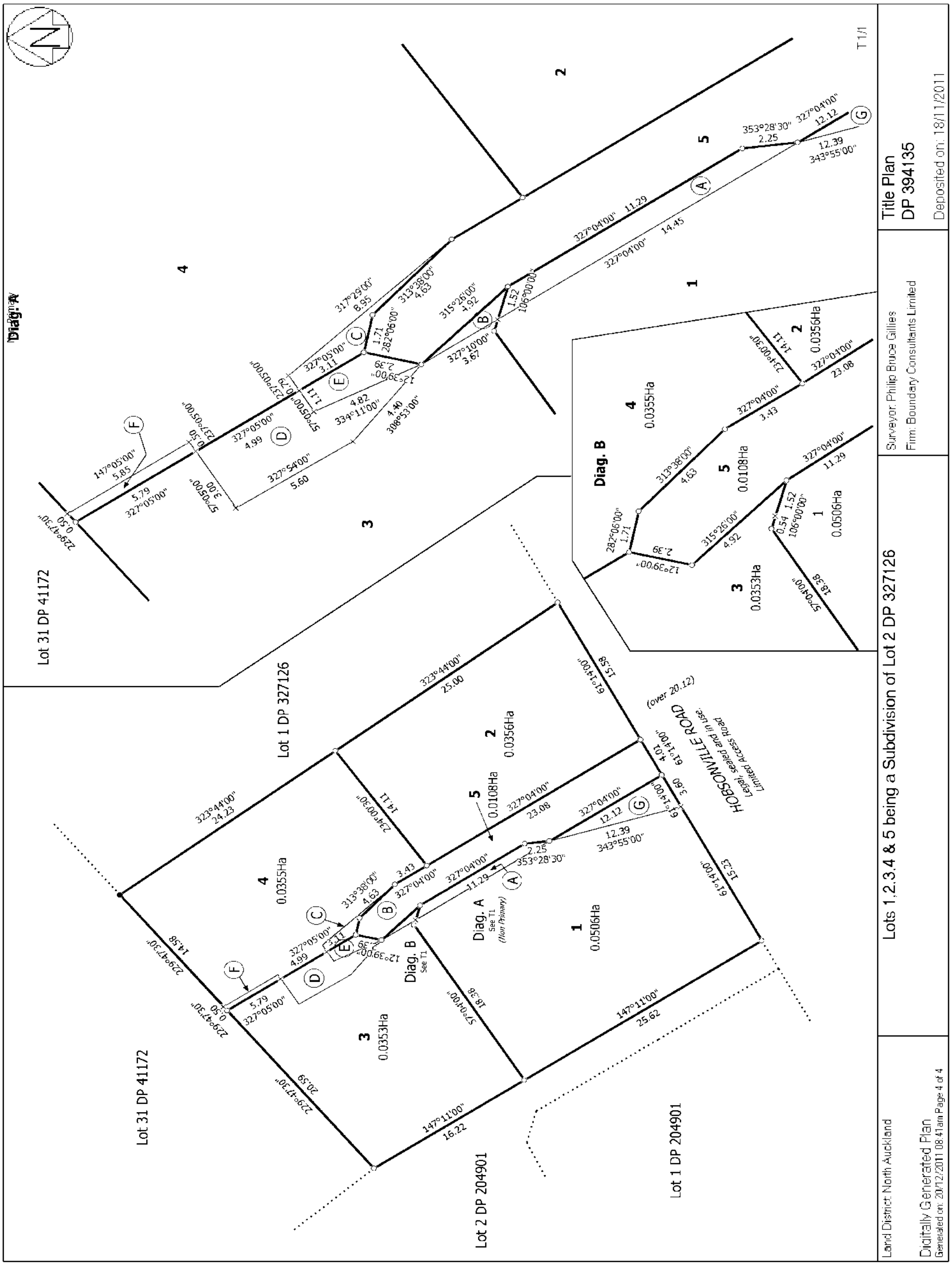
Appurtenant hereto is a stormwater drainage right created by Easement Instrument 5845394.3 - 18.12.2003 at 9:34 am

The easements created by Easement Instrument 5845394.3 are subject to Section 243 (a) Resource Management Act 1991

8887148.1 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 18.11.2011 at 4:46 pm (affects Lot 2 DP 394135)

Subject to Section 241(2) Resource Management Act 1991 (affects DP 394135)

10966609.4 Mortgage to Industrial and Commercial Bank of China (New Zealand) Limited - 30.11.2017 at 4:51 pm


Title Plan
DP 394135
Deposited on: 18/11/2011
Surveyor: Philip Bruce Gillies
Firm: Boundary Consultants Limited
Lots 1,2,3,4 & 5 being a Subdivision of Lot 2 DP 327126
Land District: North Auckland
Digitally Generated Plan
HOBSONVILLE ROAD
Lot 31 DP 41172
Lot 1 DP 327126
Lot 2 DP 204901
Lot 1 DP 204901
Diag. A
Diag. B
T1/1

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier 376598
Land Registration District North Auckland
Date Issued 18 November 2011

Prior References
110147

Estate	Fee Simple
Area	353 square metres more or less
Legal Description	Lot 3 Deposited Plan 394135

Registered Owners
Jieun An

Estate	Fee Simple - 1/4 share
Area	108 square metres more or less
Legal Description	Lot 5 Deposited Plan 394135

Registered Owners
Jieun An

Interests

C428346.1 Certificate pursuant to Section 94C Transit New Zealand Act 1989 declaring that part of State Highway 18 known as Hobsonville Road, commencing at its junction with State Highway 16 and proceeding in an eastern direction to Upper Harbour Drive to be a limited access road - 5.11.1992 at 2.01 pm

Appurtenant hereto is a stormwater drainage right created by Easement Instrument 5845394.3 - 18.12.2003 at 9:34 am

The easements created by Easement Instrument 5845394.3 are subject to Section 243 (a) Resource Management Act 1991

8887148.1 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 18.11.2011 at 4:46 pm (affects Lot 3 DP 394135)

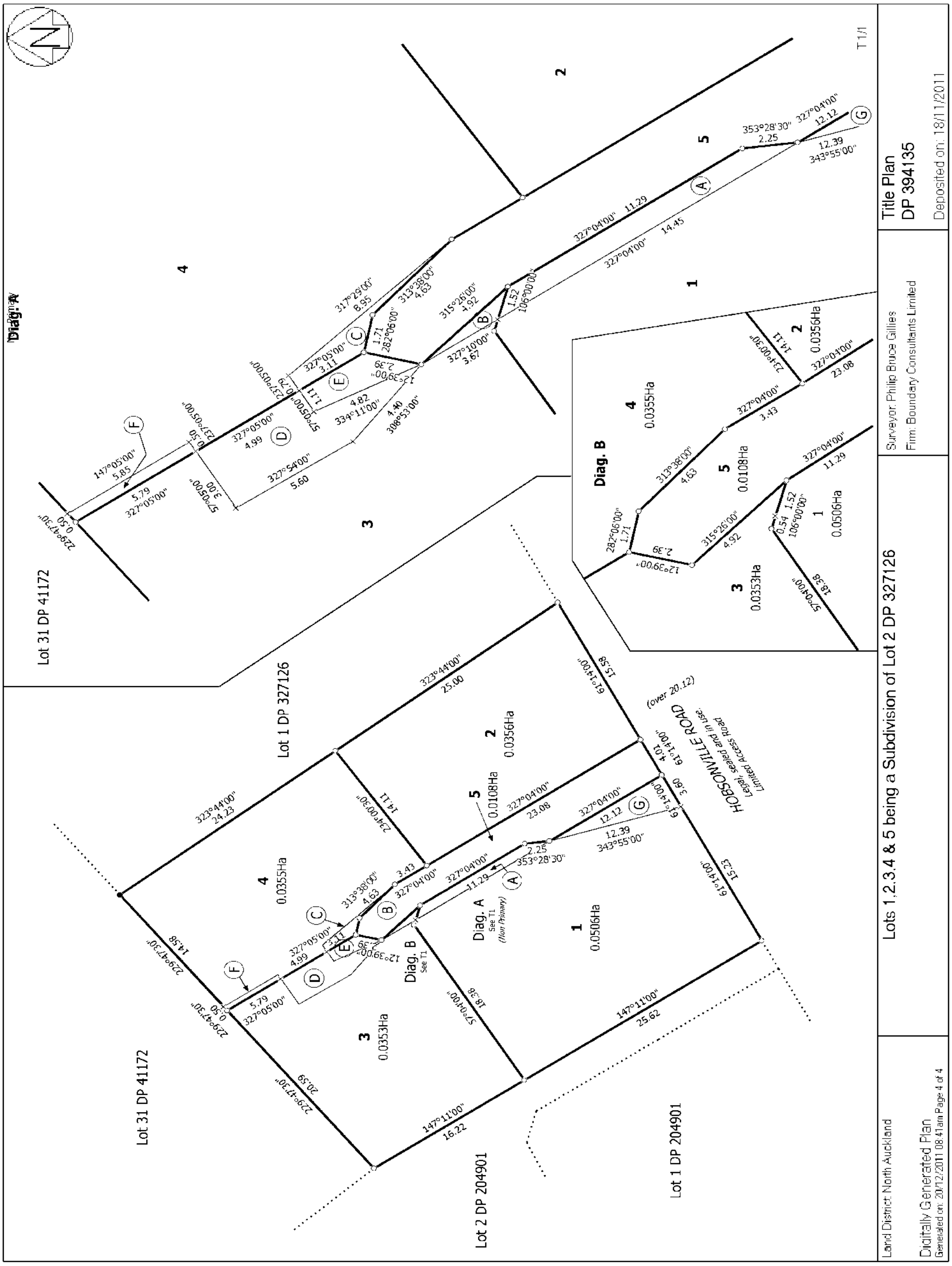
Subject to Section 241(2) Resource Management Act 1991 (affects DP 394135)

Subject to a right to convey electricity, gas, telecommunications, water and computer media over part Lot 3 DP 394135 marked B on DP 394135, stormwater drainage easement over part Lot 3 DP 394135 marked D on DP 394135 and right of way and stormwater drainage easement over part Lot 3 DP 394135 marked E on DP 394135 created by Easement Instrument 8887148.5 - 18.11.2011 at 4:46 pm

Appurtenant hereto is a right to convey electricity, gas, telecommunications, water and computer media and stormwater drainage easement and appurtenant to Lot 3 DP 394135 herein is a right of way created by Easement Instrument 8887148.5 - 18.11.2011 at 4:46 pm

Some of the easements created by Easement Instrument 8887148.5 are subject to Section 243 (a) Resource Management Act 1991 (see DP 394135)

11616310.3 Mortgage to ANZ Bank New Zealand Limited - 29.11.2019 at 4:16 pm


T1/1
Title Plan
DP 394135
Deposited on: 18/11/2011
Surveyor: Philip Bruce Gillies
Firm: Boundary Consultants Limited
Lots 1,2,3,4 & 5 being a Subdivision of Lot 2 DP 327126
Land District: North Auckland
Digitally Generated Plan
Diag. B
Diag. A
HOBSONVILLE ROAD
Lot 31 DP 41172
Lot 1 DP 327126
Lot 2 DP 204901
Lot 1 DP 204901
1 0.0506Ha
2 0.0356Ha
3 0.0353Ha
4 0.0355Ha
5 0.0108Ha

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier 376599
Land Registration District North Auckland
Date Issued 18 November 2011

Prior References
110147

Estate	Fee Simple
Area	355 square metres more or less
Legal Description	Lot 4 Deposited Plan 394135

Registered Owners
Yinan Pan and Jiayi Chen

Estate	Fee Simple - 1/4 share
Area	108 square metres more or less
Legal Description	Lot 5 Deposited Plan 394135

Registered Owners
Yinan Pan and Jiayi Chen

Interests

C428346.1 Certificate pursuant to Section 94C Transit New Zealand Act 1989 declaring that part of State Highway 18 known as Hobsonville Road, commencing at its junction with State Highway 16 and proceeding in an eastern direction to Upper Harbour Drive to be a limited access road - 5.11.1992 at 2.01 pm

Appurtenant hereto is a stormwater drainage right created by Easement Instrument 5845394.3 - 18.12.2003 at 9:34 am

The easements created by Easement Instrument 5845394.3 are subject to Section 243 (a) Resource Management Act 1991

8887148.1 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 18.11.2011 at 4:46 pm (affects Lot 4 DP 394135)

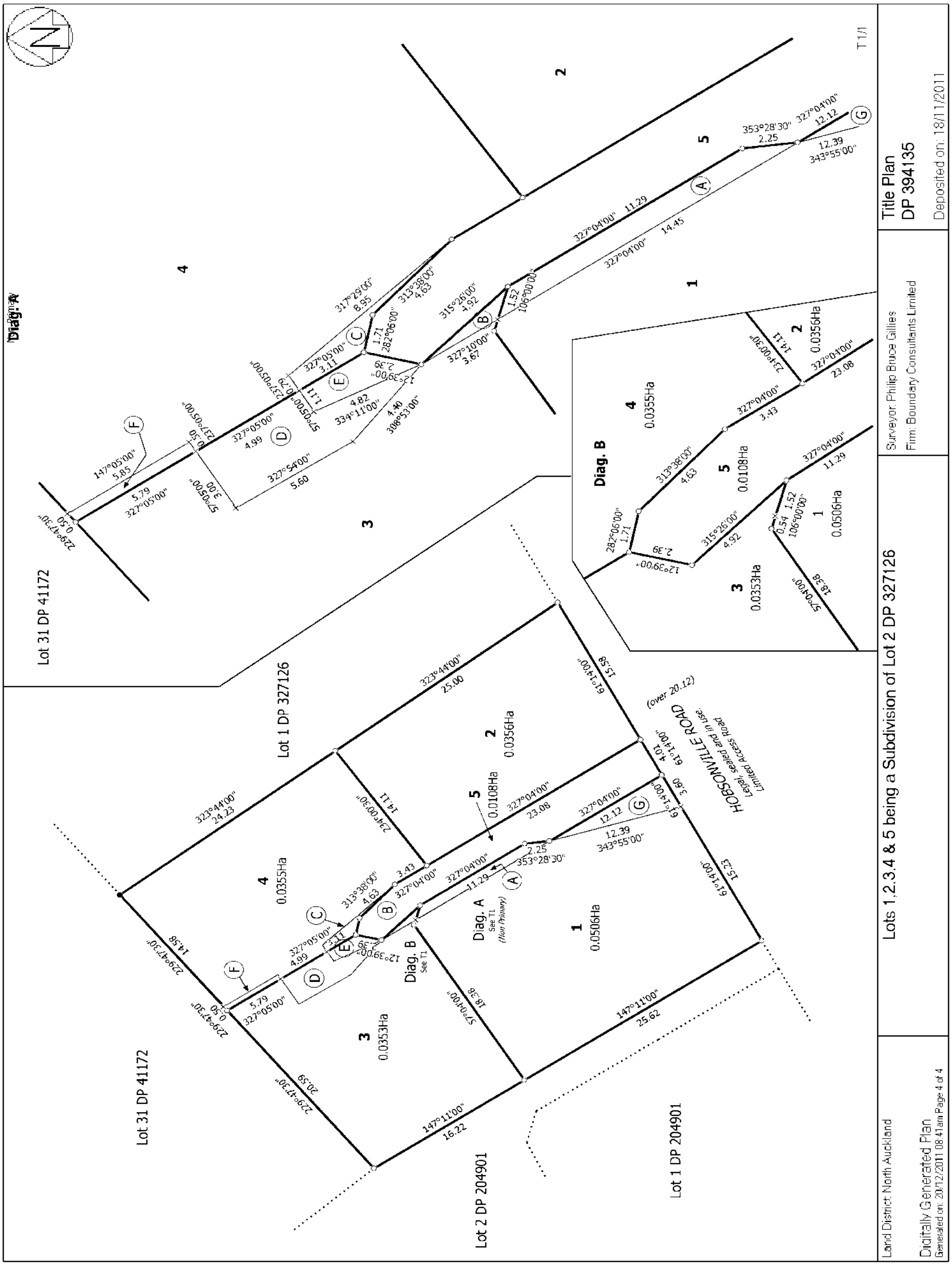
Subject to Section 241(2) Resource Management Act 1991 (affects DP 394135)

Subject to a right of way over part Lot 4 DP 394135 marked C on DP 394135 and stormwater drainage easement over part Lot 4 DP 394135 marked F on DP 394135 created by Easement Instrument 8887148.5 - 18.11.2011 at 4:46 pm

Appurtenant hereto is a stormwater drainage easement, right to convey electricity, gas, telecommunications, water and computer media and appurtenant to Lot 4 DP 394135 herein is a right of way created by Easement Instrument 8887148.5 - 18.11.2011 at 4:46 pm

Some of the easements created by Easement Instrument 8887148.5 are subject to Section 243 (a) Resource Management Act 1991 (see DP 394135)

10023146.2 Mortgage to ANZ Bank New Zealand Limited - 14.4.2015 at 6:09 pm


T1/1
Title Plan
DP 394135
Deposited on: 18/11/2011
Surveyor: Philip Bruce Gillies
Firm: Boundary Consultants Limited
Lots 1,2,3,4 & 5 being a Subdivision of Lot 2 DP 327126
Land District: North Auckland
Digitally Generated Plan
Diag. B
Lot 31 DP 41172
Lot 1 DP 327126
Lot 2 DP 204901
Lot 1 DP 204901
HOBSONVILLE ROAD
Limited Access Road
Legal, sealed and in use.
(over 20.12)
Diag. A
Diag. B
1
0.0506Ha
2
0.0356Ha
3
0.0353Ha
4
0.0355Ha
5
0.0108Ha

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
GAZETTE NOTICE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**570610**
Land Registration District	**North Auckland**
Date Registered	10 November 2011 07:00 am

Prior References
NA26B/617

Type	Fee Simple	**Instrument**	GN 8910540.4
Area	4.3746 hectares more or less		
Legal Description	Section 7 Survey Office Plan 445955		
Purpose	Severance		

Registered Owners
Her Majesty the Queen

Interests

Title Diagram GN 8910540.4

Cpy - 01/01, Pgs - 001, 21/11/11, 14:37

DocID: 512981060

Extract from *New Zealand Gazette*, 3/11/2011, No. 168, p. 4704

Severance Taken—State Highway 16, Hobsonville, Auckland

Pursuant to section 119(1) of the Public Works Act 1981, and to a delegation from the Minister for Land Information, Ronald Alistair Jolly, Land Information New Zealand, declares the land described in the Schedule to this notice to be taken as severance and shall remain vested in the Crown on the date of publication hereof in the *New Zealand Gazette*.

North Auckland Land District—Auckland

Schedule

Severance

Area ha	Description
4.3746	Part Lot 1 DP 67207 (part Computer Freehold Register NA26B/617); shown as Section 7 on SO 445955.

Dated at Wellington this 27th day of October 2011.

R. A. JOLLY, for the Minister for Land Information.

(LINZ CPC/2011/16290)

ln7673

NOTICE NO: 7673

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
GAZETTE NOTICE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **579742**
Land Registration District **North Auckland**
Date Registered 28 March 2012 07:00 am

Prior References

6039970.1	D622123.1	NA21C/1292
NA41D/693	NA41D/696	

Type	Fee Simple	**Instrument**	GN 9023653.1
Area	266 square metres more or less		
Legal Description	Section 35, 41-42, 45-46, 49, 51-54 Survey Office Plan 447691		
Purpose	for the Functioning Indirectly of a Road (Segregation Strip)		

Registered Owners
Her Majesty The Queen

Interests

Extract from *New Zealand Gazette*, 22/3/2012, No. 35, p. 1070

Land Declared Road and Segregation Strip—State Highway 18, Hobsonville, Auckland

Pursuant to the Public Works Act 1981, and to a delegation from the Minister for Land Information, Kerry McPhail, Land Information New Zealand:

(a) Pursuant to section 114, declares the land described in the First Schedule to this notice to be road which, pursuant to section 5 of the Land Transport Management Act 2003, forms part of State Highway 18 and remains vested in the Crown and which has the effect of adding the land in the Second Schedule to State Highway 18, pursuant to section 5 of the Land Transport Management Act 2003, and vests in the Crown;

(b) Declares the land described in the Third Schedule to this notice to be set apart, pursuant to section 52(1), for the functioning indirectly of a road (segregation strip) and shall remain vested in the Crown;

(c) Pursuant to section 116, declares the road described in the Fourth Schedule to this notice to be stopped and, pursuant to section 52(1), is set apart for the functioning indirectly of a road (segregation strip) and shall remain vested in the Crown

on the date of publication hereof in the *New Zealand Gazette*.

North Auckland Land District—Auckland

First Schedule

Land Declared as Road

Area ha	Description
1.4493	Part Section 1 SO 70438 (part Gazette Notice D622123.1); shown as Section 1 on SO 447691.
1.6878	Part Lot 7 DP 62344 (part Computer Freehold Register NA41D/696); shown as Section 4 on SO 447691.
1.0303	Part Lot 4 DP 62344 (part Computer Freehold Register NA41D/693); shown as Section 5 on SO 447691.
2.6396	Part Section 1 SO 332263 (part Gazette Notice 6039970.1); shown as Section 11 on SO 447691.
2.9965	Part Lot 2 DP 66045 (part Computer Freehold Register NA21C/1292); shown as Section 12 on SO 447691.

Second Schedule

Legal Road to be Added to State Highway

Area m^2	Description
9838	Part Legal Road (Trig Road); shown as Section 13 on SO 447691.
2908	Part Legal Road (Trig Road); shown as Section 23 on SO 447691.
5	Part Legal Road (Trig Road); shown as Section 43 on SO 447691.
7	Part Legal Road (Trig Road); shown as Section 44 on SO 447691.
57	Part Legal Road (Trig Road); shown as Section 59 on SO 447691.

Third Schedule

Land Set Apart for the Functioning Indirectly of a Road (Segregation Strip)

Area m^2	Description
36	Part Lot 7 DP 62344 (part Computer Freehold Register NA41D/696); shown as Section 35 on SO 447691.
10	Part Section 1 SO 332263 (part Gazette Notice 6039970.1); shown as Section 41 on SO 447691.
11	Part Section 1 SO 332263 (part Gazette Notice 6039970.1); shown as Section 42 on SO 447691.
1	Part Section 1 SO 332263 (part Gazette Notice 6039970.1); shown as Section 45 on SO 447691.
87	Part Lot 2 DP 66045 (part Computer Freehold Register NA21C/1292); shown as Section 46 on SO 447691.
1	Part Lot 4 DP 62344 (part Computer Freehold Register NA41D/693); shown as Section 49 on SO 447691.
40	Part Lot 4 DP 62344 (part Computer Freehold Register NA41D/693); shown as Section 51 on SO 447691.
8	Part Lot 7 DP 62344 (part Computer Freehold Register NA41D/696); shown as Section 52 on SO 447691.
24	Part Lot 7 D 62344 (part Computer Freehold Register NA41D/696); shown as Section 53 on SO 447691.
48	Part Section 1 SO 70438 (balance Gazette Notice D622123.1); shown as Section 54 on SO 447691.

Fourth Schedule

Road Stopped and Set Apart for the Functioning Indirectly of a Road (Segregation Strip)

Area m^2	Description
5	Part State Highway; shown as Section 43 on SO 447691.
7	Part State Highway; shown as Section 44 on SO 447691.
57	Part State Highway; shown as Section 59 on SO 447691.

Dated at Wellington this 15th day of March 2012.

K. MCPHAIL, for the Minister for Land Information.

(LINZ CPC/2011/16289)

ln1753

Title Diagram Title Dia

Cpy - 01/01,Pgs - 001,12/04/12,08:16

DocID. 513223450

NOTICE NO: 1753

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
GAZETTE NOTICE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**579743**
Land Registration District	**North Auckland**
Date Registered	28 March 2012 07:00 am

Prior References
9023653.1

Type	Fee Simple	**Instrument**	GN 9023653.1
Area	69 square metres more or less		
Legal Description	Section 43-44, 59 Survey Office Plan 447691		
Purpose	for the Functioning Indirectly of a Road (Segregation Strip)		

Registered Owners
Her Majesty the Queen

Interests

Extract from *New Zealand Gazette*, 22/3/2012, No. 35, p. 1070

Land Declared Road and Segregation Strip—State Highway 18, Hobsonville, Auckland

Pursuant to the Public Works Act 1981, and to a delegation from the Minister for Land Information, Kerry McPhail, Land Information New Zealand:

(a) Pursuant to section 114, declares the land described in the First Schedule to this notice to be road which, pursuant to section 5 of the Land Transport Management Act 2003, forms part of State Highway 18 and remains vested in the Crown and which has the effect of adding the land in the Second Schedule to State Highway 18, pursuant to section 5 of the Land Transport Management Act 2003, and vests in the Crown;

(b) Declares the land described in the Third Schedule to this notice to be set apart, pursuant to section 52(1), for the functioning indirectly of a road (segregation strip) and shall remain vested in the Crown;

(c) Pursuant to section 116, declares the road described in the Fourth Schedule to this notice to be stopped and, pursuant to section 52(1), is set apart for the functioning indirectly of a road (segregation strip) and shall remain vested in the Crown

on the date of publication hereof in the *New Zealand Gazette*.

North Auckland Land District—Auckland

First Schedule

Land Declared as Road

Area ha	Description
1.4493	Part Section 1 SO 70438 (part Gazette Notice D622123.1); shown as Section 1 on SO 447691.
1.6878	Part Lot 7 DP 62344 (part Computer Freehold Register NA41D/696); shown as Section 4 on SO 447691.
1.0303	Part Lot 4 DP 62344 (part Computer Freehold Register NA41D/693); shown as Section 5 on SO 447691.
2.6396	Part Section 1 SO 332263 (part Gazette Notice 6039970.1); shown as Section 11 on SO 447691.
2.9965	Part Lot 2 DP 66045 (part Computer Freehold Register NA21C/1292); shown as Section 12 on SO 447691.

Second Schedule

Legal Road to be Added to State Highway

Area m^2	Description
9838	Part Legal Road (Trig Road); shown as Section 13 on SO 447691.
2908	Part Legal Road (Trig Road); shown as Section 23 on SO 447691.
5	Part Legal Road (Trig Road); shown as Section 43 on SO 447691.
7	Part Legal Road (Trig Road); shown as Section 44 on SO 447691.
57	Part Legal Road (Trig Road); shown as Section 59 on SO 447691.

Third Schedule

Land Set Apart for the Functioning Indirectly of a Road (Segregation Strip)

Area m^2	Description
36	Part Lot 7 DP 62344 (part Computer Freehold Register NA41D/696); shown as Section 35 on SO 447691.
10	Part Section 1 SO 332263 (part Gazette Notice 6039970.1); shown as Section 41 on SO 447691.
11	Part Section 1 SO 332263 (part Gazette Notice 6039970.1); shown as Section 42 on SO 447691.
1	Part Section 1 SO 332263 (part Gazette Notice 6039970.1); shown as Section 45 on SO 447691.
87	Part Lot 2 DP 66045 (part Computer Freehold Register NA21C/1292); shown as Section 46 on SO 447691.
1	Part Lot 4 DP 62344 (part Computer Freehold Register NA41D/693); shown as Section 49 on SO 447691.
40	Part Lot 4 DP 62344 (part Computer Freehold Register NA41D/693); shown as Section 51 on SO 447691.
8	Part Lot 7 DP 62344 (part Computer Freehold Register NA41D/696); shown as Section 52 on SO 447691.
24	Part Lot 7 D 62344 (part Computer Freehold Register NA41D/696); shown as Section 53 on SO 447691.
48	Part Section 1 SO 70438 (balance Gazette Notice D622123.1); shown as Section 54 on SO 447691.

Fourth Schedule

Road Stopped and Set Apart for the Functioning Indirectly of a Road (Segregation Strip)

Area m^2	Description
5	Part State Highway; shown as Section 43 on SO 447691.
7	Part State Highway; shown as Section 44 on SO 447691.
57	Part State Highway; shown as Section 59 on SO 447691.

Dated at Wellington this 15th day of March 2012.

K. MCPHAIL, for the Minister for Land Information.

(LINZ CPC/2011/16289)

ln1753

Title Diagram Title Dia
Cpy - 01/01, Pgs - 001, 12/04/12, 08:18
DocID: 513223459

NOTICE NO: 1753

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**649590**
Land Registration District	**North Auckland**
Date Issued	17 October 2014

Prior References
NA1921/84

Estate	Fee Simple
Area	459 square metres more or less
Legal Description	Lot 1 Deposited Plan 467569

Registered Owners

Samuel Joseph Peterson as to a 1/2 share

Janessa Rachelle Bartsch as to a 1/2 share

Interests

9858227.5 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 17.10.2014 at 5:09 pm

Subject to a right to convey telecommunications and computer media in gross over part marked A on DP 467569 in favour of Chorus New Zealand Limited created by Easement Instrument 9858227.6 - 17.10.2014 at 5:09 pm

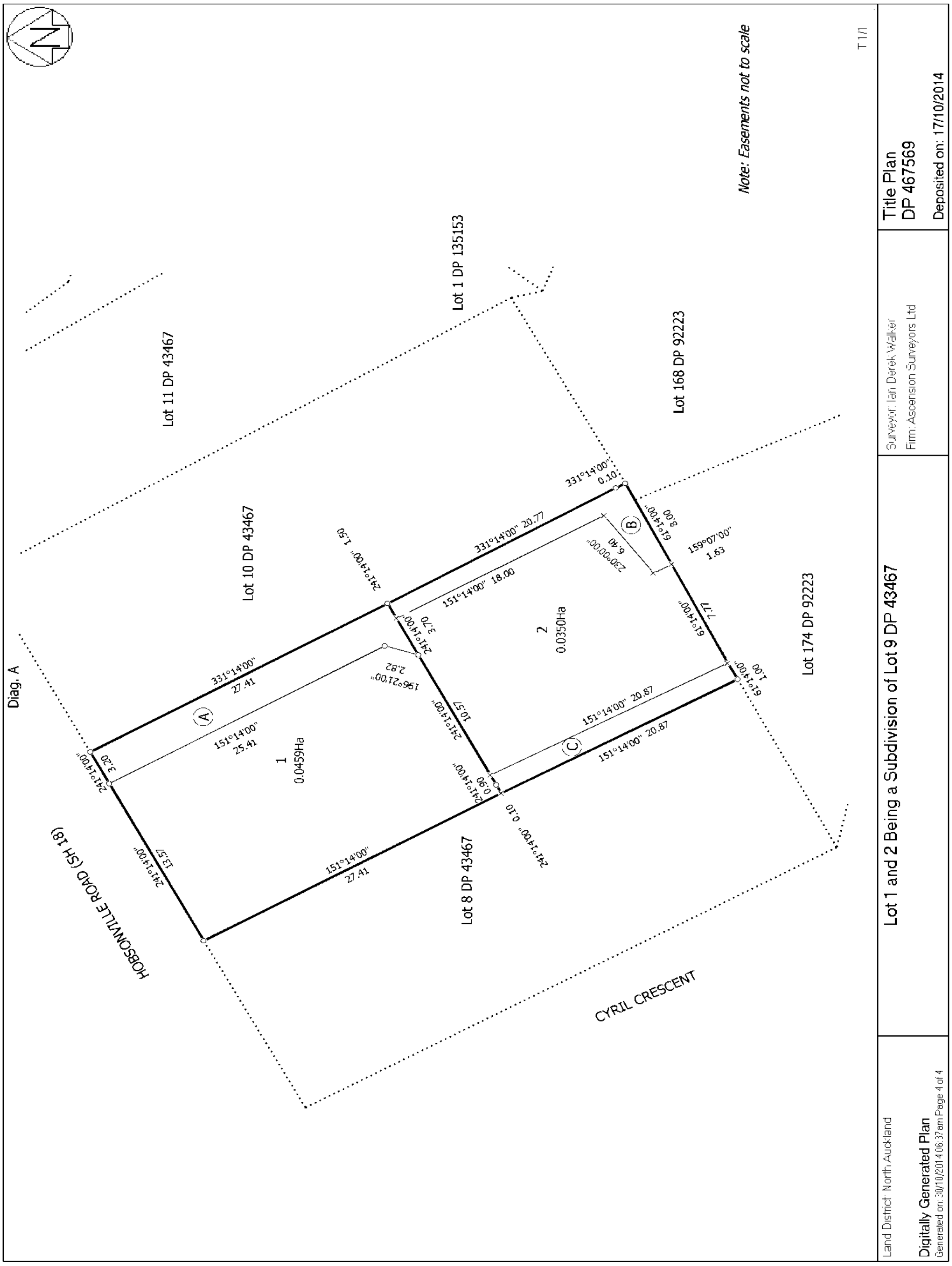
Subject to a right of way and a right to convey water, electricity, telecommunications and computer media over part marked A on DP 467569 created by Easement Instrument 9858227.8 - 17.10.2014 at 5:09 pm

Appurtenant hereto is a right to convey wastewater created by Easement Instrument 9858227.8 - 17.10.2014 at 5:09 pm

The easements created by Easement Instrument 9858227.8 are subject to Section 243 (a) Resource Management Act 1991

10042305.3 Mortgage to Westpac New Zealand Limited - 30.4.2015 at 4:41 pm

Identifier **649590**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**756484**
Land Registration District	**North Auckland**
Date Issued	06 November 2017

Prior References
NA106C/432 NA106C/433

Estate	Fee Simple
Area	890 square metres more or less
Legal Description	Lot 1-2 Deposited Plan 503537 and Lot 2 Deposited Plan 173673

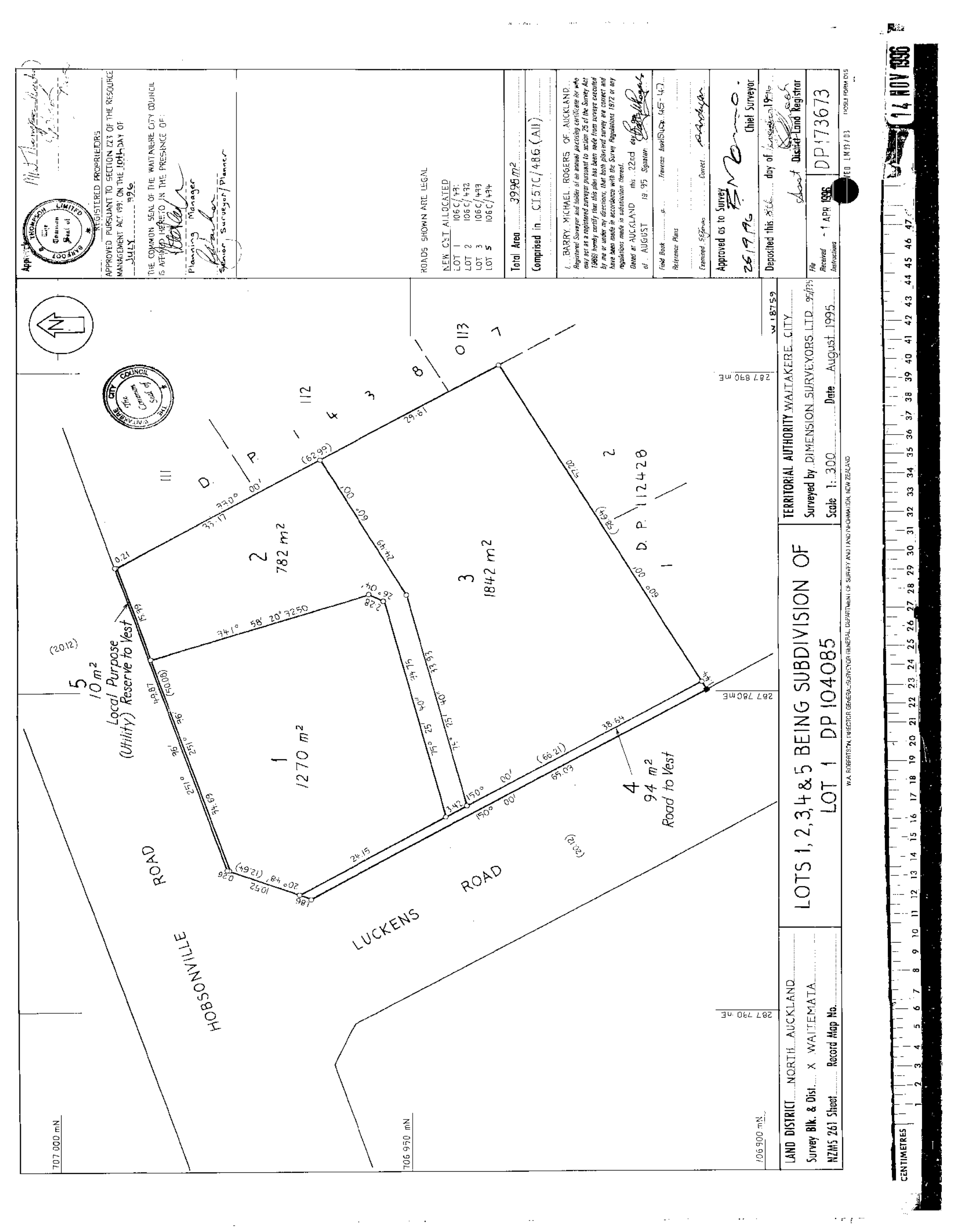
Registered Owners
Christopher Lewis Keall, Heather Janet Keall and Rowan Stanley Kingstone

Interests

Subject to Section 241(2) Resource Management Act 1991 (see DP 503537)

Land Covenant in Covenant Instrument 12315797.1 - 1.2.2022 at 9:53 am

Identifier **756484**



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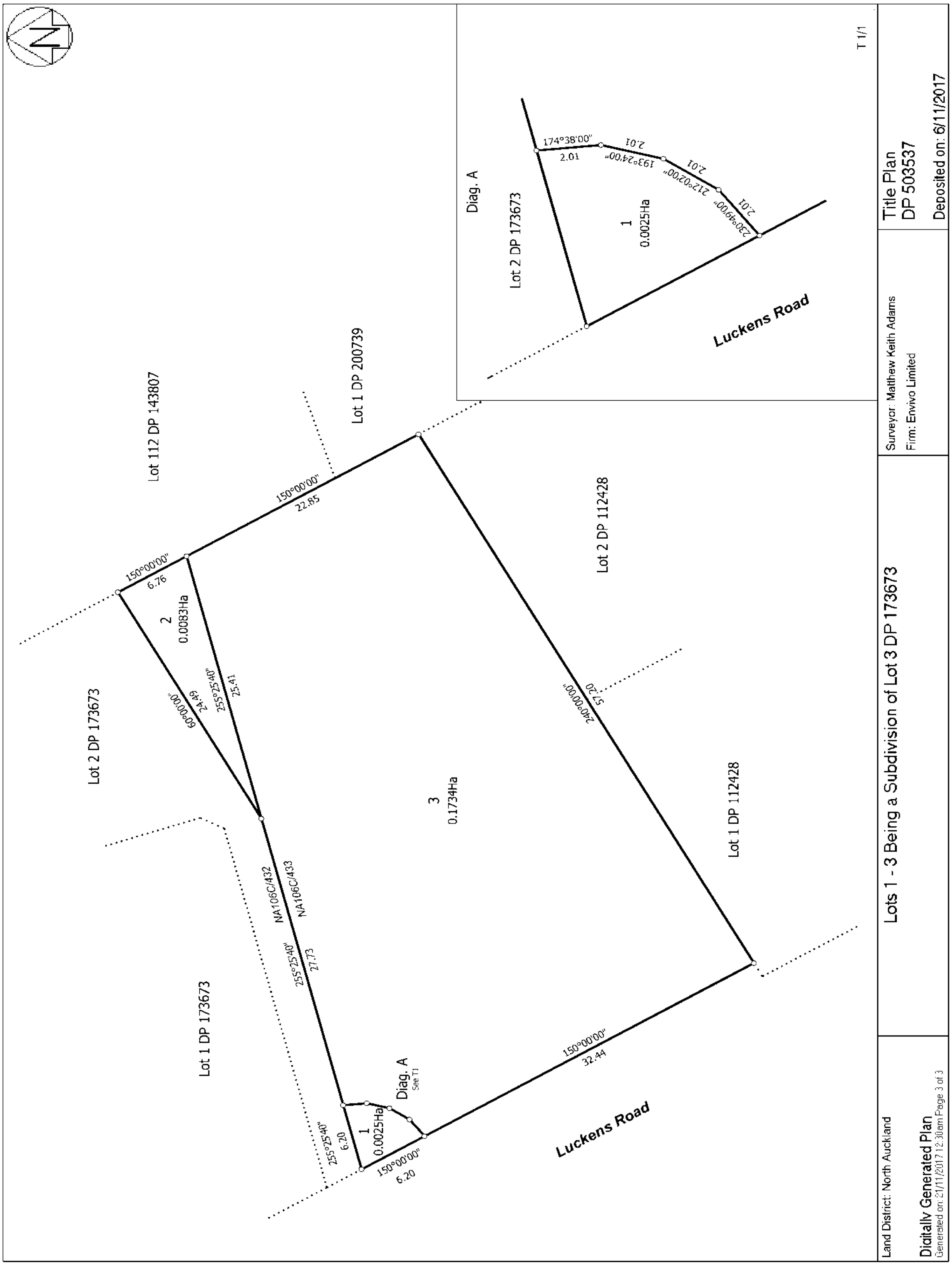


RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**1000393**
Land Registration District	**North Auckland**
Date Issued	19 May 2022

Prior References
NA11A/79

Estate	Fee Simple
Area	136 square metres more or less
Legal Description	Lot 1, 6 Deposited Plan 563162

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Estate	Fee Simple - 1/4 share
Area	181 square metres more or less
Legal Description	Lot 5 Deposited Plan 563162

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Interests

Subject to Section 241(2) Resource Management Act 1991 (affects DP 563162)

12252703.2 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 19.5.2022 at 11:09 am (affects Lot 1 DP 563162)

Subject to a right (in gross) to convey telecommunications over part Lot 5 DP 563162 marked E on DP 563162 in favour of Chorus New Zealand Limited created by Easement Instrument 12252703.3 - 19.5.2022 at 11:09 am

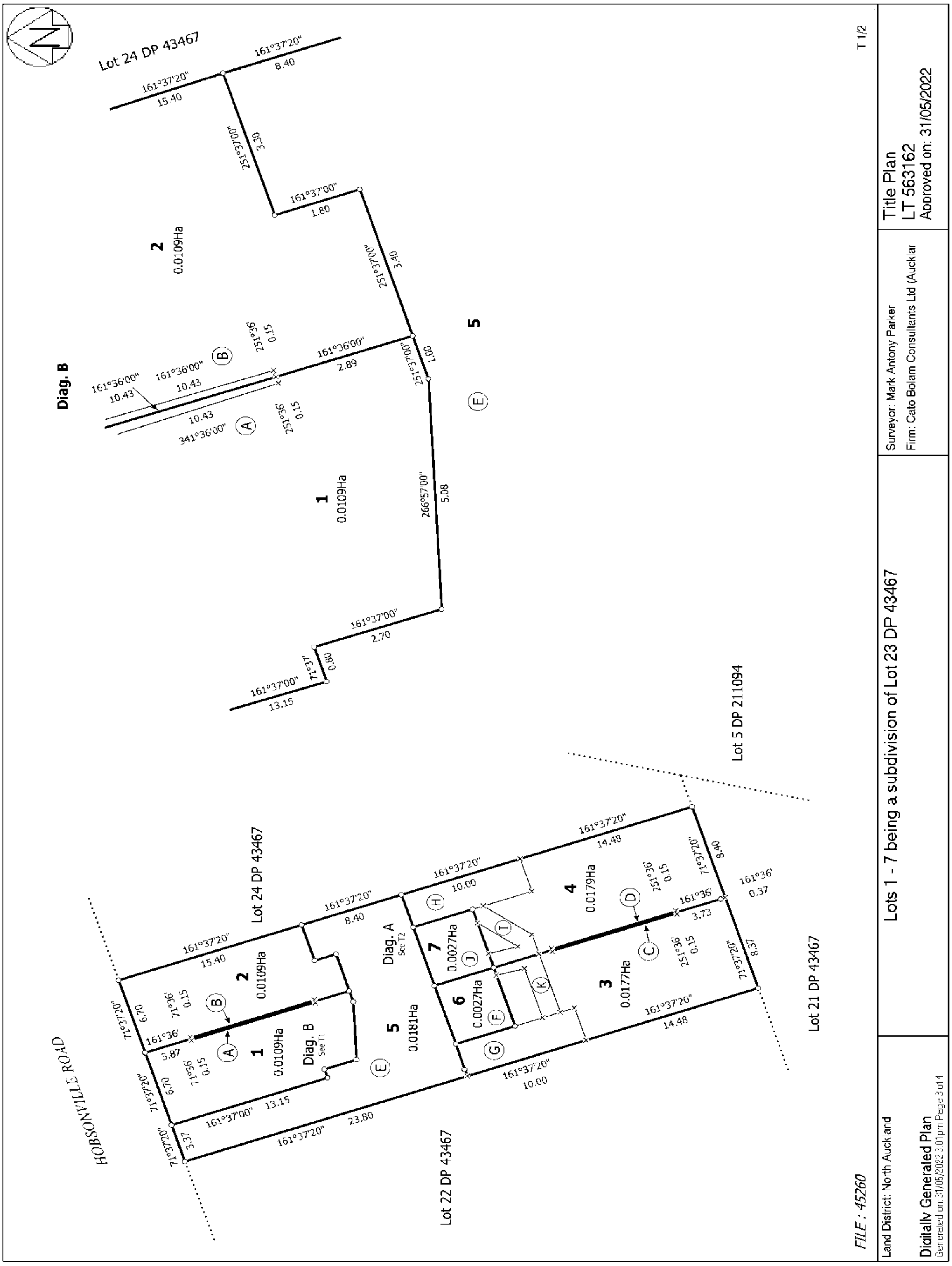
Subject to a right to convey water, electricity and telecommunications and right to drain water over part Lot 5 DP 563162 marked E, right to a party wall over part Lot 1 DP 563162 marked A, right to drain water and convey electricty over part Lot 6 DP 563162 marked F all on DP 563162 created by Easement Instrument 12252703.4 - 19.5.2022 at 11:09 am

Appurtenant hereto is a right to drain water, to Lot 1 DP 563162 is a right to a party wall and to Lot 1 and 6 DP 563162 is a right to convey water, electricity and telecommunications and created by Easement Instrument 12252703.4 - 19.5.2022 at 11:09 am

The easements created by Easement Instrument 12252703.4 are subject to Section 243 (a) Resource Management Act 1991

Land Covenant in Covenant Instrument 12252703.5 - 19.5.2022 at 11:09 am (affects Lot 1 and 6 DP 563162)

Identifier **1000393**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier 1000394
Land Registration District North Auckland
Date Issued 19 May 2022

Prior References
NA11A/79

Estate	Fee Simple
Area	136 square metres more or less
Legal Description	Lot 2, 7 Deposited Plan 563162

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Estate	Fee Simple - 1/4 share
Area	181 square metres more or less
Legal Description	Lot 5 Deposited Plan 563162

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Interests

Subject to Section 241(2) Resource Management Act 1991 (affects DP 563162)

12252703.2 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 19.5.2022 at 11:09 am (affects Lot 2 DP 563162)

Subject to a right (in gross) to convey telecommunications over part Lot 5 DP 563162 marked E on DP 563162 in favour of Chorus New Zealand Limited created by Easement Instrument 12252703.3 - 19.5.2022 at 11:09 am

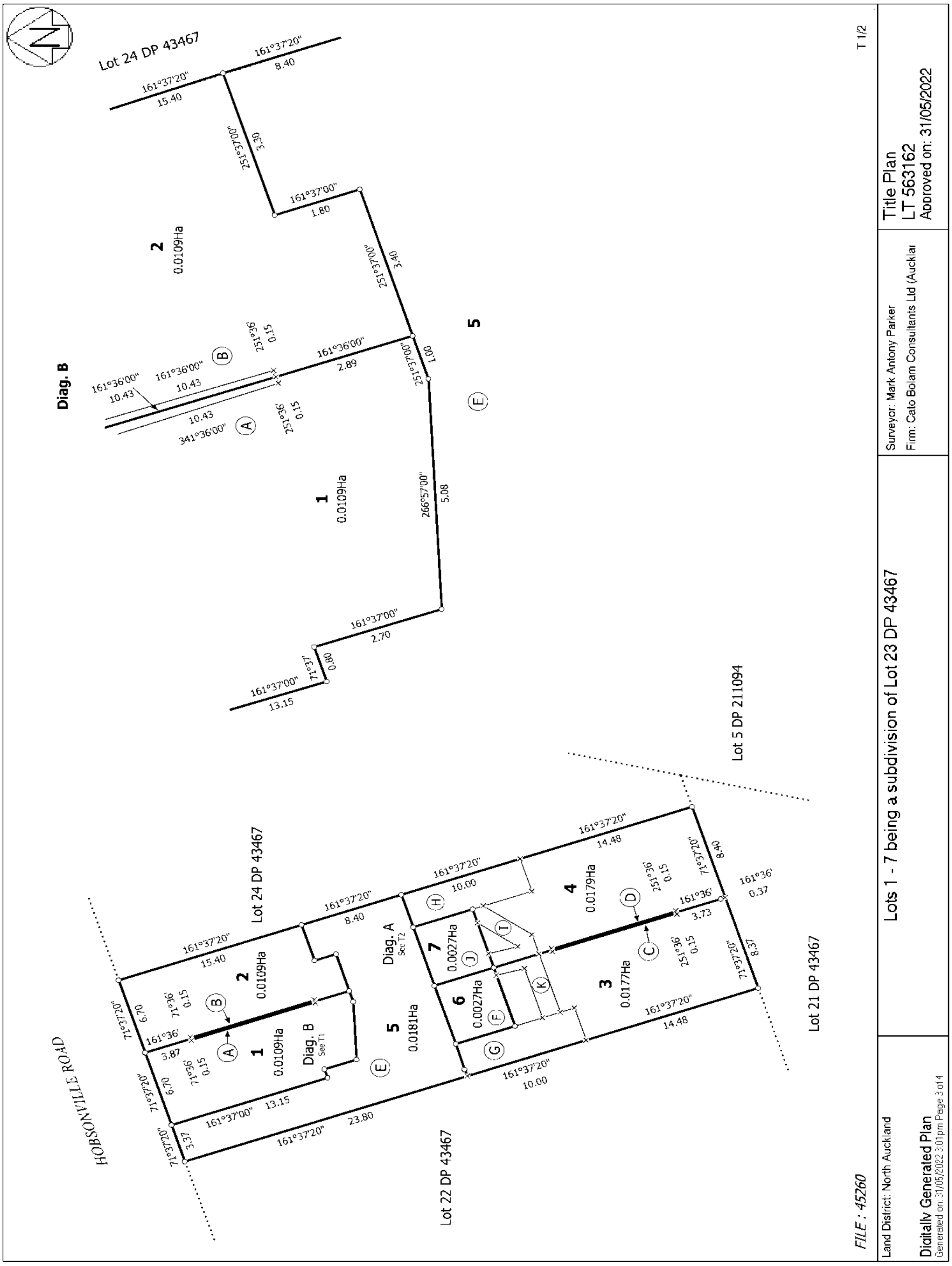
Subject to a right to convey water, electricity and telecommunications and right to drain water over part Lot 5 DP 563162 marked E, right to a party wall over part Lot 2 DP 563162 marked B, right to drain water and convey water, electricty and telecommunications over part Lot 7 DP 563162 marked J all on DP 563162 created by Easement Instrument 12252703.4 - 19.5.2022 at 11:09 am

Appurtenant hereto is a right to drain water, to Lot 2 DP 563162 is a right to a party wall and to Lot 2 and 7 DP 563162 is a right to convey water, electricity and telecommunications and created by Easement Instrument 12252703.4 - 19.5.2022 at 11:09 am

The easements created by Easement Instrument 12252703.4 are subject to Section 243 (a) Resource Management Act 1991

Land Covenant in Covenant Instrument 12252703.5 - 19.5.2022 at 11:09 am (affects Lot 2 and 7 DP 563162)

Identifier **1000394**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **1000395**
Land Registration District **North Auckland**
Date Issued 19 May 2022

Prior References
NA11A/79

Estate	Fee Simple
Area	177 square metres more or less
Legal Description	Lot 3 Deposited Plan 563162

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Estate	Fee Simple - 1/4 share
Area	181 square metres more or less
Legal Description	Lot 5 Deposited Plan 563162

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Interests

Subject to Section 241(2) Resource Management Act 1991 (affects DP 563162)

12252703.2 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 19.5.2022 at 11:09 am (affects Lot 3 DP 563162)

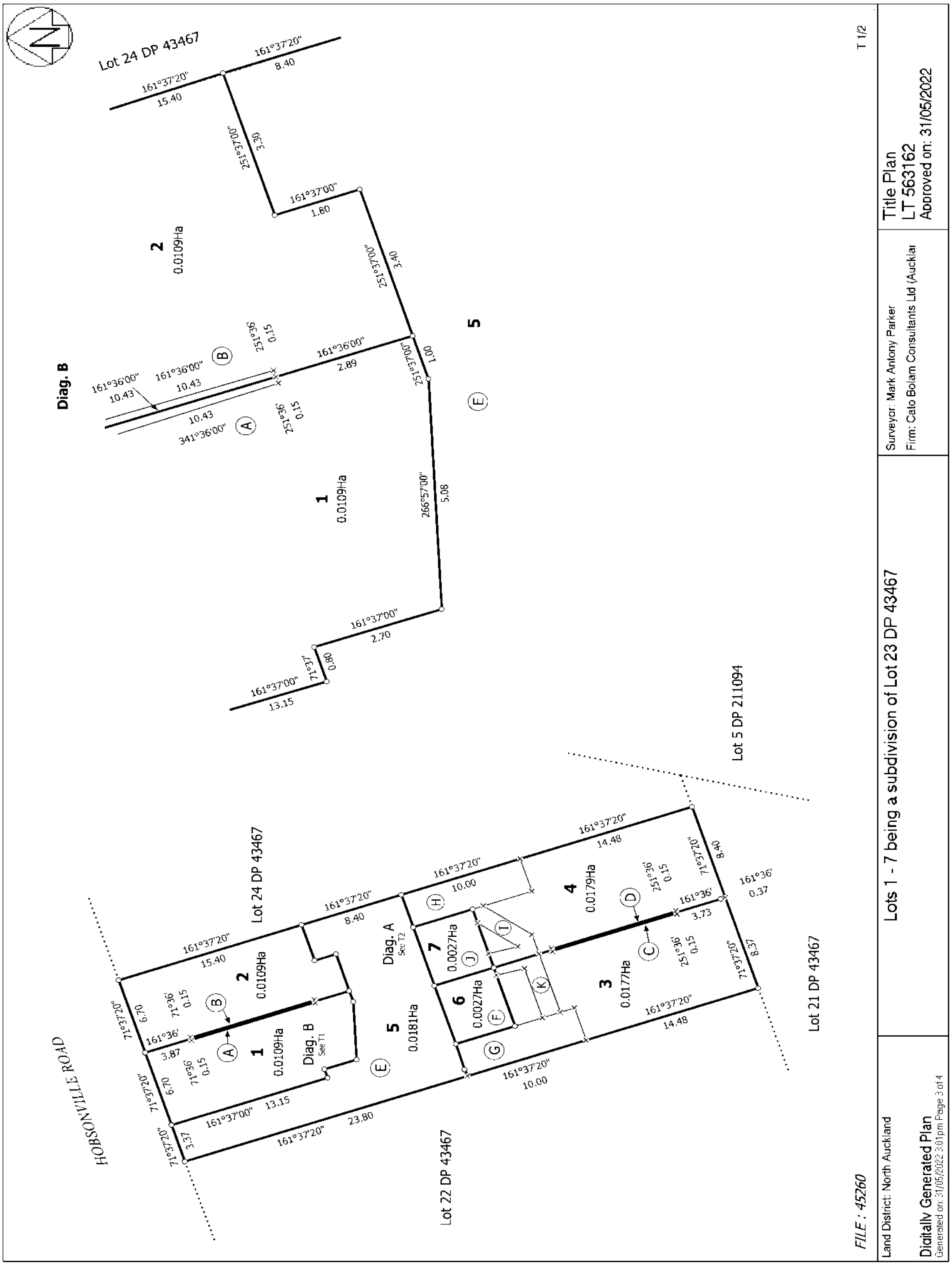
Subject to a right (in gross) to convey telecommunications over part Lot 5 DP 563162 marked E on DP 563162 in favour of Chorus New Zealand Limited created by Easement Instrument 12252703.3 - 19.5.2022 at 11:09 am

Subject to a right to convey water, electricity and telecommunications and right to drain water over part Lot 5 DP 563162 marked E, right to a party wall over part Lot 3 DP 563162 marked C and right to drain water over part Lot 3 DP 563162 marked G and K all on DP 563162 created by Easement Instrument 12252703.4 - 19.5.2022 at 11:09 am

Appurtenant hereto is a right to drain water, to Lot 3 DP 563162 is a right to a party wall and to Lot 3 DP 563162 is a right to convey water, electricity and telecommunications and created by Easement Instrument 12252703.4 - 19.5.2022 at 11:09 am

The easements created by Easement Instrument 12252703.4 are subject to Section 243 (a) Resource Management Act 1991

Land Covenant in Covenant Instrument 12252703.5 - 19.5.2022 at 11:09 am (affects Lot 3 DP 563162)


Title Plan
LT 563162
Approved on: 31/05/2022
Surveyor: Mark Antony Parker
Firm: Cato Bolam Consultants Ltd (Aucklar
Lots 1 - 7 being a subdivision of Lot 23 DP 43467
Land District: North Auckland
Digitally Generated Plan
FILE : 45260
T 1/2
HOBSONVILLE ROAD
Lot 24 DP 43467
Lot 22 DP 43467
Lot 21 DP 43467
Lot 5 DP 211094
Diag. A
Diag. B

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **1000396**
Land Registration District **North Auckland**
Date Issued 19 May 2022

Prior References
NA11A/79

Estate	Fee Simple
Area	179 square metres more or less
Legal Description	Lot 4 Deposited Plan 563162

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Estate	Fee Simple - 1/4 share
Area	181 square metres more or less
Legal Description	Lot 5 Deposited Plan 563162

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Interests

Subject to Section 241(2) Resource Management Act 1991 (affects DP 563162)

12252703.2 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 19.5.2022 at 11:09 am (affects Lot 4 DP 563162)

Subject to a right (in gross) to convey telecommunications over part Lot 5 DP 563162 marked E on DP 563162 in favour of Chorus New Zealand Limited created by Easement Instrument 12252703.3 - 19.5.2022 at 11:09 am

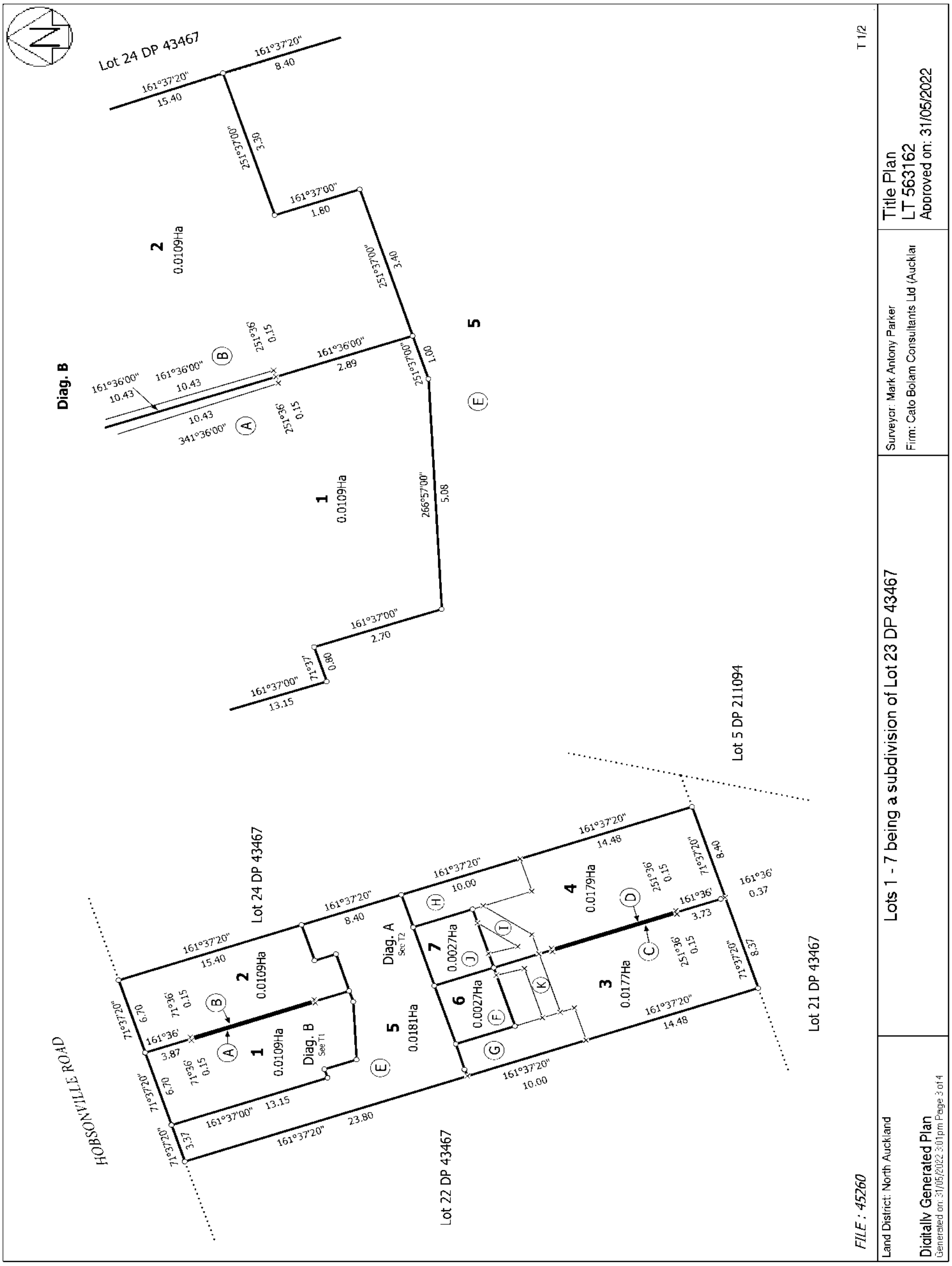
Subject to a right to convey water, electricity and telecommunications and right to drain water over part Lot 5 DP 563162 marked E, right to a party wall over part Lot 4 DP 563162 marked D and right to drain water over part Lot 4 DP 563162 marked H and I all on DP 563162 created by Easement Instrument 12252703.4 - 19.5.2022 at 11:09 am

Appurtenant hereto is a right to drain water, to Lot 4 DP 563162 is a right to a party wall and to Lot 4 DP 563162 is a right to convey water, electricity and telecommunications and created by Easement Instrument 12252703.4 - 19.5.2022 at 11:09 am

The easements created by Easement Instrument 12252703.4 are subject to Section 243 (a) Resource Management Act 1991

Land Covenant in Covenant Instrument 12252703.5 - 19.5.2022 at 11:09 am (affects Lot 4 DP 563162)

Identifier **1000396**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
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R.W. Muir
Registrar-General
of Land

Identifier	**NA3C/1174**
Land Registration District	**North Auckland**
Date Issued	06 May 1964

Prior References
NA840/245

Estate	Fee Simple
Area	809 square metres more or less
Legal Description	Lot 10 Deposited Plan 43467

Registered Owners
Rohan Keshavan Kuttuva

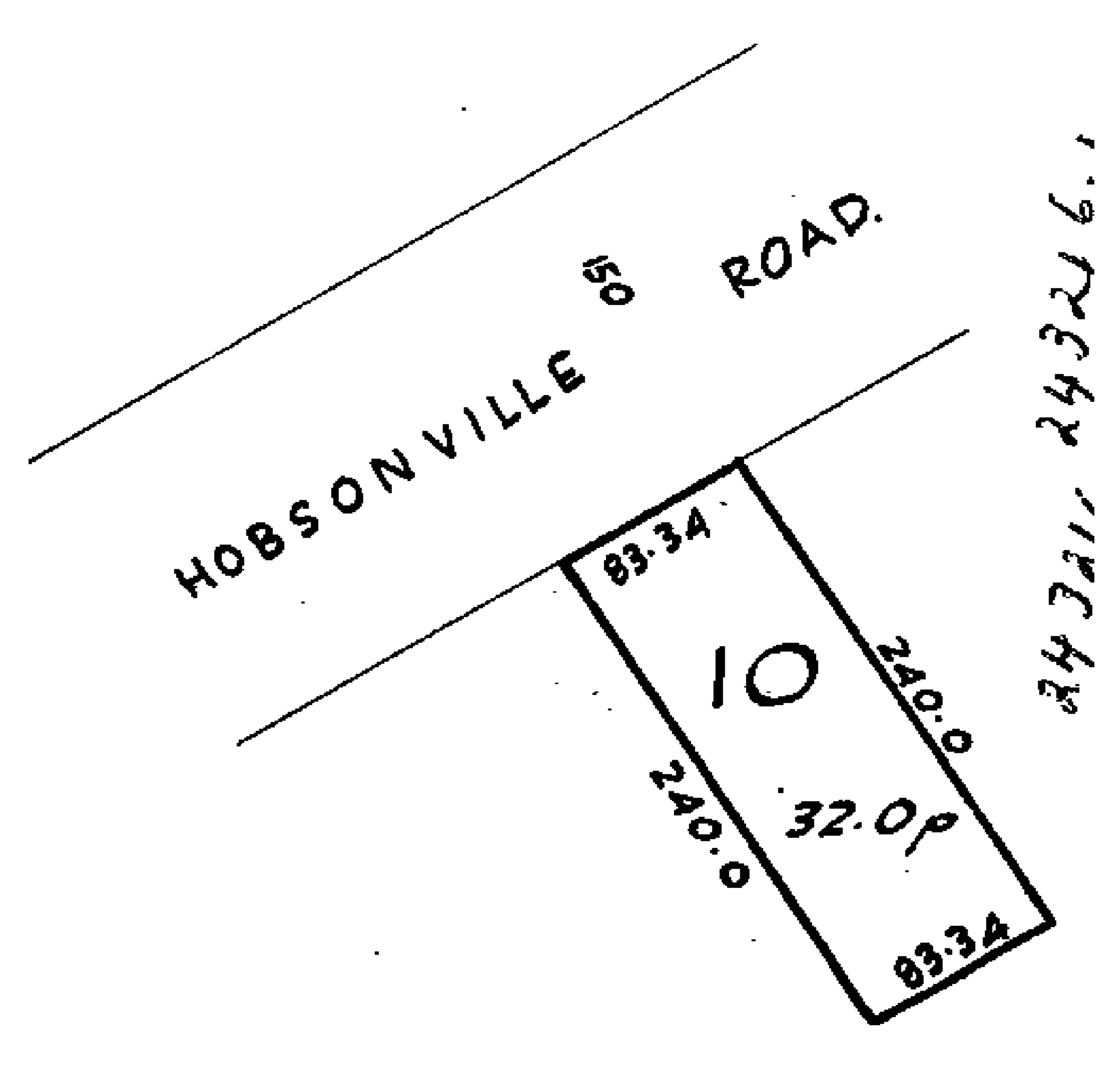
Interests

Subject to a drainage right in favour of The Waitemata County Council created by Transfer 572524

Fencing Agreement in Transfer A5942 - 6.5.1964

11036099.3 Mortgage to ANZ Bank New Zealand Limited - 6.3.2018 at 2:49 pm

Identifier **NA3C/1174**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier **NA7D/1392**
Land Registration District **North Auckland**
Date Issued 23 February 1966

Prior References
NA840/245

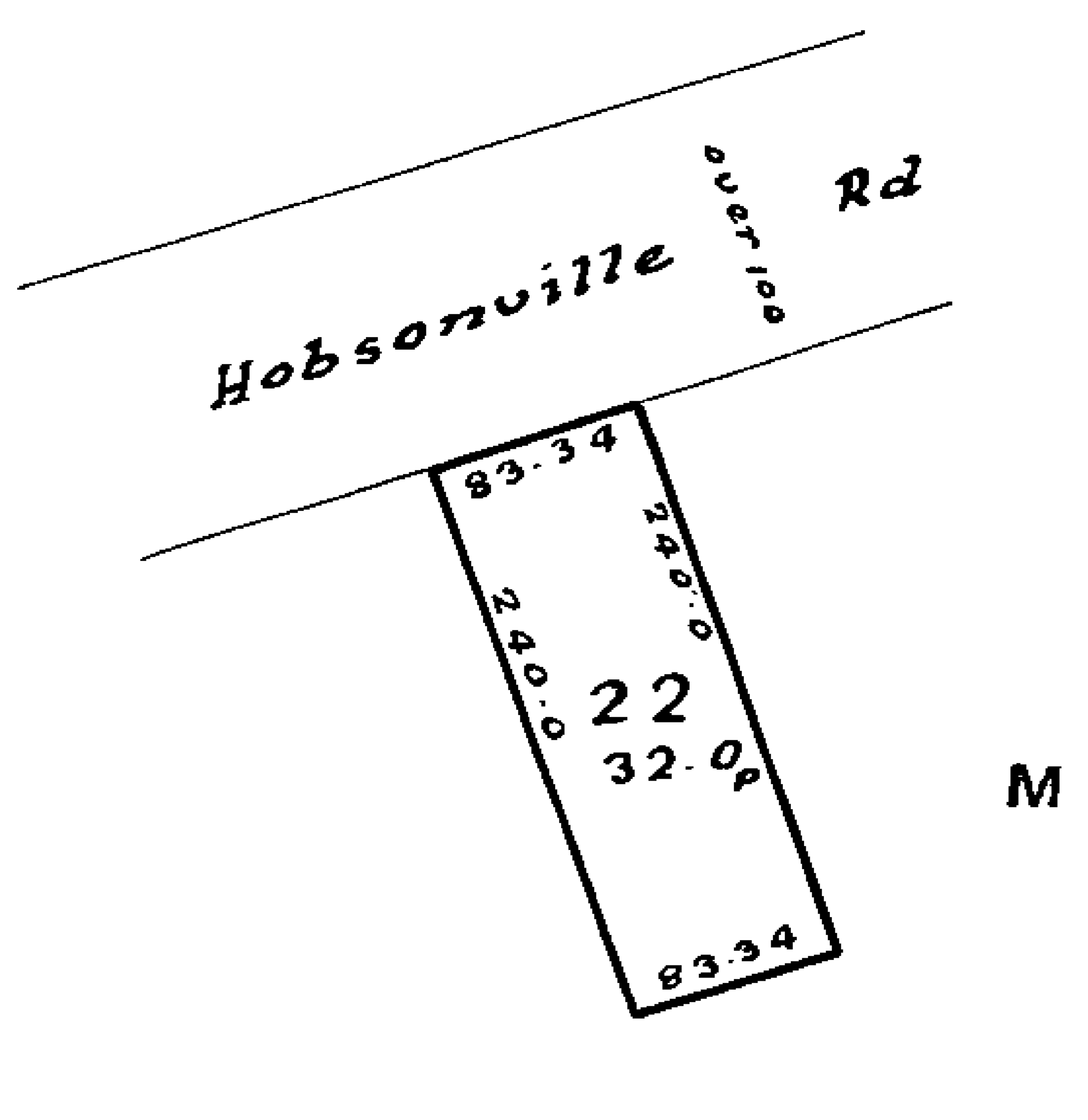
Estate	Fee Simple
Area	809 square metres more or less
Legal Description	Lot 22 Deposited Plan 43467

Registered Owners
Jerry's Home (2013) Limited

Interests

12216548.3 Mortgage to Cressida Capital One Limited - 18.8.2021 at 3:35 pm

Identifier **NA7D/1392**



RECORD OF TITLE
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R.W. Muir
Registrar-General
of Land

Identifier	**NA10D/299**
Land Registration District	**North Auckland**
Date Issued	21 January 1966

Prior References
NA1611/79

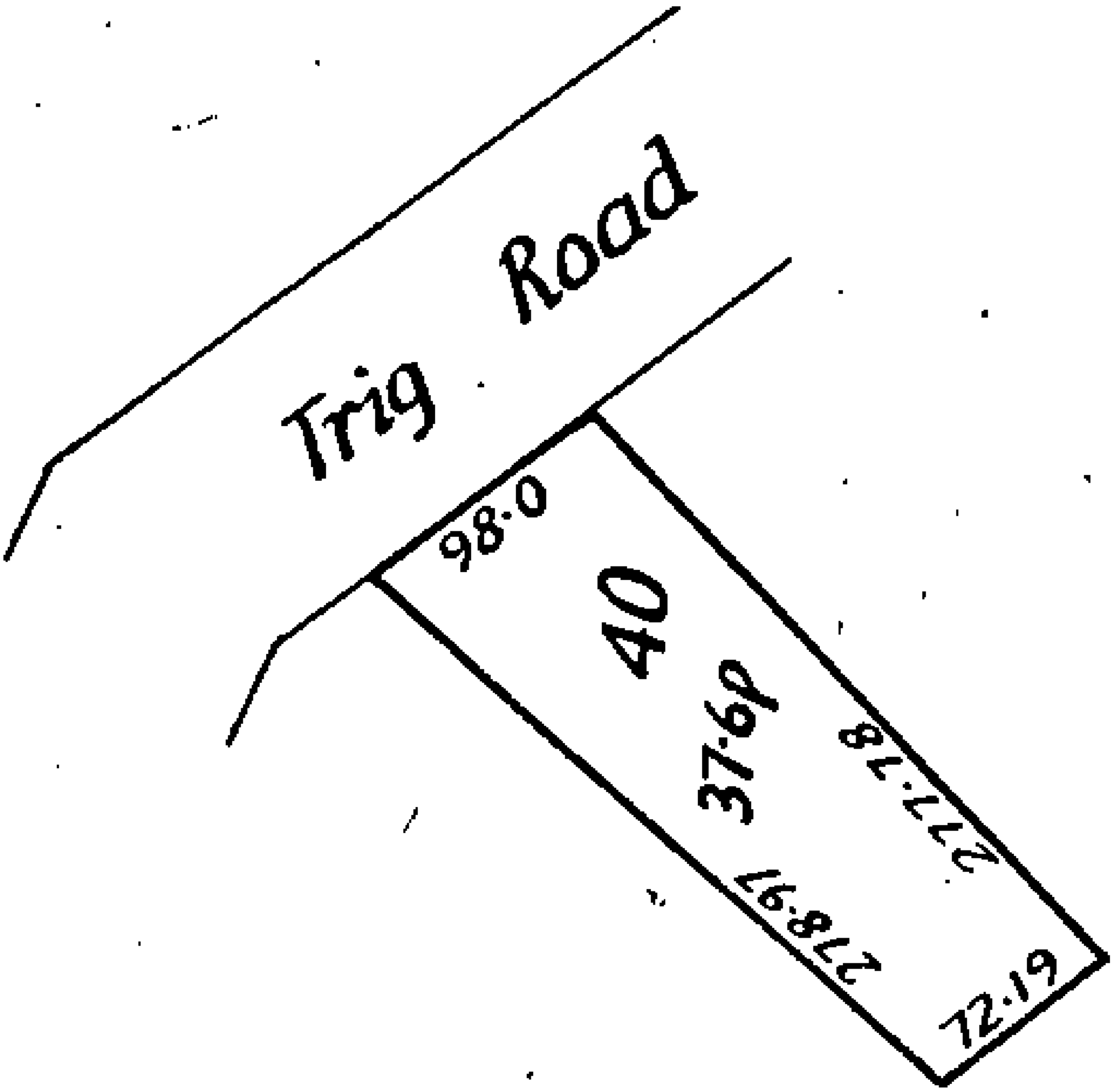
Estate	Fee Simple
Area	951 square metres more or less
Legal Description	Lot 40 Deposited Plan 41172

Registered Owners
Gayo Edward Vodanovich and Yvonne Pauline Vodanovich

Interests

Subject to a drainage right (in gross) over part in favour of The Waitemata County Council created by Transfer 534328

Identifier **NA10D/299**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier	**NA11A/72**
Land Registration District	**North Auckland**
Date Issued	02 May 1967

Prior References
NA840/245

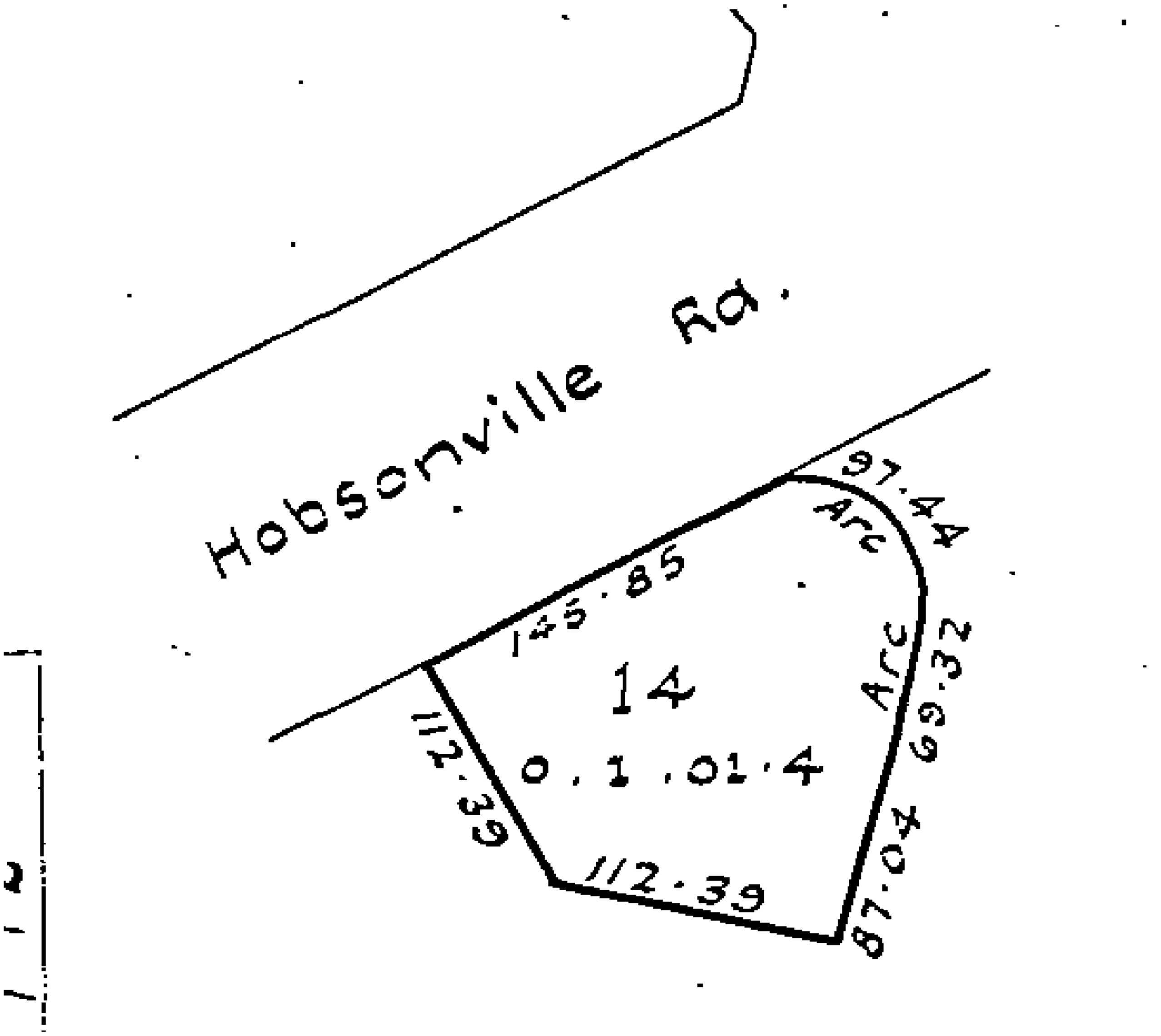
Estate	Fee Simple
Area	1047 square metres more or less
Legal Description	Lot 14 Deposited Plan 43467

Registered Owners
Kevin John Hooper and Geertruida Maria Hooper

Interests

C379567.3 Mortgage to ASB Bank Limited - 27.5.1992 at 10.51 am

Identifier **NA11A/72**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier	**NA11A/76**
Land Registration District	**North Auckland**
Date Issued	02 May 1967

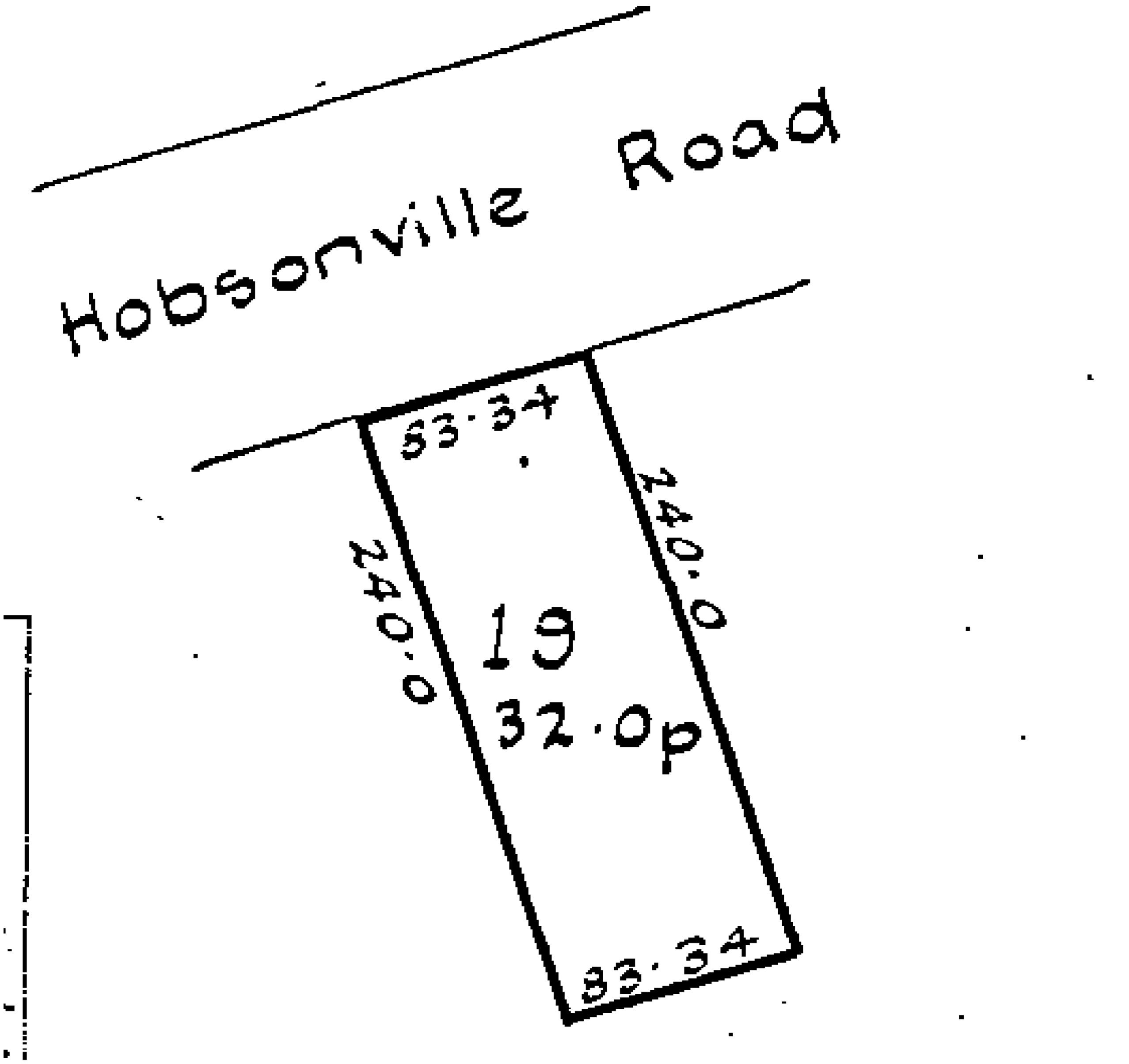
Prior References
NA840/245

Estate	Fee Simple
Area	809 square metres more or less
Legal Description	Lot 19 Deposited Plan 43467

Registered Owners
Tawaki Views Limited

Interests

Identifier **NA11A/76**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier	**NA11A/77**
Land Registration District	**North Auckland**
Date Issued	02 May 1967

Prior References
NA840/245

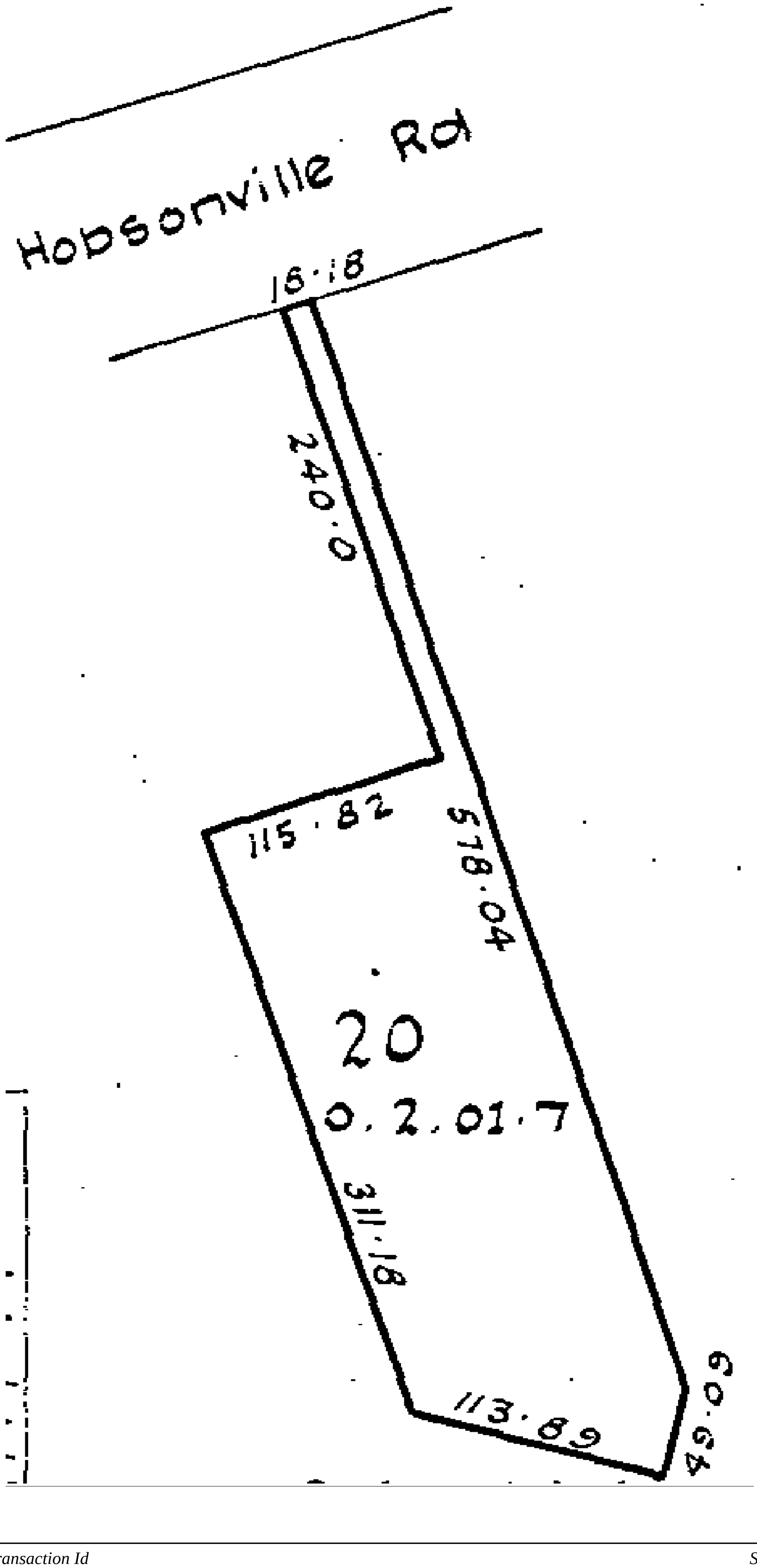
Estate	Fee Simple
Area	2066 square metres more or less
Legal Description	Lot 20 Deposited Plan 43467

Registered Owners
Tawaki Views Limited

Interests

11576516.1 Mortgage to Kiwibank Limited - 18.10.2019 at 4:56 pm

Identifier **NA11A/77**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier	**NA21C/1293**
Land Registration District	**North Auckland**
Date Issued	26 November 1971

Prior References
NA578/66

Estate	Fee Simple
Area	4.0469 hectares more or less
Legal Description	Lot 3 Deposited Plan 66045

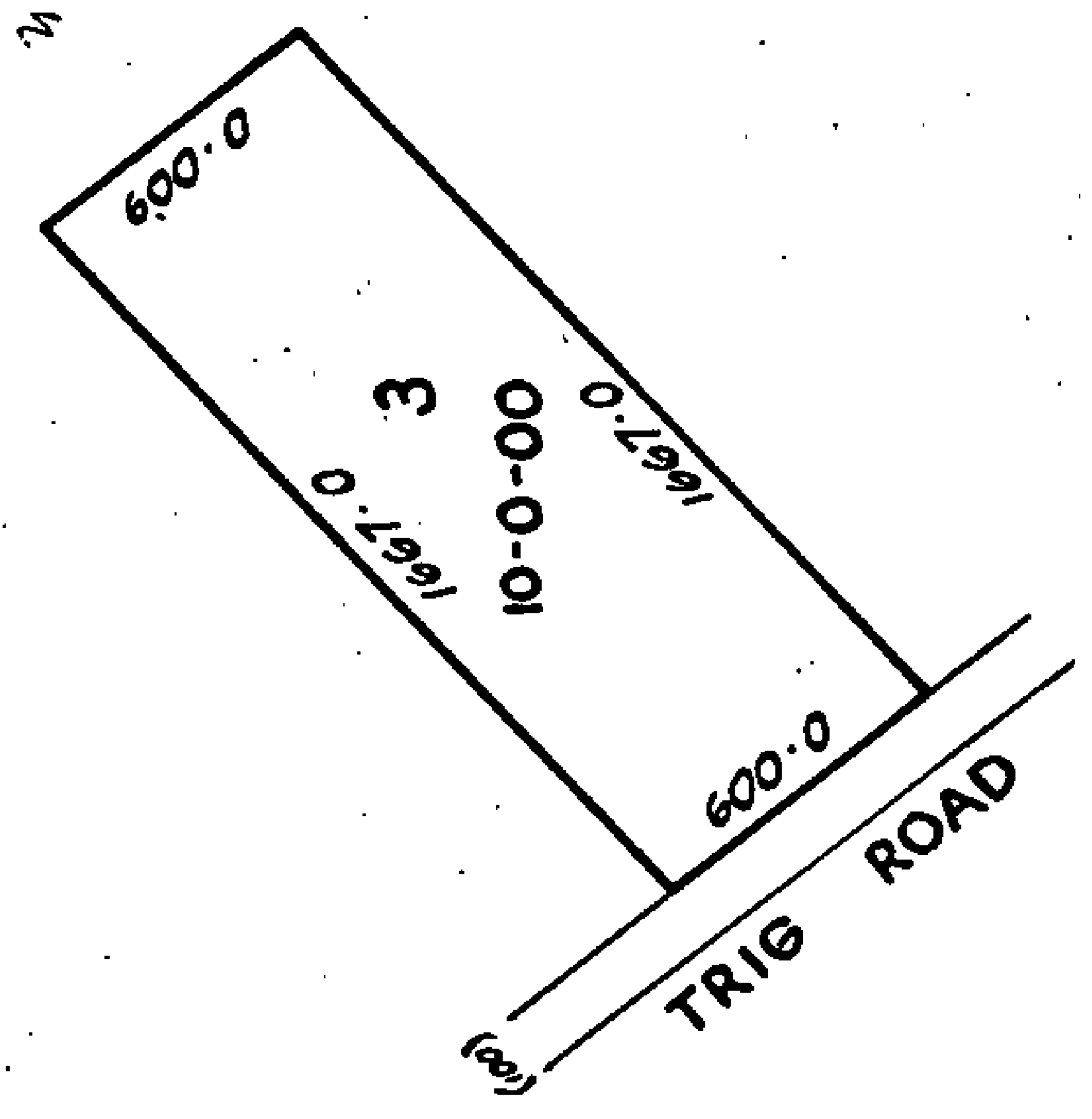
Registered Owners
Jui-Yin Huang Hu (also known as Huang Jui-Yin Hu)

Interests

Fencing Covenant in Transfer C877701.4 - 15.8.1995 at 11.51 am

Land Covenant in Transfer C877701.4 - 15.8.1995 at 11:51 am

Identifier **NA21C/1293**



RECORD OF TITLE
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R.W. Muir
Registrar-General
of Land

Identifier	**NA21C/1294**
Land Registration District	**North Auckland**
Date Issued	26 November 1971

Prior References
NA578/66

Estate	Fee Simple
Area	4.3600 hectares more or less
Legal Description	Lot 4 Deposited Plan 66045

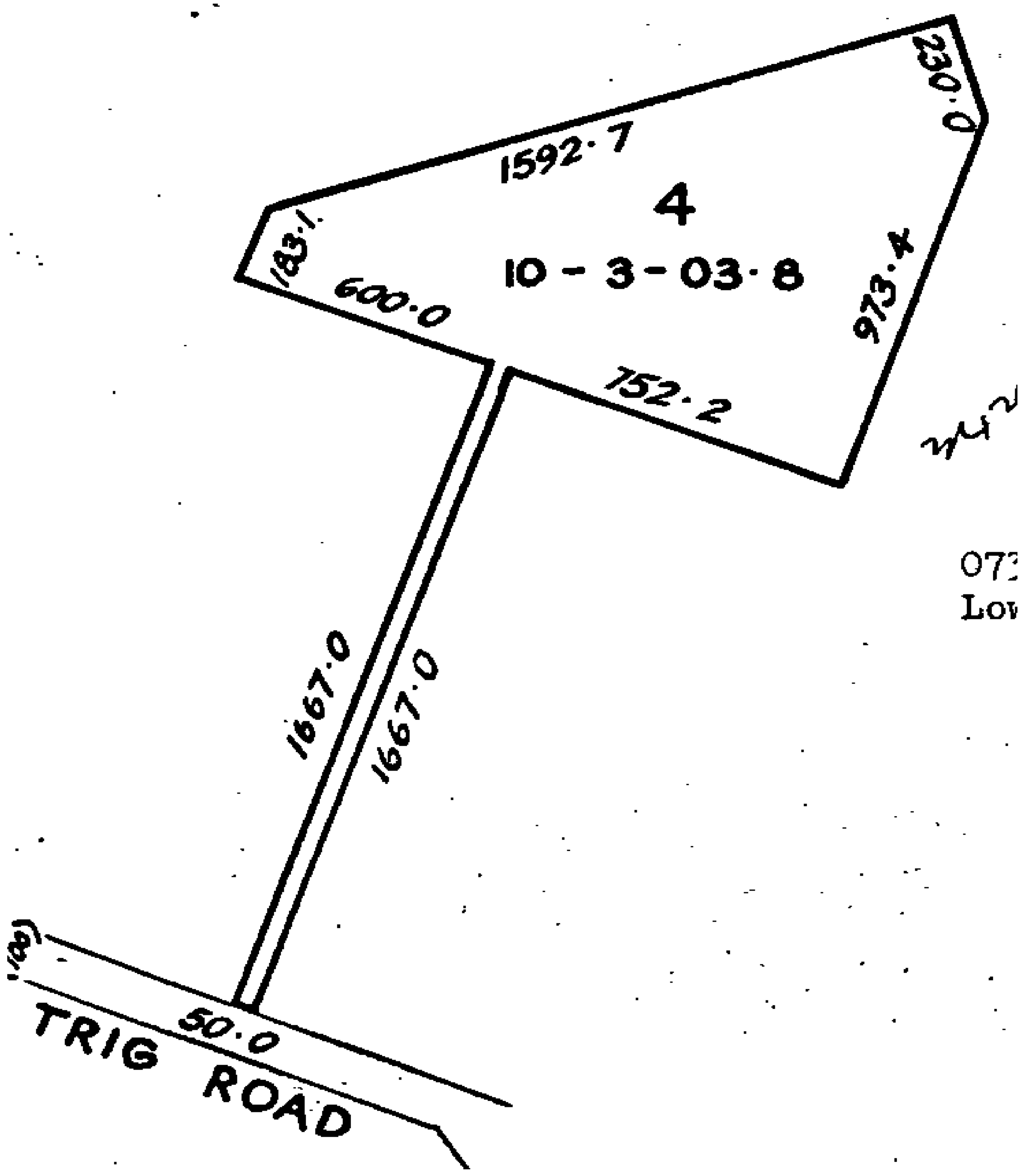
Registered Owners
Hsiu-Ho Lin

Interests

Fencing Covenant in Transfer C877701.4 - 15.8.1995 at 11.51 am

Land Covenant in Transfer C877701.4 - 15.8.1995 at 11:51 am

Identifier **NA21C/1294**



RECORD OF TITLE
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R.W. Muir
Registrar-General
of Land

Identifier	**NA21C/1296**
Land Registration District	**North Auckland**
Date Issued	26 November 1971

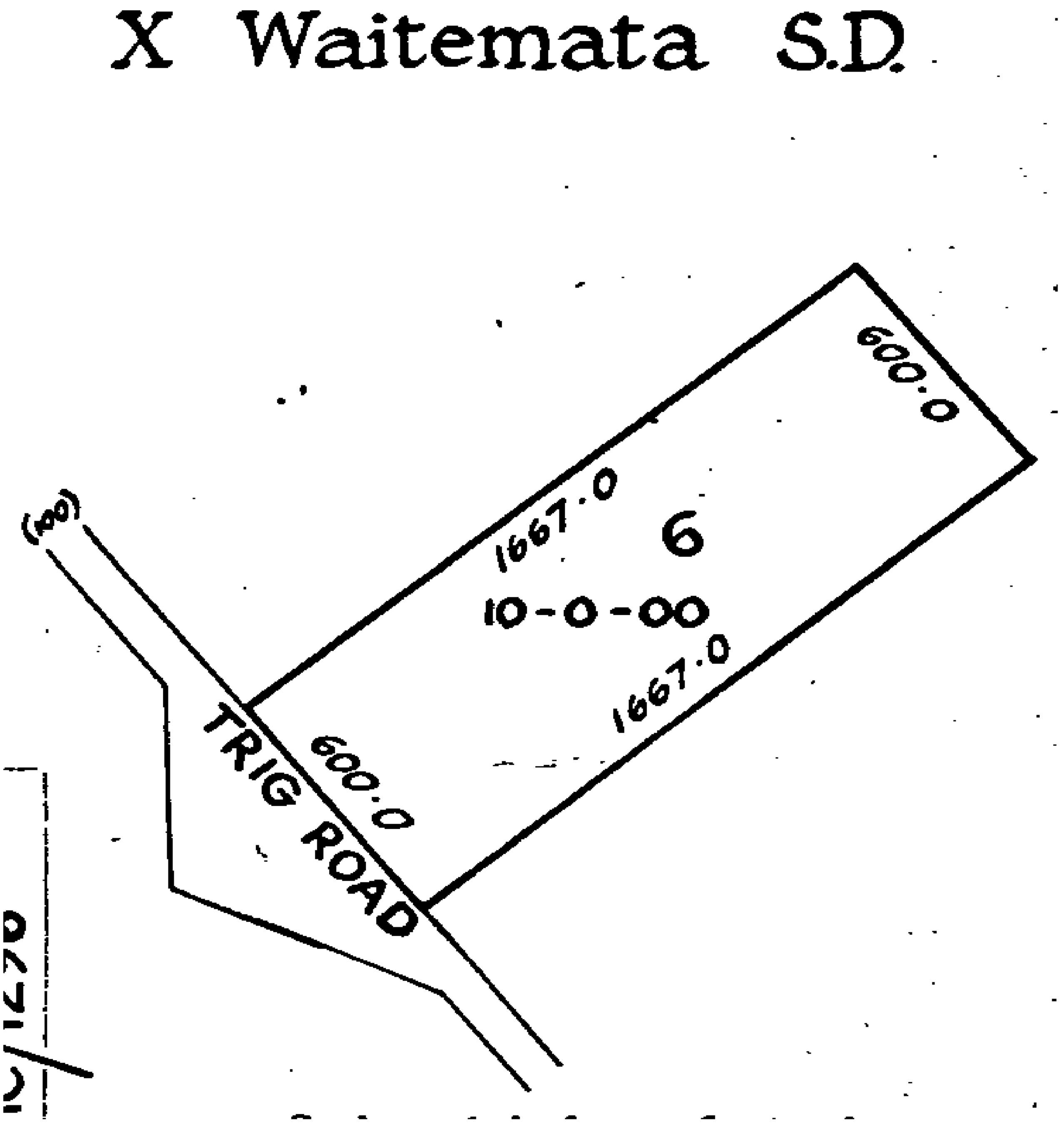
Prior References
NA578/66

Estate	Fee Simple
Area	4.0469 hectares more or less
Legal Description	Lot 6 Deposited Plan 66045

Registered Owners
Weimei Wu and Yau Min Chan

Interests

10835066.3 Mortgage to ANZ Bank New Zealand Limited - 3.7.2017 at 11:17 am


X Waitemata S.D.
600.0
1667.0
6
10-0-00
1667.0
600.0
TRIG ROAD
(100)

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
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R.W. Muir
Registrar-General
of Land

Identifier	**NA21C/1297**
Land Registration District	**North Auckland**
Date Issued	26 November 1971

Prior References
NA578/66 NA578/67

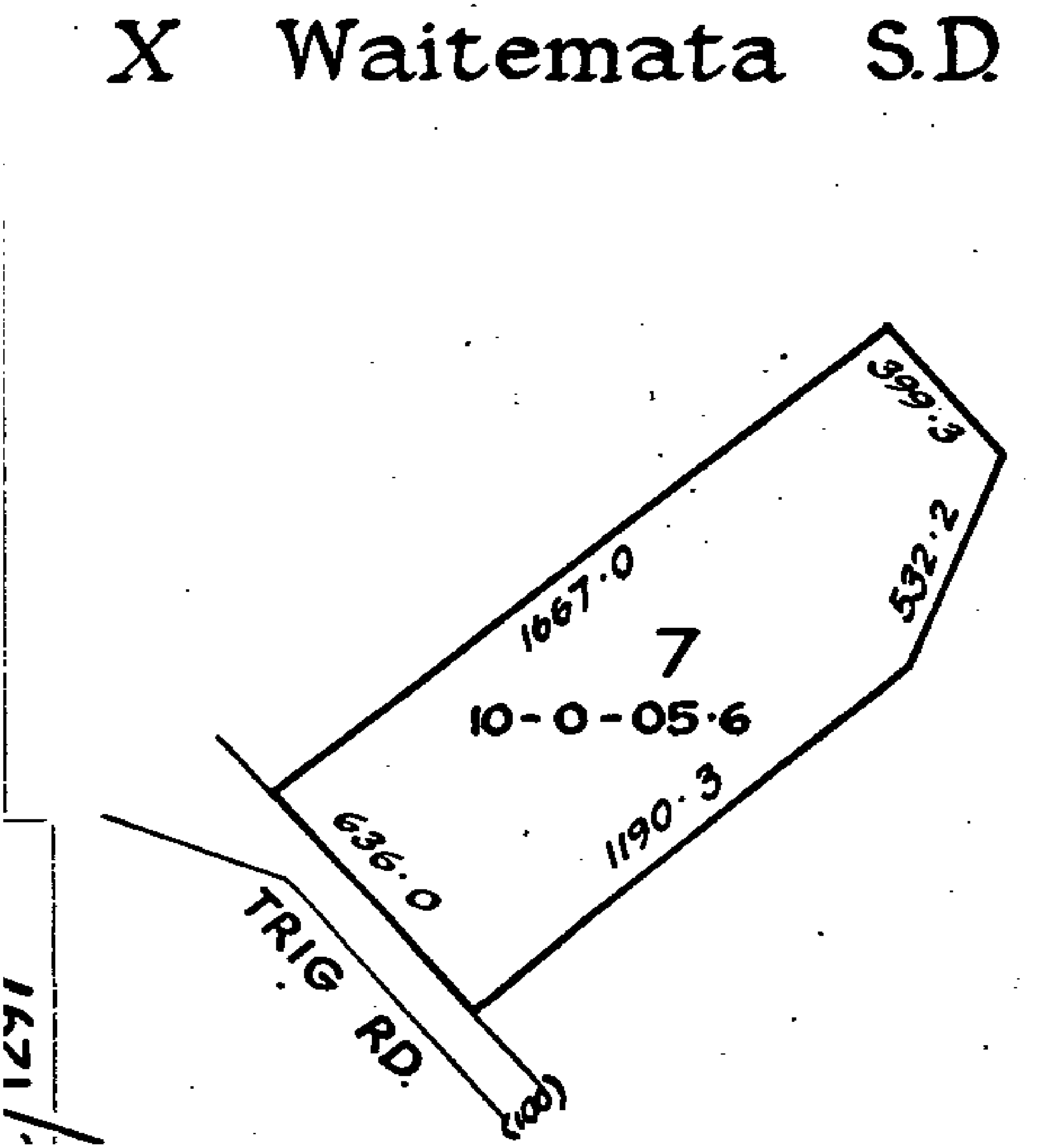
Estate	Fee Simple
Area	4.0610 hectares more or less
Legal Description	Lot 7 Deposited Plan 66045

Registered Owners
Pauline Diane Howlett

Interests

B053335.1 Settled under the Joint Family Homes Act 1964 - 14.4.1982 at 11.25 am

Identifier **NA21C/1297**



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R.W. Muir
Registrar-General
of Land

Identifier	**NA21C/1298**
Land Registration District	**North Auckland**
Date Issued	26 November 1971

Part-Cancelled

Prior References
NA578/66 NA578/67

Estate	Fee Simple
Area	4.0481 hectares more or less
Legal Description	Lot 8 Deposited Plan 66045

Registered Owners

Chiang Lin-Hwa Shih as to a 1/4 share

Kite Tseng as to a 1/2 share

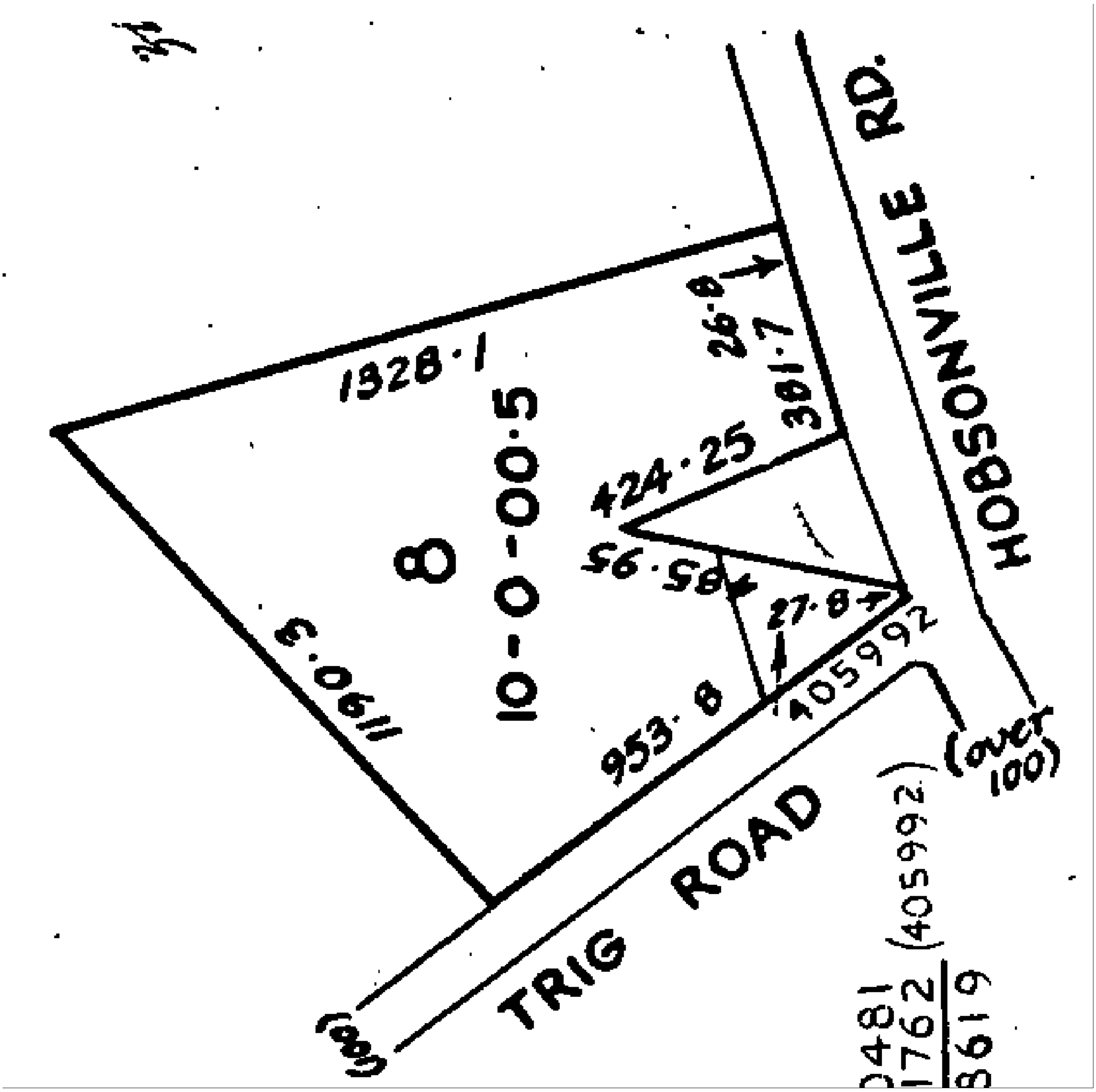
Kite Tseng as to a 1/4 share

Interests

405992.1 Gazette Notice taking part within land ("A on S.O. 48997) 1762m² for electrical works vested in the Waitemata Electric Power Board from and after the 1st day of May 1975 - 19.6.1975 at 9.33 am

C428346.1 Certificate pursuant to Section 94(c) Transit New Zealand Act 1989 declaring that part of State Highway No.18 known as Hobsonville Road, commencing at its junction with State Highway 16 and proceeding in an eastern direction to Upper Harbour Drive to be a limited access road - 5.1.1992 at 2.01 pm

Identifier **NA21C/1298**



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UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier	**NA21C/1299**
Land Registration District	**North Auckland**
Date Issued	26 November 1971

Prior References
NA578/67

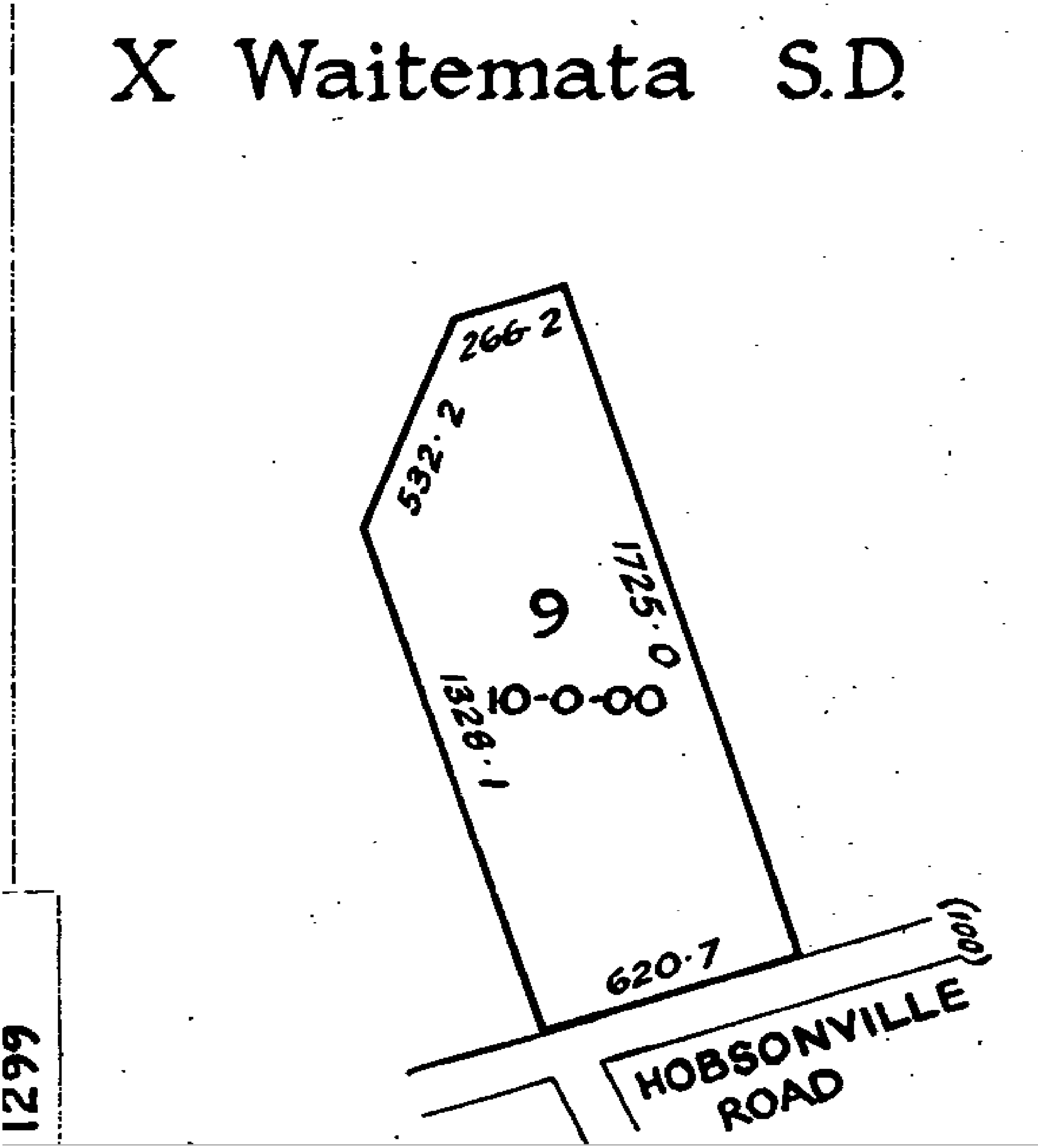
Estate	Fee Simple
Area	4.0469 hectares more or less
Legal Description	Lot 9 Deposited Plan 66045

Registered Owners
78 Hobsonville Limited

Interests

C428346.1 Notice pursuant to Section 94C Transit New Zealand Act 1989 declaring the adjoining State Highway No.18 known as Hobsonville Road, commencing at its junction with State Highway 16 and proceeding in an eastern direction to Upper Harbour Drive to be a limited access road - 5.1.1992 at 2.01 pm

Identifier **NA21C/1299**



RECORD OF TITLE
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R.W. Muir
Registrar-General
of Land

Identifier NA21C/1300
Land Registration District North Auckland
Date Issued 26 November 1971

Prior References
NA578/67

Estate	Fee Simple
Area	4.1809 hectares more or less
Legal Description	Lot 10 Deposited Plan 66045

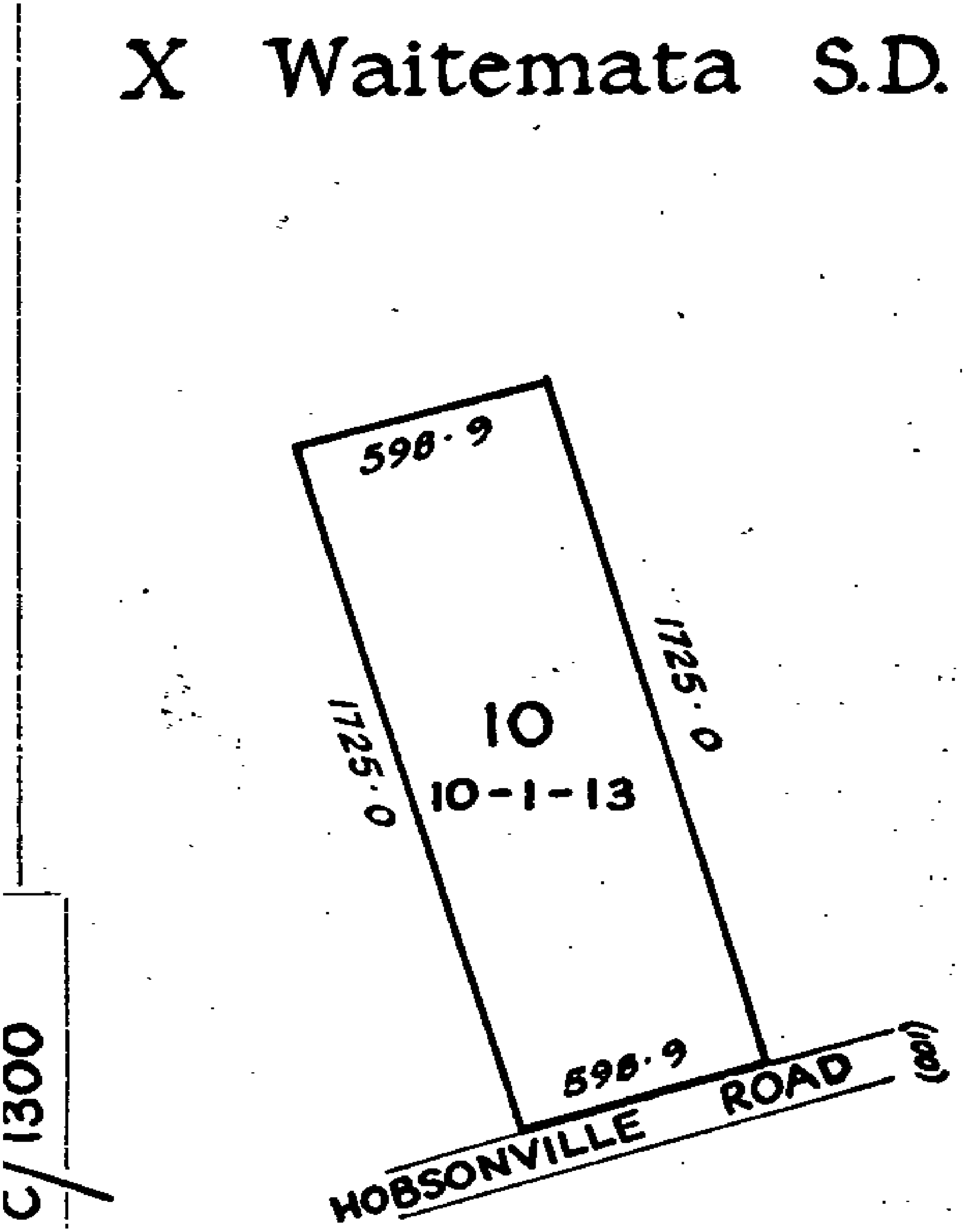
Registered Owners
Xianlong He

Interests

C428346.1 Notice pursuant to Section 94C Transit New Zealand Act 1989 declaring the adjoining State Highway No.18 known as Hobsonville Road, commencing at its junction with State Highway 16 and proceeding in an eastern direction to Upper Harbour Drive to be a limited access road - 5.1.1992 at 2.01 pm

10361918.4 Mortgage to ANZ Bank New Zealand Limited - 23.3.2016 at 12:50 pm

Identifier NA21C/1300



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier	**NA22D/1210**
Land Registration District	**North Auckland**
Date Issued	02 June 1972

Prior References
NA20B/136

Estate	Fee Simple
Area	857 square metres more or less
Legal Description	Lot 11 Deposited Plan 43467

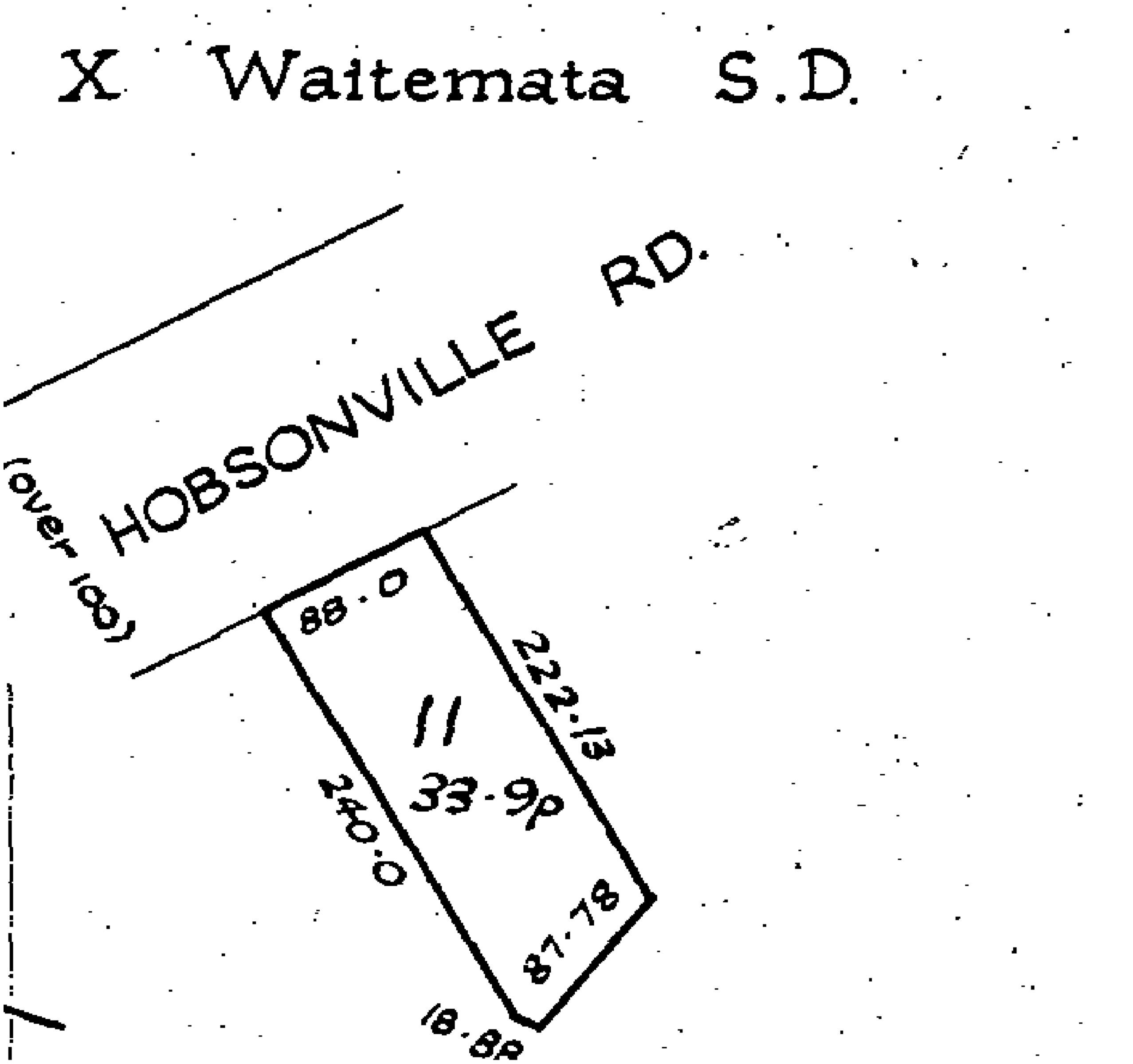
Registered Owners
Bo Yu and Lulu Wang

Interests

Subject to Section 59 Land Act 1948

11778423.3 Mortgage to Westpac New Zealand Limited - 30.6.2020 at 4:20 pm

Identifier **NA22D/1210**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
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R.W. Muir
Registrar-General
of Land

Identifier NA26B/618
Land Registration District North Auckland
Date Issued 26 March 1974

Prior References
NA1022/205

Estate	Fee Simple
Area	5.1142 hectares more or less
Legal Description	Lot 2 Deposited Plan 67207

Registered Owners

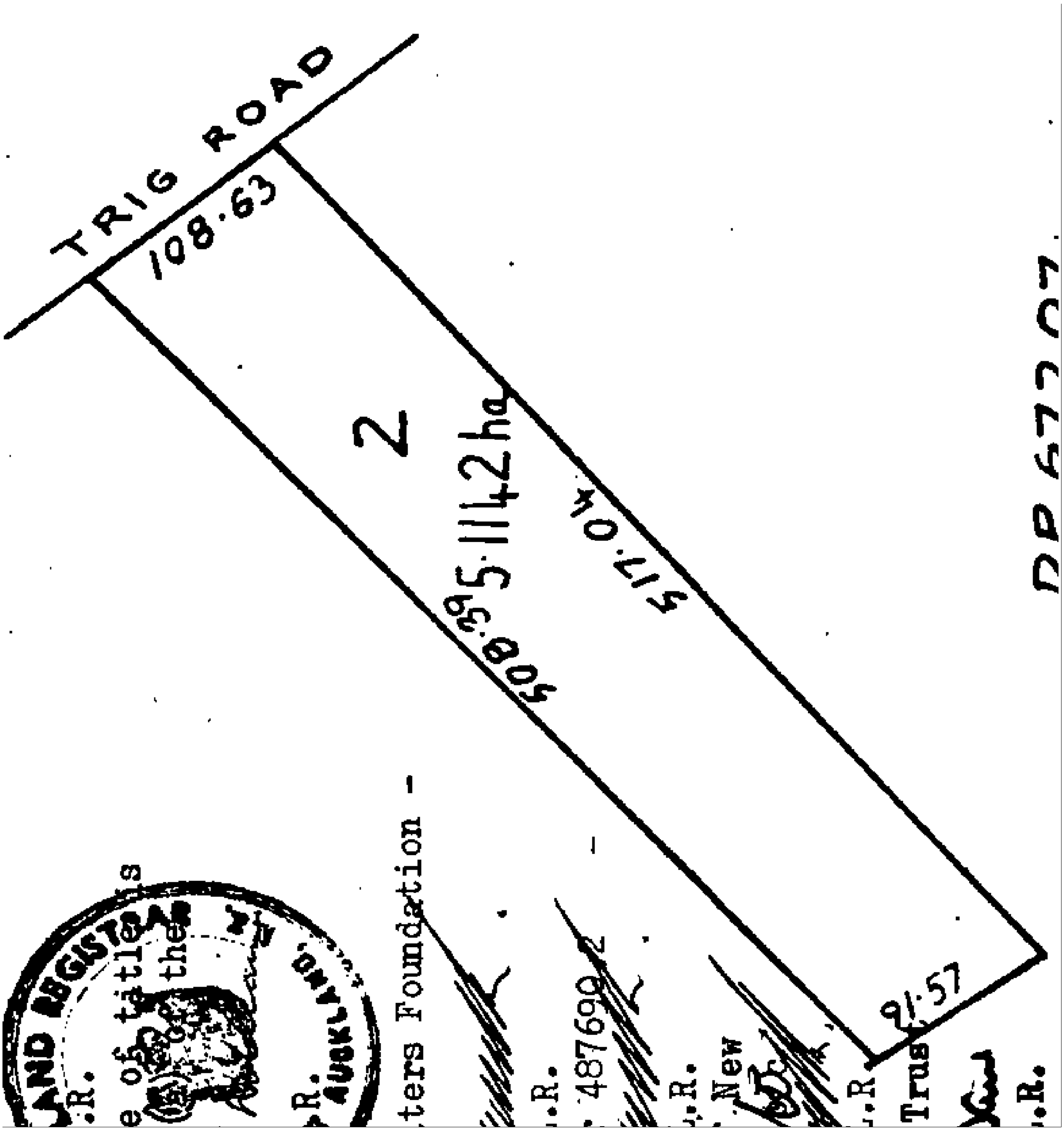
Han-Ting Lin as to a 1/20 share

Han-Chun Lin as to a 1/20 share

Che Lung Huang and Hung Sai Chao Huang as to a 2/5 share

Yung-Hsiang Hsu and Lien-Ying Chen as to a 1/2 share

Interests


TRIG ROAD
108·63
2
5·1142ha
517·04
508·39
91·57

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
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R.W. Muir
Registrar-General
of Land

Identifier	**NA31C/472**
Land Registration District	**North Auckland**
Date Issued	07 August 1975

Prior References
GN 405992.1

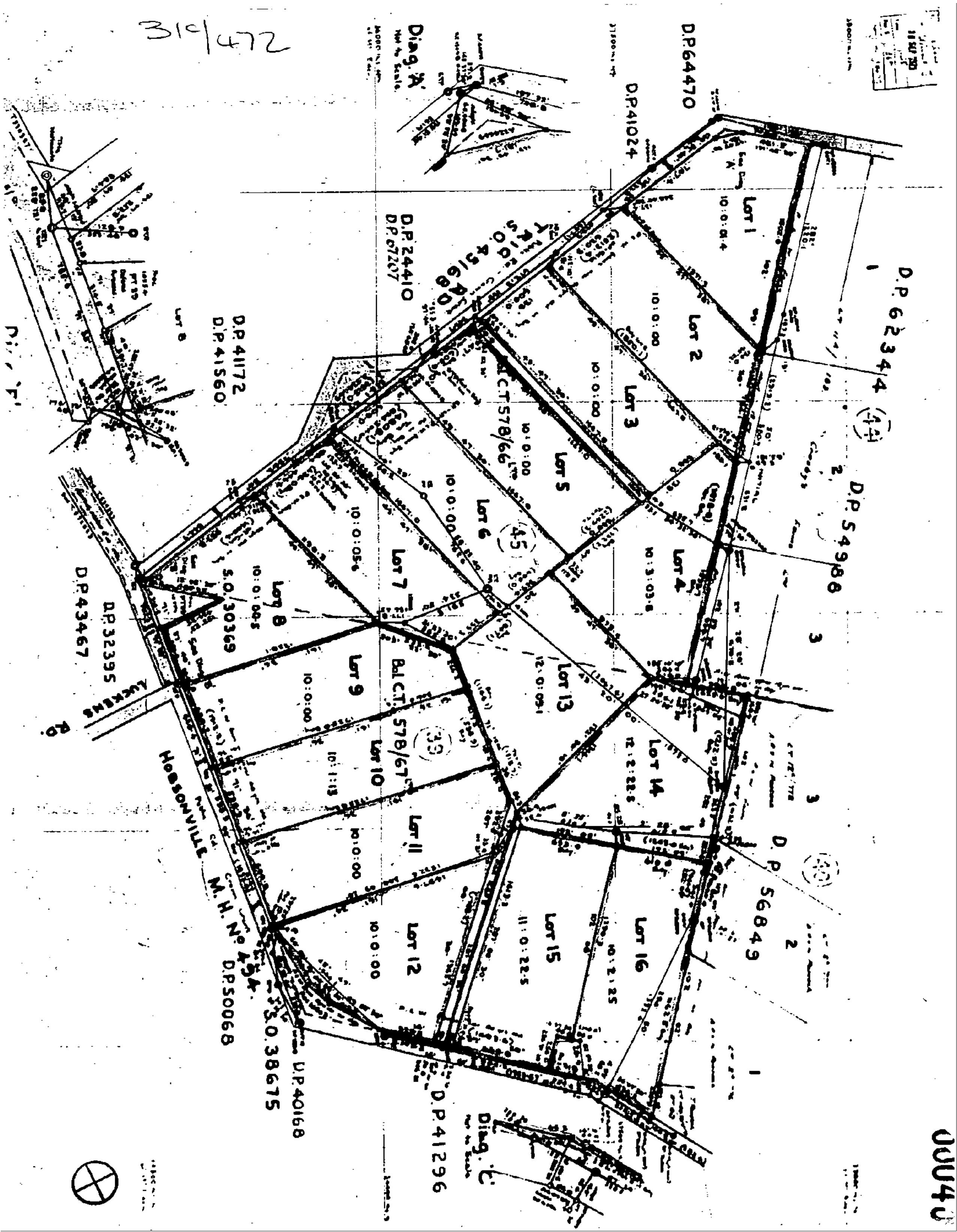
Estate	Fee Simple
Area	1762 square metres more or less
Legal Description	Part Lot 8 Deposited Plan 66045

Registered Owners
Vector Northern Property Limited

Interests

C428346.1 Certificate pursuant to Section 94C Transit New Zealand Act 1989 declaring that part of State Highway No.18 known as Hobsonville Road, commencing at its junction with State Highway 16 and proceeding in an eastern direction to Upper Harbour Drive to be a limited access road - 5.11.1992 at 2.01 pm

Identifier **NA31C/472**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
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R.W. Muir
Registrar-General
of Land

Identifier NA38A/548
Land Registration District North Auckland
Date Issued 06 May 1977

Prior References
NA20B/136

Estate	Fee Simple
Area	809 square metres more or less
Legal Description	Lot 17 Deposited Plan 43467

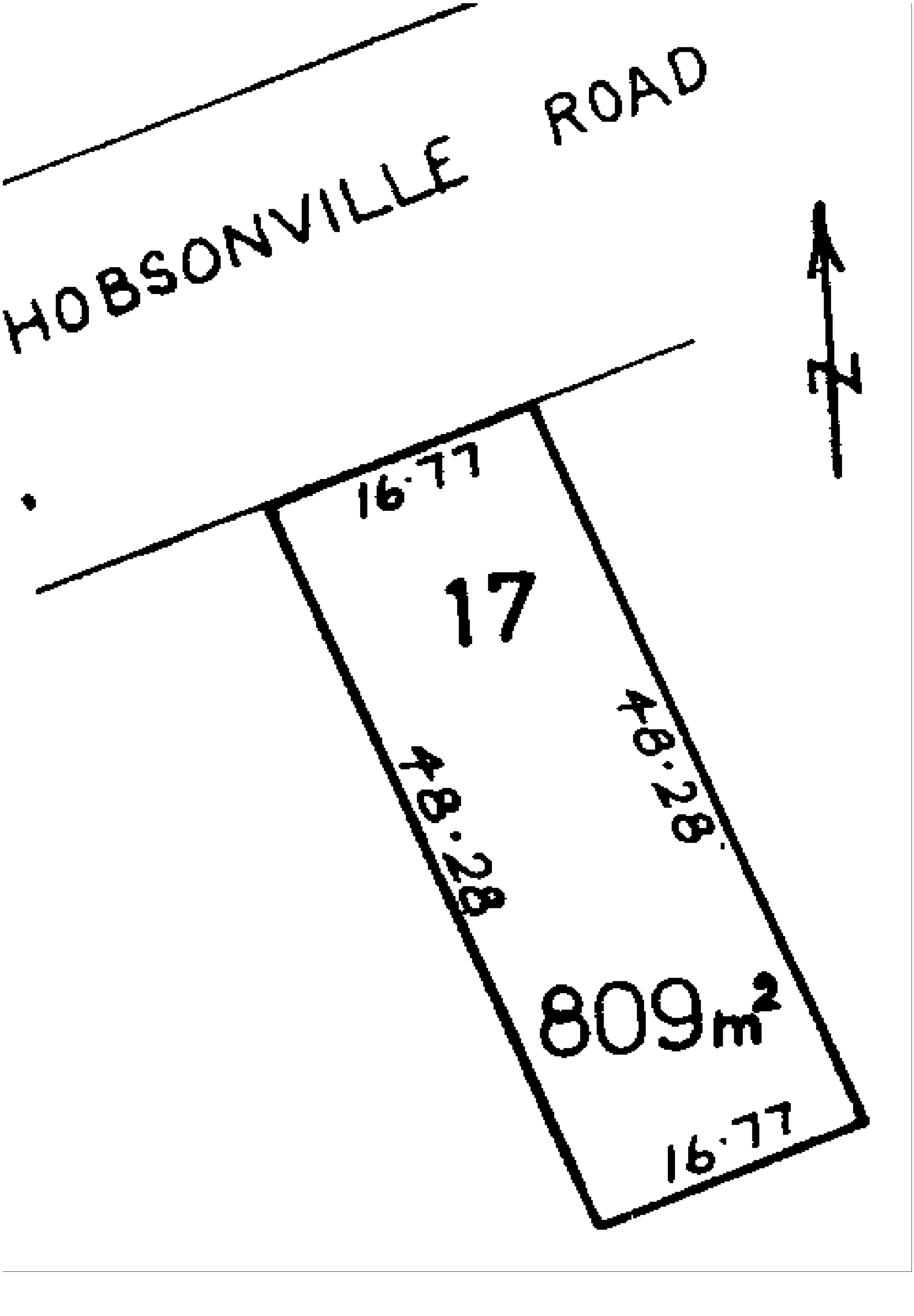
Registered Owners
Eric Ngan and Peixia Feng

Interests

Subject to Section 59 Land Act 1948

10855324.2 Mortgage to ANZ Bank New Zealand Limited - 18.8.2017 at 2:09 pm

Identifier **NA38A/548**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier	**NA38A/715**
Land Registration District	**North Auckland**
Date Issued	28 June 1977

Prior References
NA20B/136

Estate	Fee Simple
Area	1540 square metres more or less
Legal Description	Lot 21 Deposited Plan 43467

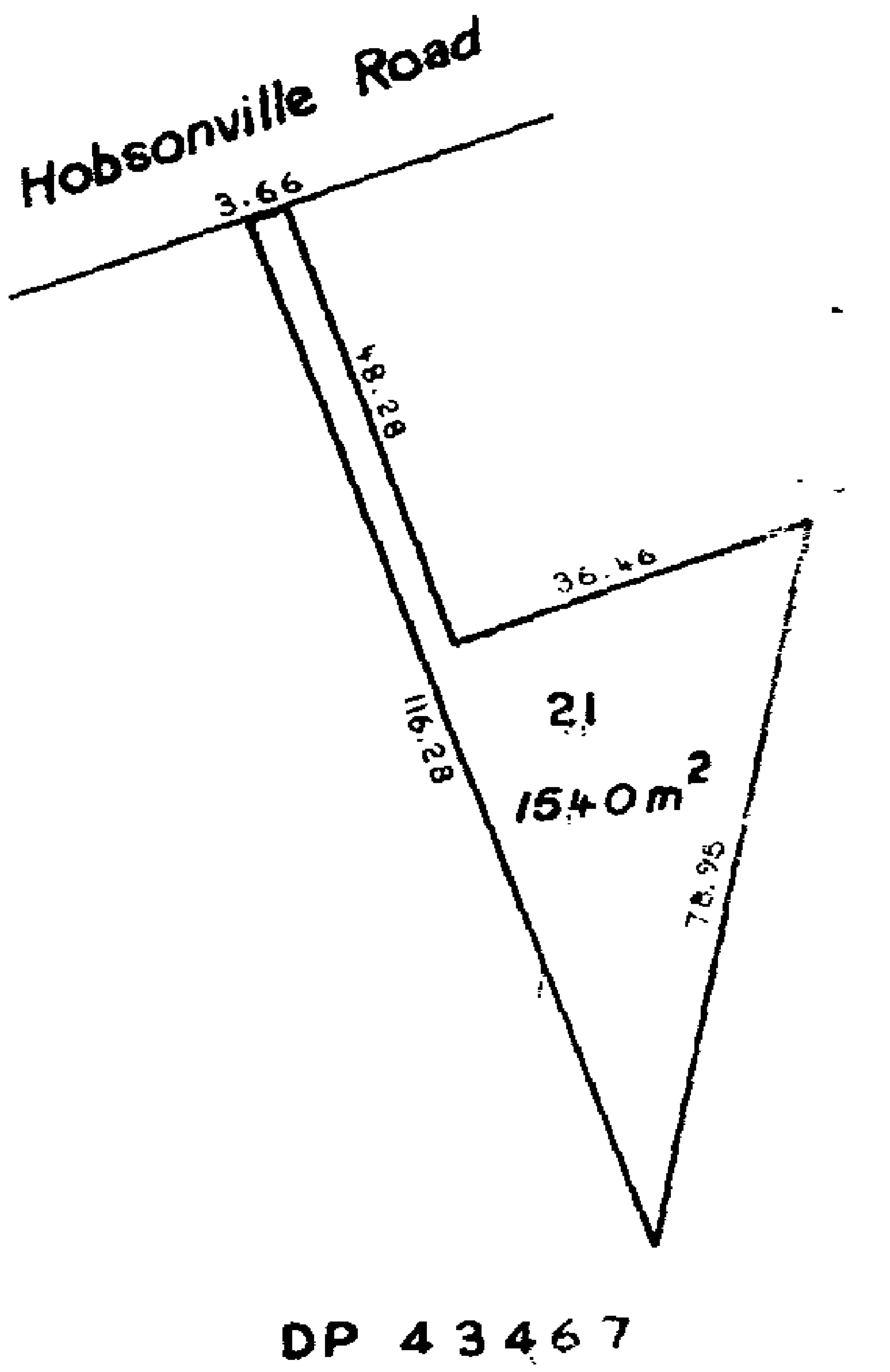
Registered Owners
Jerry's Home (2013) Limited

Interests

Subject to Section 59 Land Act 1948

12216009.3 Mortgage to Cressida Capital One Limited - 18.8.2021 at 3:34 pm

Identifier **NA38A/715**



RECORD OF TITLE
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R.W. Muir
Registrar-General
of Land

Identifier NA46C/506
Land Registration District North Auckland
Date Issued 25 October 1979

Prior References
NA26B/619

Estate	Fee Simple
Area	5.2103 hectares more or less
Legal Description	Lot 3 Deposited Plan 67207

Registered Owners

David Lin as to a 1/5 share

Chien-Yeh Sun as to a 1/5 share

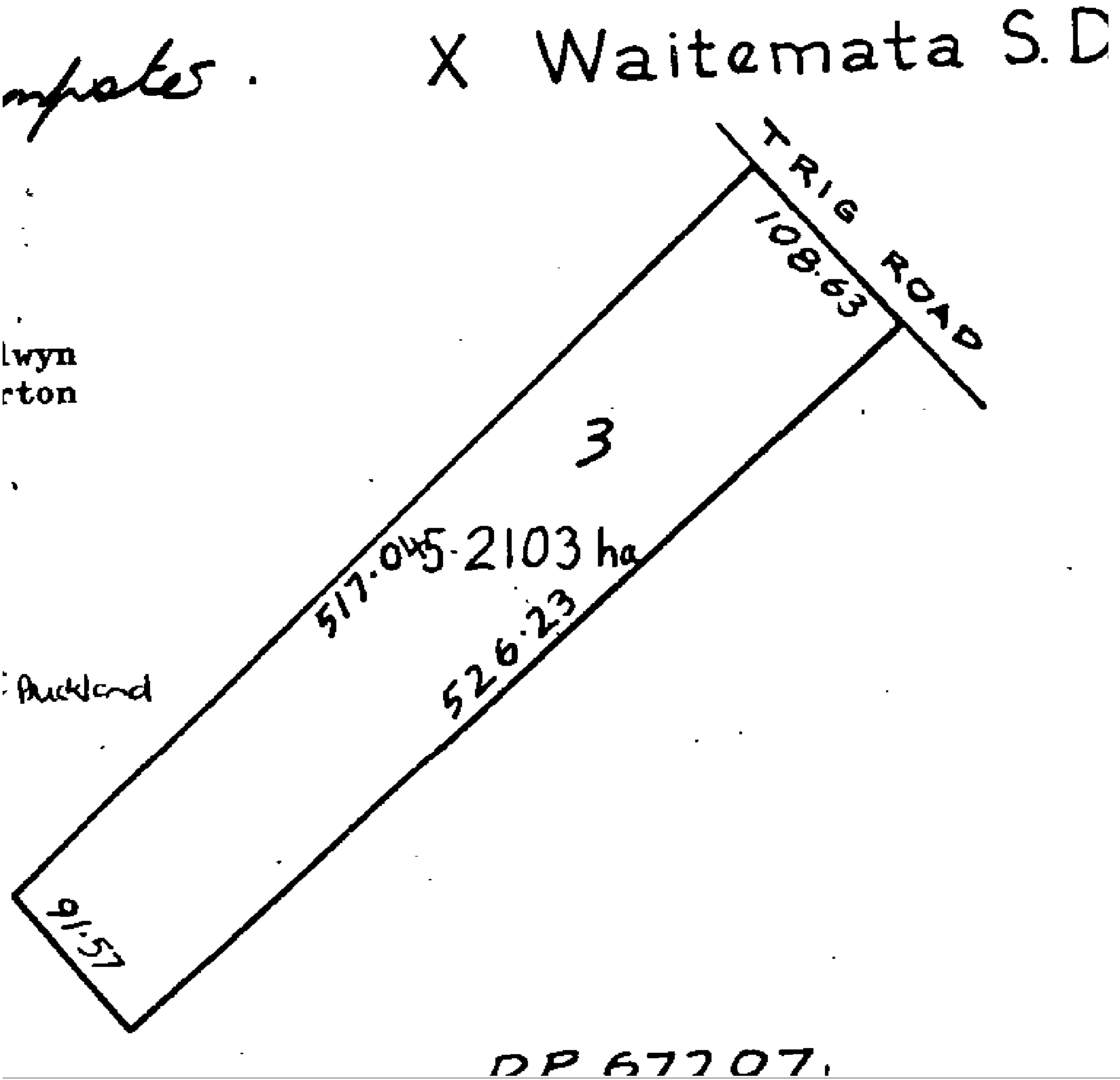
Wendy Jao and Prince & Partners Trustee Company Limited as to a 2/5 share

Hsu-Huang Cheng, Chung-Ling Chang and Benjamin Ban Chong Bong as to a 1/10 share

Huei Fu Jack Lin, Hsin Yi Chu and Yen-Hung Henry Lin as to a 1/10 share

Interests

Identifier **NA46C/506**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier	**NA61D/402**
Land Registration District	**North Auckland**
Date Issued	13 May 1986

Prior References
NA44B/813

Estate	Fee Simple
Area	5.1282 hectares more or less
Legal Description	Part Lot 2 Deposited Plan 86769

Registered Owners

Li-O Lee as to a 2/5 share

Su-Chin Lin as to a 7/20 share

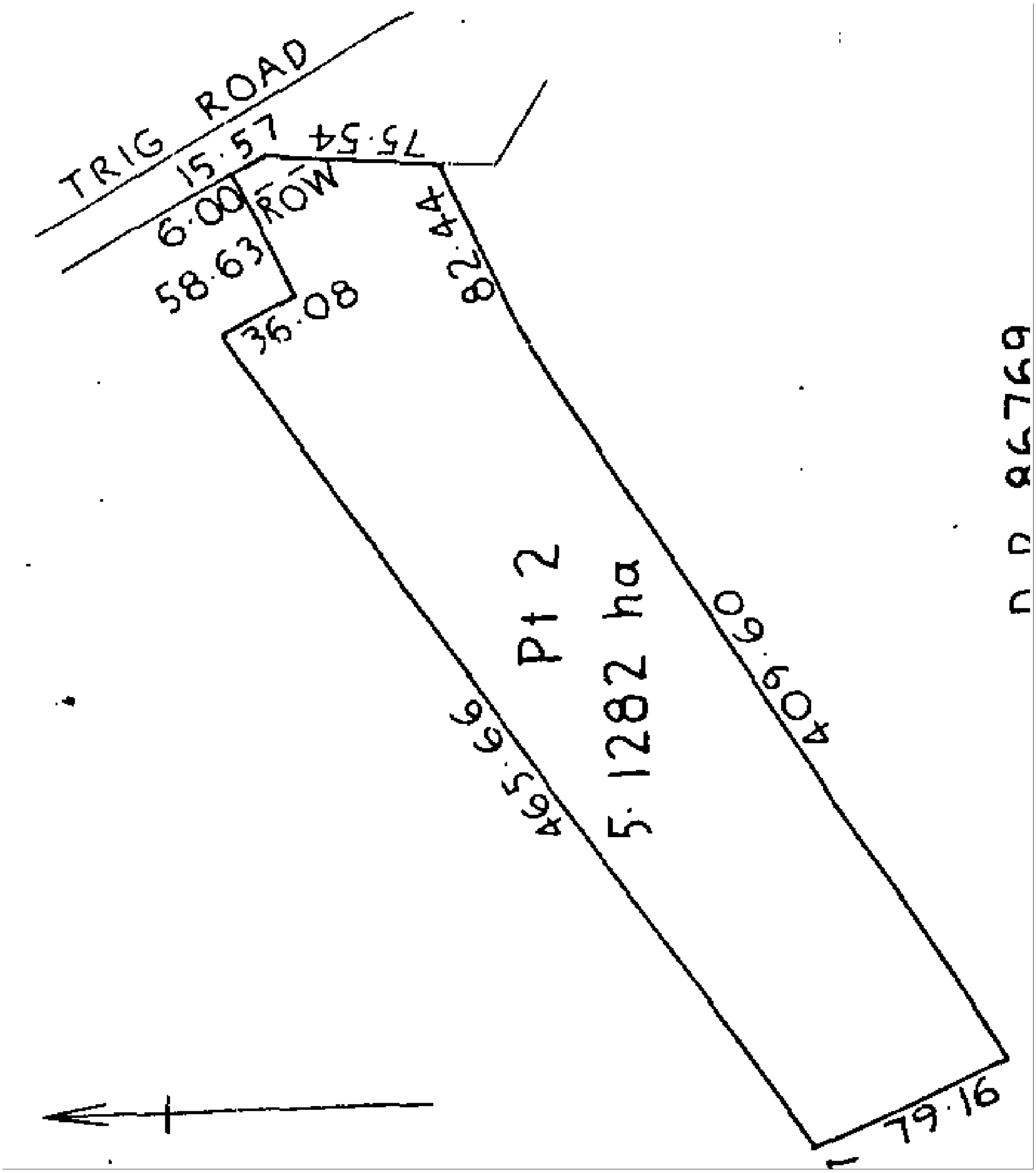
Shu-Cheng Chen as to a 1/4 share

Interests

Subject to a right of way over part marked A on DP 86769 specified in Easement Certificate 398232.4

7179382.4 Mortgage to Westpac New Zealand Limited - 3.1.2007 at 9:00 am

Identifier **NA61D/402**



RECORD OF TITLE
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R.W. Muir
Registrar-General
of Land

Identifier **NA62A/827**
Land Registration District **North Auckland**
Date Issued 13 May 1986

Prior References
NA44B/812 NA44B/813

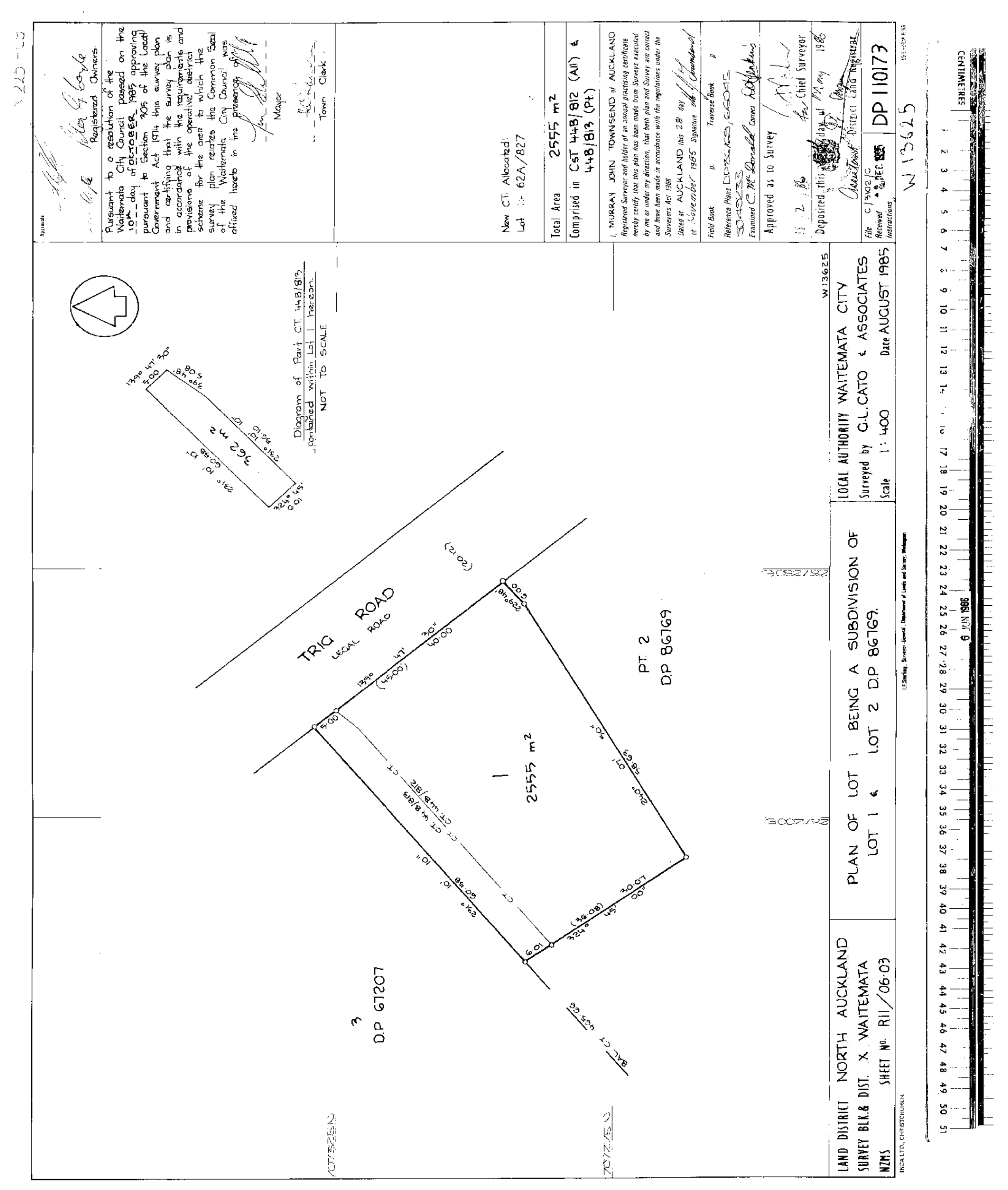
Estate Fee Simple
Area 2555 square metres more or less
Legal Description Lot 1 Deposited Plan 110173

Registered Owners
Auckland Council

Interests

Appurtenant hereto is a right of way specified in Easement Certificate 398232.4 (Affects part)

Identifier **NA62A/827**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
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R.W. Muir
Registrar-General
of Land

Identifier	**NA74D/281**
Land Registration District	**North Auckland**
Date Issued	12 December 1988

Prior References
NA11A/71

Estate	Fee Simple - 1/2 share
Area	845 square metres more or less
Legal Description	Lot 13 Deposited Plan 43467

Registered Owners
Anne Shepperd

Estate	Leasehold	**Instrument**	L B927007.3
		Term	999 years commencing on the 14.11.1988
Legal Description	Flat 1 Deposited Plan 128226		

Registered Owners
Anne Shepperd

Interests

B927007.3 Lease of Flat 1 DP 128226 Term 999 years commencing on the 14.11.1988 Composite CT NA74D/281 issued - 12.12.1988 at 11.52 am (Affects Fee Simple)

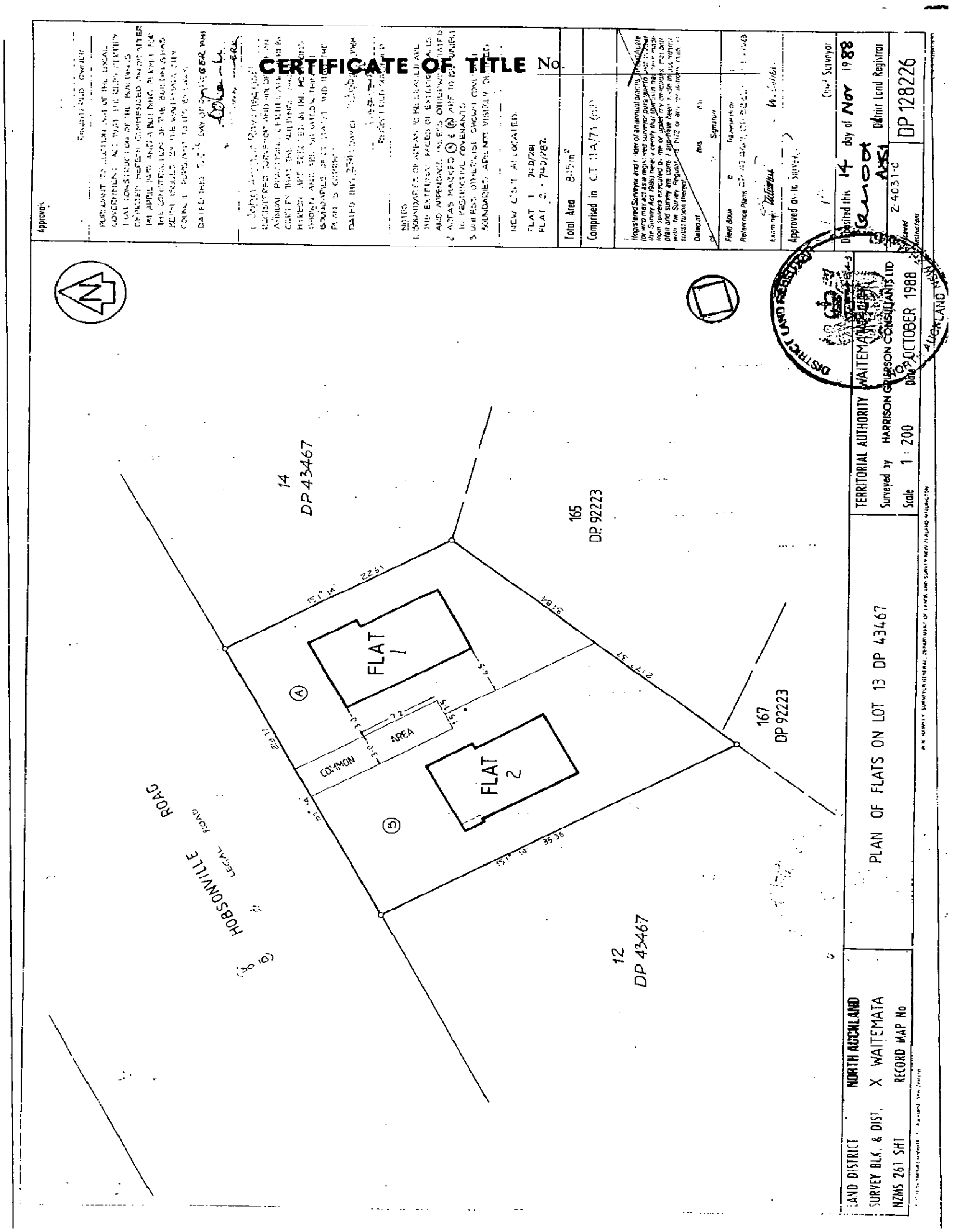
Land Covenant in Lease B927007.3 - 12.12.1988 at 11.52 am (Affects Fee Simple)

B927007.4 Lease of Flat 2 Composite 74D/282 issued - 12.12.1988 at 11.52 am (Affects Fee Simple)

Land Covenant in Lease B927007.4 - 12.12.1988 at 11.52 am (Affects Fee Simple)

D324123.2 Mortgage to Mortgage Holding Trust Company Limited - 27.10.1998 at 3.20 pm

Identifier **NA74D/281**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
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R.W. Muir
Registrar-General
of Land

Identifier NA74D/282
Land Registration District North Auckland
Date Issued 12 December 1988

Prior References
NA11A/71

Estate	Fee Simple - 1/2 share
Area	845 square metres more or less
Legal Description	Lot 13 Deposited Plan 43467

Registered Owners
Michael Bruce Coutts and Jane Louise Coutts

Estate	Leasehold	**Instrument**	L B927007.4
		Term	999 years commencing on the 14.11.1988
Legal Description	Flat 2 Deposited Plan 128226		

Registered Owners
Michael Bruce Coutts and Jane Louise Coutts

Interests

B927007.3 Lease of Flat 1 Composite CT NA74D/281 issued - 12.12.1988 at 11.52 am (Affects Fee Simple)

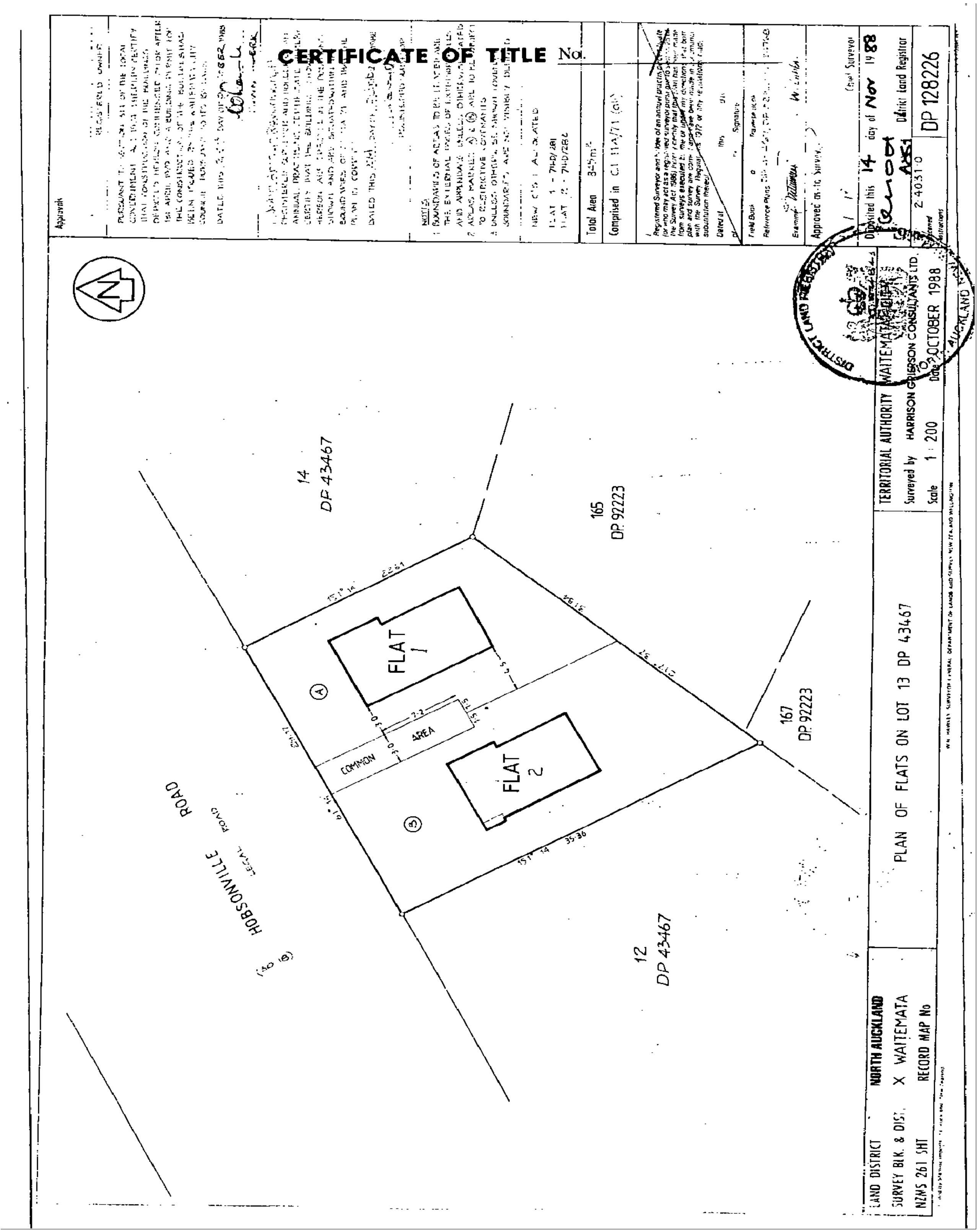
Land Covenant in Lease B927007.3 - 12.12.1988 at 11.52 am (Affects Fee Simple)

Land Covenant in Lease B927007.4 - 12.12.1988 at 11.52 am (Affects Fee Simple)

B927007.4 Lease of Flat 2 DP 128226 Term 999 years commencing on the 14.11.1988 Composite CT NA74D/282 issued - 12.12.1988 at 11.52 am (Affects Fee Simple)

11354503.3 Mortgage to ANZ Bank New Zealand Limited - 28.2.2019 at 4:25 pm

Identifier **NA74D/282**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
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R.W. Muir
Registrar-General
of Land

Identifier	**NA76B/800**
Land Registration District	**North Auckland**
Date Issued	19 April 1989

Prior References
NA11A/75

Estate	Fee Simple - 1/2 share		
Area	809 square metres more or less		
Legal Description	Lot 18 Deposited Plan 43467		

Registered Owners
Stephanie Louise Rae and Alex Robin Nieuwenhuis

Estate	Leasehold	**Instrument**	L B981247.5
		Term	999 years as from and including 14.3.1989
Legal Description	Flat 1 Deposited Plan 130372 and Carport 1 Deposited Plan 130372		

Registered Owners
Stephanie Louise Rae and Alex Robin Nieuwenhuis

Interests

B981247.5 Lease of Flat 1 and Carport 1 DP 130372 for the space of 999 years as from and including 14.3.1989 Composite CT NA76B/800 issued - 19.4.1989 at 1.37 pm (Affects Fee Simple)

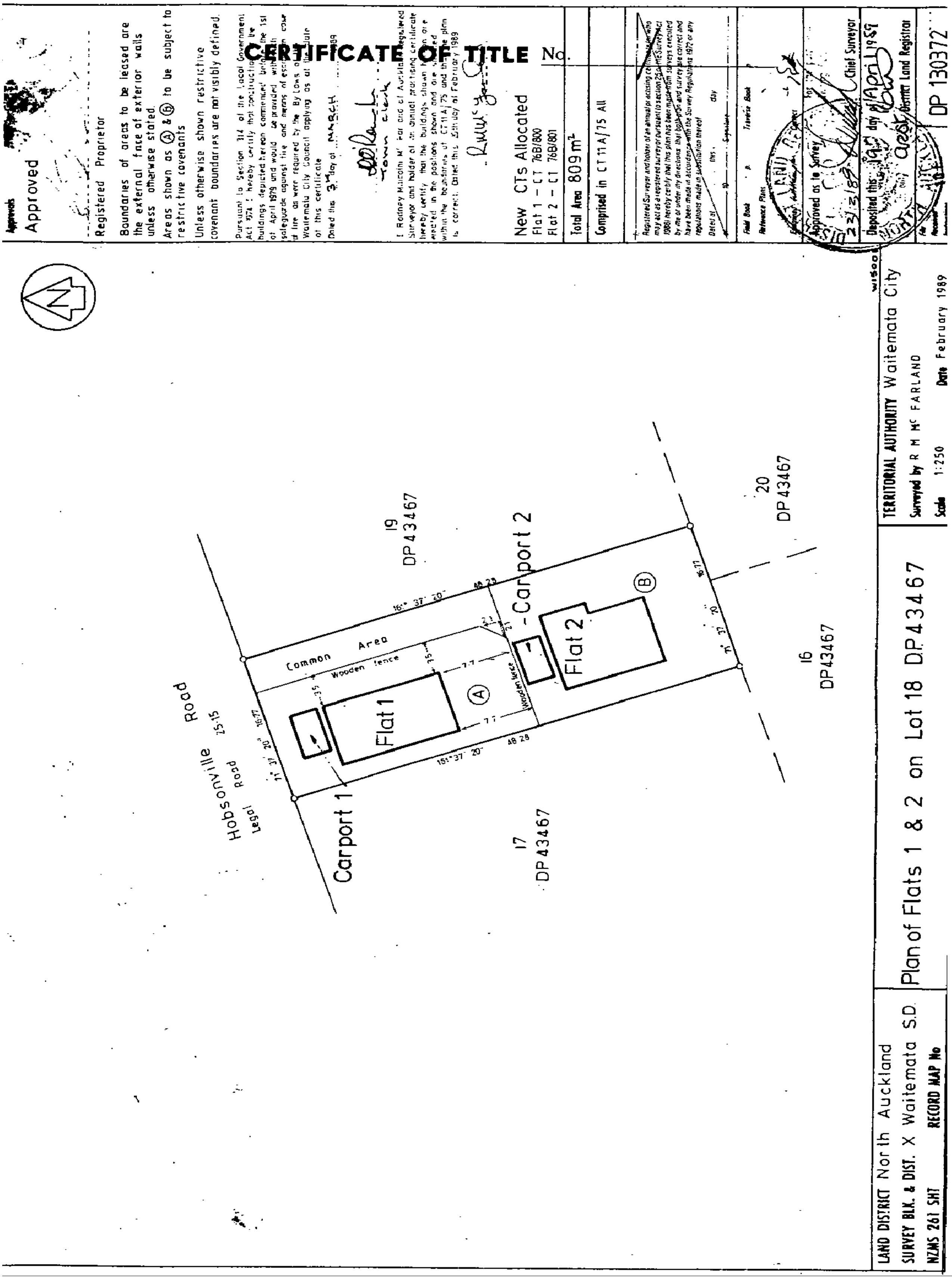
Land Covenant in Lease B981247.5 - 19.4.1989 at 1.37 pm (Affects Fee Simple)

B981247.6 Lease of Flat 2 and Carport 2 Composite CT NA76B/801 issued - 19.4.1989 at 1.37 pm (Affects Fee Simple)

Land Covenant in Lease B981247.6 - 19.4.1989 at 1.37 pm (Affects Fee Simple)

12266273.3 Mortgage to Westpac New Zealand Limited - 15.10.2021 at 11:29 am

Identifier **NA76B/800**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA76B/801**
Land Registration District	**North Auckland**
Date Issued	19 April 1989

Prior References
NA11A/75

Estate	Fee Simple - 1/2 share		
Area	809 square metres more or less		
Legal Description	Lot 18 Deposited Plan 43467		

Registered Owners
Dylan Depak Patel and Nitisha Limbachia

Estate	Leasehold	**Instrument**	L B981247.6
		Term	999 years as from and including 14.3.1989
Legal Description	Flat 2 Deposited Plan 130372 and Carport 2 Deposited Plan 130372		

Registered Owners
Dylan Depak Patel and Nitisha Limbachia

Interests

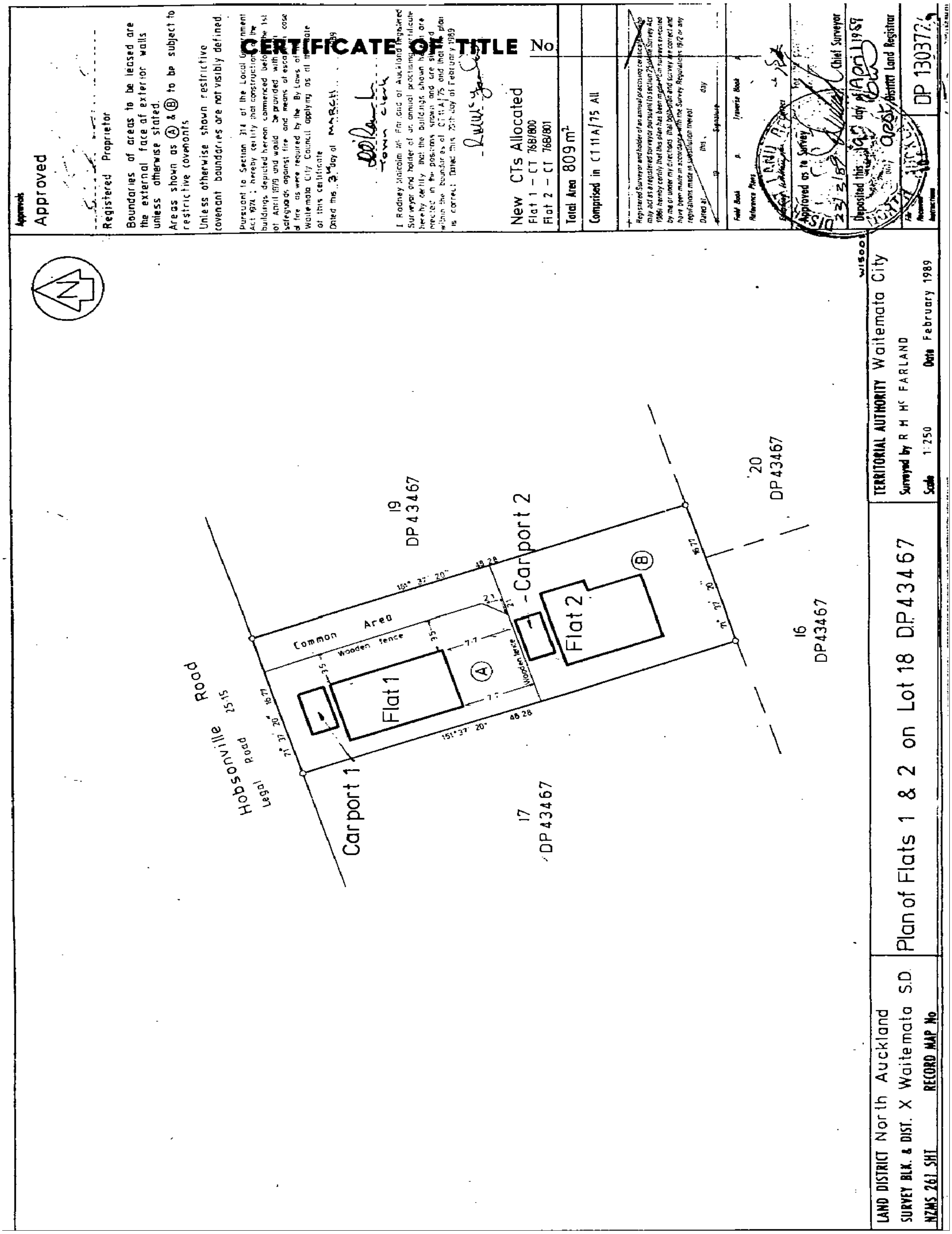
B981247.5 Lease of Flat 1 and Carport 1 Composite CT NA76B/800 issued - 19.4.1989 at 1.37 pm (Affects Fee Simple)

Land Covenant in Lease B981247.5 - 19.4.1989 at 1.37 pm (Affects Fee Simple)

Land Covenant in Lease B981247.6 - 19.4.1989 at 1.37 pm (Affects Fee Simple)

B981247.6 Lease of Flat 2 and Carport 2 DP 130372 for the space of 999 years as from and including 14.3.1989 Composite CT NA76B/801 issued - 19.4.1989 at 1.37 pm (Affects Fee Simple)

12268636.2 Mortgage to Westpac New Zealand Limited - 22.10.2021 at 3:18 pm


CERTIFICATE OF TITLE No
Approved
Registered Proprietor
Boundaries of areas to be leased are the external face of exterior walls unless otherwise stated.
Areas shown as A & B to be subject to restrictive covenants
Unless otherwise shown restrictive covenant boundaries are not visibly defined.
New CTs Allocated
Flat 1 - CT 76B/800
Flat 2 - CT 76B/801
Total Area 809 m²
Comprised in CT 11A/75 All
Approved as to Survey
Chief Surveyor
District Land Registrar
DP 130372
Hobsonville Road
Legal Road
Carport 1
Carport 2
Flat 1
Flat 2
Common Area
Wooden fence
19 DP 43467
20 DP 43467
16 DP 43467
17 DP 43467
TERRITORIAL AUTHORITY Waitemata City
Surveyed by R M McFARLAND
Scale 1:250
Date February 1989
Plan of Flats 1 & 2 on Lot 18 DP 43467
LAND DISTRICT North Auckland
SURVEY BLK. & DIST. X Waitemata S.D.
NZMS 261 SHT
RECORD MAP No

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA79B/111**
Land Registration District	**North Auckland**
Date Issued	13 October 1989

Prior References
NA79A/579

Estate	Fee Simple - 1/7 share
Area	2595 square metres more or less
Legal Description	Lot 1 Deposited Plan 133982

Registered Owners
Carl Patrick Smith

Estate	Leasehold	**Instrument**	L C054438.4
		Term	999 years as from and including 22 September 1989
Legal Description	Flat 1 Deposited Plan 134241 and Carport 1 Deposited Plan 134241		

Registered Owners
Carl Patrick Smith

Interests

Fencing Agreement in Transfer A132916 (Affects Fee Simple)

C054438.4 Lease of Flat 1 and Carport 1 Deposited Plan 134241 for the space of 999 years as from and including 22 September 1989 Composite CT NA79B/111 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.4 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.5 Lease of Flat 2 Composite CT NA79B/112 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.5 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.6 Lease of Flat 3 Composite CT NA79B/113 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.6 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.7 Lease of Flat 4 Composite CT NA79B/114 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.7 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.8 Lease of Flat 5 Composite CT NA79B115 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.8 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.9 Lease of Flat 6 Composite CT NA79B/116 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

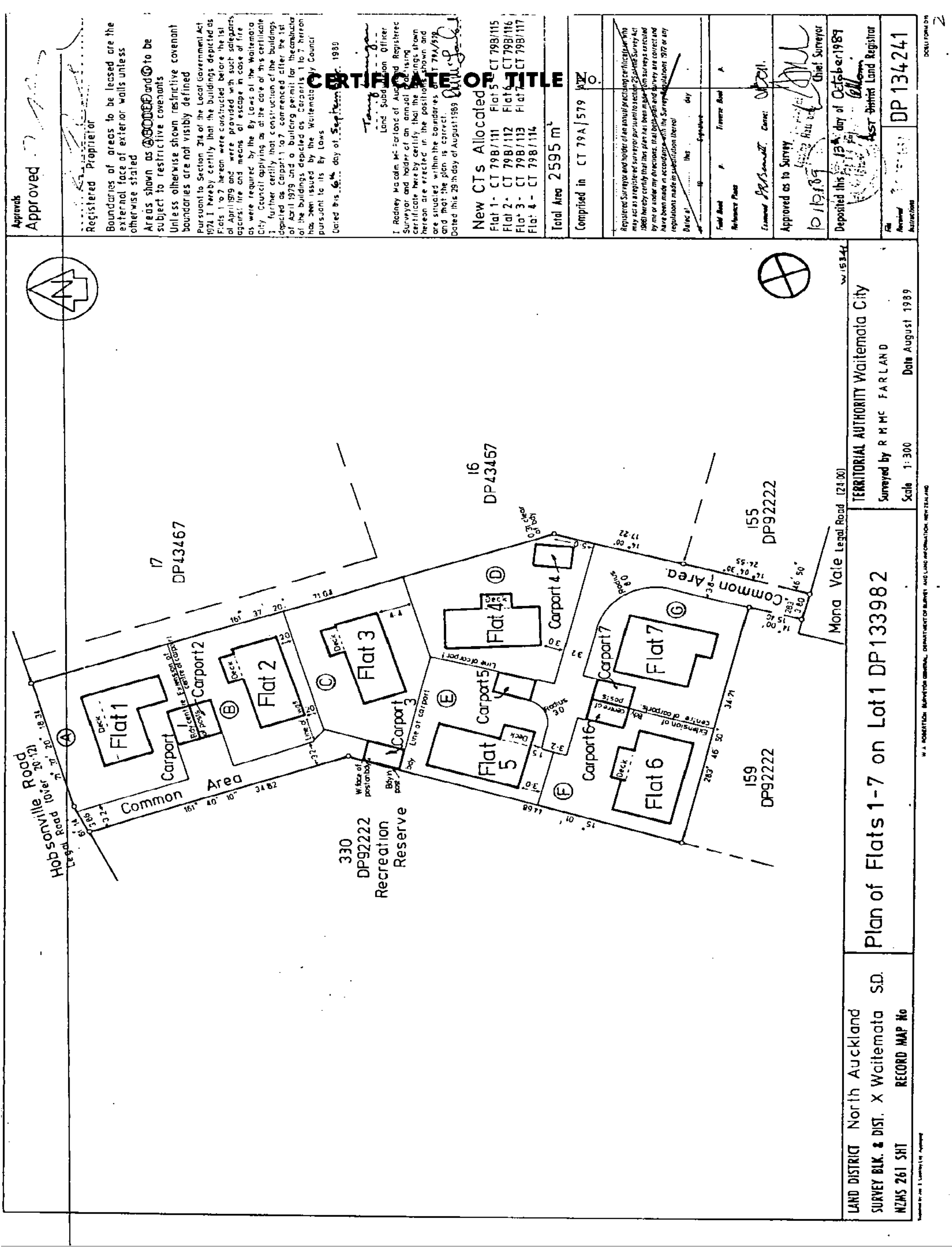
Land Covenant in Lease C054438.9 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.10 Lease of Flat 7 Composite CT NA79B/117 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.10 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

10803753.2 Mortgage to Bank of New Zealand - 29.5.2017 at 4:21 pm

Identifier **NA79B/111**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier NA79B/112
Land Registration District North Auckland
Date Issued 13 October 1989

Prior References
NA79A/579

Estate	Fee Simple - 1/7 share
Area	2595 square metres more or less
Legal Description	Lot 1 Deposited Plan 133982

Registered Owners
Erica Laurie Crump as to a 1/2 share
Shane Eric Crump as to a 1/2 share

Estate	Leasehold	**Instrument**	L C054438.5
		Term	999 years as from and including 22 September 1989
Legal Description	Flat 2 Deposited Plan 134241 and Carport 2 Deposited Plan 134241		

Registered Owners
Erica Laurie Crump as to a 1/2 share
Shane Eric Crump as to a 1/2 share

Interests

Fencing Agreement in Transfer A132196 (Affects Fee Simple)

C054438.4 Lease of Flat 1 Composite CT NA79B/111 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.4 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.5 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.5 Lease of Flat 2 and Carport 2 DP 134241 for the space of 999 years as from and including 22 September 1989 Composite NA79B/112 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.6 Lease of Flat 3 Composite CT NA79B/113 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.6 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.7 Lease of Flat 4 Composite CT NA79B/114 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.7 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.8 Lease of Flat 5 Composite CT NA79B/115 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.8 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.9 Lease of Flat 6 Composite CT NA79B/116 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

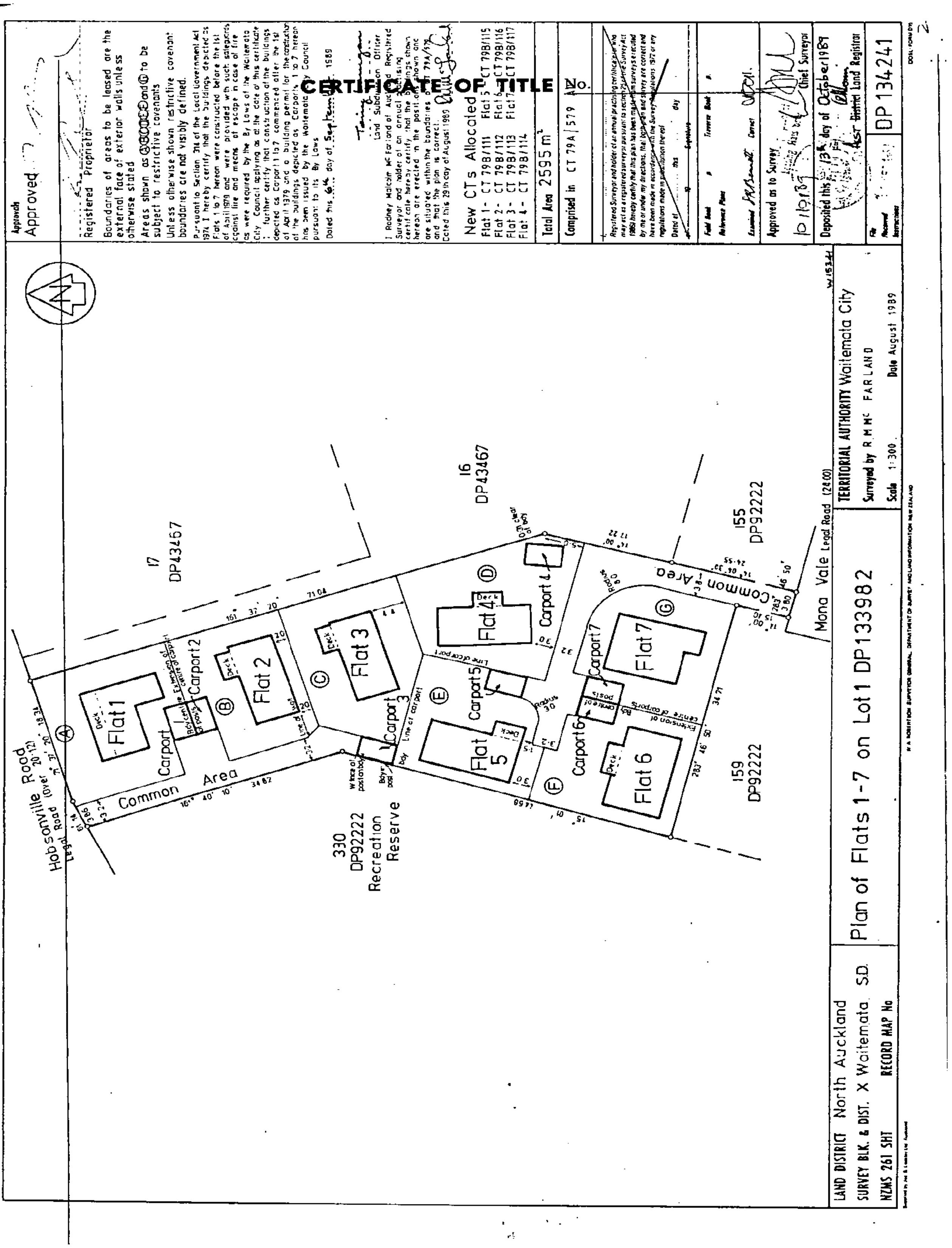
Land Covenant in Lease C054438.9 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.10 Lease of Flat 7 Composite CT NA79B/117 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.10 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

8689970.3 Mortgage to Bank of New Zealand - 11.2.2011 at 12:02 pm

Identifier **NA79B/112**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **NA79B/113**
Land Registration District **North Auckland**
Date Issued 13 October 1989

Prior References
NA79A/579

Estate	Fee Simple - 1/7 share
Area	2595 square metres more or less
Legal Description	Lot 1 Deposited Plan 133982

Registered Owners
Marvin Rey Garcia Garcia and Hannah Roselle Baltazar Chan

Estate	Leasehold	**Instrument**	L C054438.6
		Term	999 years as from and including 22 September 1989
Legal Description	Flat 3 Deposited Plan 134241 and Carport 3 Deposited Plan 134241		

Registered Owners
Marvin Rey Garcia Garcia and Hannah Roselle Baltazar Chan

Interests

Fencing Agreement in Transfer A132196 (Affects Fee Simple)

C054438.4 Lease of Flat 1 Composite CT NA79B/111 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.4 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.5 Lease of Flat 2 Composite CT NA79B/112 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.5 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.6 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.6 Lease of Flat 3 and Carport 3 DP 134241 for the space of 999 years as from and including 22 September 1989 Composite CT NA79B/113 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.7 Lease of Flat 4 Composite CT NA79B/114 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.7 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.8 Lease of Flat 5 Composite CT NA79B/115 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.8 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

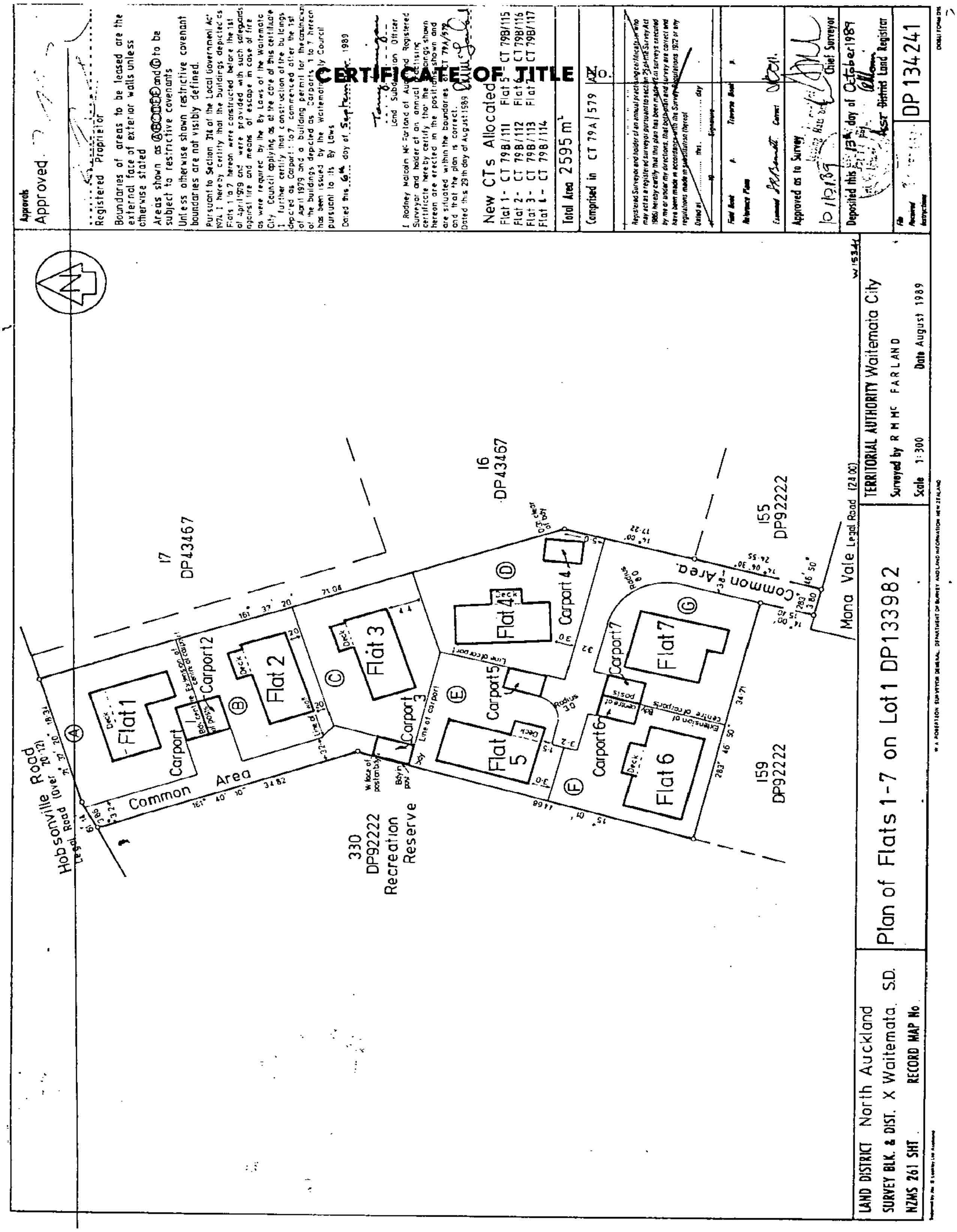
C054438.9 Lease of Flat 6 Composite CT NA79B/116 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.9 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.10 Lease of Flat 7 Composite CT NA79B/117 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.10 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

12297635.2 Mortgage to Westpac New Zealand Limited - 17.12.2021 at 3:17 pm


CERTIFICATE OF TITLE
Approvals
Approved
Registered Proprietor
Boundaries of areas to be leased are the external face of exterior walls unless otherwise stated
Areas shown as ABCDEF and G to be subject to restrictive covenants
Unless otherwise shown restrictive covenant boundaries are not visibly defined.
Pursuant to Section 318 of the Local Government Act 1974 I hereby certify that the buildings depicted as Flats 1 to 7 hereon were constructed before the 1st of April 1979 and were provided with such safeguards against fire and means of escape in case of fire as were required by the By Laws of the Waitemata City Council applying as at the date of this certificate. I further certify that construction of the buildings depicted as Carport 1 to 7 commenced after the 1st of April 1979 and a building permit for the construction of the buildings depicted as Carports 1 to 7 hereon has been issued by the Waitemata City Council pursuant to its By Laws
Dated this 6th day of September 1989
Land Subdivision Officer
I Rodney Malcolm McFarland of Auckland Registered Surveyor and holder of an annual practising certificate hereby certify that the buildings shown hereon are erected in the positions shown and are situated within the boundaries of CT 79A/579 and that the plan is correct.
Dated this 29th day of August 1989
New CTs Allocated
Flat 1 - CT 79B/111 Flat 5 - CT 79B/115
Flat 2 - CT 79B/112 Flat 6 - CT 79B/116
Flat 3 - CT 79B/113 Flat 7 - CT 79B/117
Flat 4 - CT 79B/114
Total Area 2595 m²
Comprised in CT 79A/579 AK.
Approved as to Survey
10/10/89
Chief Surveyor
Deposited this 13th day of October 1989
Asst District Land Registrar
DP 134241
Hobsonville Road Legal Road (Over 20.12)
Common Area
Flat 1
Flat 2
Flat 3
Flat 4
Flat 5
Flat 6
Flat 7
Carport
Carport 2
Carport 3
Carport 4
Carport 5
Carport 6
Carport 7
17 DP43467
16 DP43467
330 DP92222 Recreation Reserve
159 DP92222
155 DP92222
Mona Vale Legal Road (24.00)
LAND DISTRICT North Auckland
SURVEY BLK. & DIST. X Waitemata S.D.
NZMS 261 SHT
RECORD MAP No
Plan of Flats 1-7 on Lot 1 DP133982
TERRITORIAL AUTHORITY Waitemata City
Surveyed by R M Mc FARLAND
Scale 1:300
Date August 1989

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA79B/114**
Land Registration District	**North Auckland**
Date Issued	13 October 1989

Prior References
NA79A/579

Estate	Fee Simple - 1/7 share
Area	2595 square metres more or less
Legal Description	Lot 1 Deposited Plan 133982

Registered Owners
Jodi Anna Nehring

Estate	Leasehold	**Instrument**	L C054438.7
		Term	999 years as from and including 22nd September 1989
Legal Description	Flat 4 Deposited Plan 134241 and Carport 4 Deposited Plan 134241		

Registered Owners
Jodi Anna Nehring

Interests

Fencing Agreement in Transfer A132916 (Affects Fee Simple)

C054438.4 Lease of Flat 1 Composite CT NA79B/111 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.4 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.5 Lease of Flat 2 Composite CT NA79B/112 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.5 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.6 Lease of Flat 3 Composite CT NA79B/113 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.6 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.7 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.7 Lease of Flat 4 and Carport 4 DP 134241 for the space of 999 years as from and including 22nd September 1989 Composite CT NA79B/114 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.8 Leaseof Flat 5 Composite CT NA79B/115 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

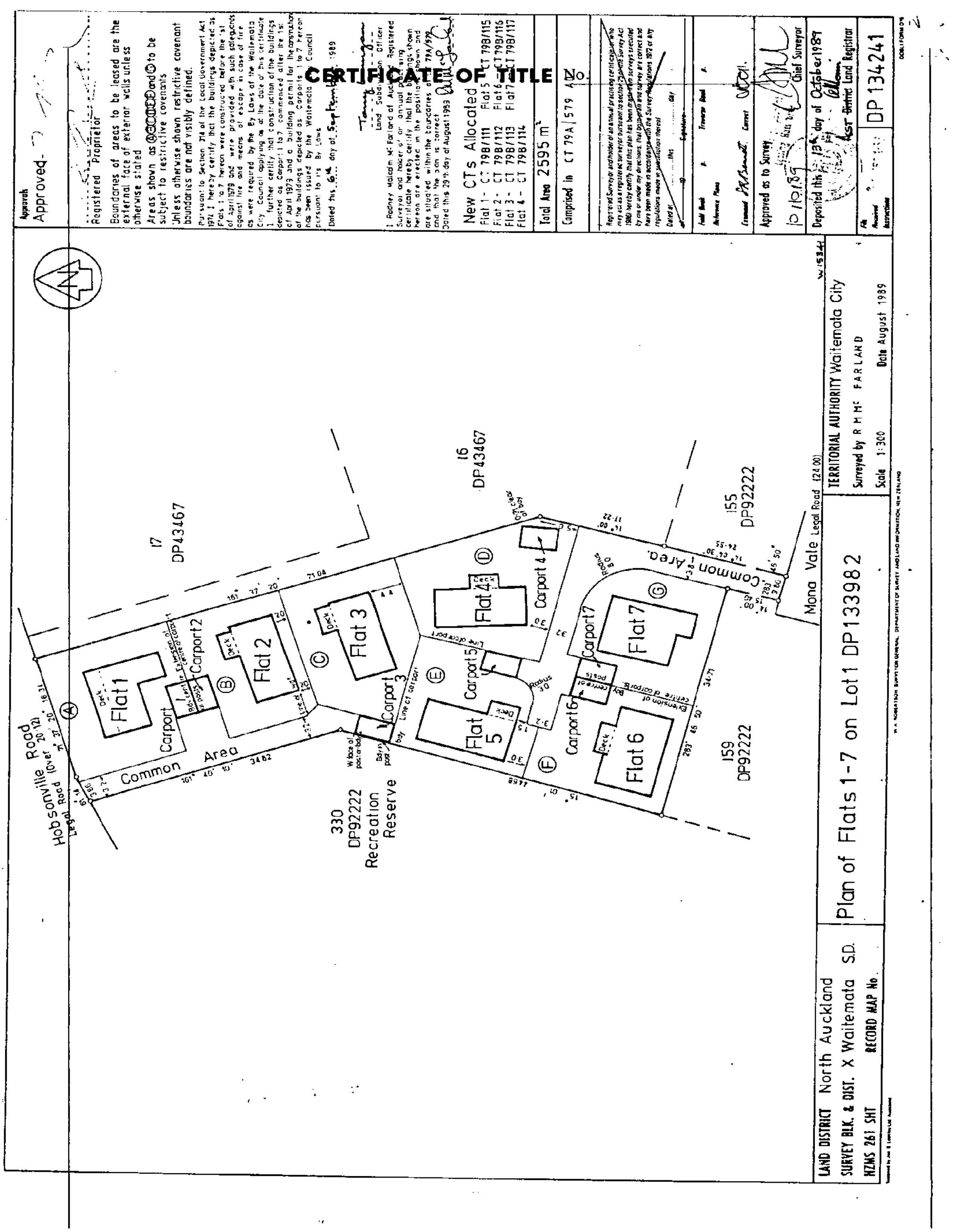
Land Covenant in Lease C054438.8 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.9 Lease of Flat 6 Composite CT NA79B/116 issued- 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.10 Lease of Flat 7 Composite CT NA79B/117 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.10 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

8076528.2 Mortgage to ASB Bank Limited - 23.2.2009 at 11:42 am


CERTIFICATE OF TITLE
Plan of Flats 1-7 on Lot1 DP133982
DP 134241
TERRITORIAL AUTHORITY Waitemata City
LAND DISTRICT North Auckland
SURVEY BLK. & DIST. X Waitemata S.D.
HZMS 261 SHT
RECORD MAP No.
Scale 1:300
Date August 1989
Total Area 2595 m²
Comprised in CT 79A/579
New CTs Allocated
Flat 1 - CT 79B/111
Flat 2 - CT 79B/112
Flat 3 - CT 79B/113
Flat 4 - CT 79B/114
Flat 5 - CT 79B/115
Flat 6 - CT 79B/116
Flat 7 - CT 79B/117
Hobsonville Road
Mona Vale
Common Area
Flat 1
Flat 2
Flat 3
Flat 4
Flat 5
Flat 6
Flat 7
330 DP92222 Recreation Reserve
17 DP43467
16 DP43467
155 DP92222
159 DP92222

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA79B/115**
Land Registration District	**North Auckland**
Date Issued	13 October 1989

Prior References
NA79A/579

Estate	Fee Simple - 1/7 share		
Area	2595 square metres more or less		
Legal Description	Lot 1 Deposited Plan 133982		

Registered Owners
Arleen McCracken

Estate	Leasehold	**Instrument**	L C054438.8
		Term	999 years as from and including 22nd September 1989
Legal Description	Flat 5 Deposited Plan 134241 and Carport 5 Deposited Plan 134241		

Registered Owners
Arleen McCracken

Interests

Fencing Agreement in Transfer A132916 (Affects Fee Simple)

C054438.4 Lease of Flat 1 Composite CT NA79B/111 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.4 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.5 Lease of Flat 2 Composite CT NA79B/112 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.5 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.6 Lease of Flat 3 Composite CT NA79B/113 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.6 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.7 Lease of Flat 4 Composite CT NA79B/114 issued- 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.7 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.8 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.8 Lease of Flat 5 and Carport 5 DP 134241 for the space of 999 years as from and including 22nd September 1989 Composite CT NA79B/115 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

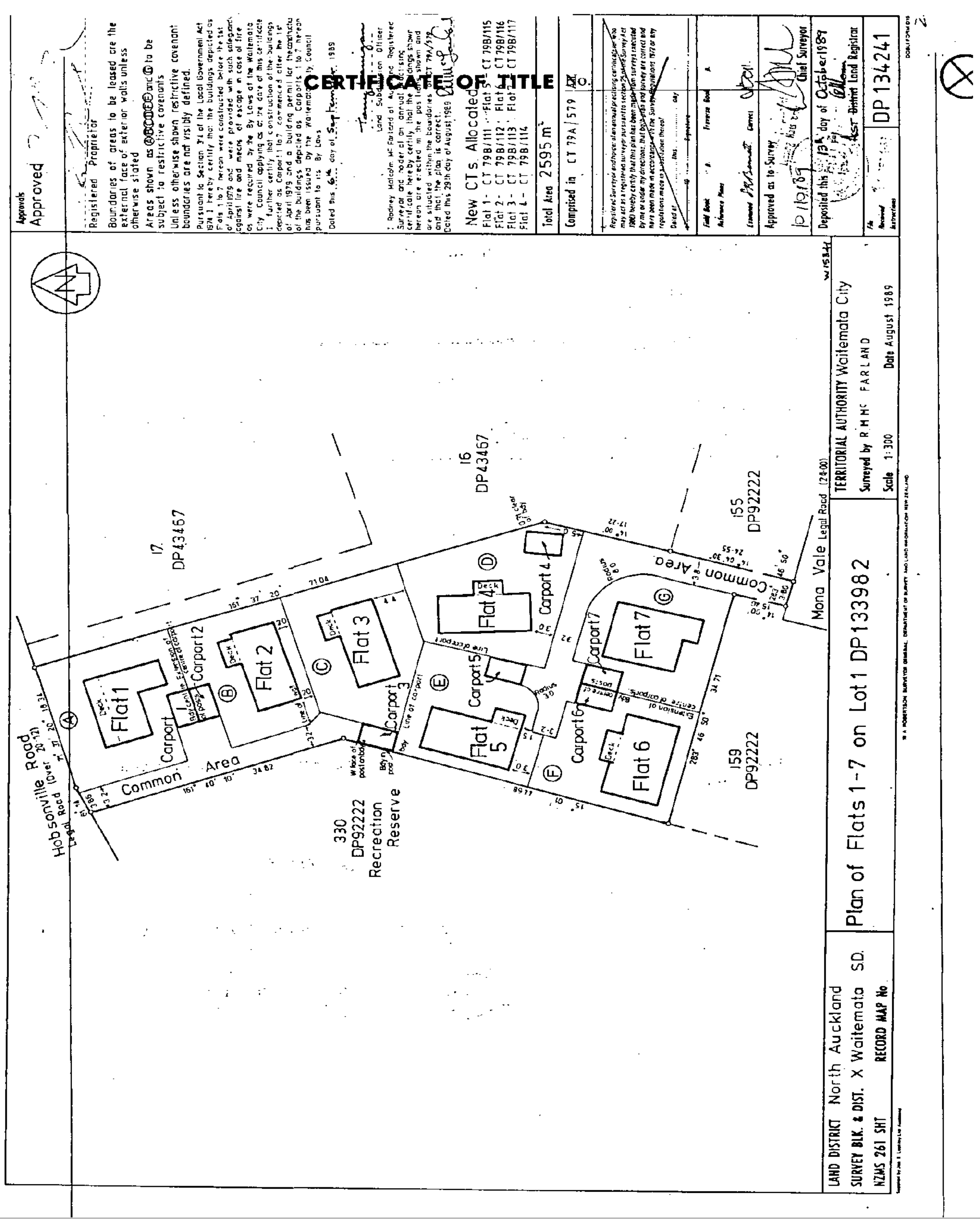
C054438.9 Lease of Flat 6 Composite CT NA79B/116 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.9 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.10 Lease of Flat 7 Composite CT NA79B/117 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.10 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Identifier **NA79B/115**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA79B/116**
Land Registration District	**North Auckland**
Date Issued	13 October 1989

Prior References
NA79A/579

Estate	Fee Simple - 1/7 share		
Area	2595 square metres more or less		
Legal Description	Lot 1 Deposited Plan 133982		

Registered Owners
Chendong Wu and Wenwei Dai

Estate	Leasehold	**Instrument**	L C054438.9
		Term	999 years as from and including 22nd September 1989
Legal Description	Flat 6 Deposited Plan 134241 and Carport 6 Deposited Plan 134241		

Registered Owners
Chendong Wu and Wenwei Dai

Interests

Fencing Agreement in Transfer A132916 (Affects Fee Simple)

C054438.4 Lease of Flat 1 Composite CT NA79B/111 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.4 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.5 Lease of Flat 2 Composite CT NA79B/112 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.5 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.6 Lease of Flat 3 Composite CT NA79B/113 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.6 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.7 Lease of Flat 4 Composite CT NA79B/114 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.7 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.8 Lease of Flat 5 Composite CT NA79B/115 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.8 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.9 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

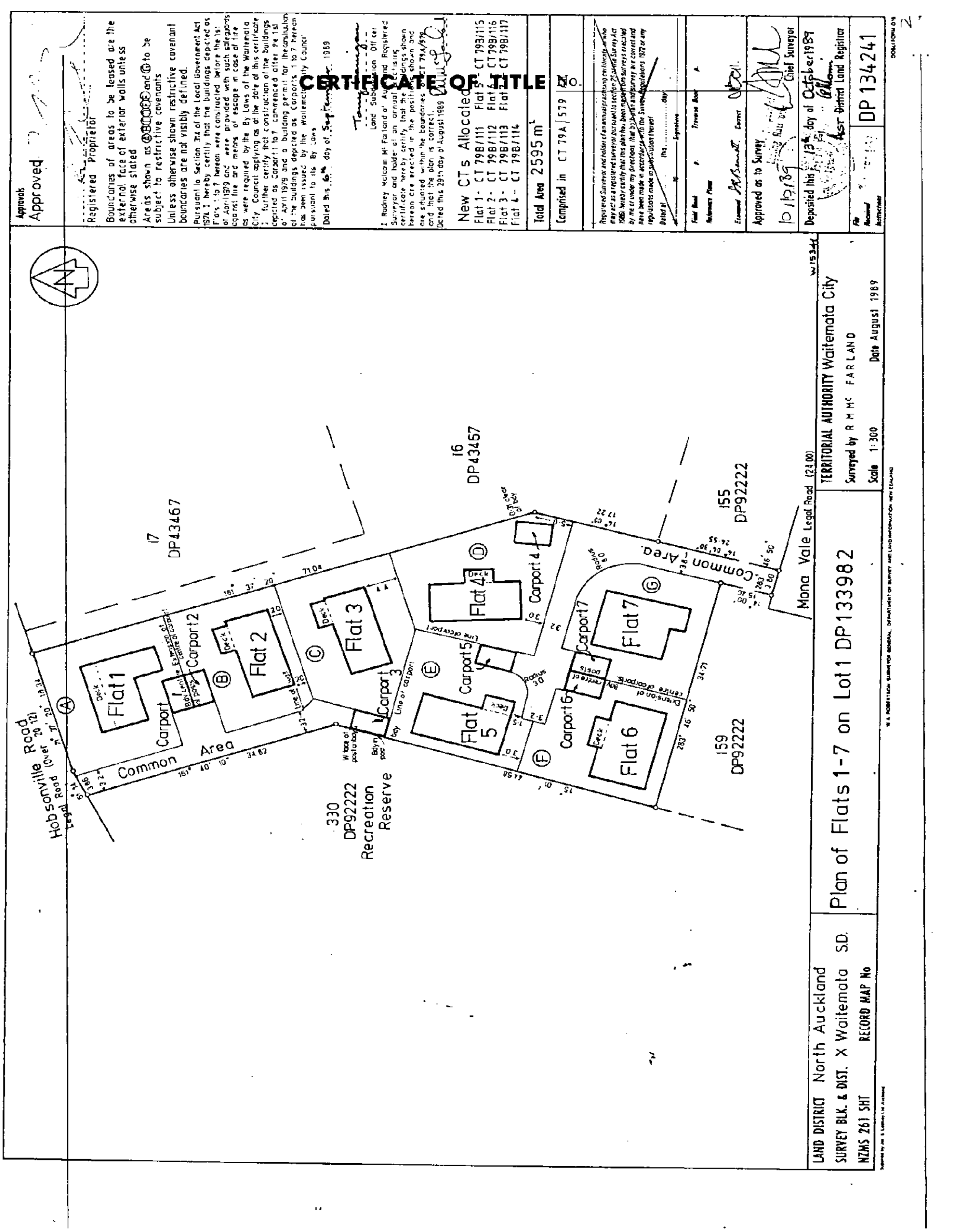
C054438.9 Lease of Flat 6 and Carport 6 DP 134241 for the space of 999 years as from and including 22nd September 1989 Composite CT NA79B/116 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.10 Lease of Flat 7 Composite CT NA79B/117 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.10 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

11868137.2 Mortgage to ASB Bank Limited - 30.9.2020 at 12:21 pm

Identifier **NA79B/116**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier NA79B/117
Land Registration District North Auckland
Date Issued 13 October 1989

Prior References
NA79A/579

Estate Fee Simple - 1/7 share
Area 2595 square metres more or less
Legal Description Lot 1 Deposited Plan 133982

Registered Owners
Stuart Gregory Gamble and Anita Joan Gamble

Estate Leasehold
Instrument L C054438.10
Term 999 years as from and including 22nd September 1989
Legal Description Flat 7 Deposited Plan 134241 and Carport 7 Deposited Plan 134241

Registered Owners
Stuart Gregory Gamble and Anita Joan Gamble

Interests

Fencing Agreement in Transfer A132916 (Affects Fee Simple)

C054438.4 Lease of Flat 1 Composite CT NA79B/111 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.4 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.5 Lease of Flat 2 Composite CT NA79B/112 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.5 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.6 Lease of Flat 3 Composite CT NA79B/113 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.6 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.7 Lease of Flat 4 Composite CT NA79B/114 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.7 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.8 Lease of Flat 5 Composite CT NA79B/115 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.8 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.9 Lease of Flat 6 Composite CT NA79B/116 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

Land Covenant in Lease C054438.9 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

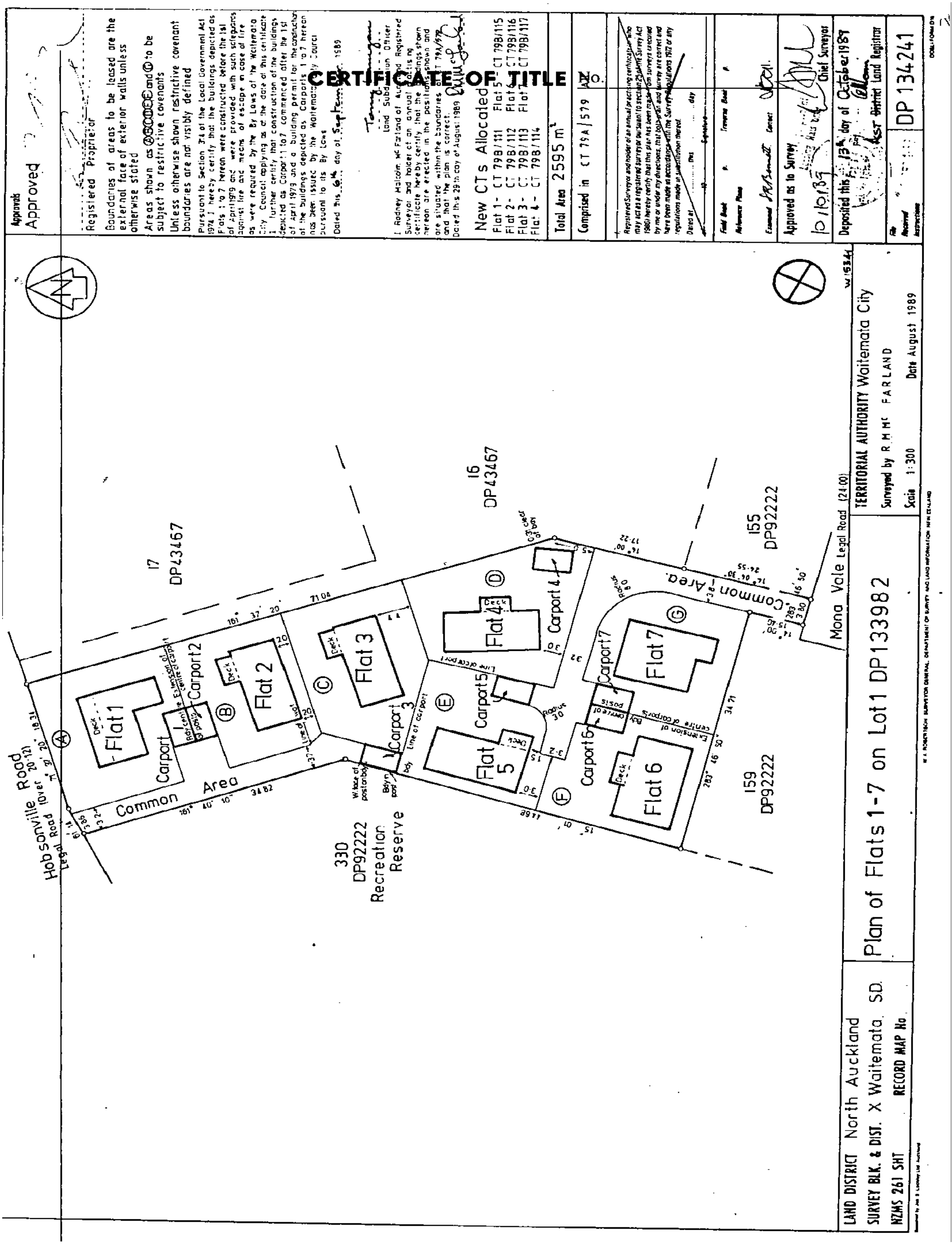
Land Covenant in Lease C054438.10 - 13.10.1989 at 1.32 pm (Affects Fee Simple)

C054438.10 Lease of Flat 7 and Carport 7 DP 134241 for the space of 999 years as from and including 22nd September 1989 Composite CT NA79B/117 issued - 13.10.1989 at 1.32 pm (Affects Fee Simple)

8003603.2 Mortgage to ASB Bank Limited - 26.11.2008 at 1:41 pm

12222734.1 Variation of Mortgage 8003603.2 - 19.8.2021 at 10:15 am

Identifier **NA79B/117**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA83C/586**
Land Registration District	**North Auckland**
Date Issued	21 September 1990

Prior References
NA11A/80

Estate	Fee Simple - 1/2 share		
Area	829 square metres more or less		
Legal Description	Lot 24 Deposited Plan 43467		

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Estate	Leasehold	**Instrument**	L C191809.2
		Term	999 years commencing on the 24th August 1990
Legal Description	Flat 1 Deposited Plan 140836 and Carport 1 Deposited Plan 140836		

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Interests

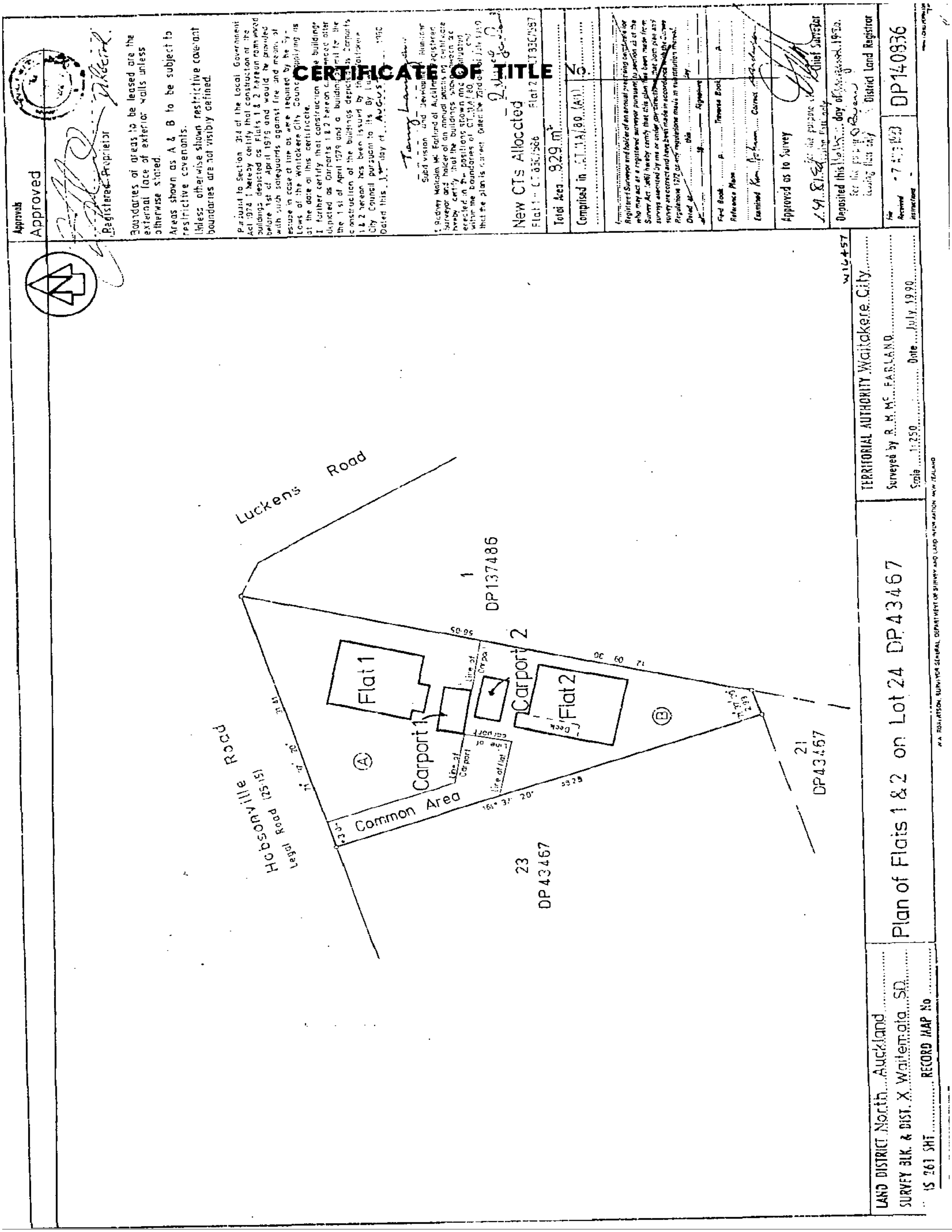
C191809.2 Lease of Flat 1 and Carport 1 DP 140836 Term 999 years commencing on the 24th August 1990
Composite CT NA83C/586 issued - 21.9.1990 (Affects Fee Simple)

Land Covenant in Lease C191809.2 - 21.9.1990 (Affects Fee Simple)

C191809.3 Lease of Flat 2 Composite CT NA83C/587 issued - 21.9.1990 (Affects Fee Simple)

Land Covenant in Lease C191809.3 - 21.9.1990 (Affects Fee Simple)

11822727.5 Mortgage to ASB Bank Limited - 5.11.2021 at 5:19 pm


CERTIFICATE OF TITLE
Approved
Registered Proprietor
Boundaries of areas to be leased are the external face of exterior walls unless otherwise stated.
Areas shown as A & B to be subject to restrictive covenants.
Unless otherwise shown restrictive covenant boundaries are not visibly defined.
New CTs Allocated
Total Area 829 m²
DP140936
Luckens Road
Hobsonville Road
Legal Road (25.15)
Flat 1
Flat 2
Carport 1
Carport 2
Common Area
1
DP137486
21
DP43467
23
DP43467
TERRITORIAL AUTHORITY Waitakere City
Surveyed by R.H.MC FARLAND
Scale 1:250
Date July 1990
Plan of Flats 1 & 2 on Lot 24 DP43467
LAND DISTRICT North Auckland
SURVEY BLK. & DIST. X Waitemata SD
RECORD MAP No

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA83C/587**
Land Registration District	**North Auckland**
Date Issued	21 September 1990

Prior References
NA11A/80

Estate	Fee Simple - 1/2 share		
Area	829 square metres more or less		
Legal Description	Lot 24 Deposited Plan 43467		

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Estate	Leasehold	**Instrument**	L C191809.3
		Term	999 years commencing on the 24th August 1990
Legal Description	Flat 2 Deposited Plan 140836 and Carport 2 Deposited Plan 140836		

Registered Owners
Mark Darron Waller, Ruth Vivienne Waller and DHT (2020) 4 Limited

Interests

C191809.2 Lease of Flat 1 Composite CT NA83C/586 issued - 21.9.1990 at 9.15 am (Affects Fee Simple)

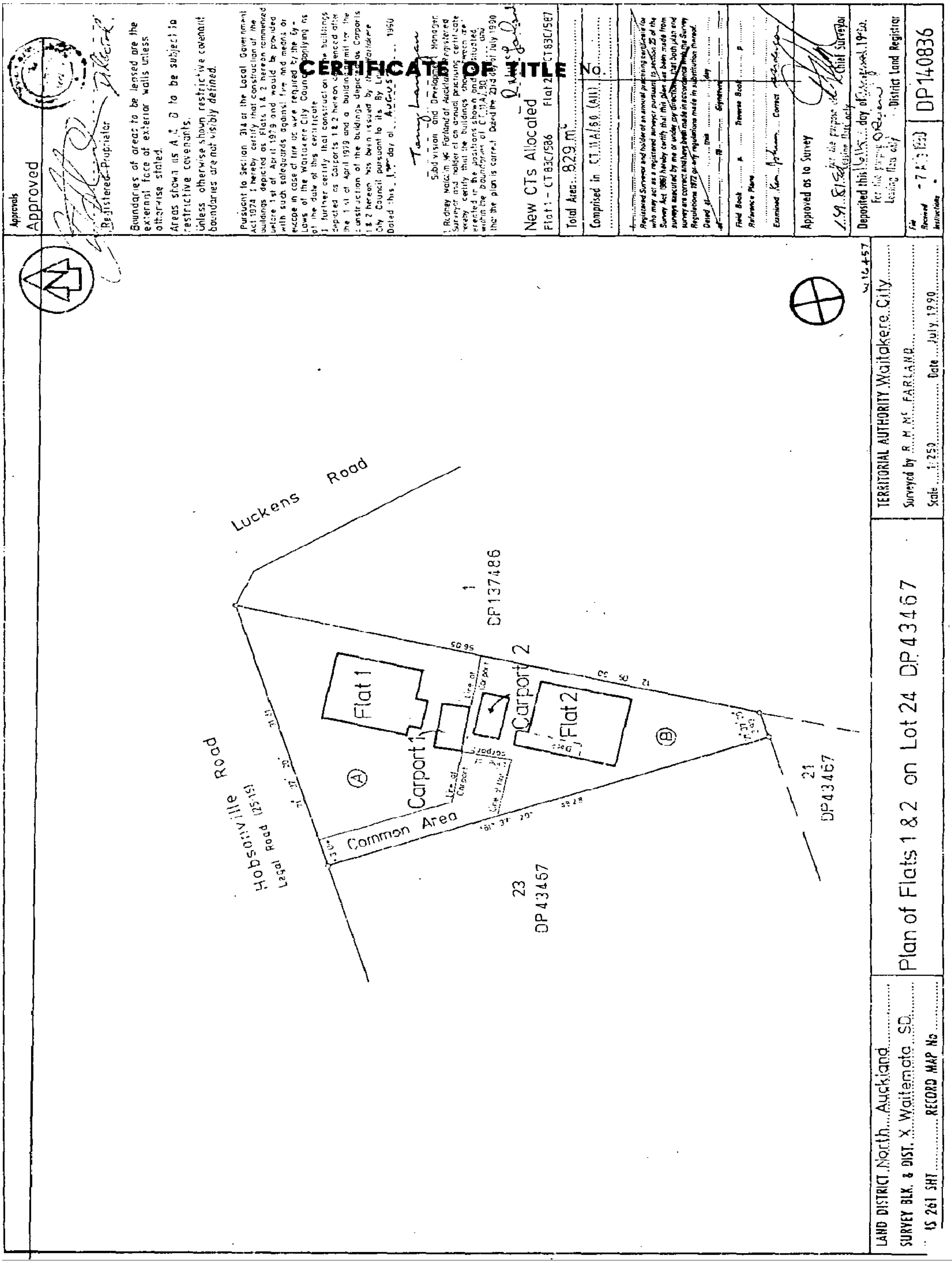
Land Covenant in Lease C191809.2 - 21.9.1990 at 9.15 am (Affects Fee Simple)

Land Covenant in Lease C191809.3 - 21.9.1990 at 9.15 am (Affects Fee Simple)

C191809.3 Lease of Flat 2 and Carport 2 DP 140836 Term 999 years commencing on the 24th August 1990
Composite CT NA83C/587 issued - 21.9.1990 at 9.15 am (Affects Fee Simple)

11822727.6 Mortgage to ASB Bank Limited - 5.11.2021 at 5:19 pm

Identifier **NA83C/587**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA85B/400**
Land Registration District	**North Auckland**
Date Issued	25 February 1991

Prior References
NA11A/73

Estate	Fee Simple - 1/3 share		
Area	1889 square metres more or less		
Legal Description	Lot 16 Deposited Plan 43467		

Registered Owners
Douglas Robert MacKay and John Donald MacKay

Estate	Leasehold	**Instrument**	L C240972.1
		Term	999 years commencing on the 8th February 1991
Legal Description	Flat 1 Deposited Plan 143651 and Garage 1 Deposited Plan 143651		

Registered Owners
Douglas Robert MacKay and John Donald MacKay

Interests

C240972.1 Lease of Flat 1 and Garage 1 DP 143651 Term 999 years commencing on the 8th February 1991 Composite CT NA85B/400 issued - 25.2.1991 (Affects Fee Simple)

Land Covenant in Lease C240972.1 - 25.2.1991 (Affects Fee Simple)

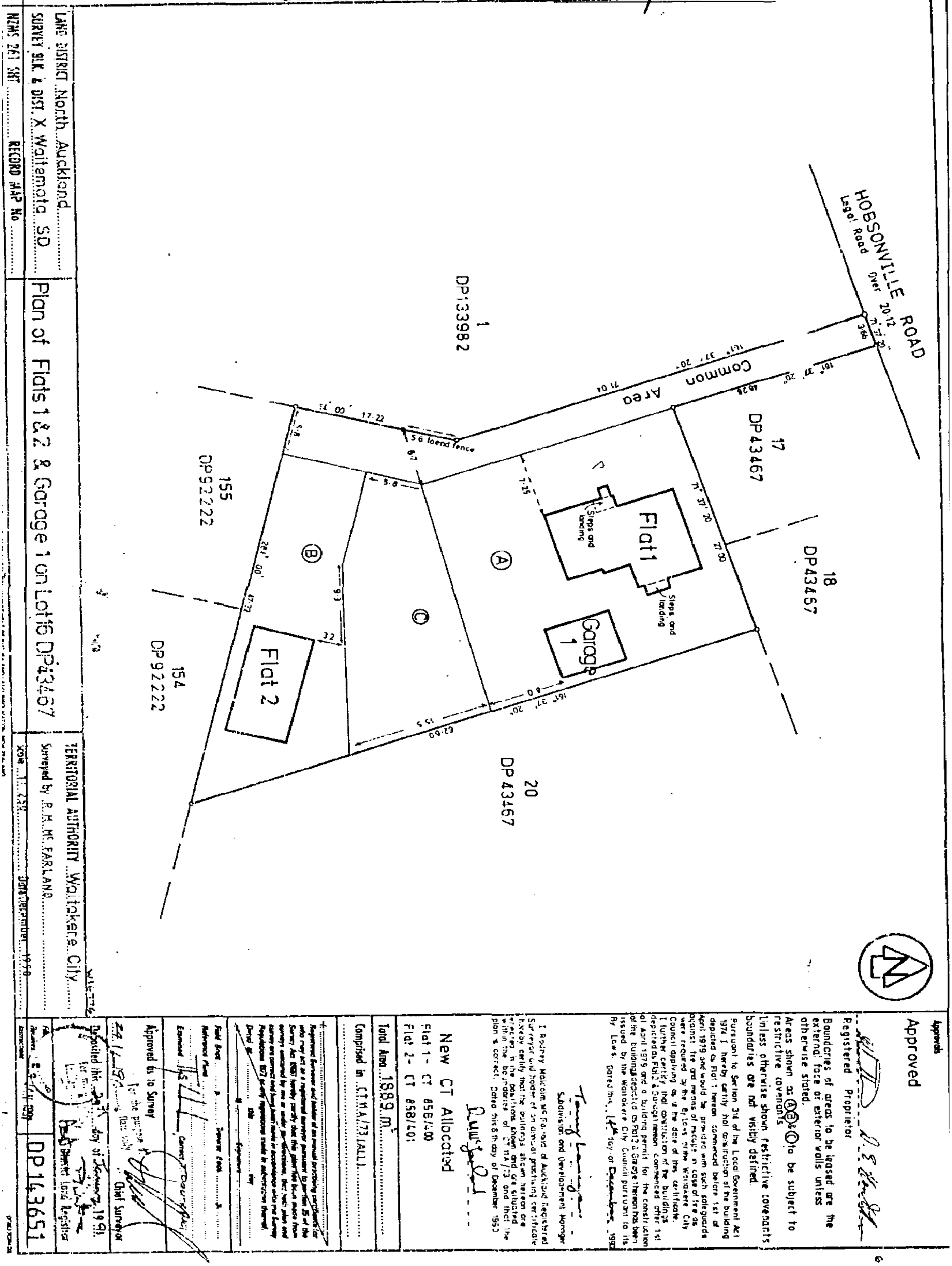
C240972.2 Lease of Flat 2 Composite CT NA85B/401 issued - 25.2.1991 (Affects Fee Simple)

Land Covenant in Lease C240972.2 - 25.2.1991 (Affects Fee Simple)

D622583.3 Lease of Carport 2 DP 156405 Term 989 years 3 months commencing on 8 November 2000 Composite CT NA94A/24 issued - produced 17.7.2001 at 11.46 am and entered 2.8.2001 at 11.27 am

D622583.4 Lease of Flat 3 and Carport 3 DP 156405 Term 989 years 3 months commencing on 8 November 2000 Composite CT NA94A/23 issued - produced 17.7.2001 at 11.46 am and entered 2.8.2001 at 11.27 am

CERTIFICATE OF TITLE No.



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA94A/23**
Land Registration District	**North Auckland**
Date Issued	02 August 2001

Prior References
85B/400-401 NA11A/73

Estate	Fee Simple - 1/3 share
Area	1889 square metres more or less
Legal Description	Lot 16 Deposited Plan 43467

Registered Owners
Brapol Limited

Estate	Leasehold	**Instrument**	L D622583.4
		Term	989 years 3 months commencing on 8 November 2000
Legal Description	Flat 3 Deposited Plan 156405 and Carport 3 Deposited Plan 156405		

Registered Owners
Brapol Limited

Interests

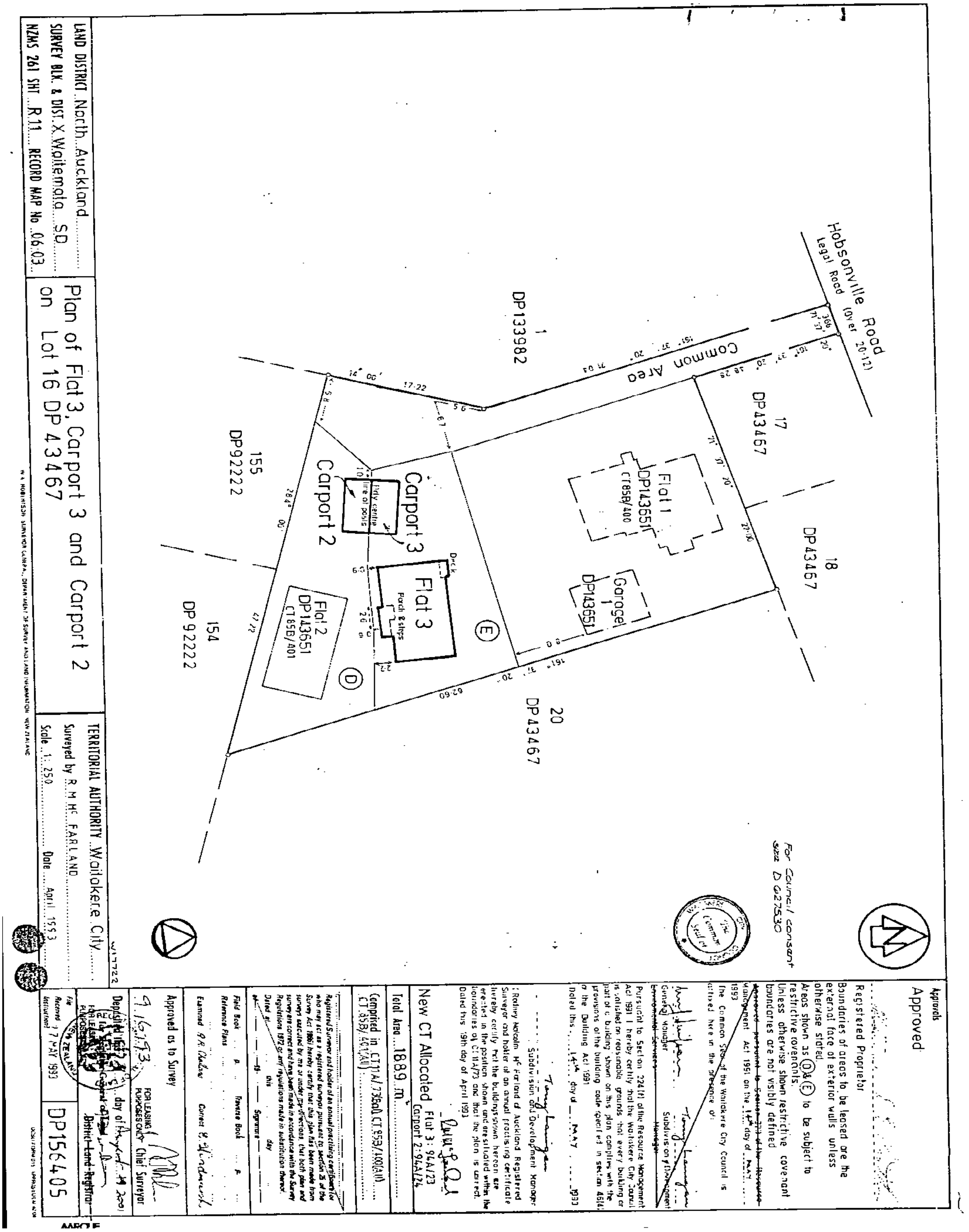
C240972.1 Lease of Flat 1 & Garage 1 DP 143651 CT NA85B/400 issued (Affects Fee Simple)

C240972.2 Lease of Flat 2 DP 143651 CT NA94A/24 issued (Affects Fee Simple)

D622583.3 Lease of Carport 2 DP 156405 CT NA94A/24 issued - 2.8.2001 (Affects Fee Simple)

D622583.4 Lease of Flat 3 and Carport 3 DP 156405 Term 989 years 3 months commencing on 8 November 2000 Composite CT NA94A/23 issued - 2.8.2001 (Affects Fee Simple)

8694148.3 Mortgage to ANZ National Bank Limited - 15.2.2011 at 3:16 pm


LAND DISTRICT North Auckland
SURVEY BLK. & DIST. X Waitemata SD
NZMS 261 SHT R11 RECORD MAP No. 06.03
Plan of Flat 3, Carport 3 and Carport 2
on Lot 16 DP 43467
TERRITORIAL AUTHORITY Waitakere City
Surveyed by R M Mc FARLAND
Scale 1:250
Date April 1993
Hobsonville Road
Legal Road (over 20.12)
Common Area
DP133982
DP43467
DP92222
DP143651
Flat 1
Flat 2
Flat 3
Garage 1
Carport 2
Carport 3
Approved
New CT Allocated Flat 3: 94A/23
Carport 2: 94A/24
Total Area 1889 m²
DP156405

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
CROSS LEASE
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA94A/24**
Land Registration District	**North Auckland**
Date Issued	02 August 2001

Prior References
85B/400-401 NA11A/73

Estate	Fee Simple - 1/3 share
Area	1889 square metres more or less
Legal Description	Lot 16 Deposited Plan 43467

Registered Owners
Ameer Rajwani and Afrose Rajwani

Estate	Leasehold	**Instrument**	L C240972.2
		Term	999 years commencing on 8 February 1991
Legal Description	Flat 2 Deposited Plan 143651		

Registered Owners
Ameer Rajwani and Afrose Rajwani

Estate	Leasehold	**Instrument**	L D622583.3
		Term	989 years 3 months commencing on 8 November 2000
Legal Description	Carport 2 Deposited Plan 156405		

Registered Owners
Ameer Rajwani and Afrose Rajwani

Interests

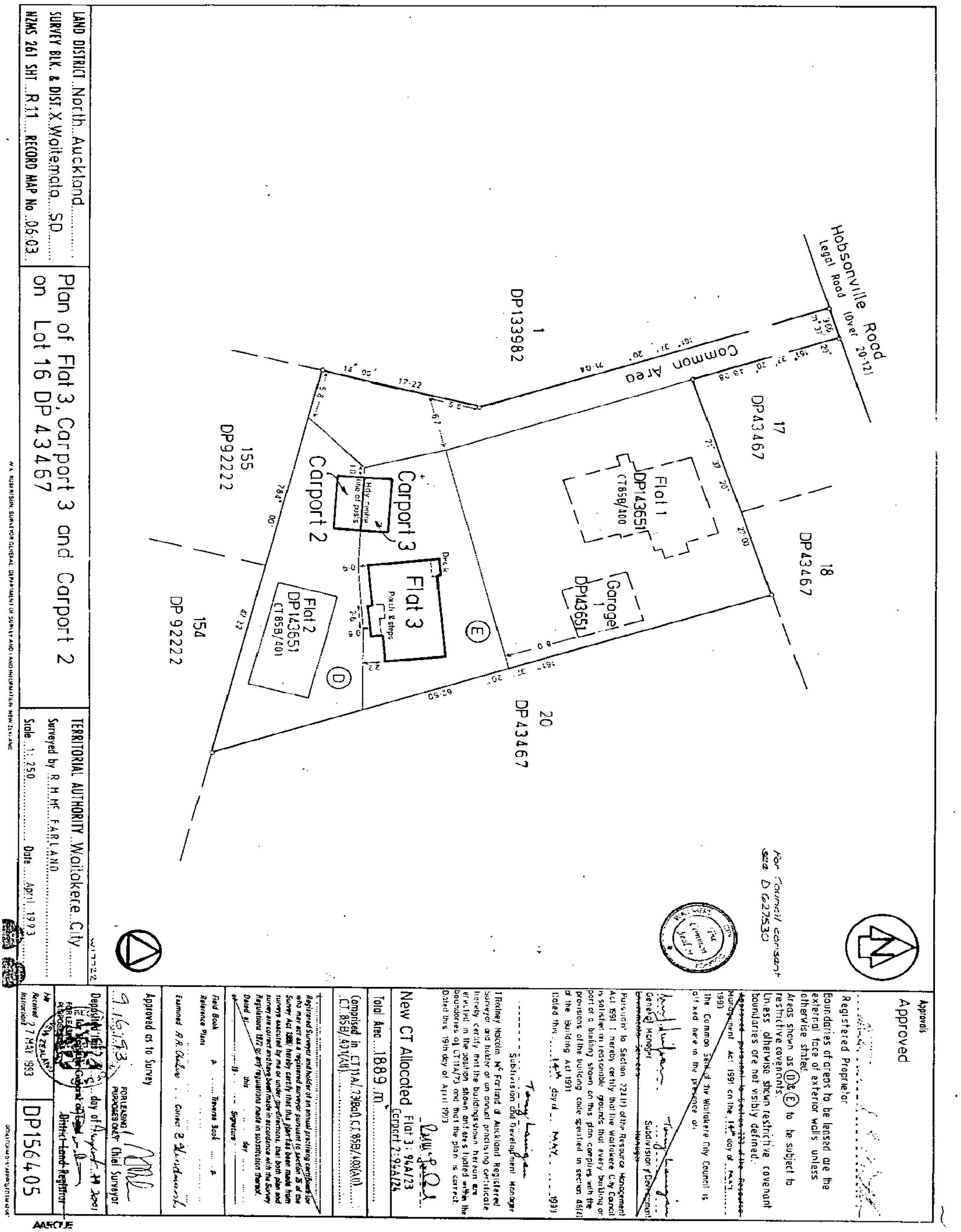
C240972.1 Lease of Flat 1 & Garage 1 DP 143651 CT NA85B/400 issued (Affects Fee Simple)

C240972.2 Lease of Flat 2 DP 143651 Term 999 years commencing on 8 February 1991 Composite CT NA94A/24 issued (Affects Fee Simple)

D622583.3 Lease of Carport 2 DP 156405 Term 989 years 3 months commencing on 8 November 2000 Composite CT NA94A/24 issued - 2.8.2001 (Affects Fee Simple)

D622583.4 Lease of Flat 3 & Carport 3 DP 156405 CT NA94A/23 issued - 2.8.2001 (Affects Fee Simple)

11489111.3 Mortgage to Bank of New Zealand - 11.7.2019 at 2:48 pm


LAND DISTRICT North Auckland
SURVEY BLK. & DIST. X Waitemata SD
NZMS 261 SHT. R11 RECORD MAP No. 06:03
Plan of Flat 3, Carport 3 and Carport 2 on Lot 16 DP 43467
TERRITORIAL AUTHORITY Waitakere City
Surveyed by R. M. Mc FARLAND
Scale 1:250 Date April 1993
Hobsonville Road
Legal Road
Common Area
1 DP133982
155 DP92222
154 DP 92222
17 DP43467
18 DP43467
20 DP43467
Flat 1 DP143651 CT85B/400
Flat 2 DP143651 CT85B/401
Flat 3
Garage 1 DP143651
Carport 2
Carport 3
Porch & steps
Deck
Approved
New CT Allocated Flat 3: 94A/23 Carport 2: 94A/24
Total Area 1889 m²
DP156405
Approved as to Survey
Chief Surveyor
District Land Registrar

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA106C/431**
Land Registration District	**North Auckland**
Date Issued	08 November 1996

Prior References
NA57C/486

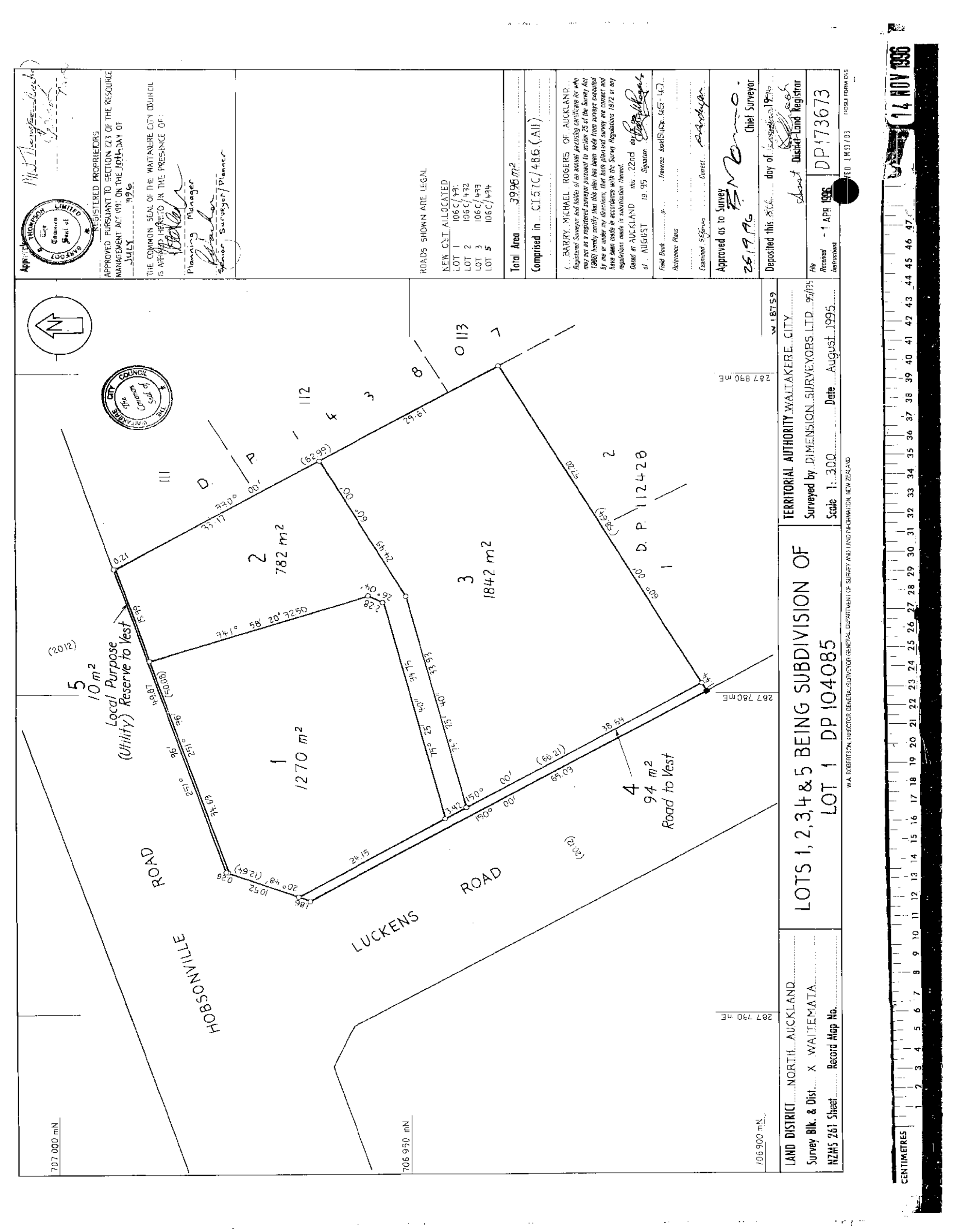
Estate	Fee Simple
Area	1270 square metres more or less
Legal Description	Lot 1 Deposited Plan 173673

Registered Owners
Barfoot & Thompson Property Limited

Interests

C861583.2 Encumbrance to Caltex Oil (N.Z.) Limited - 5.7.1995 at 11.06 am

Identifier **NA106C/431**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
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R.W. Muir
Registrar-General
of Land

Identifier	**NA106C/434**
Land Registration District	**North Auckland**
Date Issued	08 November 1996

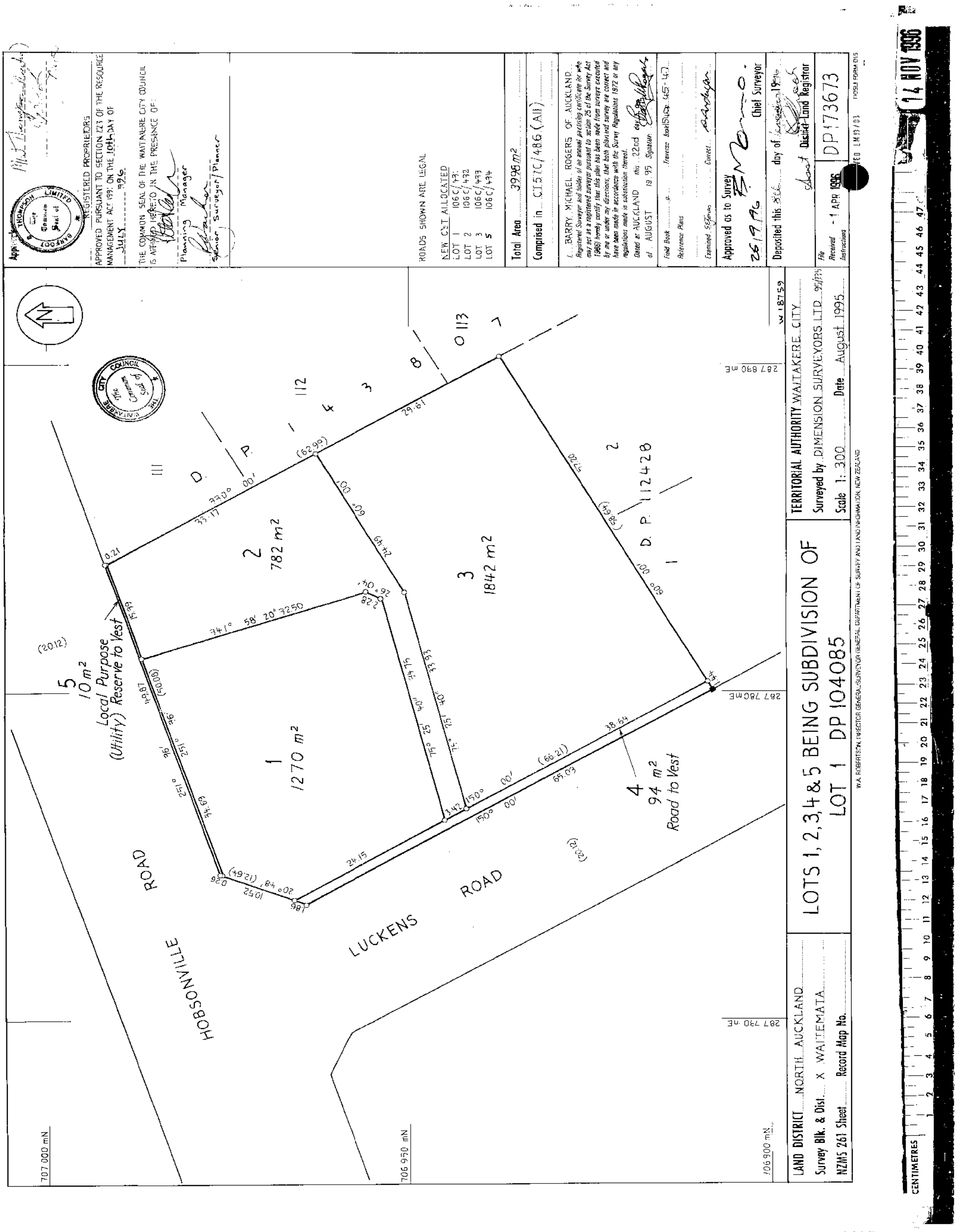
Prior References
NA57C/486

Estate	Fee Simple
Area	10 square metres more or less
Legal Description	Lot 5 Deposited Plan 173673
Purpose	local purpose (utility) reserve

Registered Owners
Auckland Council

Interests

SUBJECT TO THE RESERVES ACT 1977


LOTS 1, 2, 3, 4 & 5 BEING SUBDIVISION OF
LOT 1 DP 104085
DP 173673
HOBSONVILLE ROAD
LUCKENS ROAD
TERRITORIAL AUTHORITY WAITAKERE CITY
Surveyed by DIMENSION SURVEYORS LTD
Scale 1: 300
Date August 1995
LAND DISTRICT NORTH AUCKLAND
Total Area 3995 m²
ROADS SHOWN ARE LEGAL
1270 m²
782 m²
1842 m²
94 m²
Road to Vest
10 m²
Local Purpose (Utility) Reserve to Vest
14 NOV 1996

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **NA111C/539**
Land Registration District **North Auckland**
Date Issued 05 June 1998

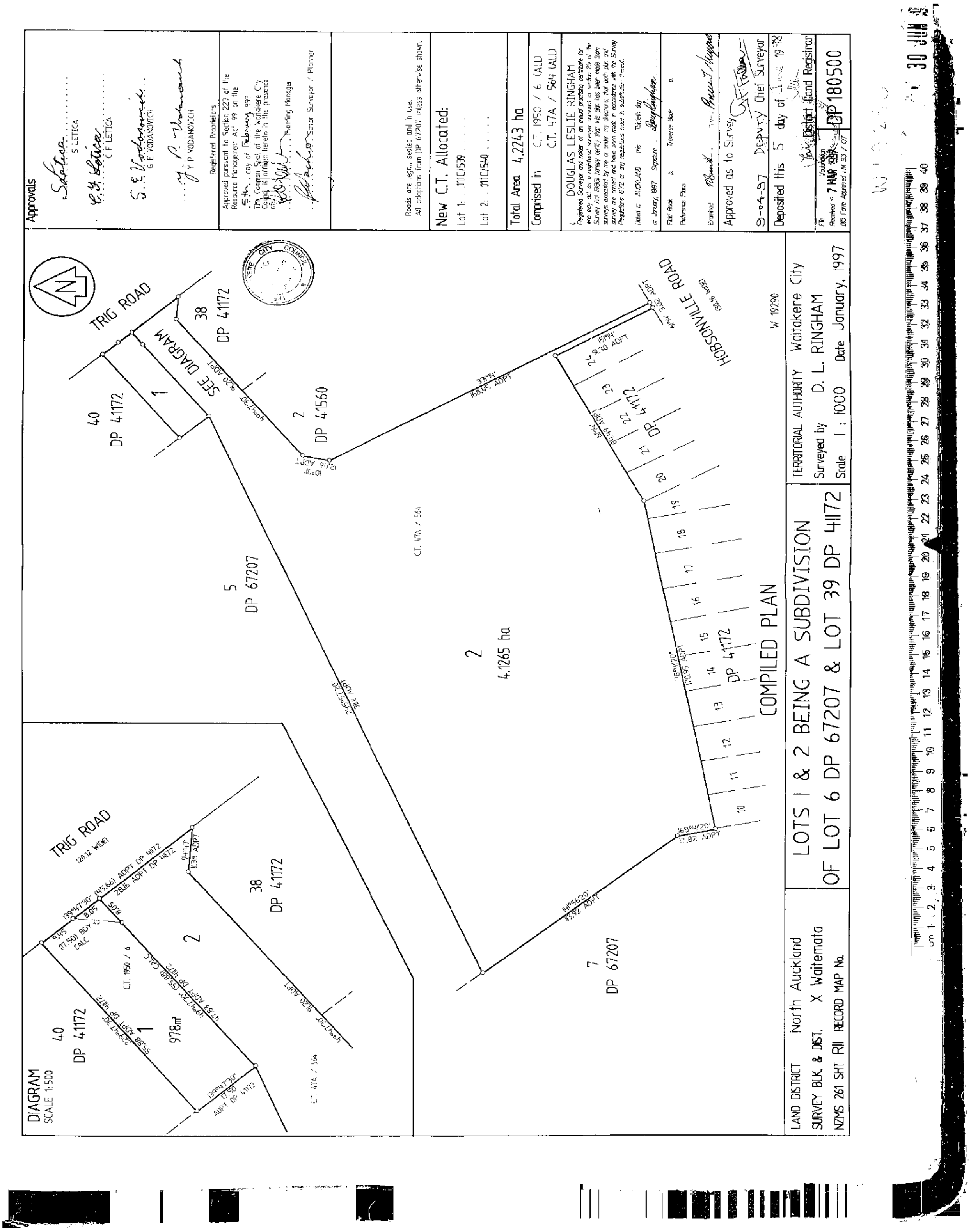
Prior References
NA1950/6 NA47A/564

Estate	Fee Simple
Area	978 square metres more or less
Legal Description	Lot 1 Deposited Plan 180500

Registered Owners
Gayo Edward Vodanovich and Yvonne Pauline Vodanovich

Interests

D404001.4 Mortgage to The National Bank of New Zealand Limited - 29.6.1999 at 9.00 am


LOTS 1 & 2 BEING A SUBDIVISION OF LOT 6 DP 67207 & LOT 39 DP 41172
COMPILED PLAN
DP 180500
Approvals
New C.T. Allocated:
Lot 1: 111C/539
Lot 2: 111C/540
Total Area 4.2243 ha
Comprised in C.T. 1950 / 6 (ALL) C.T. 47A / 564 (ALL)
DOUGLAS LESLIE RINGHAM
Approved as to Survey
Deposited this 5 day of
TRIG ROAD
HOBSONVILLE ROAD
SEE DIAGRAM
2
4.1265 ha
DP 67207
DP 41172
DP 41560
DIAGRAM SCALE 1:500
978m²
LAND DISTRICT North Auckland
SURVEY BLK & DIST. X Waitemata
NZMS 261 SHT R11 RECORD MAP No.
TERRITORIAL AUTHORITY Waitakere City
Surveyed by D. L. RINGHAM
Scale 1 : 1000 Date January, 1997

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA111C/540**
Land Registration District	**North Auckland**
Date Issued	05 June 1998

Prior References
NA47A/564

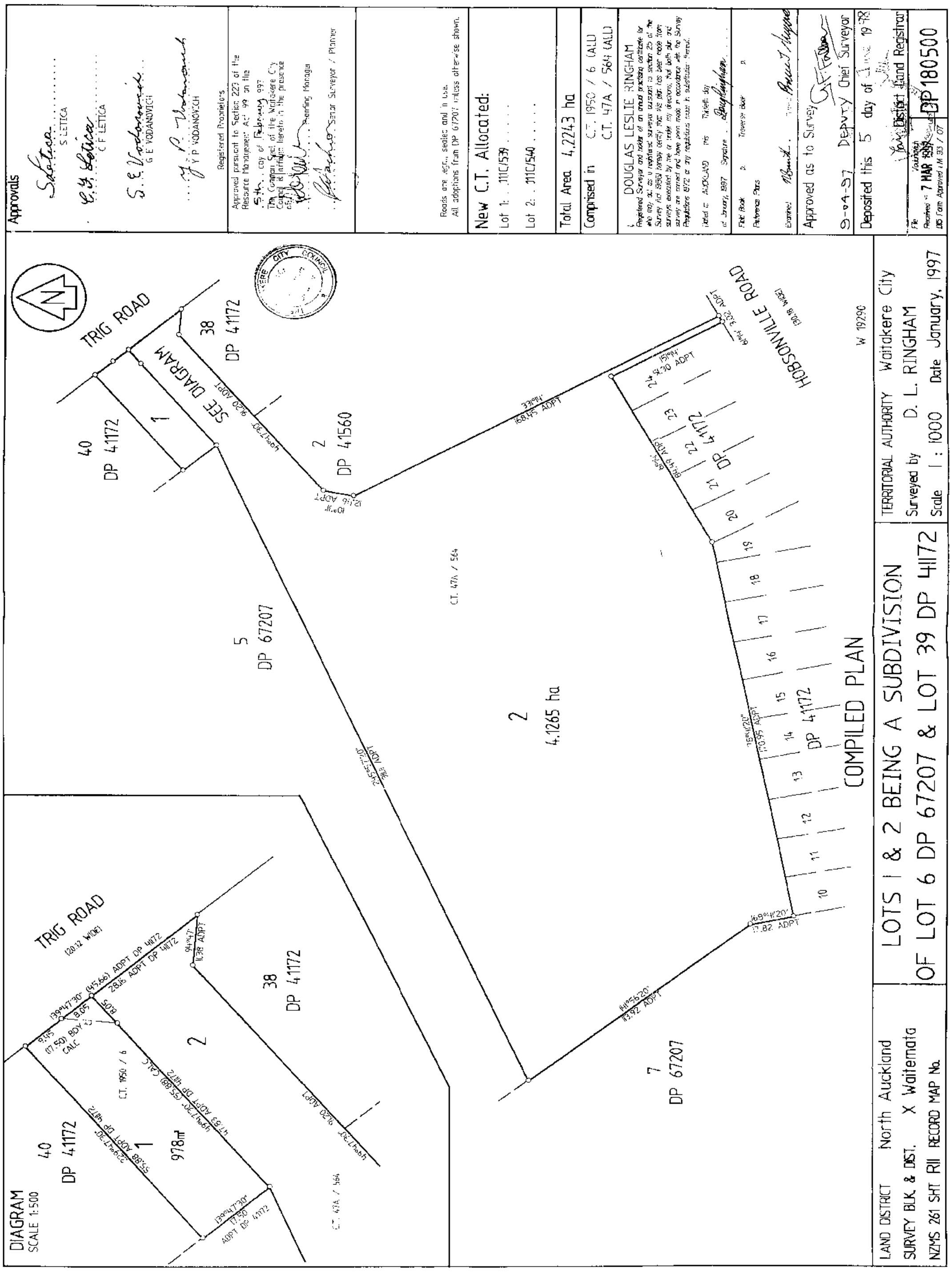
Estate	Fee Simple
Area	4.1265 hectares more or less
Legal Description	Lot 2 Deposited Plan 180500

Registered Owners
CDL Land New Zealand Limited

Interests

C428346.1 Certificate pursuant to Section 94C Transit New Zealand Act 1989 declaring the adjoining State Highway No. 18 known as Hobsonville Road to be a limited access road - 5.11.1992 at 2.10 pm

Identifier **NA111C/540**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **NA133B/324**
Land Registration District **North Auckland**
Date Issued 25 January 2001

Prior References
NA1349/78

Estate	Fee Simple
Area	400 square metres more or less
Legal Description	Lot 1 Deposited Plan 204901

Registered Owners
Jiayun Wang

Interests

Appurtenant hereto is a right of way and a sewerage right specified in Easement Certificate D573807.3 - produced 23.1.2001 at 2.12 pm and entered 25.1.2001 at 9.00 am

Subject to stormwater, water supply, electricity and telephone rights over part marked B on DP 204901 specified in Easement Certificate D573807.3 - produced 23.1.2001 at 2.12 pm and entered 25.1.2001 at 9.00 am

The easements specified in Easement Certificate D573807.3 are subject to Section 243 (a) Resource Management Act 1991

11525999.2 Mortgage to ANZ Bank New Zealand Limited - 2.9.2019 at 1:28 pm

Identifier **NA133B/324**

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
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R.W. Muir
Registrar-General
of Land

Identifier	**NA133B/325**
Land Registration District	**North Auckland**
Date Issued	25 January 2001

Prior References
NA1349/78

Estate	Fee Simple
Area	440 square metres more or less
Legal Description	Lot 2 Deposited Plan 204901

Registered Owners
Manubhai Rambhai Patel and Jyotsnaben Manubhai Patel

Interests

Appurtenant hereto are stormwater, water supply, electricity & telephone rights specified in Easement Certificate D573807.3 - produced 23.1.2001 at 2.12 pm and entered 25.1.2001 at 9.00 am

Subject to a right of way over part marked A and a sewerage right over part marked C on DP 204901specified in Easement Certificate D573807.3 - produced 23.1.2001 at 2.12 pm and entered 25.1.2001 at 9.00 am

The easements specified in Easement Certificate D573807.3 are subject to Section 243 (a) Resource Management Act 1991

12445770.3 Mortgage to ASB Bank Limited - 20.5.2022 at 1:04 pm

Identifier **NA133B/325**

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier NA1136/106
Land Registration District North Auckland
Date Issued 30 March 1955

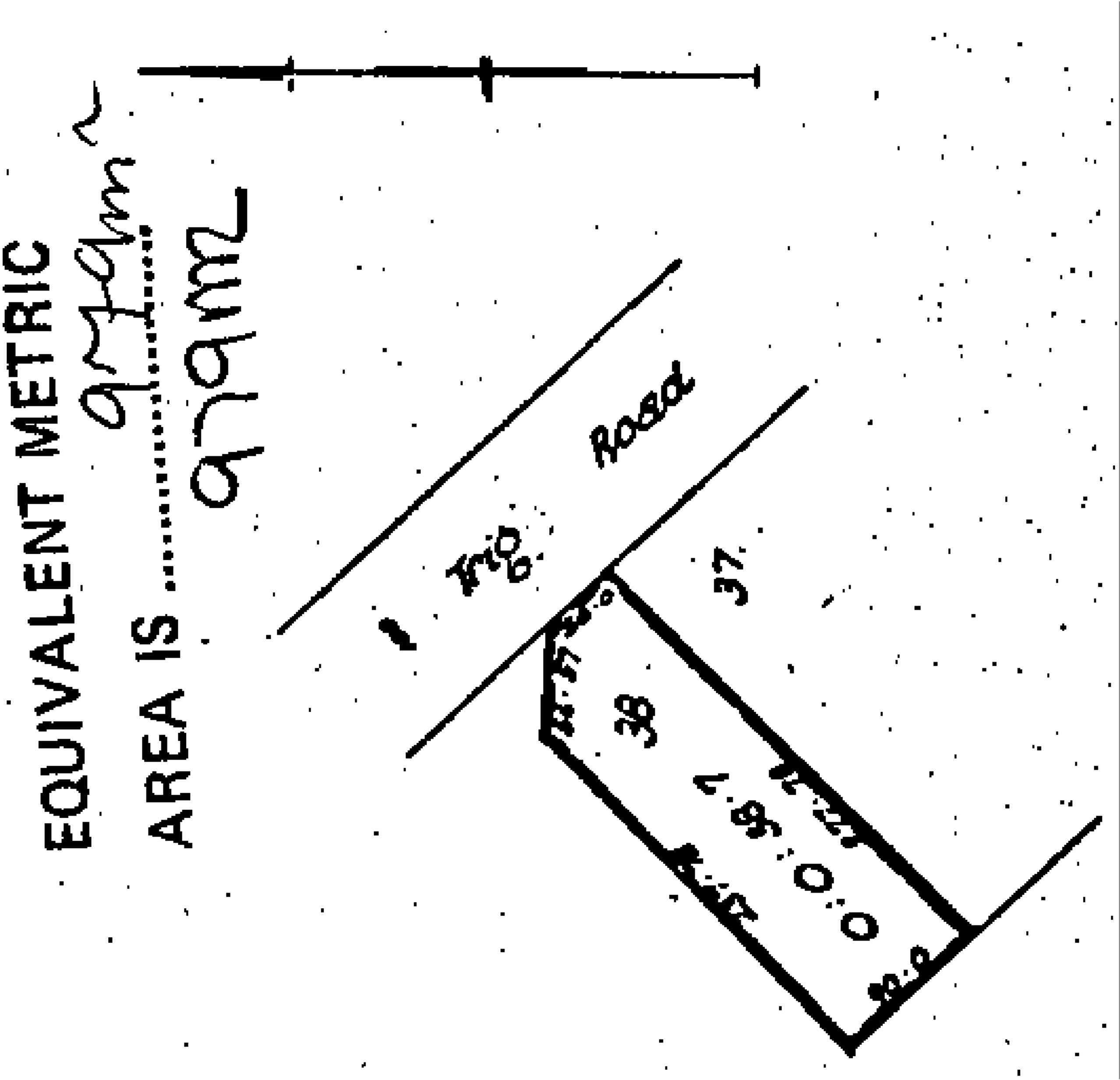
Prior References
NA1025/254

Estate	Fee Simple
Area	979 square metres more or less
Legal Description	Lot 38 Deposited Plan 41172

Registered Owners
Jia Ma and Leslie Hills Trustees Limited

Interests

12059430.3 Mortgage to CFML Lending Limited - 31.3.2021 at 4:06 pm


EQUIVALENT METRIC
AREA IS
Trig Road
37
38

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA1155/1**
Land Registration District	**North Auckland**
Date Issued	23 August 1955

Prior References
NA1025/254

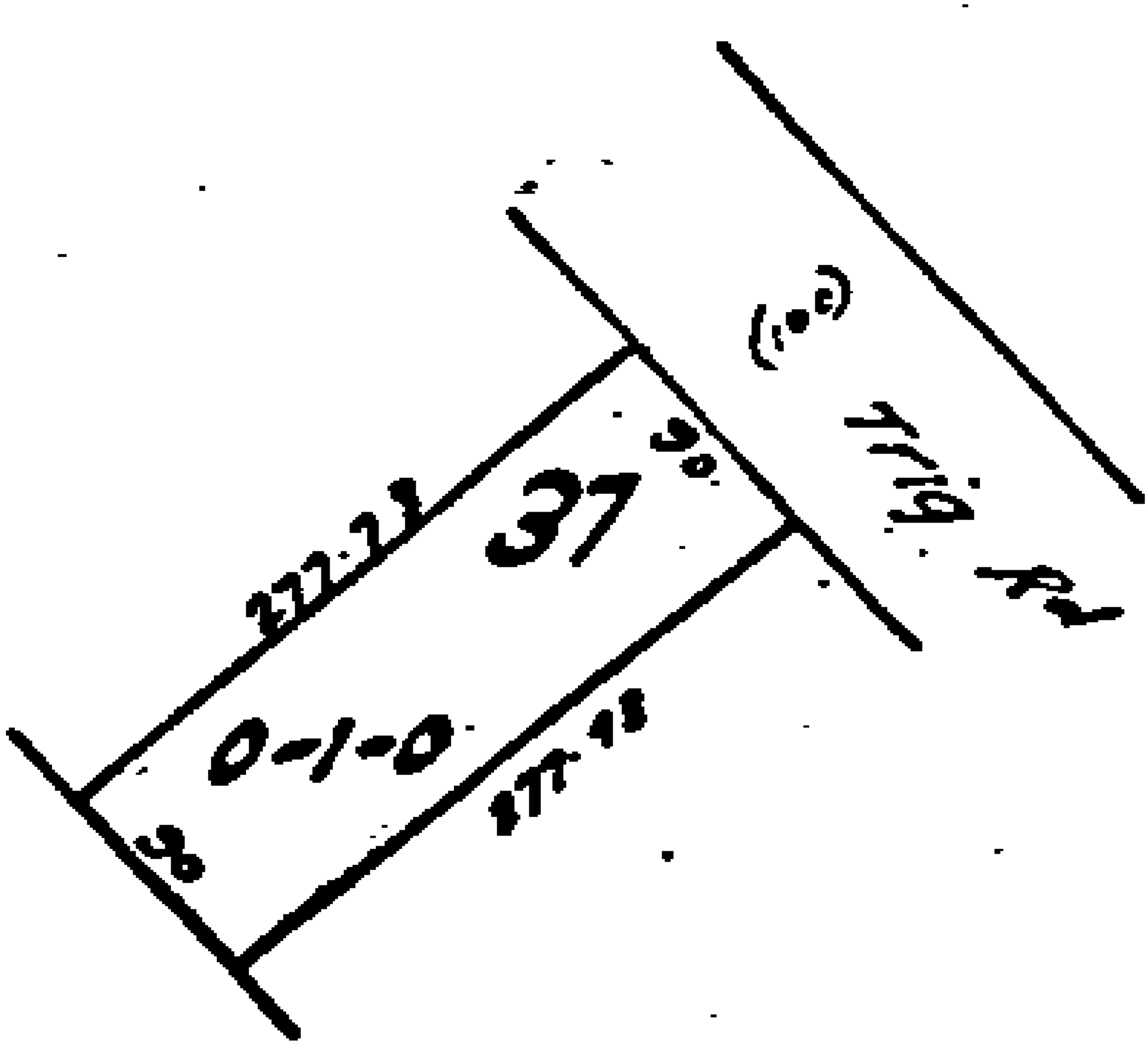
Estate	Fee Simple
Area	1012 square metres more or less
Legal Description	Lot 37 Deposited Plan 41172

Registered Owners
Hak Hung Wong, Kexin Ma and Brav Trustees No 2 Limited

Interests

12067205.2 Mortgage to ASB Bank Limited - 1.4.2021 at 4:00 pm

Identifier **NA1155/1**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
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R.W. Muir
Registrar-General
of Land

Identifier	**NA1199/49**
Land Registration District	**North Auckland**
Date Issued	23 April 1956

Prior References
NA1107/266

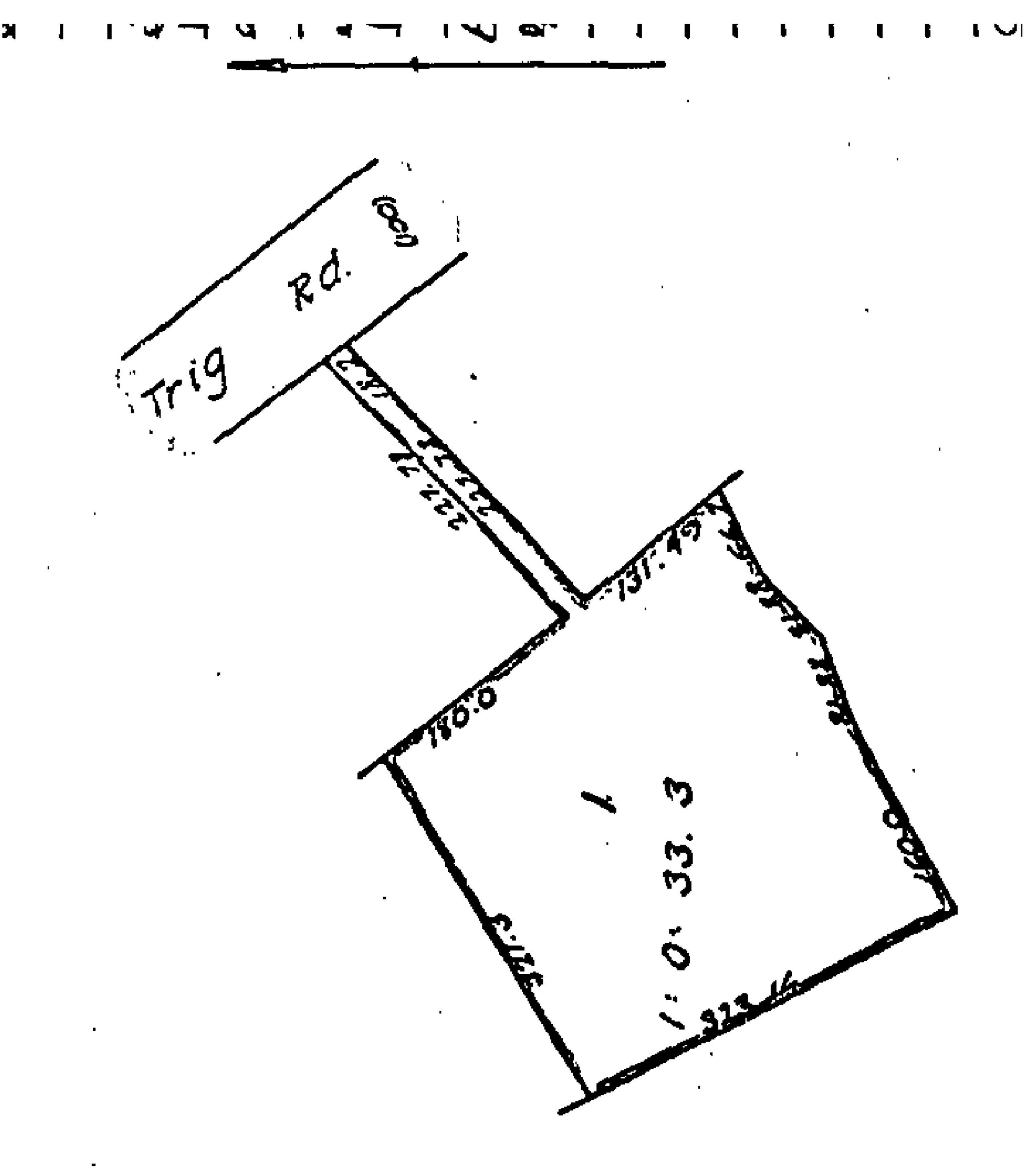
Estate	Fee Simple
Area	4889 square metres more or less
Legal Description	Lot 1 Deposited Plan 41560

Registered Owners
Amy Melinda Anderson, Stephen Mark Anderson and Smith & Partners Trustee Co. Limited

Interests

11665906.9 Mortgage to Westpac New Zealand Limited - 3.4.2020 at 3:31 pm

Identifier **NA1199/49**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
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R.W. Muir
Registrar-General
of Land

Identifier	**NA1313/4**
Land Registration District	**North Auckland**
Date Issued	15 June 1956

Prior References
NA1166/6

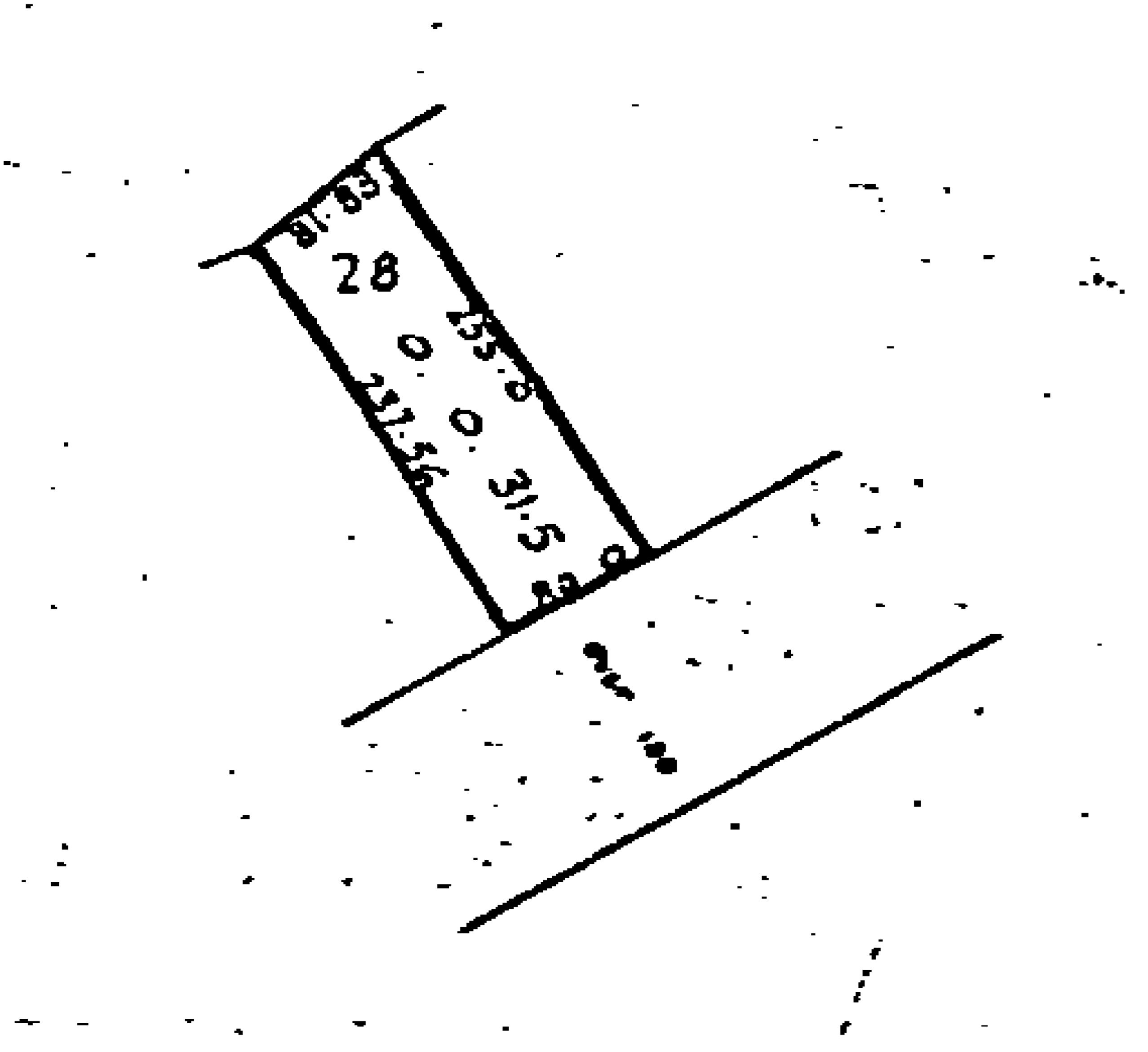
Estate	Fee Simple
Area	797 square metres more or less
Legal Description	Lot 28 Deposited Plan 41172

Registered Owners
Evan Paul Moon

Interests

7374544.2 Mortgage to ASB Bank Limited - 17.5.2007 at 9:00 am

Identifier **NA1313/4**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
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R.W. Muir
Registrar-General
of Land

Identifier	**NA1332/82**
Land Registration District	**North Auckland**
Date Issued	25 September 1956

Prior References
NA1150/10

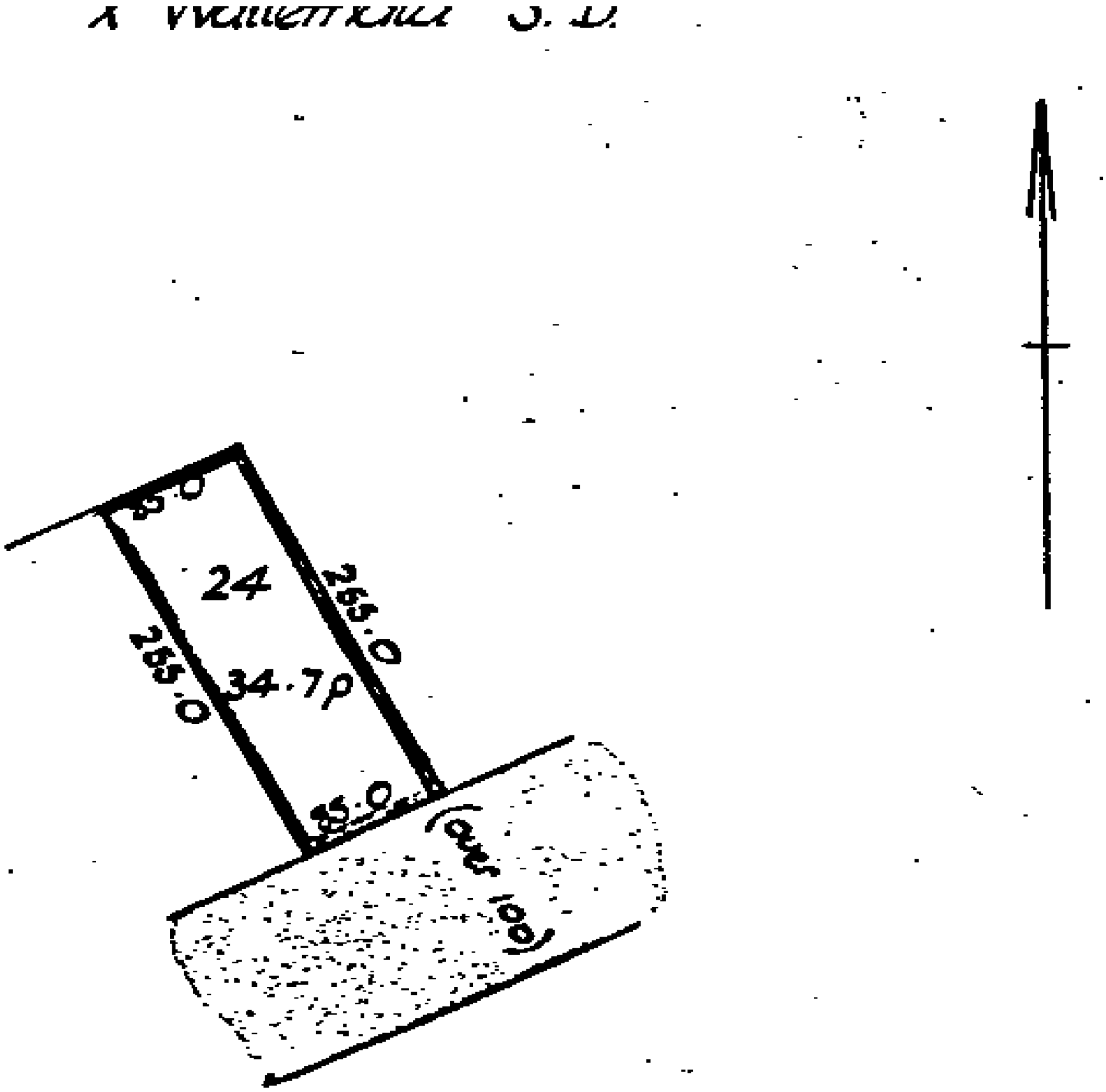
Estate	Fee Simple
Area	878 square metres more or less
Legal Description	Lot 24 Deposited Plan 41172

Registered Owners
Fantastic Trustee Limited

Interests

K47130 Building Line Restriction

7549566.2 Mortgage to ANZ National Bank Limited - 1.10.2007 at 1:19 pm


24
265.0
265.0
34.7p

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **NA1353/93**
Land Registration District **North Auckland**
Date Issued 17 December 1956

Prior References
NA1150/9

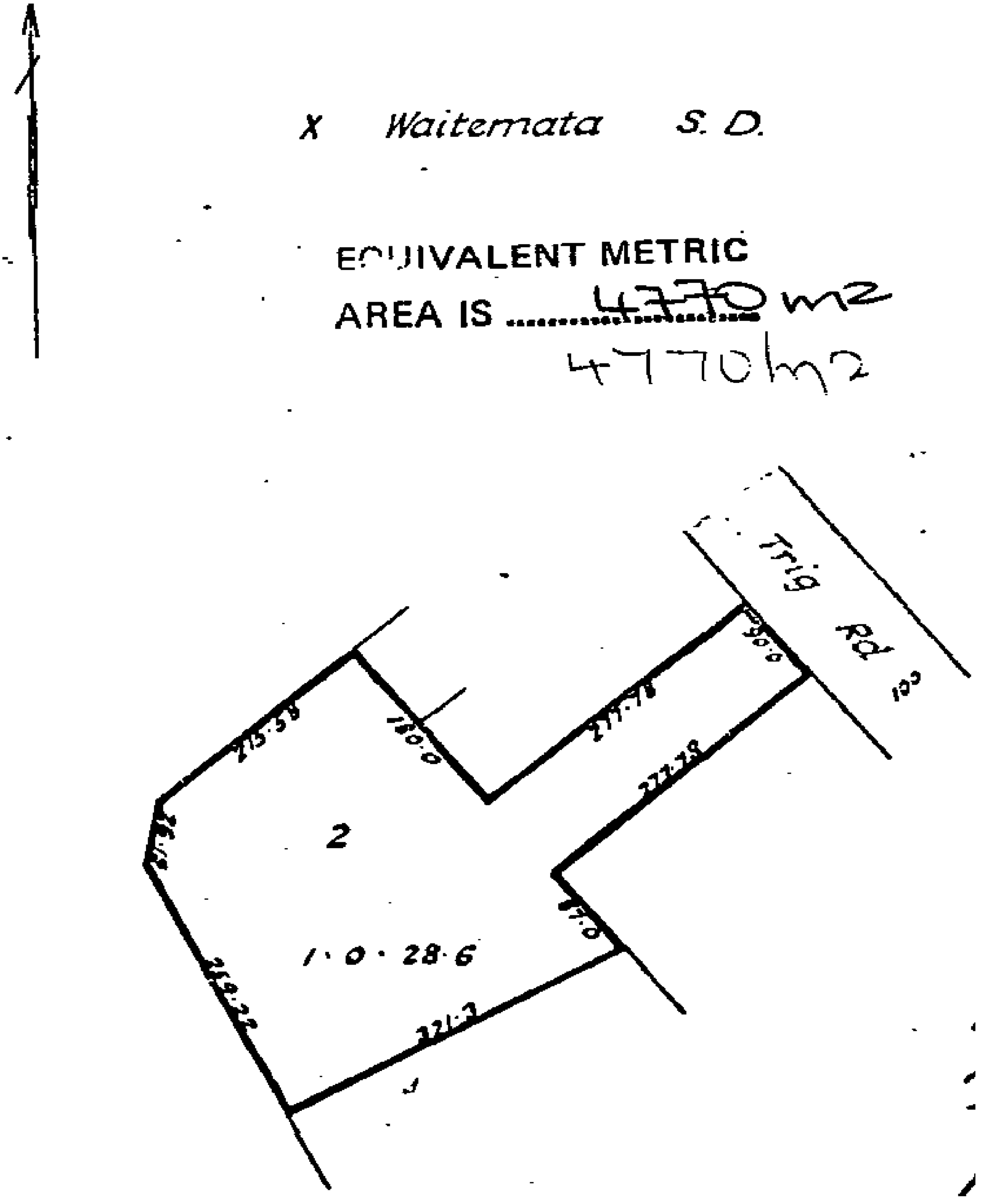
Estate	Fee Simple
Area	4770 square metres more or less
Legal Description	Lot 2 Deposited Plan 41560

Registered Owners
Do-Hyun Kim and Jin-Kyung Kim

Interests

9983624.2 Mortgage to ANZ Bank New Zealand Limited - 27.2.2015 at 12:36 pm

Identifier **NA1353/93**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA1387/91**
Land Registration District	**North Auckland**
Date Issued	27 June 1957

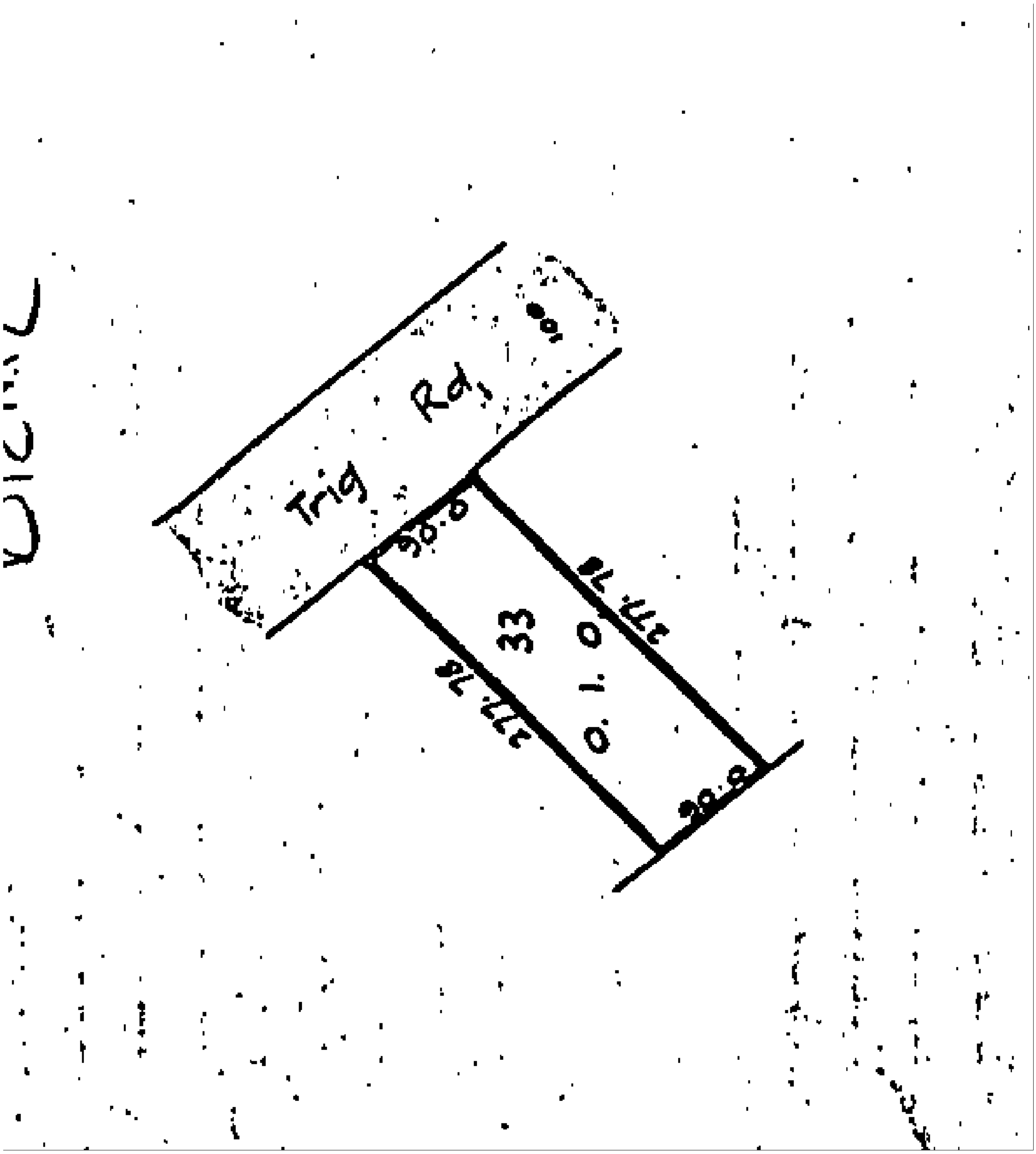
Prior References
NA1150/9

Estate	Fee Simple
Area	1012 square metres more or less
Legal Description	Lot 33 Deposited Plan 41172

Registered Owners
Martha Patricia Hartwell

Interests

Fencing Agreement in Transfer 589952 - 27.6.1957


Trig Rd.
33

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA1529/13**
Land Registration District	**North Auckland**
Date Issued	23 December 1957

Prior References
NA1166/6

Estate	Fee Simple
Area	1012 square metres more or less
Legal Description	Lot 34 Deposited Plan 41172

Registered Owners
Bharat Unka and Kalavati Unka

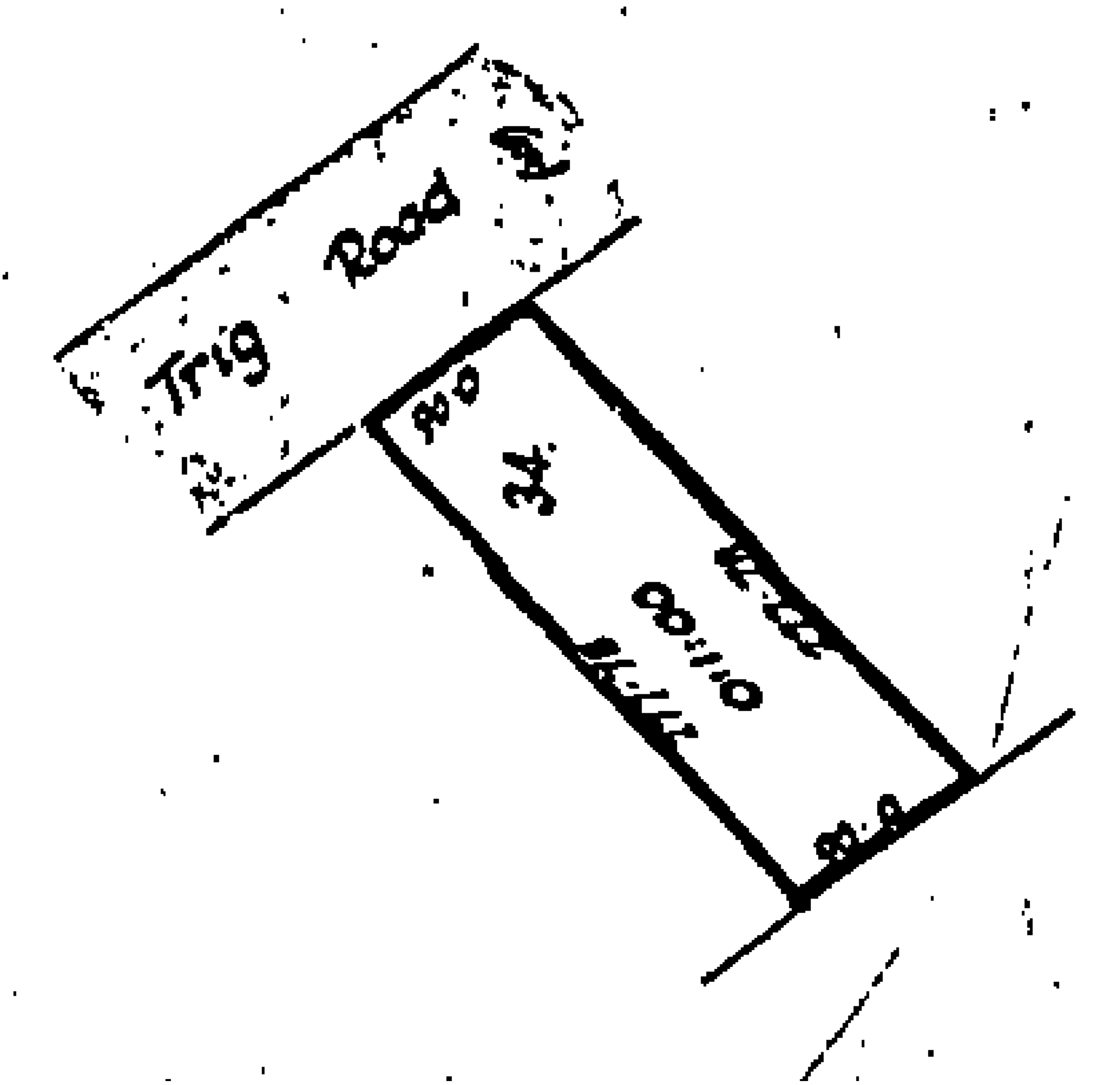
Interests

C043966.3 Mortgage to ASB Bank Limited - 21.9.1989 at 11.08 am

8885086.1 Variation of Mortgage C043966.3 - 21.10.2011 at 10:13 am

11404617.1 Variation of Mortgage C043966.3 - 5.4.2019 at 10:14 am

Identifier **NA1529/13**



RECORD OF TITLE
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R.W. Muir
Registrar-General
of Land

Identifier	**NA1539/84**
Land Registration District	**North Auckland**
Date Issued	12 March 1958

Prior References
NA1150/9

Estate	Fee Simple
Area	981 square metres more or less
Legal Description	Lot 41 Deposited Plan 41172

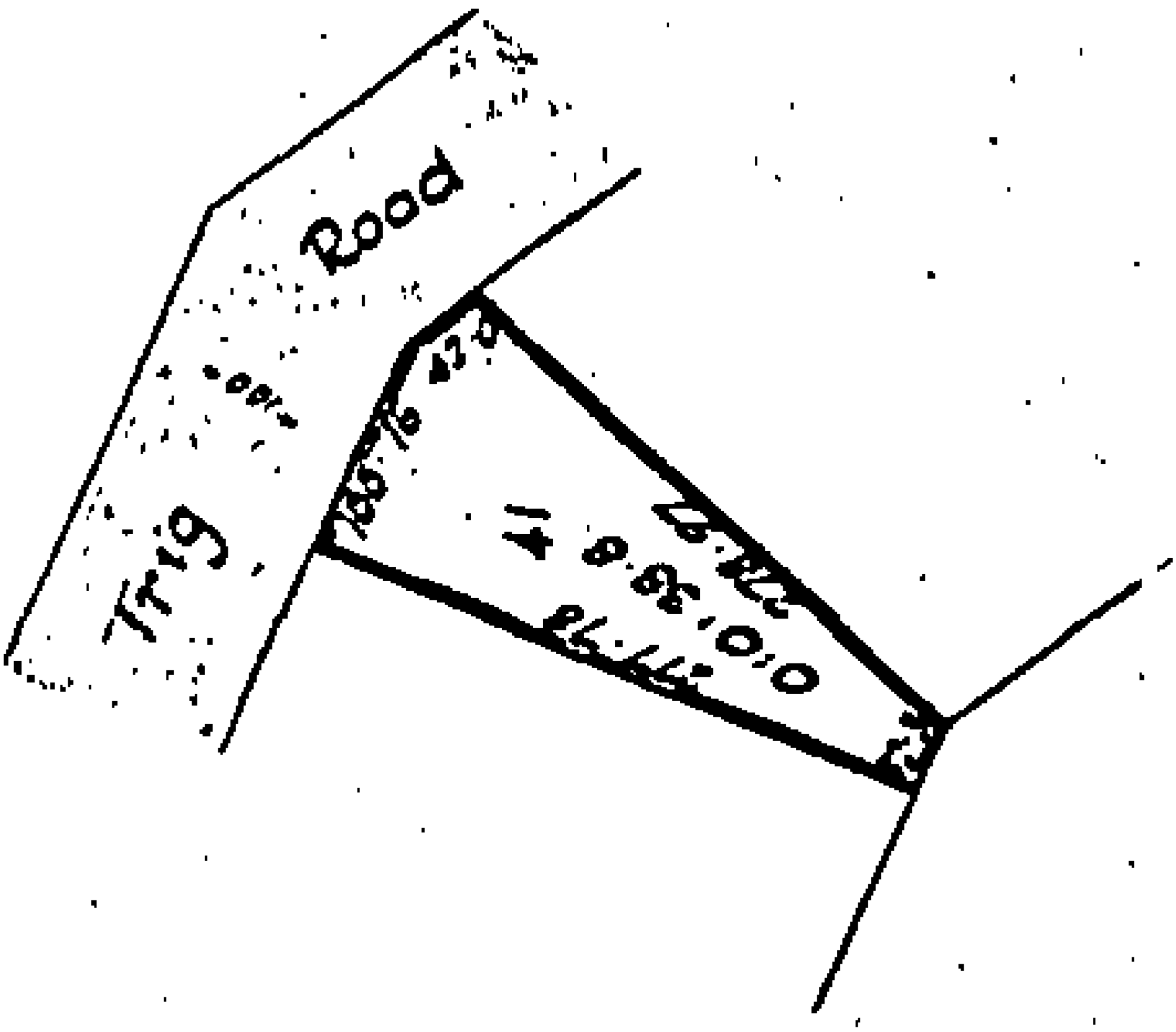
Registered Owners
Blair Leighton Christiansen and Tracey Louise Christiansen

Interests

Subject to a drainage right (in gross) in favour of The Waitemata County Council created by Transfer 534328

8258349.4 Mortgage to ANZ National Bank Limited - 4.9.2009 at 3:47 pm

Identifier **NA1539/84**



RECORD OF TITLE
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R.W. Muir
Registrar-General
of Land

Identifier NA1600/93
Land Registration District North Auckland
Date Issued 05 November 1958

Prior References
NA1150/10

Estate	Fee Simple
Area	825 square metres more or less
Legal Description	Lot 26 Deposited Plan 41172

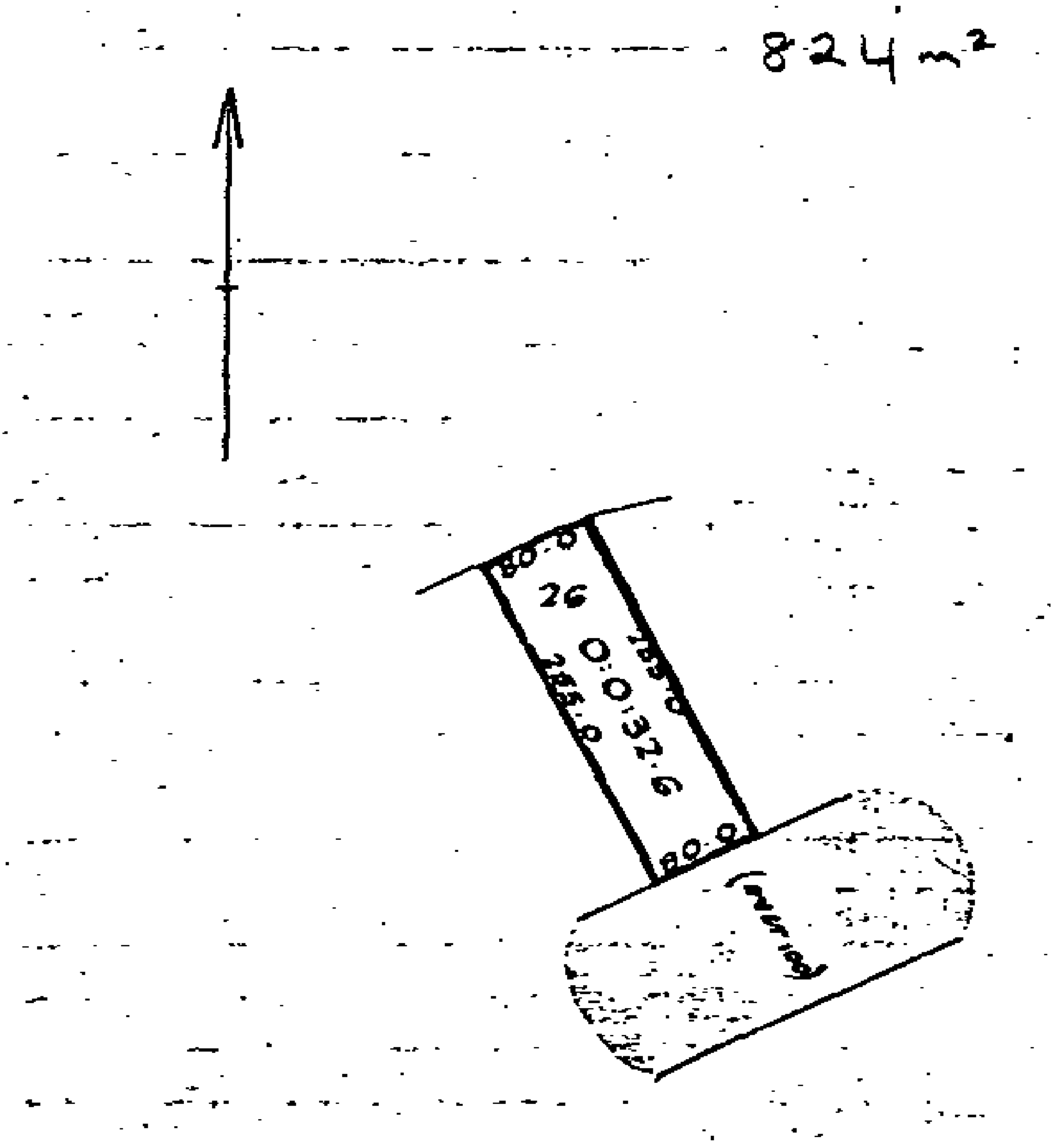
Registered Owners

Owen Henry Freeman as to a 1/2 share

Joan Miriam Freeman as to a 1/2 share

Interests

Identifier **NA1600/93**



RECORD OF TITLE
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R.W. Muir
Registrar-General
of Land

Identifier	**NA1621/89**
Land Registration District	**North Auckland**
Date Issued	17 February 1959

Prior References
NA1150/9

Estate	Fee Simple
Area	825 square metres more or less
Legal Description	Lot 25 Deposited Plan 41172

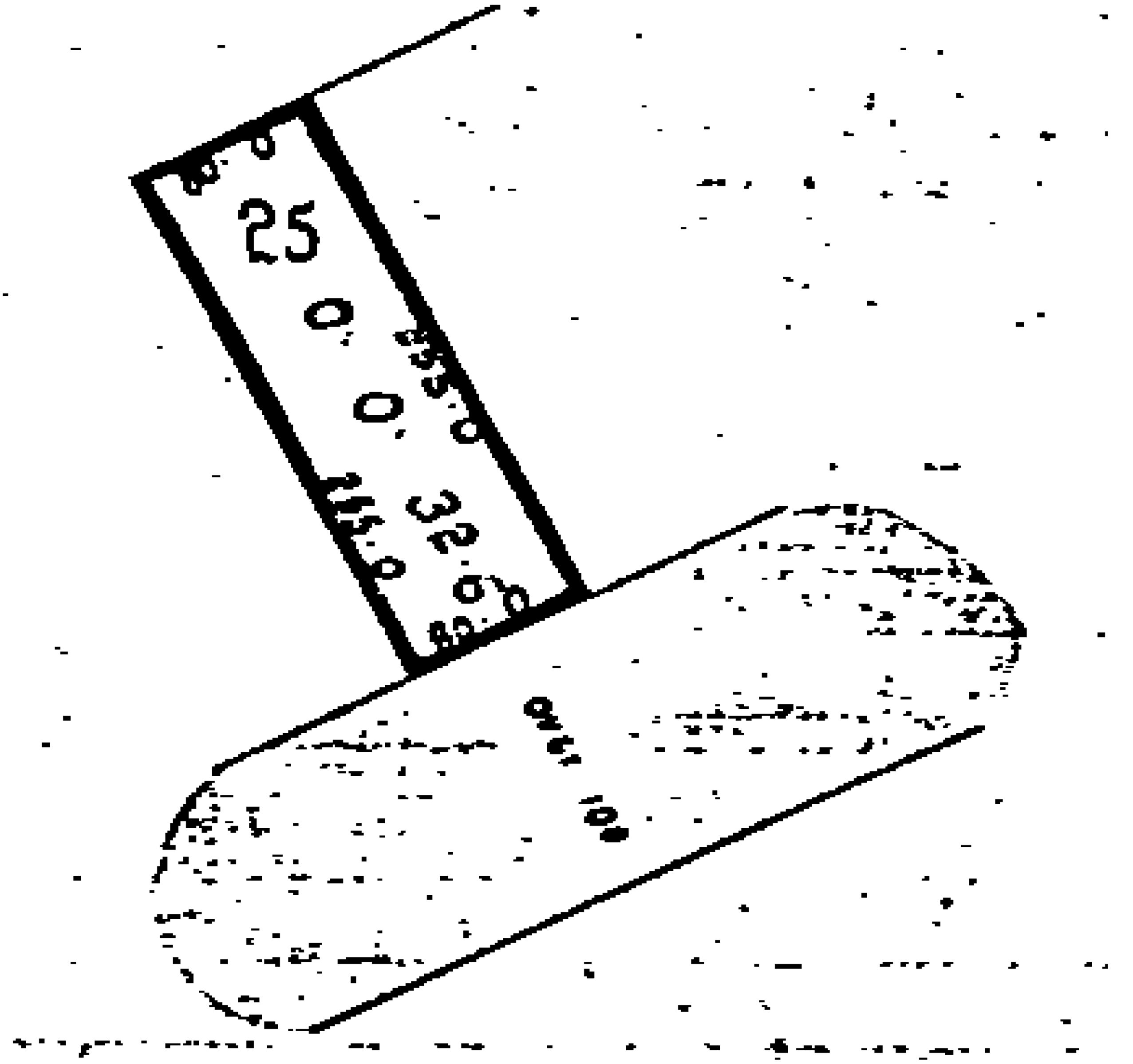
Registered Owners
Fu Yun Lau, Siu Fong Sheran Lau and Kenneth Ah Kan Koo

Interests

K47130 Building Line Restriction

11799770.2 Mortgage to ANZ Bank New Zealand Limited - 24.7.2020 at 2:18 pm

Identifier **NA1621/89**



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R.W. Muir
Registrar-General
of Land

Identifier	**NA1894/66**
Land Registration District	**North Auckland**
Date Issued	15 December 1960

Prior References
NA1150/10

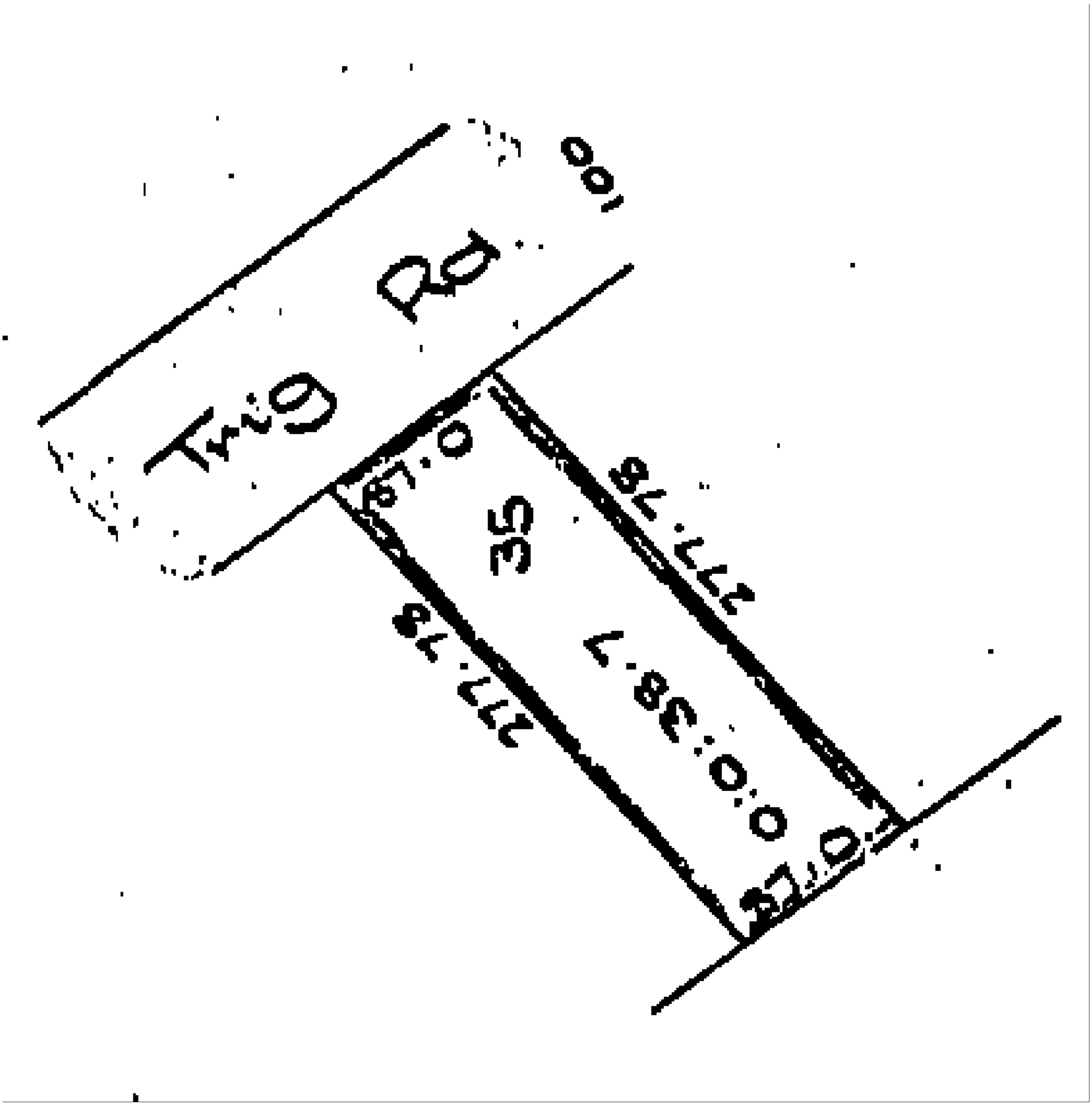
Estate	Fee Simple
Area	979 square metres more or less
Legal Description	Lot 35 Deposited Plan 41172

Registered Owners
Grant Ronald Foulds

Interests

B950894.4 Mortgage to (now) Westpac New Zealand Limited - 10.2.1989 at 9.02 am

D470255.1 Variation of Mortgage B950894.4 - 18.1.2000 at 2.16 pm


100
Trig Rd
35
277.78
277.78
0:0:38.7

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R.W. Muir
Registrar-General
of Land

Identifier	**NA1950/7**
Land Registration District	**North Auckland**
Date Issued	11 July 1961

Prior References
NA1611/79

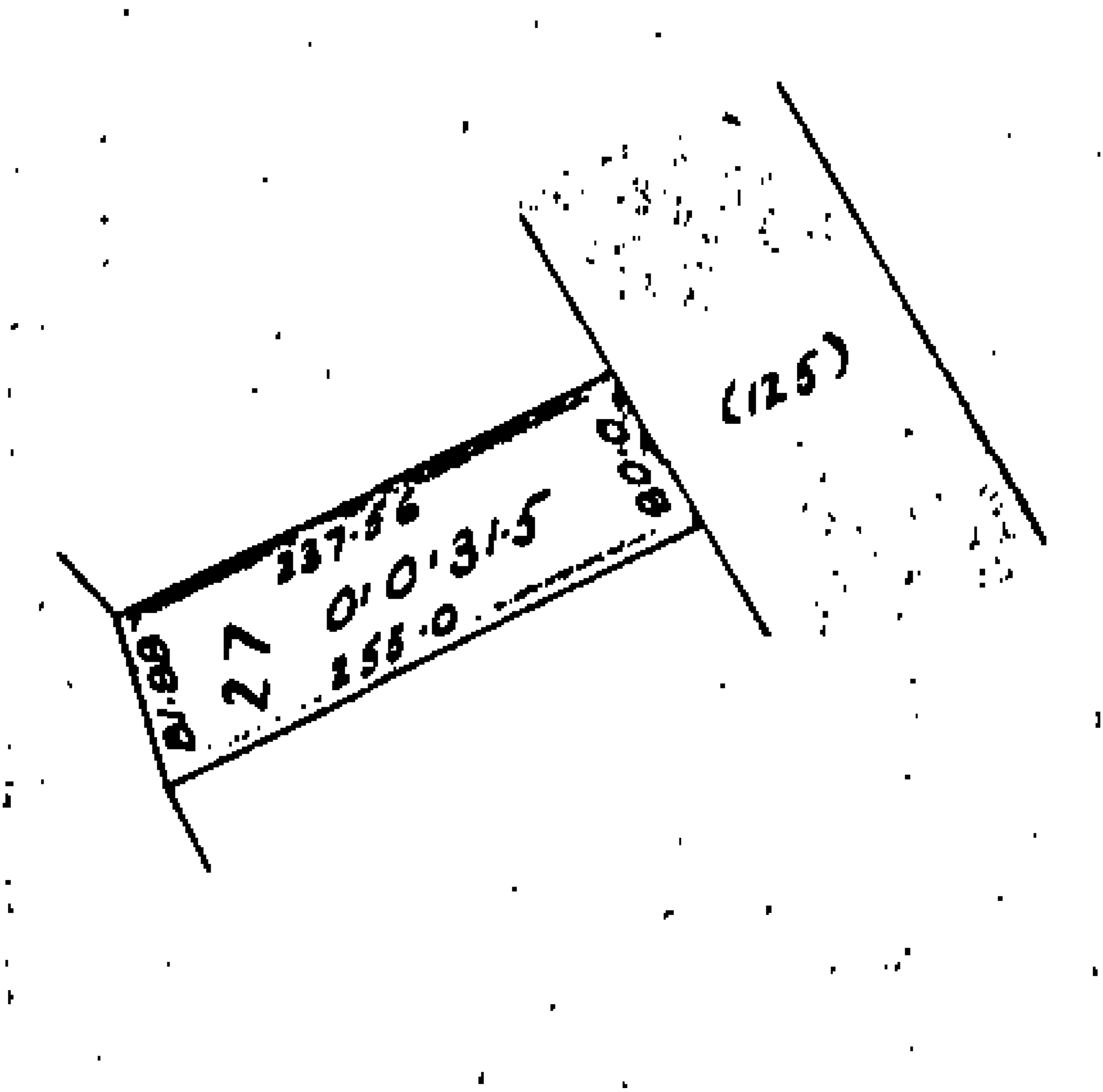
Estate	Fee Simple
Area	797 square metres more or less
Legal Description	Lot 27 Deposited Plan 41172

Registered Owners
Evan Paul Moon and Milica Zjajic-Moon

Interests

5803205.3 Mortgage to ASB Bank Limited - 18.11.2003 at 9:00 am

Identifier **NA1950/7**



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R.W. Muir
Registrar-General
of Land

Identifier	**NA1968/84**
Land Registration District	**North Auckland**
Date Issued	06 September 1961

Prior References
NA840/245

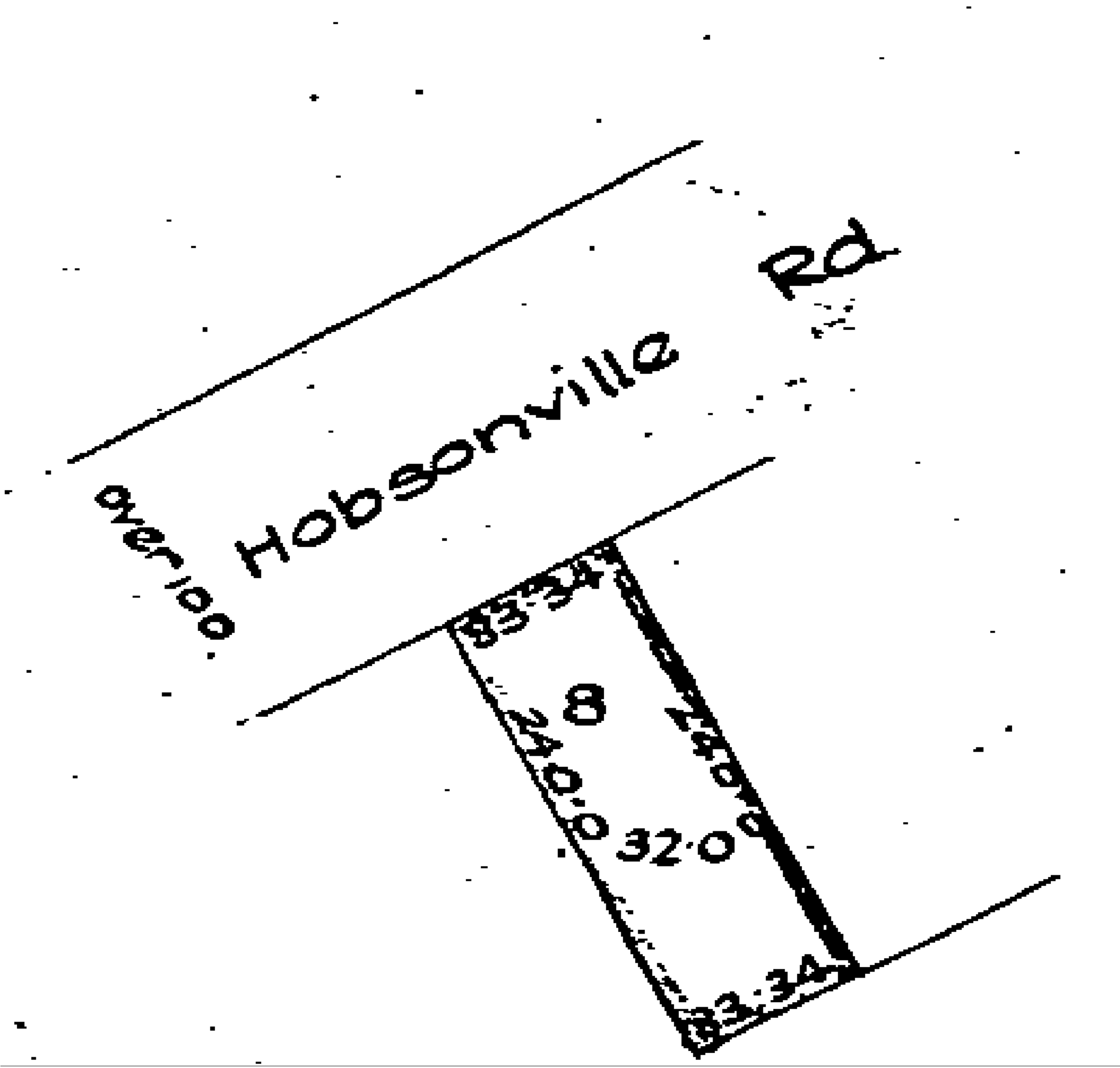
Estate	Fee Simple
Area	809 square metres more or less
Legal Description	Lot 8 Deposited Plan 43467

Registered Owners
Asiri Holdings Limited

Interests

10567548.3 Mortgage to ANZ Bank New Zealand Limited - 22.9.2016 at 4:53 pm

Identifier **NA1968/84**



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R.W. Muir
Registrar-General
of Land

Identifier	**NA1999/58**
Land Registration District	**North Auckland**
Date Issued	24 January 1962

Prior References
NA1554/76

Estate	Fee Simple
Area	1012 square metres more or less
Legal Description	Lot 31 Deposited Plan 41172

Registered Owners
Vijaya Bhaskar Kosna and Sunitha Kosna

Interests

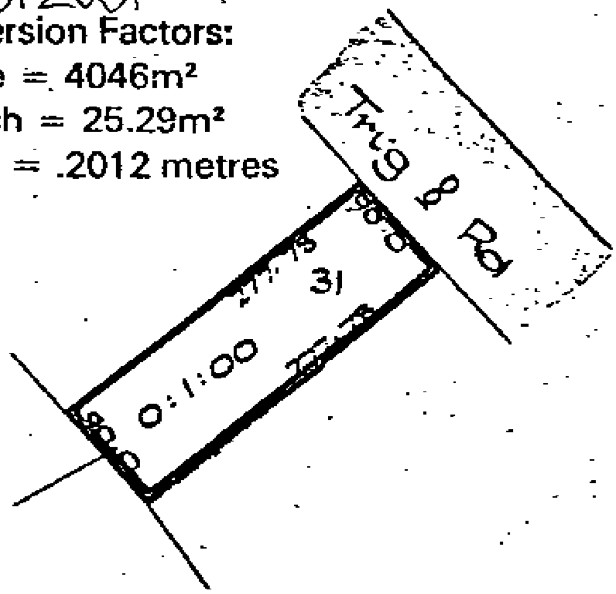
10333536.3 Mortgage to ANZ Bank New Zealand Limited - 19.2.2016 at 4:36 pm

X Waitemata S.D

METRIC AREA IS 1012m2

1012m2

Conversion Factors:
1 Acre = 4046m²
1 Perch = 25.29m²
1 Link = .2012 metres



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R.W. Muir
Registrar-General
of Land

Identifier **NA2053/54**
Land Registration District **North Auckland**
Date Issued 24 May 1962

Prior References
NA1554/76

Estate	Fee Simple
Area	1012 square metres more or less
Legal Description	Lot 32 Deposited Plan 41172

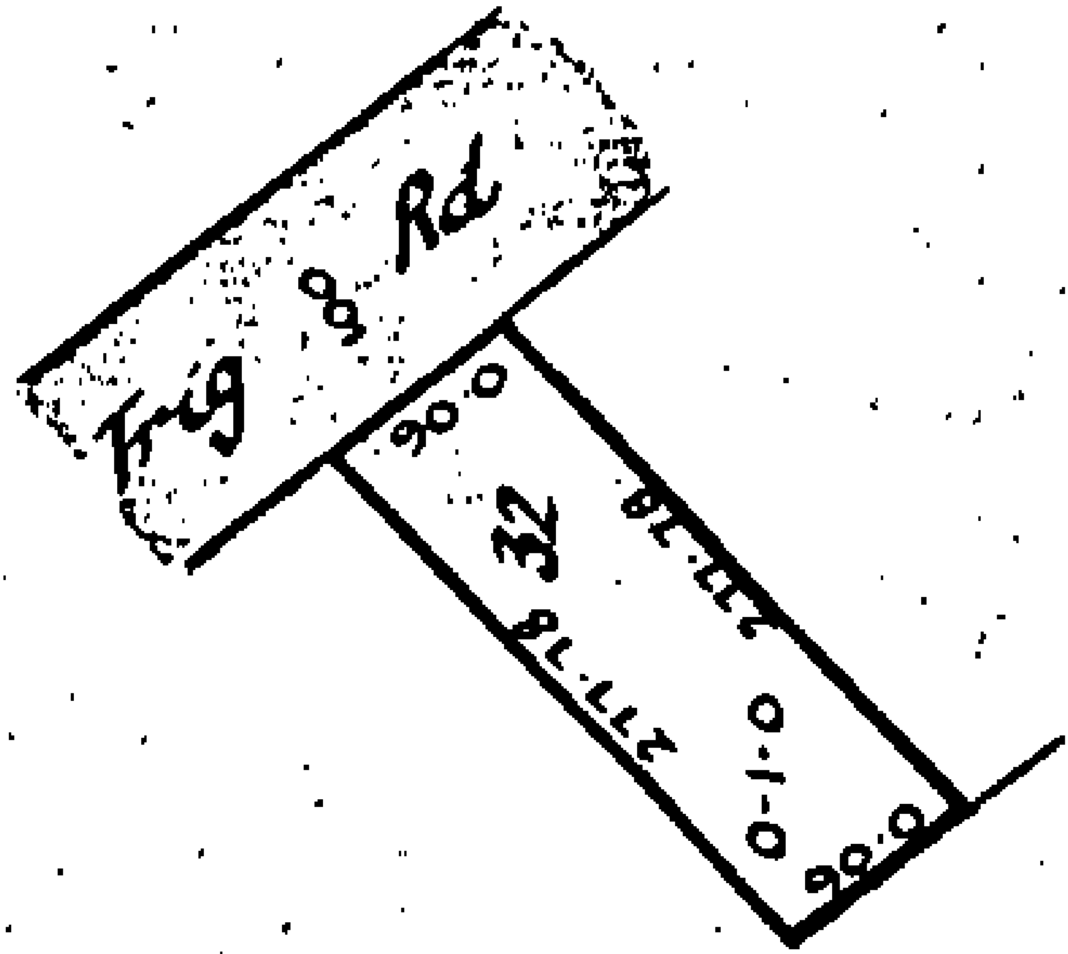
Registered Owners
Francis John Mullan

Interests

Fencing Agreement in Transfer 680190 - 24.5.1962

9967574.3 Mortgage to ASB Bank Limited - 12.2.2015 at 5:10 pm

Identifier **NA2053/54**



RECORD OF TITLE
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R.W. Muir
Registrar-General
of Land

Identifier 110146
Land Registration District North Auckland
Date Issued 18 December 2003

Prior References
NA1096/247

Estate	Fee Simple
Area	1120 square metres more or less
Legal Description	Lot 1 Deposited Plan 327126

Registered Owners
Bruce Stanley Coutts, Andrea Joy Covich Coutts and Bernard George Allen as to a 1/2 share
Bruce Stanley Coutts, Andrea Joy Covich Coutts and Bernard George Allen as to a 1/2 share

Interests

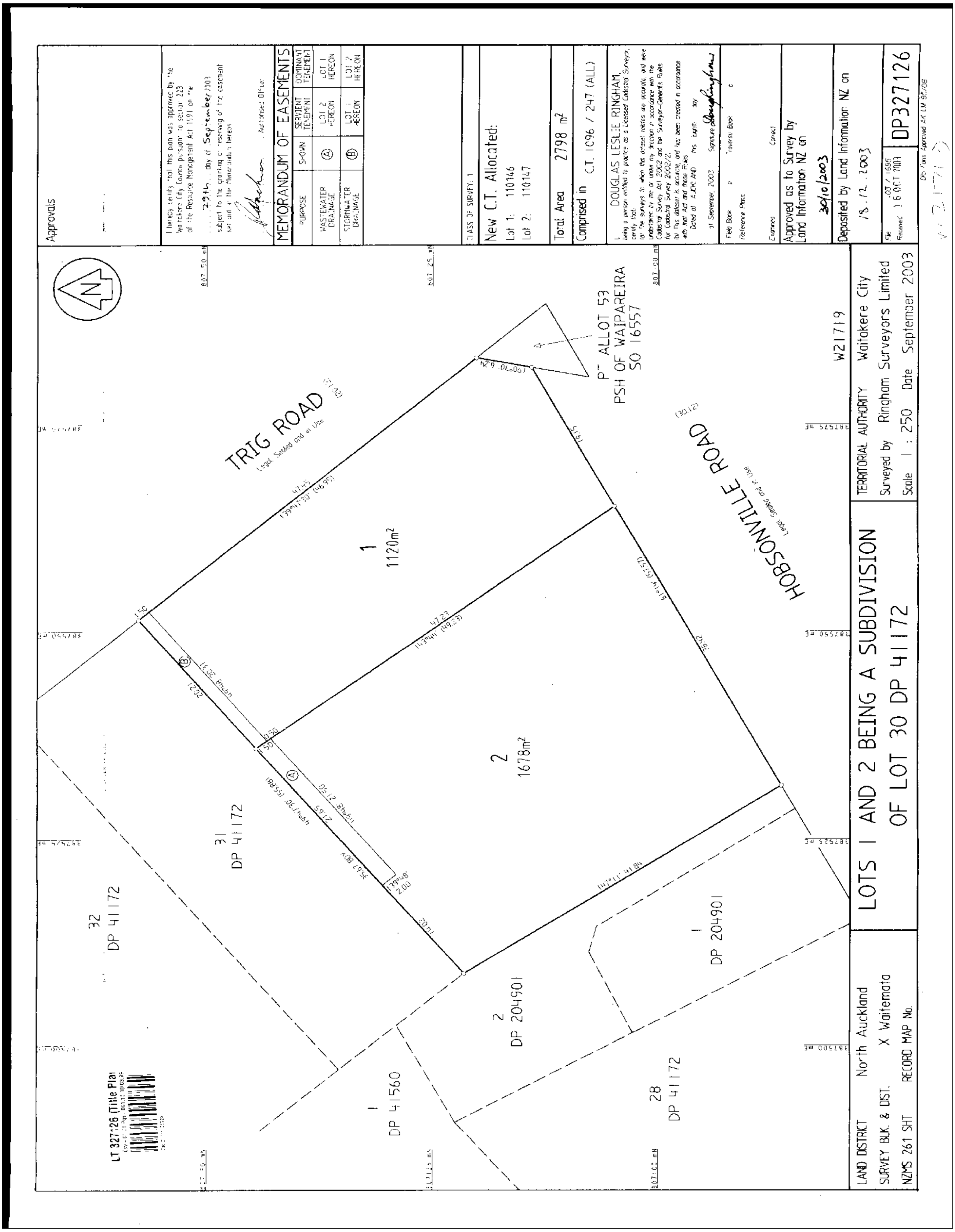
C428346.1 Certificate pursuant to Section 94C Transit New Zealand Act 1989 declaring that part of State Highway 18 known as Hobsonville Road, commencing at its junction with State Highway 16 and proceeding in an eastern direction to Upper Harbour Drive to be a limited access road - 5.11.1992 at 2.01 pm

Subject to a stormwater drainage right over part marked B on DP 327126 created by Easement Instrument 5845394.3 - 18.12.2003 at 9:34 am

The easements created by Easement Instrument 5845394.3 are subject to Section 243 (a) Resource Management Act 1991

9293393.2 Mortgage to Westpac New Zealand Limited - 31.1.2013 at 2:09 pm

Identifier **110146**



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GAZETTE NOTICE
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R.W. Muir
Registrar-General
of Land

Identifier	**192542**
Land Registration District	**North Auckland**
Date Registered	09 March 2005 09:00 am

Prior References
NA21C/1295

Type	Fee Simple	**Instrument**	GN 6339011.4
Area	4.0469 hectares more or less		
Legal Description	Lot 5 Deposited Plan 66045		
Purpose	State School		

Registered Owners
Her Majesty the Queen

Interests

Identifier 192542

Title Diagram CT192542
Cpy – 01/01, Pgs – 001, 22/03/05, 08:25

DocID: 311851411

Extract from *New Zealand Gazette*, 24/2/2005, No. 41, p. 1064

Land Acquired for State School—Trig Road, Hobsonville

Pursuant to section 20 of the Public Works Act 1981, and to a delegation from the Minister for Land Information, Stephen Robert Gilbert, Land Information New Zealand, declares that, agreements to that effect having been entered into, the land described in the Schedule to this notice is hereby acquired for a state school and vests in the Crown on the date of publication of this notice in the *New Zealand Gazette*.

North Auckland Land Registry—Waitakere City

Schedule

Area ha	Description
4.0469	Lot 5, DP 66045, all Computer Freehold Register NA21C/1295.

Dated at Christchurch this 22nd day of November 2004.

S. R. GILBERT, for the Minister for Land Information.

(LINZ CPC/1999/3753)

ln1034

NOTICE NO: 1034

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R.W. Muir
Registrar-General
of Land

Identifier	**199623**
Land Registration District	**North Auckland**
Date Issued	26 July 2005

Prior References
NA11A/60

Estate	Fee Simple
Area	400 square metres more or less
Legal Description	Lot 1 Deposited Plan 348652

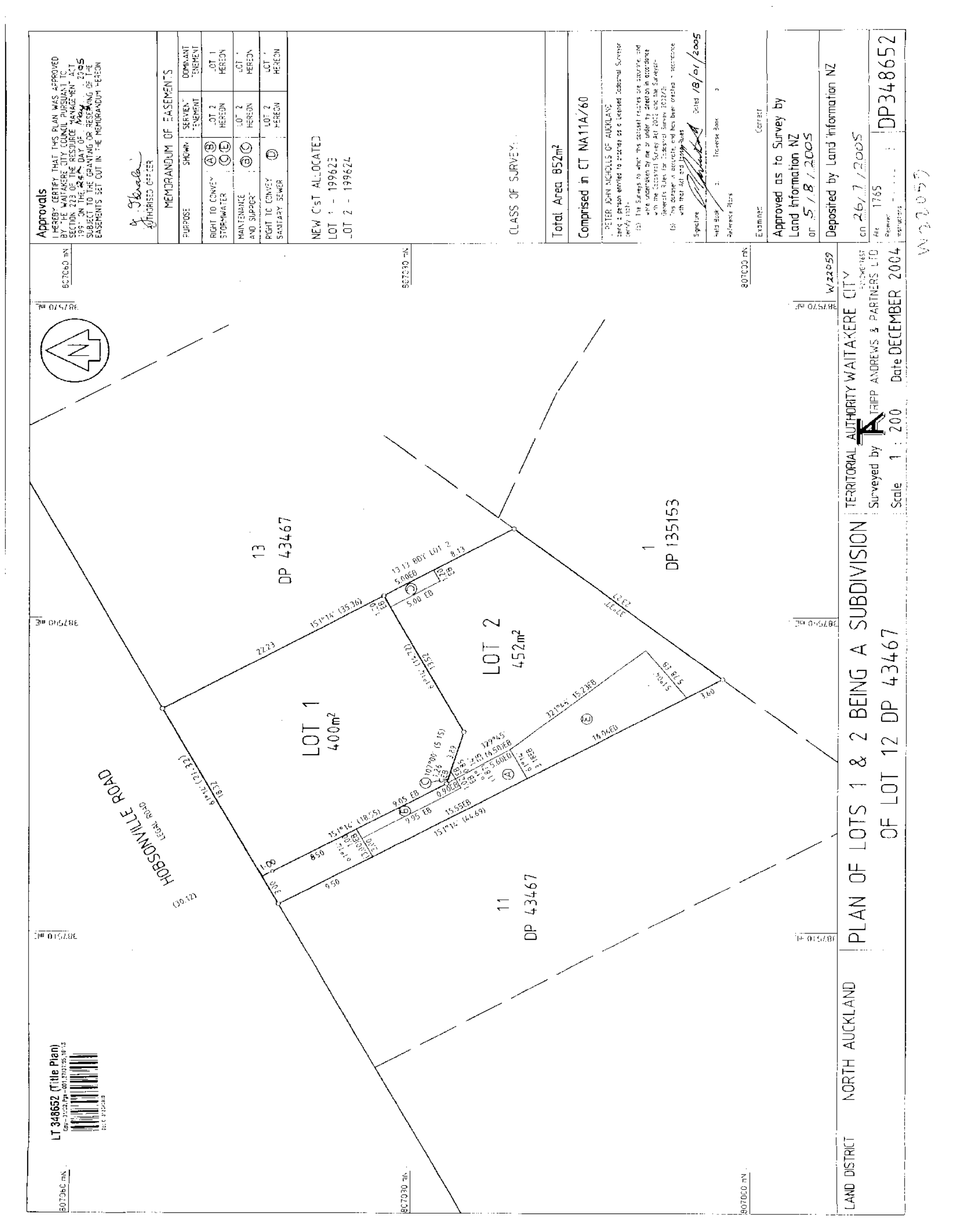
Registered Owners
Xixiu Ma

Interests

Appurtenant hereto is a right to convey stormwater & sanitary sewer and a maintenance and support easement created by Easement Instrument 6509588.4 - 26.7.2005 at 9:00 am

The easements created by Easement Instrument 6509588.4 are subject to Section 243 (a) Resource Management Act 1991

12029053.3 Mortgage to Bank of China (New Zealand) Limited - 26.2.2021 at 3:11 pm


Approvals
MEMORANDUM OF EASEMENTS
NEW C'ST ALLOCATED
LOT 1 - 199623
LOT 2 - 199624
CLASS OF SURVEY:
Total Area 852m²
Comprised in CT NA11A/60
Approved as to Survey by Land Information NZ
Deposited by Land Information NZ
DP348652
LOT 1
400m²
LOT 2
452m²
13
DP 43467
1
DP 135153
11
DP 43467
HOBSONVILLE ROAD
LAND DISTRICT
NORTH AUCKLAND
PLAN OF LOTS 1 & 2 BEING A SUBDIVISION
OF LOT 12 DP 43467
TERRITORIAL AUTHORITY WAITAKERE CITY
Scale 1 : 200
Date DECEMBER 2004
LT 348652 (Title Plan)

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier **199624**
Land Registration District **North Auckland**
Date Issued 26 July 2005

Prior References
NA11A/60

Estate	Fee Simple
Area	452 square metres more or less
Legal Description	Lot 2 Deposited Plan 348652

Registered Owners
Rav Singh Property Limited

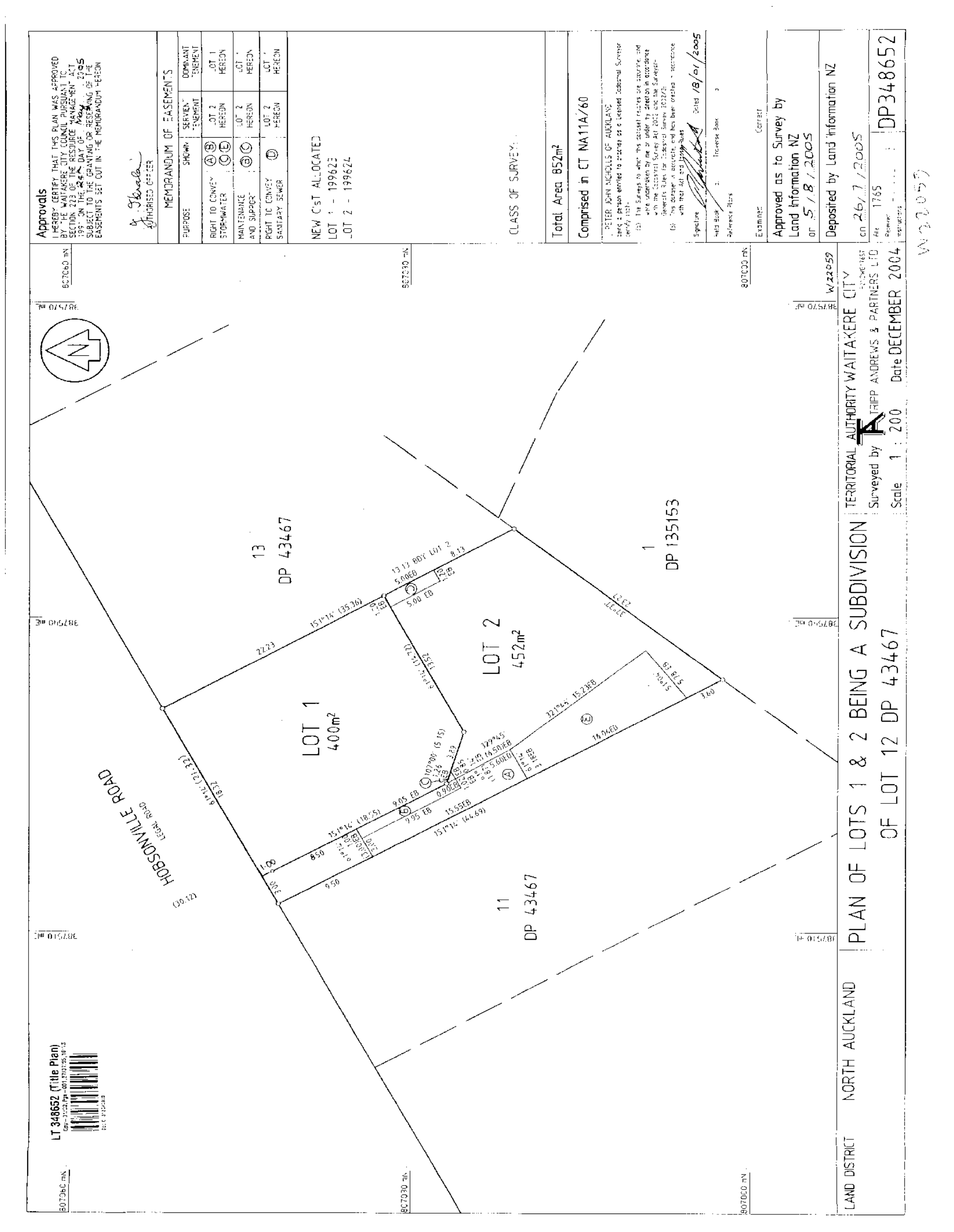
Interests

Subject to a right to convey stormwater over part marked A, B, C and E, maintenance and support easement over part marked B & C and a right to convey sanitary sewer over part marked D on DP 348652 created by Easement Instrument 6509588.4 - 26.7.2005 at 9:00 am

The easements created by Easement Instrument 6509588.4 are subject to Section 243 (a) Resource Management Act 1991

12491933.3 Mortgage to Bank of New Zealand - 1.7.2022 at 3:45 pm

Identifier **199624**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier	**287255**
Land Registration District	**North Auckland**
Date Issued	01 May 2006

Prior References
GN 6844619.1

Estate	Fee Simple
Area	2358 square metres more or less
Legal Description	Section 1 Survey Office Plan 364200

Registered Owners
Watercare Services Limited

Interests

Subject to Part IVA Conservation Act 1987

Subject to Section 11 Crown Minerals Act 1991

8447500.1 Compensation Certificate pursuant to Section 19 Public Works Act 1981 - 22.3.2010 at 12:08 pm

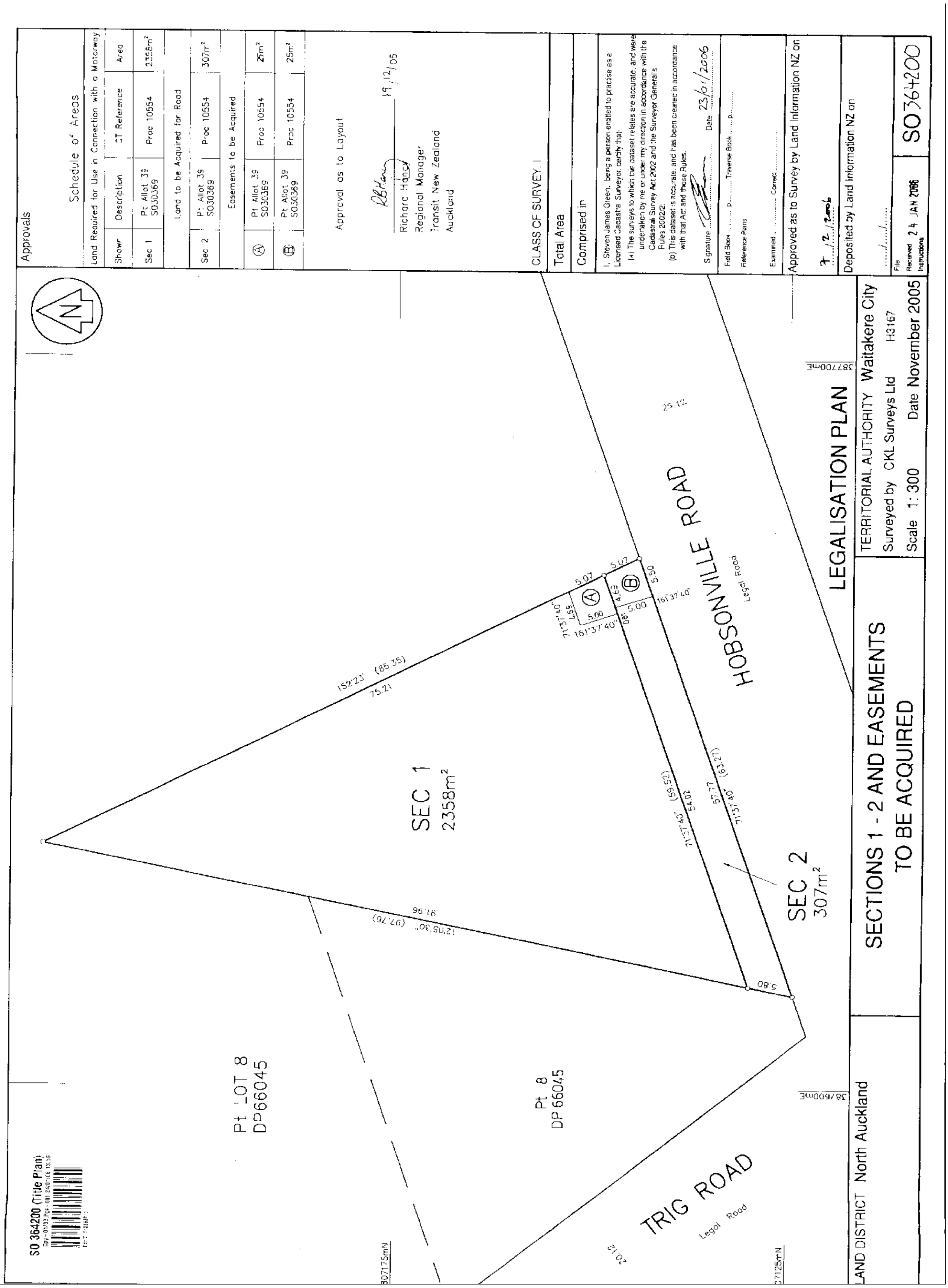
8934563.1 Notice pursuant to Section 91 Government Roading Powers Act 1989 - 6.12.2011 at 7:00 am

Subject to a right (in gross) to convey electricity over part marked A on DP 432994 in favour of Vector Limited created by Easement Instrument 9345003.1 - 30.4.2013 at 7:57 am

Subject to a right (in gross) to convey telecommunications and computer media over part marked A on SO 364200 and part marked A on DP 438695 in favour of Her Majesty the Queen created by Easement Instrument 10504407.2 - 19.7.2016 at 7:00 am

10504407.3 Partial discharge of Compensation Certificate 8447500.1 - 19.7.2016 at 7:00 am

Identifier **287255**



RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
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R.W. Muir
Registrar-General
of Land

Identifier	**376596**
Land Registration District	**North Auckland**
Date Issued	18 November 2011

Prior References
110147

Estate	Fee Simple
Area	506 square metres more or less
Legal Description	Lot 1 Deposited Plan 394135

Registered Owners
Xingyu Pan and Xiao Yan

Estate	Fee Simple - 1/4 share
Area	108 square metres more or less
Legal Description	Lot 5 Deposited Plan 394135

Registered Owners
Xingyu Pan and Xiao Yan

Interests

C428346.1 Certificate pursuant to Section 94C Transit New Zealand Act 1989 declaring that part of State Highway 18 known as Hobsonville Road, commencing at its junction with State Highway 16 and proceeding in an eastern direction to Upper Harbour Drive to be a limited access road - 5.11.1992 at 2.01 pm

Appurtenant hereto is a stormwater drainage right created by Easement Instrument 5845394.3 - 18.12.2003 at 9:34 am

The easements created by Easement Instrument 5845394.3 are subject to Section 243 (a) Resource Management Act 1991

8887148.1 Consent Notice pursuant to Section 221 Resource Management Act 1991 - 18.11.2011 at 4:46 pm (affects Lot 1 DP 394135)

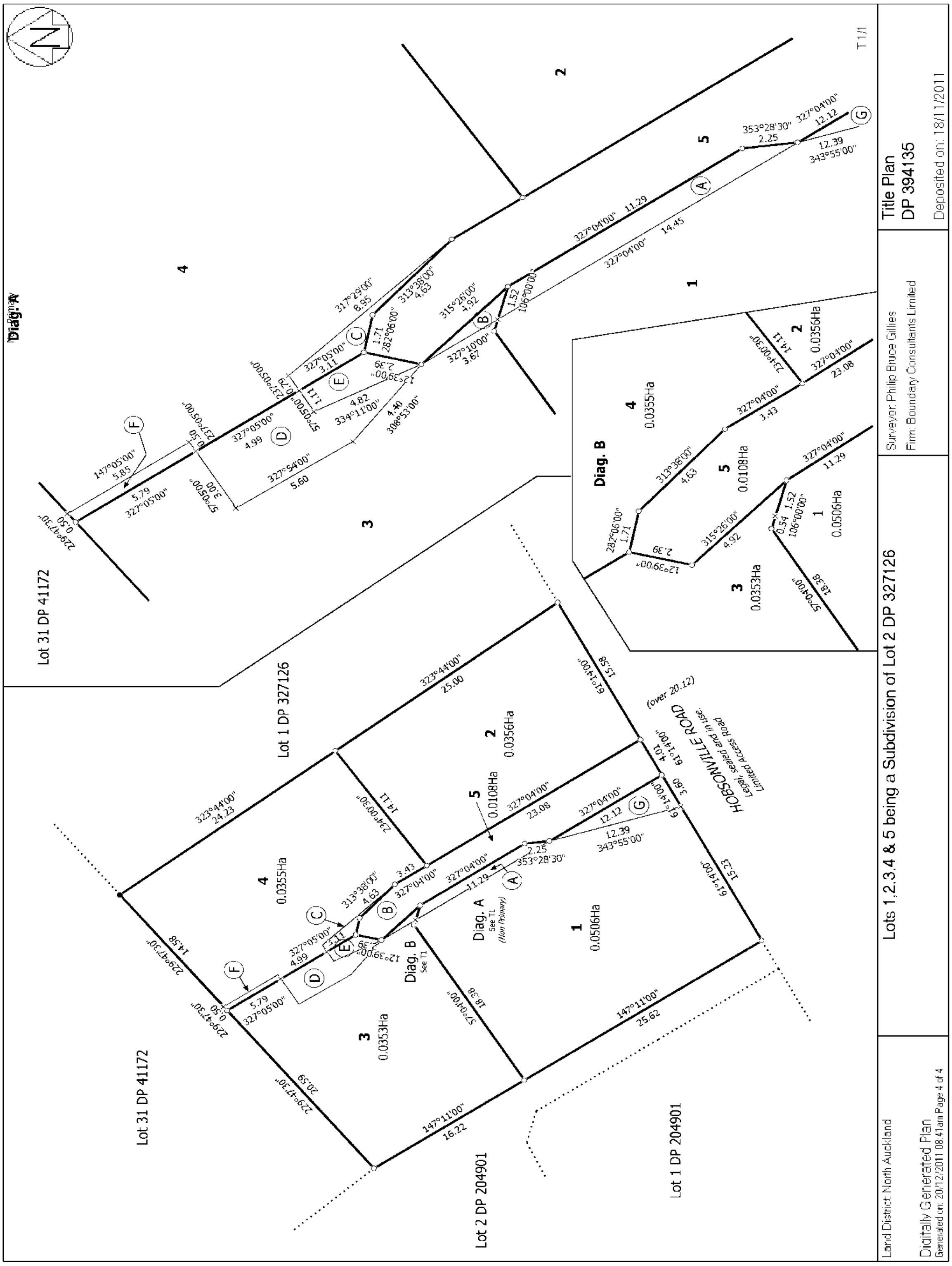
Subject to Section 241(2) Resource Management Act 1991 (affects DP 394135)

Subject to a right to convey electricity, gas, telecommunications, water and computer media over part Lot 1 DP 394135 marked A and G on DP 394135 created by Easement Instrument 8887148.5 - 18.11.2011 at 4:46 pm

Some of the easements created by Easement Instrument 8887148.5 are subject to Section 243 (a) Resource Management Act 1991 (see DP 394135)

9615010.3 Mortgage to Bank of New Zealand - 18.2.2014 at 10:45 am

Identifier **376596**



ATTACHMENT 25

CULTURAL IMPACT ASSESSMENT

CULTURAL IMPACT ASSESSMENT

FOR

TE TUPU NGĀTAHI NORTH WEST PROJECT (LOCAL AND STRATEGIC TRANSPORT NETWORK)

PREPARED FOR

TE TUPU NGĀTAHI

DECEMBER 2022

Ref. TKITT000054

Te Kawerau Iwi Tiaki Trust
PO Box 59-243 Mangere Bridge Auckland
www.tekawerau.iwi.nz

TE KAWERAU A MAKI

"Kawerau Iwi, Kawerau Mana, Kawerau Tangata"

Report No.	TKITT000054		
Prepared by:	Edward Ashby	Mana Taiao Manager	
Date of issue:	07 December 2022		
Revision:	Version 2		

EXECUTIVE SUMMARY

The North West Project proposes to upgrade and develop new sections of the local and strategic transport network extending from Whenuapai through Westgate and Brigham Creek to Waimauku. A significant element of the project is the Alternative State Highway (ASH) from Brigham Creek to western Huapai. The project sits within and across an important cultural landscape at the crossroads between the Hikurangi, Waitematā, and Kaipara Valley takiwa. It is the northern part of Te Kawerau ā Maki's heartland and contains a number of significant cultural sites and resources from our most ancient traditions through to our major Treaty settlement redress. A total of 51 cultural sites and resources were identified across the wider project area. The project was assessed against these sites and resources resulting in the documenting of eight significant adverse effects, 15 minor adverse effects, three negligible adverse effects, one potential significant beneficial effect*, one minor beneficial effect*, and 25 neutral effects. Where adverse effects were identified offsets (or further mitigation) were suggested. The significant adverse effects relate to the removal of productive topsoil, impacts to fresh water (including the taniwha), impacts to the Kumeū River (including the taniwha), impacts to fish species, setting impacts to Nga Rau Pou ā Maki, impacts to Pukewhakataratara, impacts to Wai paki i rape ō Ruarangi, and impacts to the cultural landscape. There is particular concern regarding a strategy of supporting urban growth in a flood prone catchment that holds the most regionally significant topsoil in northern Auckland. Due to these sensitivities the iwi cannot support the ASH component of the project. Advice is provided on suggested limits and offsets, and recommendations are provided for the project overall.

PEPEHA

Ko Hikurangi te maunga

Ko ngā Rau Pou ā Maki ngā tohu whakahī

Ko te Wao Nui ā Tiriwa te ngahere

Ko te Manukanuka ā Hoturoa me te Waitematā ngā moana

Ko Waitākere te awa

Ko Tainui te waka

Ko Tawhiakiterangi te tupuna

Ko Te Kawerau ā Maki te iwi

Hikurangi is the mountain

The many posts of Maki (Waitākere Ranges peaks) are the markers

Te Wao nui ā Tiriwa is the forest

Manukau and Waitematā are the harbours

Waitākere is the river

Tainui is the canoe

Tawhiakiterangi is the person

Te Kawerau ā Maki is the tribe

CONTENTS

INTRODUCTION

1.0 Project Background

Te Kawerau Iwi Tiaki Trust ('the Trust') have been commissioned by Te Tupu Ngātahi (an alliance involving Waka Kotahi, Auckland Transport, BECA, AECOM, Bell Gully and Buddle Finlay) (hereafter the Client) to prepare a Cultural Impact Assessment (CIA) for proposed upgrades and new sections of the local and strategic transport network extending from Hobsonville/Whenuapai through Westgate and Brigham Creek to Kumeū, Taupaki and Waimauku. The proposed transport network project is known as the 'North West Project'.

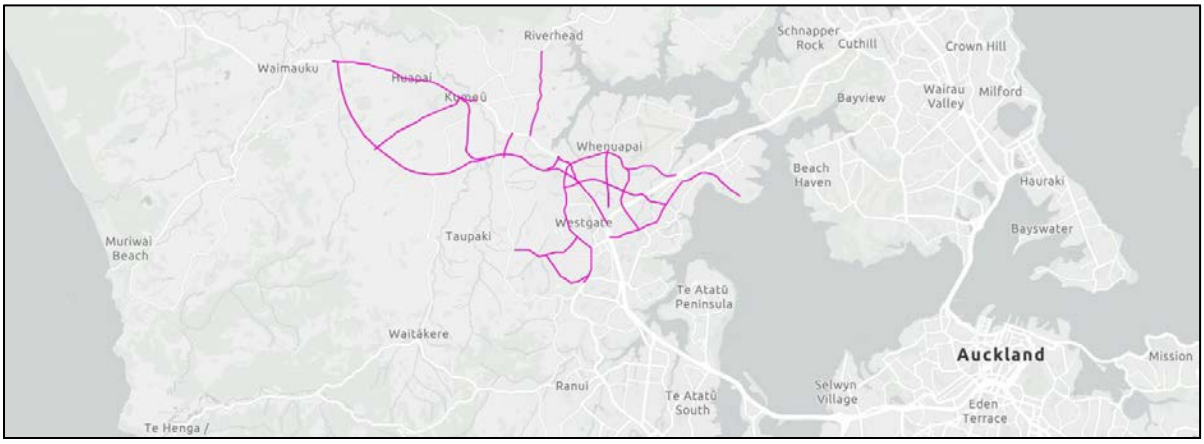


Figure 1: Plan showing Site regional context

The Client seeks to identify and protect the preferred transport network in Auckland's future growth areas. The wider strategy of Te Tupu Ngātahi is to support growth in housing and employment, to provide people with genuine travel choices, to address climate change by achieving transformative mode shift, and to address transport safety issues. For the North West Project the specific outcomes include an extensive walking and cycling network, 71km of bus lanes plus a rapid transit corridor to Kumeū-Huapai, safety upgrades, and state highway upgrades including an alternative route for State Highway 16. The network works will generally involve transport corridor widening/realignment, new corridors, bulk earthworks, bridge construction/stream crossings, stormwater management (e.g. ponds), vegetation removal/replanting, and installation of related infrastructure.

Specific to the 'strategic network' components of the North West Project are: the Alternative State Highway (ASH) route will include a new four-laned dual carriageway motorway and the upgrade of Brigham Creek Interchange; The SH16 main road (Main Rd) upgrade will include upgrading the existing corridor to a 24m wide urban corridor, including a 600m section of active mode only upgrade and realignment of Station Road to form a new signalised intersection with SH16; The development of a new rapid transit corridor (including the Regional Active Mode Corridor – RTC) and active mode corridor will be in one co-located corridor; The upgrade of Access Road (Access Rd) from a 20m width to a 30m four-lane cross-section with separated cycle lanes and footpaths on both sides of the corridor within the urban section and the north side within the rural section.

This CIA report has been prepared by the Trust as a legal entity of Te Kawerau ā Maki who are a mana whenua iwi of wider Tāmaki Makaurau (Auckland), but with particular lead interests in Hikurangi (West Auckland) and the Upper Waitematā Harbour. The purpose of this CIA report is to provide the Client and relevant statutory agencies with documentation of Te Kawerau ā Maki's cultural values, interests, and associations with the project area and its natural resources, and the potential impacts of the proposed project activities on these. This impact assessment also provides recommendations as to how to avoid, remedy or mitigate any potential cultural effects that arise from the project.

Te Kawerau ā Maki engagement in statutory processes including provision of technical advice for impact assessments is guided by our tikanga (customs and protocols) and mātauranga (tribal knowledge) and framed by Te Tiriti ō Waitangi, our Te Kawerau ā Maki Claims Settlement Act 2015, our Iwi Management Plan (IMP), and our organisational strategic values: Mana Motuhake (independence); Kaitiakitanga (guardianship and sustainable management); Whānaungatanga (people focused); Auahatanga (innovation); Mātauranga Māori (culture-driven).

2.0 Site Description

The project is situated in northern West Auckland/southwest Kaipara running from Hobsonville to Waimauku. It essentially runs along the low-lying alluvial plains between the Waitākere Ranges to the southwest, the Riverhead hill country to the north, and the Waitematā Harbour to the east. The project is situated primarily within the catchment of the Kumeū River. For the most part the project follows the alignment of SH16 and its various feeder roads, however the proposed Alternative State Highway crosses rural land to the west between the townships of Taupaki and Kumeū/Huapai.

The wider proposed project area (hereafter the Study Area) includes the entire alignment including the local and strategic network and a wider catchment of 4km radius from the project footprint. This wider area is appropriate for placing the project within its proper cultural landscape context and for capturing any potential setting impacts.

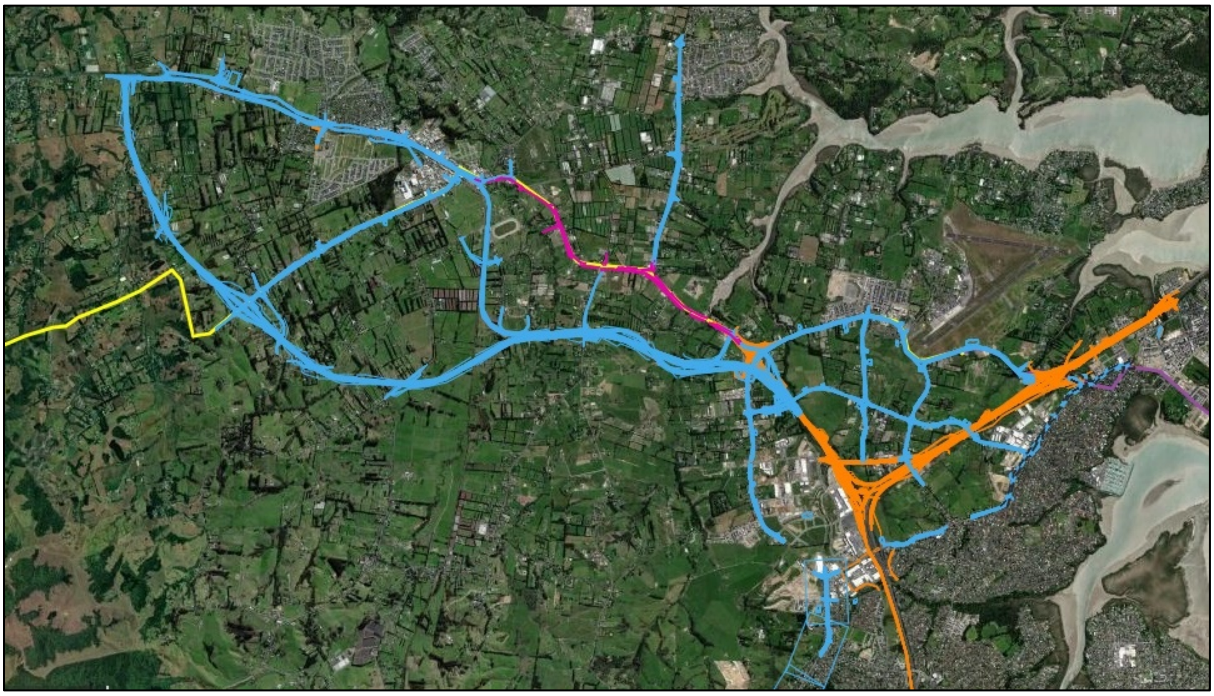


Figure 2: Plan showing Site (supplied by Client)

For the purposes of this report, the proposed project site (hereafter the Site) includes the local and strategic network footprint, including both its construction (including temporary compounds) and operational phases. Specifically this includes the Redhills, Riverhead, and Whenuapai 'arterials' as well as the strategic corridors known as ASH, Main Rd, RTC, and Access Rd.

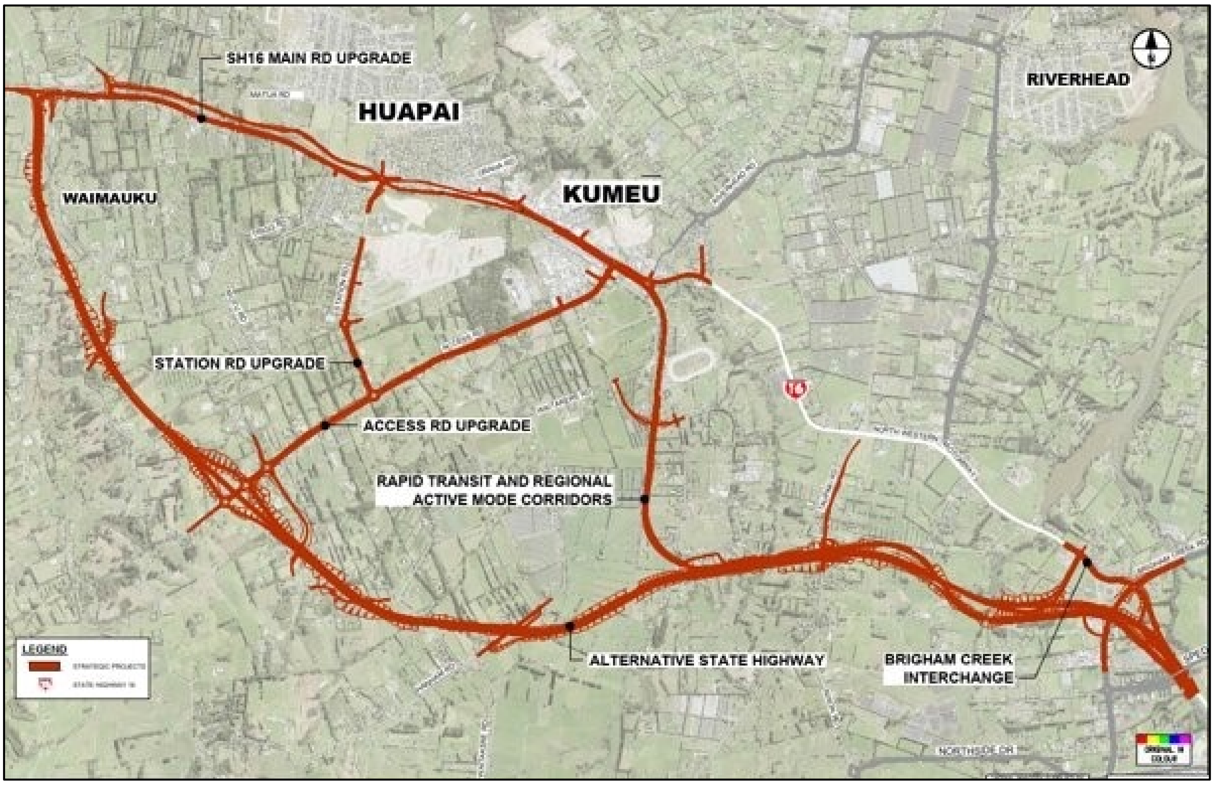


Figure 3: Plan showing Strategic Network (supplied by Client)

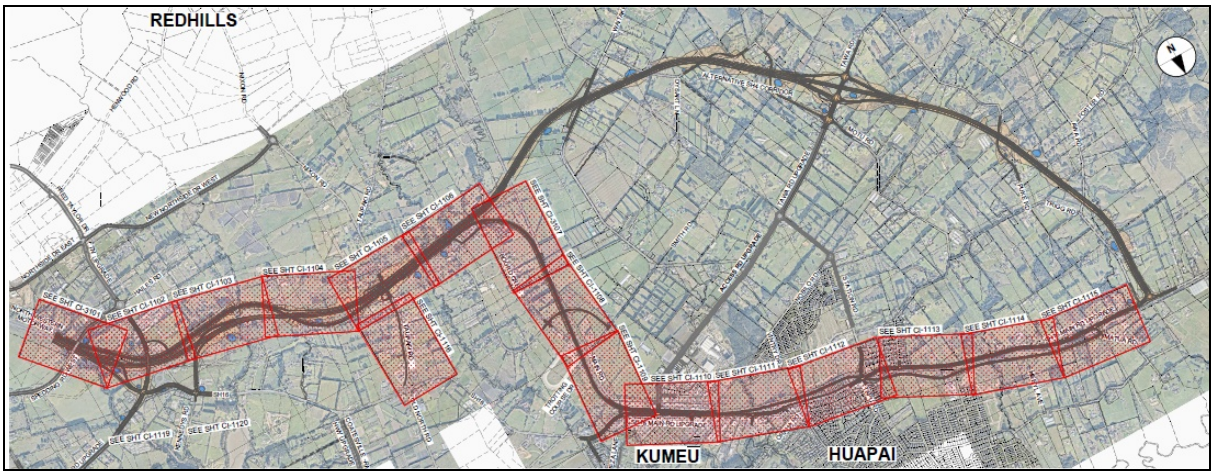


Figure 4: Plan of the Rapid Transit Corridor and Regional Active Mode (supplied by Client)

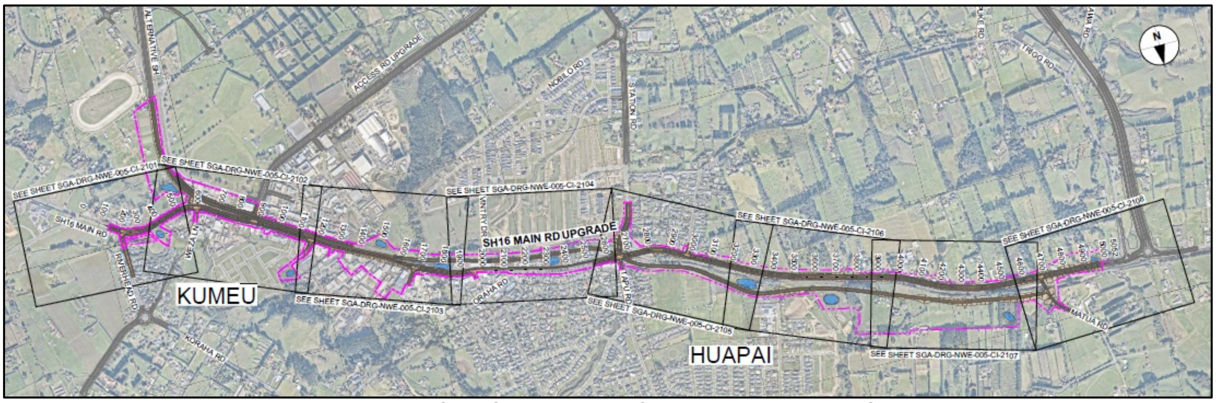


Figure 5: Plan of the SH16 Main Rd footprint (supplied by Client)

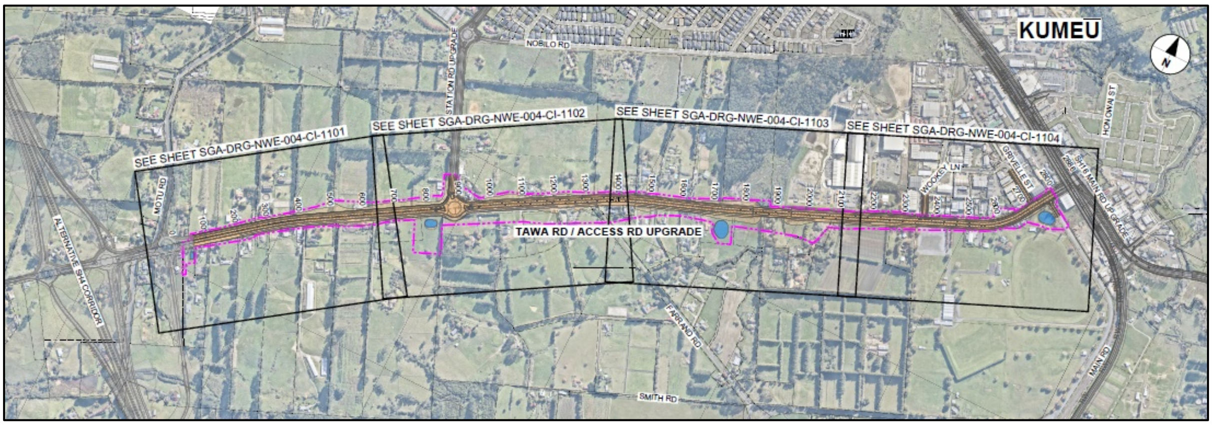


Figure 6: Plan of the Access Rd footprint (supplied by Client)

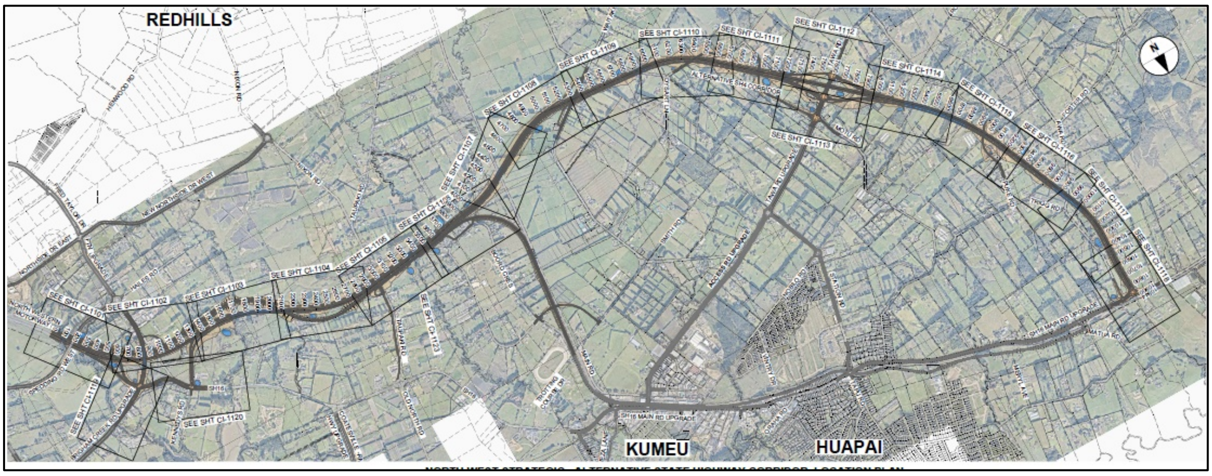


Figure 7: Plan of the Alternative State Highway footprint (supplied by Client)

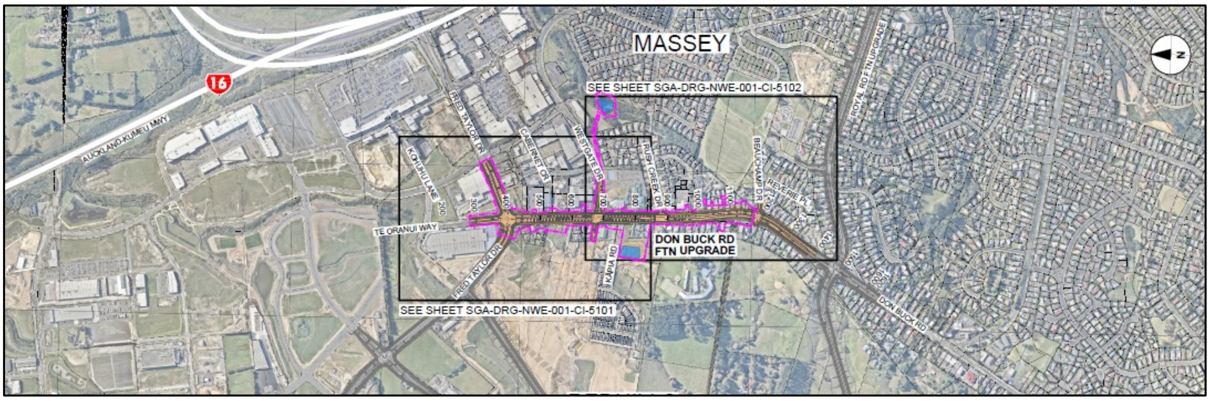


Figure 8: Plan of Don Buck Rd Local Network footprint (Supplied by Client)

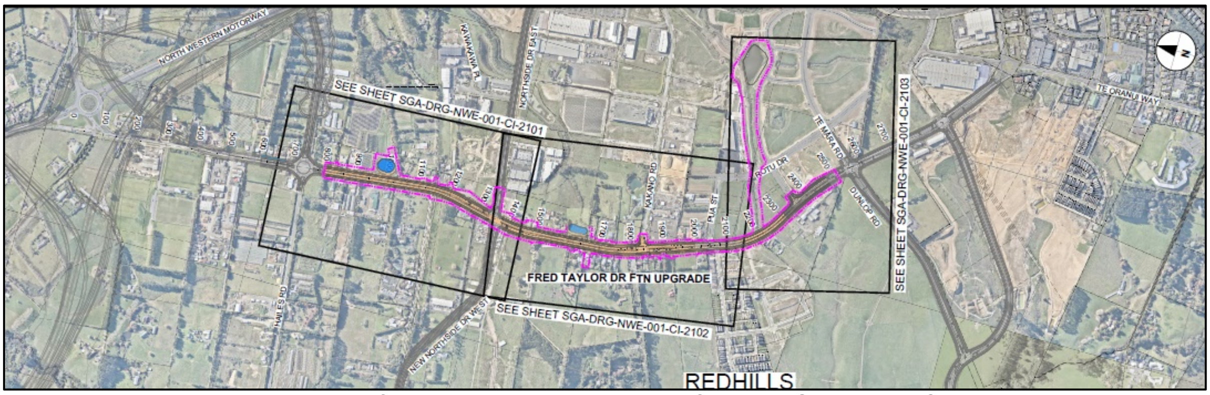


Figure 9: Plan of Fred Taylor Dr Local Network footprint (Supplied by Client)

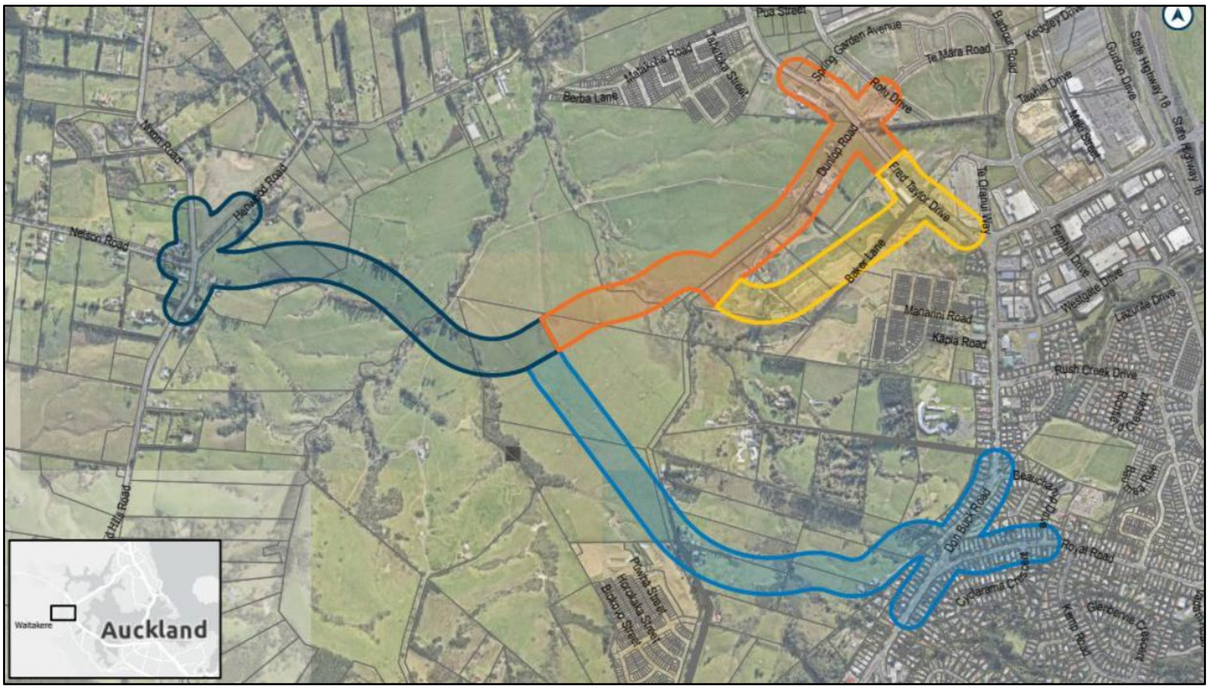


Figure 10: Plan of Red Hills Arterial footprint (Supplied by Client)

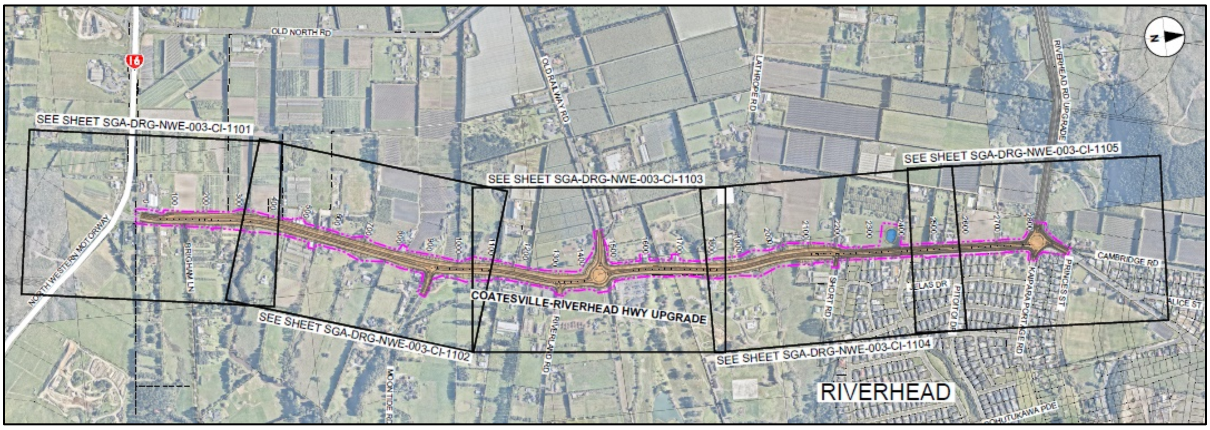


Figure 11: Plan of Coatesville-Riverhead HWY Local Network footprint (Supplied by Client)

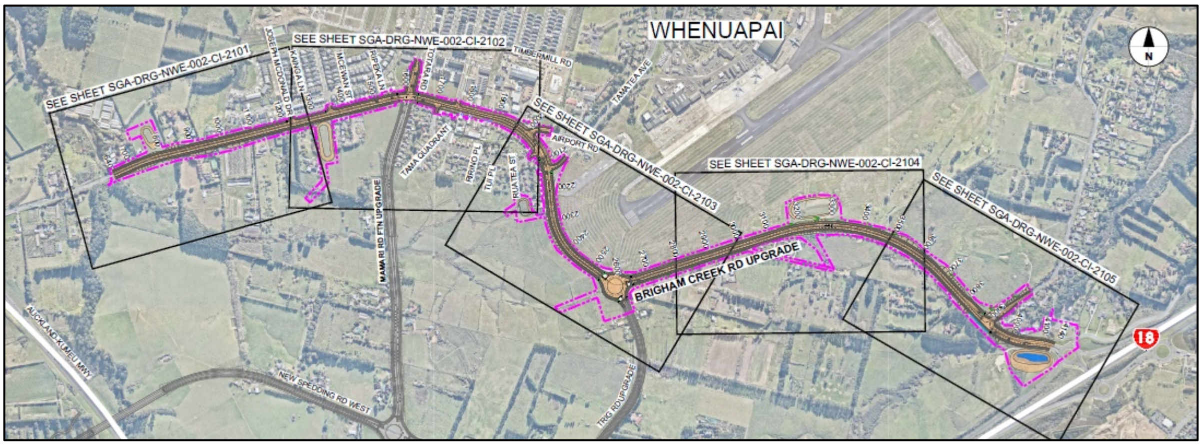


Figure 12: Plan of Brigham Creek Rd Local Network footprint (Supplied by Client)

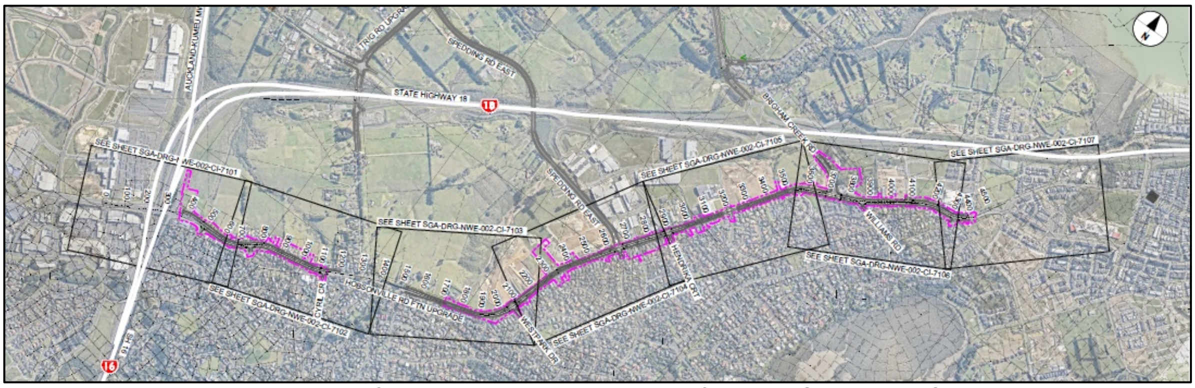


Figure 13: Plan of Hobsonville Rd Local Network footprint (Supplied by Client)

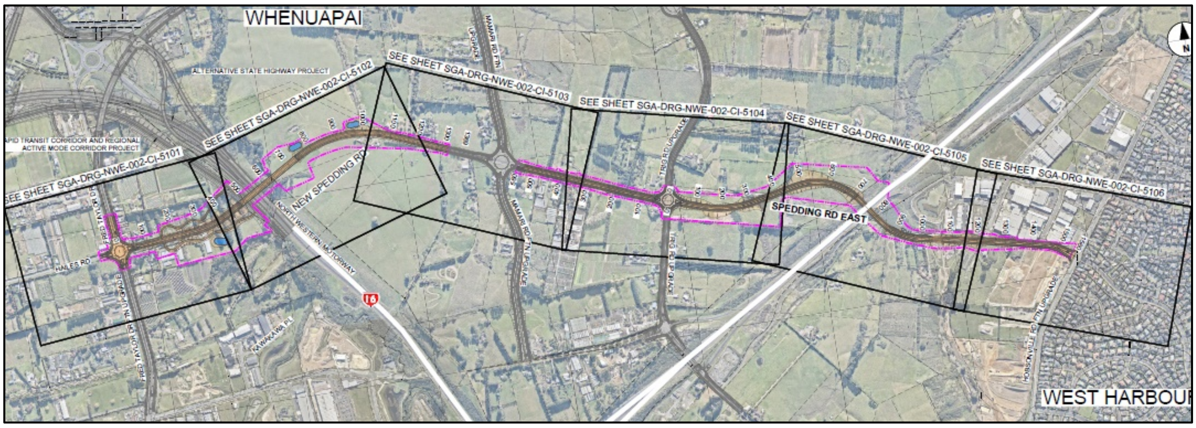


Figure 14: Plan of New Spedding Rd Local Network footprint (Supplied by Client)

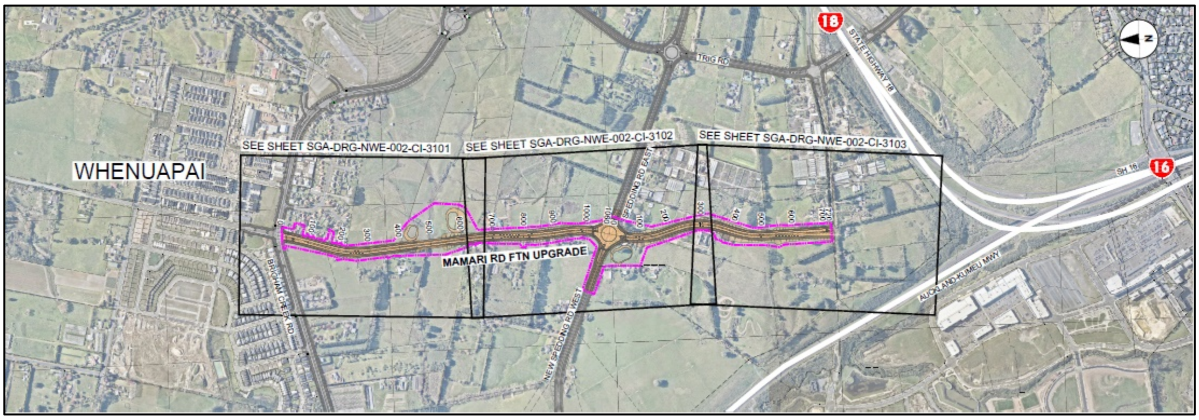


Figure 15: Plan of Mamari Rd Local Network footprint (Supplied by Client)

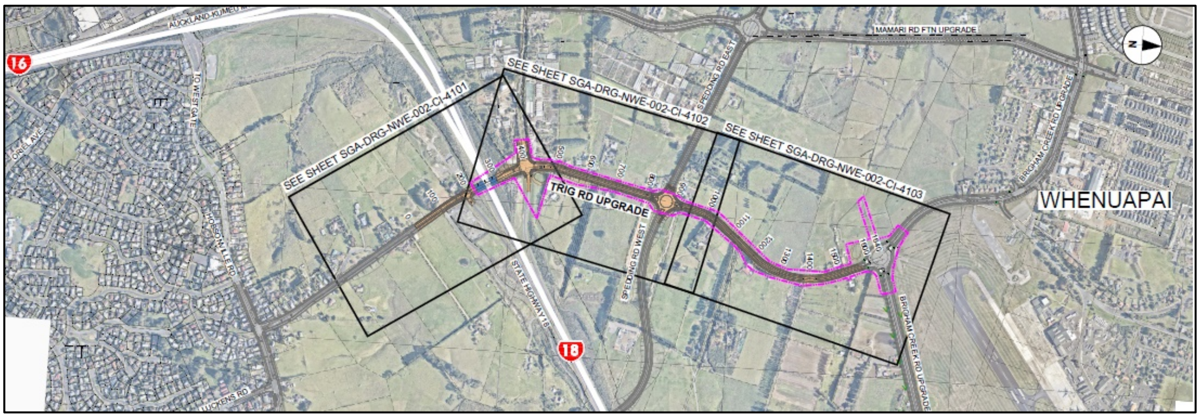


Figure 16: Plan of Trig Rd Local Network footprint (Supplied by Client)

Figure 17: Plan of Trig Rd Corridor footprint (Supplied by Client)

3.0 Aims and Objectives

The aim of this CIA report is to document Te Kawerau ā Maki's cultural values, interests, and associations with the Site; identify specific cultural sites and resources; assess the values of these sites and resources; identify the potential impacts that arise from project activities and assess the significance of effect; and provide recommendations as to how to avoid, remedy or mitigate the potential effects to Te Kawerau ā Maki.

This impact assessment will:

- provide a baseline of known environmental or natural features and resources that may hold cultural values;
- provide a statement of cultural association Te Kawerau ā Maki has with the Site and Study Area;
- identify any known cultural sites and resources within the Site or Study Area;
- describe the value or significance of such sites and resources;
- identify the potential for unrecorded cultural sites (i.e. buried Māori archaeology);
- identify the cultural constraints and risks associated with the Site and the potential significance of effects; and
- provide recommendations for further assessment where necessary and/or measures to avoid, remedy or mitigate adverse effects upon Te Kawerau ā Maki.

4.0 Statutory Context

Te Tiriti o Waitangi

The key guiding document in any consideration of planning or practice that may impact upon the cultural values or wellbeing of Mana Whenua is Te Tiriti o Waitangi. The principles of the Treaty are recognised and provided for in the sustainable management of ancestral lands, water, air, coastal sites, wāhi tapu and other taonga, and natural and physical resources. The Treaty is articulated in law through an evolving set of principles. These include:

a. reciprocity
b. rangatiratanga
c. partnership
d. shared decision-making
e. active protection
f. mutual benefit
g. right of development
h. redress.

While Article 1 of the Treaty enables the Crown to govern and make laws, Article 2 guarantees Māori rangatiratanga over their people, lands and taonga (things of value). Māori values, associations and interests with their taonga applies regardless of property titles or other constructs, and the Treaty requires that the Crown actively protect these associations and interests (including through but not limited to statutes). Article 3 provides for equality and equity of citizenship and outcome.

Te Kawerau ā Maki Claims Settlement Act 2015

Te Kawerau ā Maki Claims Settlement Act (TKaMCSA) records the acknowledgements and apology given by the Crown to Te Kawerau ā Maki for historic grievances and breaches of Te Tiriti ō Waitangi and gives effect to provisions of the Deed of Settlement that settles the historical claims of Te Kawerau ā Maki. The Act binds the Crown to Te Kawerau ā Maki to work together in accordance with Te Tiriti. The Settlement as delivered through the Act provided both cultural and commercial redress to Te Kawerau ā Maki. This includes binding protocols between Government Ministries and Te Kawerau ā Maki (Part 2, s21 to s26), a recognised and agreed area of interest (Part 1, s12(2b), Part 1 of attachments to Act), and statutory acknowledgements and deeds of recognition (Part 2, s27 to s40, and Schedule 1).

Statutory acknowledgements require relevant consent authorities, the Environment Court, and Heritage New Zealand Pouhere Taonga to: (a) have regard to the statutory acknowledgement; (b) require relevant consent authorities to record the statutory acknowledgement on statutory plans and to provide summaries of resource consent applications or copies of notices of applications to the trustees; and (c) enable the trustees and any member of Te Kawerau ā Maki to cite the statutory acknowledgement as evidence of the association of Te Kawerau ā Maki with a statutory area. The statutory acknowledgement supports Te Kawerau ā Maki trustees being considered as affected persons in relation to an activity within the area under s95E and s274 of the Resource Management Act (1991), and s59(1) and 64(1) of the Heritage New Zealand Pouhere Taonga Act (2014).

Te Kawerau ā Maki Statutory Acknowledgement Areas are:

- Taumaihi (part of Te Henga Recreation Reserve)
- Motutara Settlement Scenic Reserve and Goldie Bush Scenic Reserve
- Swanson Conservation Area
- Henderson Valley Scenic Reserve

- Coastal statutory acknowledgement
- Waitākere River and tributaries
- Kumeū River and tributaries
- Rangitōpuni Stream and tributaries
- Te Wai-ō-Pareira / Henderson Creek and tributaries
- Motutara Domain (part of Muriwai Beach Domain Recreation Reserve)
- Whatipū Scientific Reserve

Heritage New Zealand Pouhere Taonga Act 2014

Statutory protection of Māori archaeology and wāhi tapu is provided for under the Heritage New Zealand Pouhere Taonga Act 2014 (HNZPTA), which is administered by Heritage New Zealand Pouhere Taonga (HNZPT), an autonomous Crown Entity. Under the Act all *in situ* materials, sites, and features older than 1900AD are considered archaeological sites whether previously recorded or not and are afforded automatic protection from damage, modification, or destruction without first obtaining an Archaeological Authority from HNZPT. Moveable objects and artefacts that are not *in situ* but that are from an archaeological context, or are of Māori origin, are controlled under the Protected Objects Act (1975). The HNZ Act S45(2)b stipulates that works on sites of interest to Māori can only occur if (a) the practitioners can demonstrate they have the requisite competencies for recognising and respecting Māori values, and (b) the practitioners undertaking the works have access to appropriate cultural support. Under the Act Mana Whenua are enabled to provide advice or assessment regarding the management or decision taking arising from impacts to their cultural sites, provided these meet the Act's criteria. It is noted that Te Kawerau ā Maki never ceded our sovereignty to govern our taonga to HNZPT and view the HNZPTA as overstepping its authority or role as the decision-maker over the taonga of Te Kawerau ā Maki, thus being in direct breach of Article II of Te Tiriti ō Waitangi.

Resource Management Act 1991

The Resource Management Act (RMA) 1991 provides statutory recognition of the Treaty of Waitangi and the principles derived from the Treaty. It introduces the Māori resource management system via the recognition of kaitiakitanga and tino rangatiratanga and accords Territorial Local Authorities with the power to delegate authority to iwi over relevant resource management decisions. The Act contains over 30 sections, which require Councils to consider matters of importance to tangata whenua. Some of the most important of these are:

- Take into account principles of the Treaty of Waitangi and their application to the management of resources (Section 8).
- Recognition and provision for, as a matter of national importance, the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, wāhi tapu and other taonga (Section 6(e)).
- Having particular regard to the exercise of kaitiakitanga or the iwi's exercise of guardianship over resources (Section 7(a)).
- Requiring the Minister for the Environment to consider input from an iwi/hapū authority when preparing a national policy statement (Section 46).
- The ability for local authorities to transfer their functions, powers or duties under the Act to iwi authorities (Section 33).
- Development of joint management agreements between councils and iwi/hapū authorities (Section 36B to 36E).
- Having regard to any relevant planning document recognised by an iwi/hapū authority (sections 35A(b), 61.2A(a), 66.2A(a), 74.2A).
- The obligation to consult with iwi/hapū over consents, policies and plans. (Combination of all the sections above and Clause 3(1)(d) of Part 1 of the first schedule of the Resource Management Act).

An assessment of impacts on cultural values and interests (CIA) can assist both applicants and the council in meeting statutory obligations in a number of ways, including:

- preparation of an Assessment of Environmental Effects (AEE) in accordance with s88(2)(b) and Schedule 4 of the Resource Management Act 1991 (RMA)
- requests for further information under s92 of the RMA in order to assess the application
- providing information to assist the council in determining notification status under ss95 to 95F of the RMA
- providing information to enable appropriate consideration of the relevant Part II matters when making a decision on an application for resource consent under s104 of the RMA, or when undertaking a plan change
- consideration of appropriate conditions of resource consent under s108 of the RMA.

It is noted that Te Kawerau ā Maki never ceded our sovereignty to govern our taonga to local authorities and view the RMA as enabling councils to overstep their authority or role as the decision-maker over the taonga of Te Kawerau ā Maki, thus being in direct breach of Article II of Te Tiriti ō Waitangi.

Reserves Act 1977 and Conservation Act 1987

Section 4 of the Conservation Act, which is invoked by the Reserves Act, states that the Act must be interpreted and administered as to give effect to the principles of the Treaty of Waitangi.

Public Works Act 1981

The PWA and its predecessor legislation have had a considerable negative impact upon Māori amounting to a breach of Te Tiriti Article II and international conventions. Te Kawerau ā Maki's last kāinga at Kōpironui was stolen by the Crown under the PWA in the 1950s leaving our people landless. While tacit protections for Māori land have been inserted into the PWA it remains a deeply problematic piece of legislation, both in terms of acquisition of land but also disposal of 'formerly' Māori land, that is not compliant with Te Tiriti o Waitangi or tikanga Māori.

5.0 Planning Policy Context

UN Declaration on the Rights of Indigenous Peoples

New Zealand supported the UN Declaration on the Rights of Indigenous Peoples (2007) in 2010. This support was an affirmation of fundamental rights and the aspirations of the Declaration. Article 11 states that indigenous peoples have the right to practise and revitalise their cultural traditions and customs, including the right to maintain, protect and develop the past, present and future manifestations of their cultures, such as archaeological and historical sites, artefacts, designs, ceremonies, technologies and visual and performing arts and literature (clause 1). States shall provide redress through effective instruments, which may include restitution, developed in conjunction with indigenous peoples, with respect to their cultural, intellectual, religious and spiritual property taken without their free, prior and informed consent or in violation of their laws, traditions and customs. (clause 2). Article 18 and 31 note that indigenous peoples have the right to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedures, as well as to maintain and develop their own indigenous decision-making institutions. Further that Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional cultural expressions, as well as the manifestations of their sciences, technologies and cultures, including human and genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs, sports and traditional games and visual and performing arts. They also have the right to maintain, control, protect and develop their intellectual property over such cultural heritage, traditional knowledge,
and traditional cultural expressions.

ICOMOS New Zealand Charter 2010

The International Council on Monuments and Sites (ICOMOS) is UNESCOs principal advisor in matters concerning the conservation and protection of historic monuments and sites and advises the World Heritage Committee on the administration of the World Heritage Convention (which includes provision of nationally significant heritage). The New Zealand National Committee (ICOMOS NZ) produced a New Zealand Charter in 2010 which has been adopted as a standard reference document by councils. The Charter sets out conservation purposes, principles, processes and practice. The scope covers tangible and intangible heritage, the settings of heritage, and cultural landscapes. Of particular relevance the Charter states that tangata whenua kaitiakitanga over their taonga extends beyond current legal ownership wherever such cultural heritage exists. The Charter also states that the conservation of Māori heritage requires incorporation of mātauranga and therefore is conditional on decisions made in association with tangata whenua and should procced only in this context.

National Policy Statement for Freshwater Management 2020

The NPS for freshwater management provides national policy settings that relevant statutory agencies including local authorities must comply with. Central to the NPS is the concept of Te Mana ō Te Wai set out in s1.3. This is an aspirational concept that means that the integrity (physical and spiritual) of all water is upheld to its highest possible quality or state. The Crown's interpretation of the concept is that the fundamental importance of water is recognised and that by protecting the health of freshwater we protect the health and well-being of the wider environment, including by protecting wai mauri, and the restoration of the balance between water, the environment, and communities. It provides six principles for the management of water (s1.3(4)). Relevant to tangata whenua are: (a) Mana whakahaere: the power, authority, and obligations of tangata whenua to make decisions that maintain, protect, and sustain the health and well-being of, and their relationship with, freshwater; (b) Kaitiakitanga: the obligation of tangata whenua to preserve, restore, enhance, and sustainably use freshwater for the benefit of present and future generations; (c) Manākitanga: the process by which tangata whenua show respect, generosity, and care for freshwater and for others. Policy 2.2(2) states that tangata whenua are actively involved in freshwater management (including decision-making processes), and Māori freshwater values are identified and provided for. Policy 2.2(3) requires that freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments. Section 3.4 sets out how councils must actively involve tangata whenua in the management of fresh water.

Auckland Unitary Plan

At a Local Government level, the Auckland Unitary Plan (AUP) provides for the protection and management of matters of importance to Mana Whenua including the environment and cultural heritage. These matters are set out in the Regional Policy Statement Chapter B6, but are also embedded in the lower-order policies and rules throughout the Plan.

Policy B6.2.2 provides for the recognition of Treaty of Waitangi/Te Tiriti ō Waitangi partnerships and participation. This includes Policy B6.2.2(1) that provides for Mana Whenua to actively participate in the sustainable management of natural and physical resources including ancestral lands, water, sites, wāhi tapu and other taonga.

Policy B6.3.2 deals with recognising Mana Whenua values and includes clause (1) that enables Mana Whenua to identify their values associated with ancestral lands, freshwater, biodiversity, and cultural heritage places and areas, and clause (2) that requires the integration of Mana Whenua values, mātauranga and tikanga in the management of natural and physical resources within the ancestral rohe. Clause (3) ensures that any assessment of environmental effects for an activity that may affect Mana Whenua values includes an appropriate assessment of adverse effects on those values. Clause (6) of the policy requires resource management decisions to have particular regard to potential impacts on: the holistic nature of the Mana Whenua world view; the exercise of kaitiakitanga; mauri; customary activities; sites and areas with significance spiritual or cultural heritage value; and any protected customary right under the Takutai Moana Act (2011).

Policy B6.5.2 provides for the active protection of Mana Whenua cultural heritage. Clause (2) sets out a framework for identifying and evaluating Mana Whenua cultural heritage using the assessment factors of: mauri; wāhi tapu; kōrero tūturu; rawa tūturu; hiahiatanga tūturu; and whakaaronui o te wā. Clause (4) requires the protection of places and areas listed in Schedule 12 Sites and Places of Signifiance to Mana Whenua from adverse effects. Clause (7) provides for the inclusion of a Māori cultural assessment in structure planning and plan change processes, and clause (9) encourages appropriate design, materials and techniques for infrastructure in areas of known historic settlement and occupation.

Iwi Management Plan

Te Kawerau ā Maki Resource Management Statement (1995) was lodged with Council explicitly as an iwi authority planning document under sections 66(c) and 74(b) of the RMA 1991 (since repealed). The IMP describes the continuing role of Te Kawerau ā Maki as kaitiaki (guardians) and provides policies to guide statutory authorities and applicants. Policy 2.2(2) promotes the integration of Te Kawerau ā Maki tikanga in resource management, while clause (3) requires engagement by all agencies within the rohe to help give effect to the kaitiaki role of the iwi. Policy 4.1.2(3) requires that cumulative effects upon Te Kawerau ā Maki are fully recognised and provided for. Policy 4.2.2 concerns Te Kawerau ā Maki cultural heritage and requires the protection of all heritage sites including access requirements (s4.2.2(1)); the involvement of Te Kawerau ā Maki in all instances where potential effects may arise (s4.2.2(2)); and the recognition of Te Kawerau ā Maki cultural and spiritual values (s4.2.2(3 and 4)). Policy 4.3.2 concerns the management of kōiwi, while s4.4.2 regards the management of water. Activities in the Coastal Marine Area are covered by s4.5.2. Waste management policies are described in s4.6.2 and land and landscape policies are set out in s4.7.2. Indigenous flora and fauna policy settings are described in s.4.8.2 including opposition to all destruction of native flora and fauna without Te Kawerau ā Maki written consent. Policy 4.9.2 concerns Te Kawerau ā Maki participation in design of the built environment and interpretation of heritage. The IMP also details formal support and adoption of the 1993 Matātua Declaration on cultural and intellectual property rights of indigenous peoples.

6.0 Te Ao Māori

Our worldview is the framework by which we understand and navigate our physical and metaphysical environment. A full account of the cosmological underpinnings of Te Ao Māori is not offered here but in brief it recognises both the spiritual and the physical, is guided by different domains governed by atua or distinct spiritual entities, and involves several core concepts including whakapapa, mana, wairua, mauri, tapu, and noa. Te Ao Māori places emphasis on the holistic link between people and the environment. Mātauranga is the knowledge or wisdom about the world developed over generations and passed down from tūpuna, while tikanga is the evolving set of principles and customary practices by which Māori give effect to this knowledge to navigate the world safely.

Papatūānuku

The primordial goddess embodying the whenua or land. She is the earthmother to all living things. This whakapapa is one of the reasons why whenua is the name for placenta as well as land, and why in Te Ao Māori tangata whenua belong to the whenua and not the other way around. Papatūānuku is a source of rejuvenation and life.

Ranginui

The primordial god embodying the sky or heavens. He is the skyfather to all living things. When he was separated from his wife Papatūānuku by their children, his tears became the rain which is considered tapu until it reaches the ground (wai Māori).

Tūmatauenga

The god of war and human activities and a progenitor of humanity.

Tāwhirimātea

The god of weather including thunder, lightning, wind, clouds and storms. He was opposed to the forced separation of his parents Papatūānuku and Ranginui and therefore he wars with his brothers and their descendants to this day.

Tāne

The god of forests and animals and an originator and protector of humans. Responsible for separating the embrace of his parents and ushering in Te Ao Marama (the age of light).

Tangaroa

The god of the sea, lakes, rivers and animals that live in them. There is a close and sometimes contentious relationship between Tangaroa and Tāne reflected in creatures such as reptiles and whales and in the dynamic between the sea and the coastline.

Rongo

The god of cultivated plants and agriculture also associated with peace.

Haumia-tiketike

The god of uncultivated plants and wild foraging.

Matā-oho

The local god of volcanic activity and earthquakes that formed the Tāmaki volcanic field.

Whakapapa

The sacred genealogy linking all things. Humans whakapapa not only to human tūpuna (ancestors), but also to the whenua, atua and their respective lineages. All indigenous animals and plants have an interconnected whakapapa. Whakapapa is a prerequisite of mana whenua, whānaungatanga, and kaitiakitanga.

Mana

A core metaphysical concept regarding the inherent authority or power of people, places or objects. Mana is derived or delegated from atua and, in the case of humans, is both inherited and earned through actions. Everything including people has an element or degree of mana. A person or tribe's mana can increase or decrease depending on the success, failure or nature of actions (or inactions) and is directly tied to their wellbeing. Undertaking the responsibilities of manakitanga and kaitiakitanga successfully are examples of maintaining or enhancing mana and contribute to cementing mana whenua.

Tapu

A core metaphysical concept regarding a state or degree of sacredness, prohibition, being set apart or forbidden. Tapu is a state where a person, place or thing is under the protection of or dedicated to an atua and is thus removed from profane or normal or common things and uses. Tapu is closely linked to mana and governs the behaviour of individuals and the wider society. Everything including people has an element or degree of tapu that must be preserved and respected. It is a priority of rangatira, tohunga and kaitiaki to maintain tapu and to ensure it is not diluted by common things. As with mana, the maintenance of tapu is directly linked to the wellbeing of both individuals and the tribe.

Noa

A core metaphysical concept regarding a normal or common (and sometimes profane) state that is in essence the opposite of tapu. Noa actions and things (whakanoa) can dilute tapu.

Wairua

A core metaphysical concept regarding the immortal spiritual or non-physical element of people, places or things.

Mauri

A core metaphysical concept regarding the essence that binds the physical and the spiritual together to enable life to exist and to thrive. Mauri is a sacred element and can be weakened or enhanced. When damaged or diluted the binding between the physical and the spiritual realms is weakened and life begins to falter and fail. It is the sacred obligation of mana whenua, through the act of kaitiakitanga, to maintain the balance of mauri within people, places, objects, ecosystems, and the hapū or iwi.

Mātauranga

The body of knowledge or customary wisdom and skill embedded within the tohunga, whānau, hapū and iwi. Mātauranga is passed down the generations from tūpuna but is also added onto through successive generations of uri, and culturally encodes hundreds of years of observations, measurements, theory, and custom regarding Te Ao Māori and the environment.

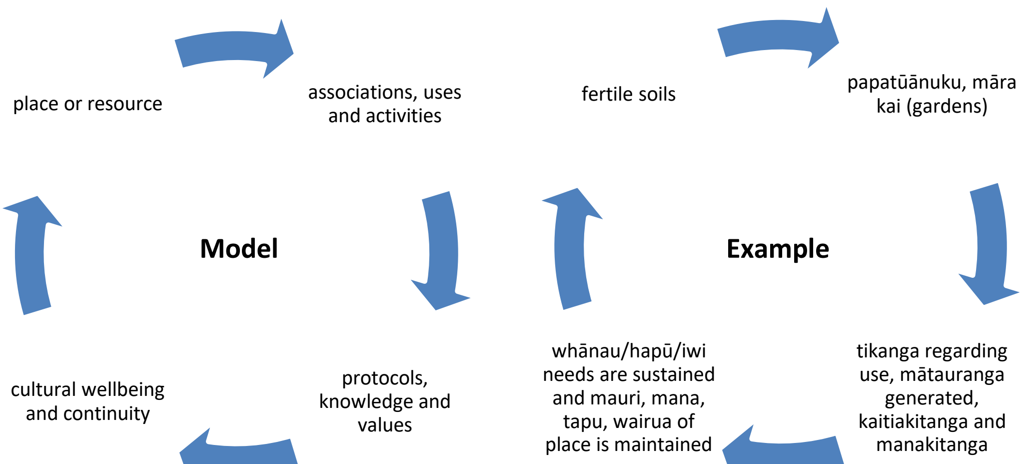
Tikanga

The lore, customs, practices, protocols, rules and methods that give effect to the application of mātauranga in navigating the natural and social world. There are different tikanga for different contexts and in different domains.

Cultural Values

Cultural values are the shared norms that govern the continuation of culture and provide the framework for social and individual actions. Key values include: rangatiratanga (chiefly authority or self-governorship), whānaungatanga (kinship and reciprocal connection through shared whakapapa), wairuatanga (spirituality), manakitanga (hospitality and showing care), and kaitiakitangata (guardianship or stewardship).

A model of how cultural values function is provided below.



7.0 Scoping and Consultation

The Study Area comprises a 4000m radius from the Site (from any point along its corridor). This radius is considered appropriate given the large scale of the Site and the presence of heritage sites within the catchment that could have setting or indirect impacts. Within this area all appropriate and known cultural sites, areas, landscapes and resources have been identified. Te Kawerau ā Maki however reserve the right to withhold certain information regarding wāhi tapu or sites that are culturally and spiritually sensitive to the iwi.

This report includes all known or appropriate-to-report elements of the natural and cultural environment within the Site and Study Area considered to hold cultural value for Te Kawerau ā Maki. This information forms the baseline of the assessment. This includes native biodiversity and ecology, geological and topographic features, natural resources including water bodies, built heritage such as marae, socio-cultural features such as papakāinga, cultural landscapes, historic or cultural sites, Māori archaeological sites, pou whenua and significant cultural public art.

Mātauranga/cultural knowledge of the Site and Study Area has been obtained, where appropriate, from Te Kawerau ā Maki kaumatua, kuia and other holders of knowledge within the iwi. Readily available published and unpublished written records, illustrations, maps, archaeological and geological records were reviewed during preparation of this cultural assessment. Spatially referenced heritage asset data was reviewed from the Auckland Council Cultural Heritage Inventory (CHI) and the New Zealand Archaeological Association (NZAA) recording scheme database (ArchSite). Other information, reports, and impact assessments available for the Site that have been provided by the Client have been reviewed including: engineering and design drawings of the route and a summary analysis of impacts identified from other disciplines. The opinions contained within this document may change and/or develop as new information is released.

This Cultural Impact Assessment involved a desktop study based on review of technical information, cultural knowledge of the area, and research, as well as site visits along the corridor to assess and confirm site conditions.

8.0 Assessment Approach

Following standard Environmental Impact Assessment (EIA) methodologies and planning terminology, but adapted for CIA purposes, this report will:

a. **Identify** the cultural sites, areas and resources (defined as both tangible and intangible cultural heritage, natural resources of cultural interest, and socio-cultural features) within a Study Area encompassing the proposed Site and a wider area that may be directly or indirectly impacted. The Study Area is defined as approximately 4000m radius of the Site to correspond with a likely area of setting impacts (e.g. noise, visual), indirect impacts, and a logical catchment of the cultural landscape.

b. Provide comment on the cultural **value** of the identified cultural sites, areas and resources. Māori cultural value is not derived from national or local policy but is defined and determined by tangata whenua and their particular world view and culture. Māori values are distinct from historic, archaeological or other value-systems, and are recognised by the courts and statute as their own legitimate knowledge-system with tangata whenua being the experts. Māori values are informed by whakapapa and guided by tikanga and kawa, with emphasis placed on the associative and living connection to places and resources which sustain cultural knowledge (mātauranga), practices, and spiritual and physical wellbeing. All cultural sites, areas and resources are of value to Te Kawerau ā Maki, who hold a holistic view of the environment and the unique relationship of the iwi to the whenua. It is difficult to apply a Western paradigm of value hierarchy or significance ranking (i.e. 'low, medium, high') when using a Te Ao Māori lens. Nevertheless, the methodology here attempts to distinguish the relative importance of matters as determined by a number of criteria, including the degree of mana, tapu or mauri, the degree to which a resource has specific kōrero or mātauranga, its sensitivity to changes (ability to absorb impacts), and its relative scarcity. This approach recognises that a matters' value is intrinsic but relative to context. This approach is supported by RMA Part II matters noting the relationship of tangata whenua with their lands, waters, and taonga as nationally significant. The approach is set out below:

- high: cultural sites/areas/resources that retain their integrity overall, are either rare or are common but hold specific customary uses or mātauranga, are considered a wāhi tohu or landscape indicator, or have a high sensitivity to change.
- medium: cultural sites/areas/resources that retain the key elements of their integrity, are either uncommon or are common but hold specific customary uses or mātauranga, or have a moderate sensitivity to change.
- low: cultural sites/areas/resources that have been significantly degraded or damaged, are common and do not hold specific current customary uses or mātauranga, or have a low sensitivity to change.

Value is also assigned against the cultural values identified in the AUP Policy B6.5.2(2):

i. Mauri: the mauri (life force and life-supporting capacity) and mana (integrity) of the place or resource holds special significance to Mana Whenua;
ii. Wāhi Tapu: the place or resource is a wāhi tapu of special, cultural, historic, metaphysical and or spiritual importance to Mana Whenua;
iii. Kōrero Tūturu: The place has special historical and cultural significance to Mana Whenua;
iv. Rawa Tūturu: the place provides important customary resources for Mana Whenua
v. Hiahiatanga Tūturu: the place or resource is a repository for Mana Whenua cultural and spiritual values; and
vi. Whakaaronui o te Wa: the place has special amenity, architectural or educational significance to Mana Whenua.

c. Identify the potential **impacts** to cultural resources and elements. Only Mana Whenua can define the impact to their cultural values, but guidance is noted below. Cultural impacts can be:

- no change
- negligible: changes result in small impacts on integrity of the site/area/resource such that their function is reduced but not notably diminished, ability to understand/appreciate/use/access is impacted to a inconsequential degree, the ability to interpret the cultural landscape or setting is impacted but the change can easily be absorbed.
- minor: changes result in small impacts on integrity of the site/area/resource such that their function is reduced but not significantly diminished, ability to understand/appreciate/use/access is impacted to a small degree, the ability to interpret the cultural landscape or setting is impacted to a small degree or change can otherwise be largely absorbed.
- moderate: changes result in appreciable/significant impacts on the integrity of the site/area/resource such that their function is impeded, ability to understand/appreciate/use/access is impacted to a notable degree, the ability to interpret the cultural landscape or setting is impacted to a notable degree or change can otherwise not be absorbed.
- major: changes result in large scale/total impacts on the integrity of the site/area/resource such that their function is effectively destroyed, ability to understand/appreciate/use/access is impacted to a significant degree/is no longer possible, the ability to interpret the cultural landscape or setting is impacted to a significant degree or change can otherwise not be absorbed and the landscape or setting is no longer recognisable/able to function.

Impacts can be either adverse or beneficial. Impacts can also be temporary or permanent. They can occur during the construction or the operational phase of a development. Impacts can be:

i. direct (i.e. physical impacts resulting from a development, impacts to the settings of cultural sites or the character of cultural landscapes, visual, noise, odour, or culturally inappropriate land use activities).
ii. indirect (i.e. traffic congestion, erosion due to vegetation loss, or other secondary impacts that occur over time or in a secondary location to the original activity).
iii. cumulative (i.e. impacts which are caused by the combined result of past, current and future activities, or in-combination impacts).

d. Define the **significance of effect** resulting from combining the value of a cultural site, area or resource and the level of potential impact to that site, area or resource. Significance of effect is assessed pre-mitigation but can also be assessed again post-mitigation to ascertain the *residual effect* and effectiveness of any proposed mitigation. Significant effects (within a planning framework) are those with moderate or large effects (either adverse or beneficial). This method is outlined below in Table 1. Note that positive effects will be coloured green.

Table 1: Significance of effect

		LEVEL OF IMPACT				
		No Change	Negligible	Minor	Moderate	Major
CULTURAL VALUE	High	Neutral	Minor	Moderate	Large	Large
	Medium	Neutral	Negligible	Minor	Moderate	Large
	Low	Neutral	Negligible	Negligible	Minor	Moderate

9.0 Assumptions and Limitations

Te Kawerau ā Maki are the experts of our own culture and tikanga. This expertise and the equal weighting of mātauranga Māori evidence is accepted in the courts and by statute. Through a necessity to work within a Western planning framework we utilise planning language where possible to aid in mutual understanding, however there is difficulty in the translation and application of some core cultural concepts to such a framework. This is particularly an issue when segmenting or demarcating value spatially, when ascribing a type of significance hierarchy, and when limiting value to tangible elements, whereas Māori hold a holistic perspective that operates differently to typical Western paradigms. This means that where there is doubt or confusion over a term or point of discussion, readers should contact Te Kawerau ā Maki directly for clarification.

Due to the sensitive nature of certain cultural knowledge, areas and sites (e.g. burial grounds), Te Kawerau ā Maki reserves the right not to identify the exact spatial extents or provide full information of such areas to retain and protect this knowledge within the iwi. In other situations, while a general area may be known to be of cultural significance the exact spatial extent or location of the site may have been lost over successive generations. Where possible and appropriate, sites are described and defined to enable discussion of the impacts while acknowledging these limitations.

The environmental and archaeological data relied upon for elements of this report are derived from secondary sources and it is assumed the data and opinions within these and other secondary sources is reasonably accurate.

The CHI and ArchSite databases are a record of known archaeological and historic sites. They are not an exhaustive record of all surviving historic or cultural sites and resources and do not preclude the existence of further sites which are unknown at present. The databases also utilise a site location point co-ordinate system rather than detailing site extents or cultural landscapes.

10.0 Topography and Geology

The Site is situated across the alluvial plains of the Kumeū River and Upper Waitematā Harbour, which crosses a number of underlying geological substrata. Near the mid-point of the network near Westgate this includes Waitematā Group East Coast Bays Formation being of "*Alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grits.*" Near Whenuapai and Riverhead the underlying geology is of Late Pliocene to Middle Pleistocene pumiceous river deposits being of "*Pumiceous mud, sand and gravel with muddy peat and lignite: rhyolite pumice, including non-welded ignimbrite, tephra and alluvia*." Within the Kumeū basin the underlying geology is Holocene river deposits consisting of "*Sand, silt mud and clay with local gravel and peat beds.*" Near Waimauku and Huapai the underlying geology is Tauranga Group Middle Pleistocene - Late Pleistocene river and hill slope deposits being "*Predominantly pumiceous sand, silt, mud and clay, with interbedded gravel and peat.*"

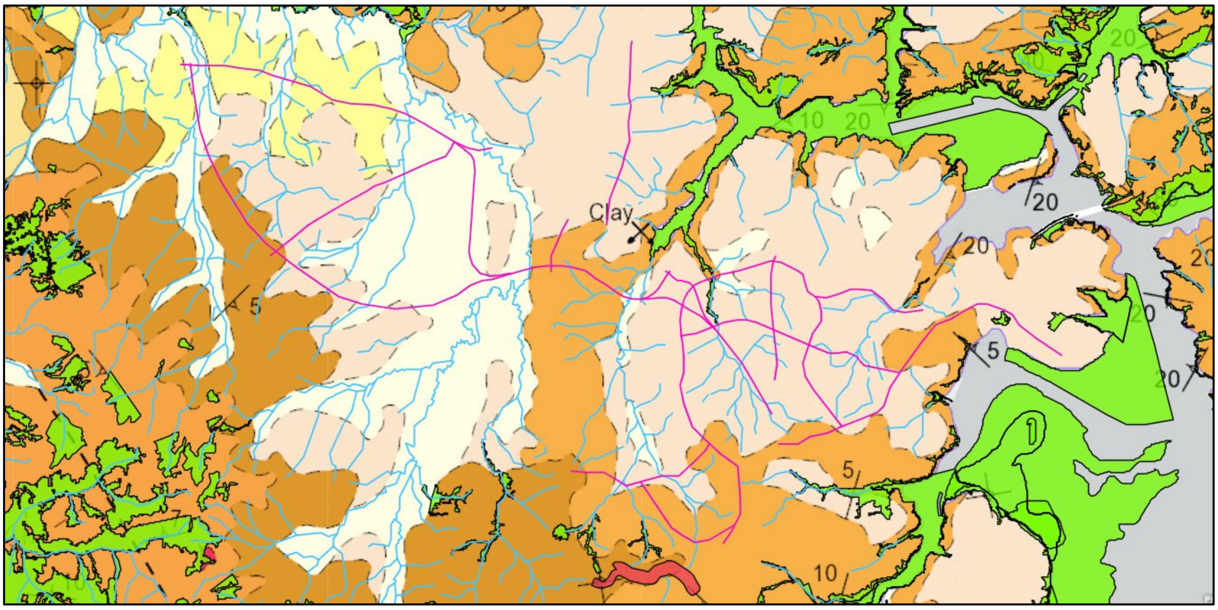


Figure 18: Map showing the underlying geology of the Study Area (adapted from GNS Science)

While all whenua is associated with Papatūānuku, alluvial soils are particularly valued due to their unique composition and higher organic content making them highly productive for horticulture, and thus containing a strong sense of mauri. The Land-Use Capability of these alluvial soils ranges from 1 (negligible limitations to horticulture) to 3 (moderate limitations to horticulture) meaning they are of very high productive quality, and in fact the largest area of high quality horticultural soils in northern Auckland.

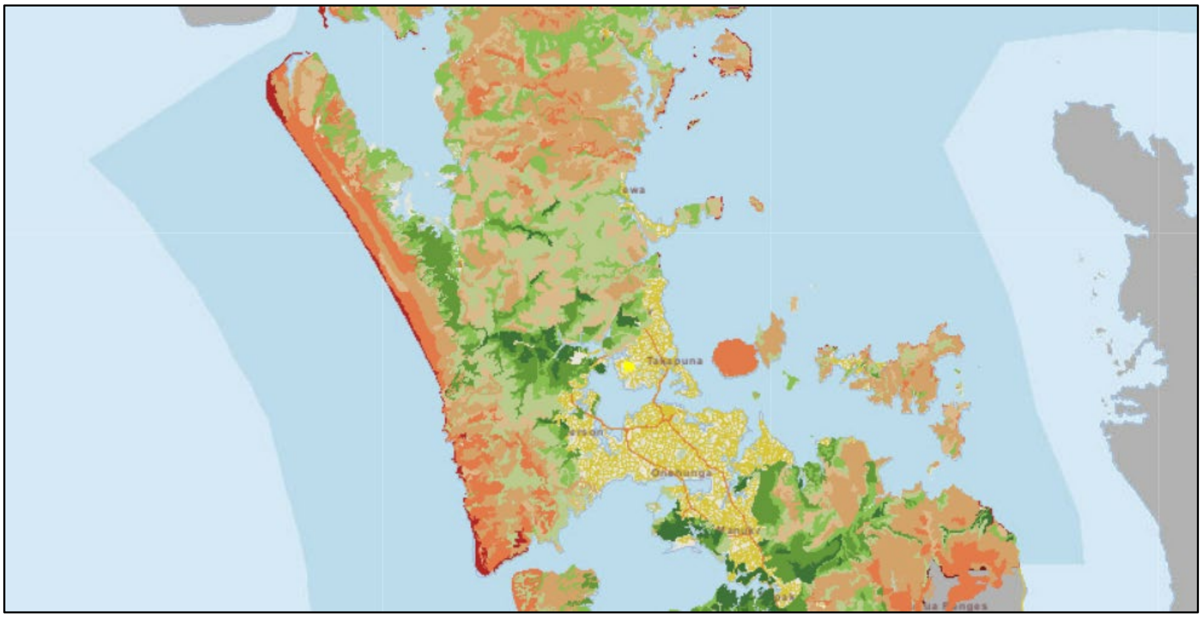


Figure 19: Land-use capability map showing high productivity within the Study Area (from Auckland Council)

The topography of the Site is low-lying alluvial plains for the most part, with steeper terrain to the south along the Waitakēre Ranges and to the north along the Riverhead hillcountry. The major drainage catchment is the Kumeū River but the Site also drains to Te Wai Roa ō Kahu (Upper Waitematā Harbour) and to Te Wai ō Pareira (Henderson Creek) via Manutewhau awa. The landscape is predominantly of an open rural (pasture) character but with areas of urban character at Whenuapai, Westgate, Kumeū and Huapai. There are no Outstanding Natural Features (ONFs) or Outstanding Natural Landscapes (ONLs) within or immediately adjoining the Site footprint, although ONLs are within the western part of the Study Area.

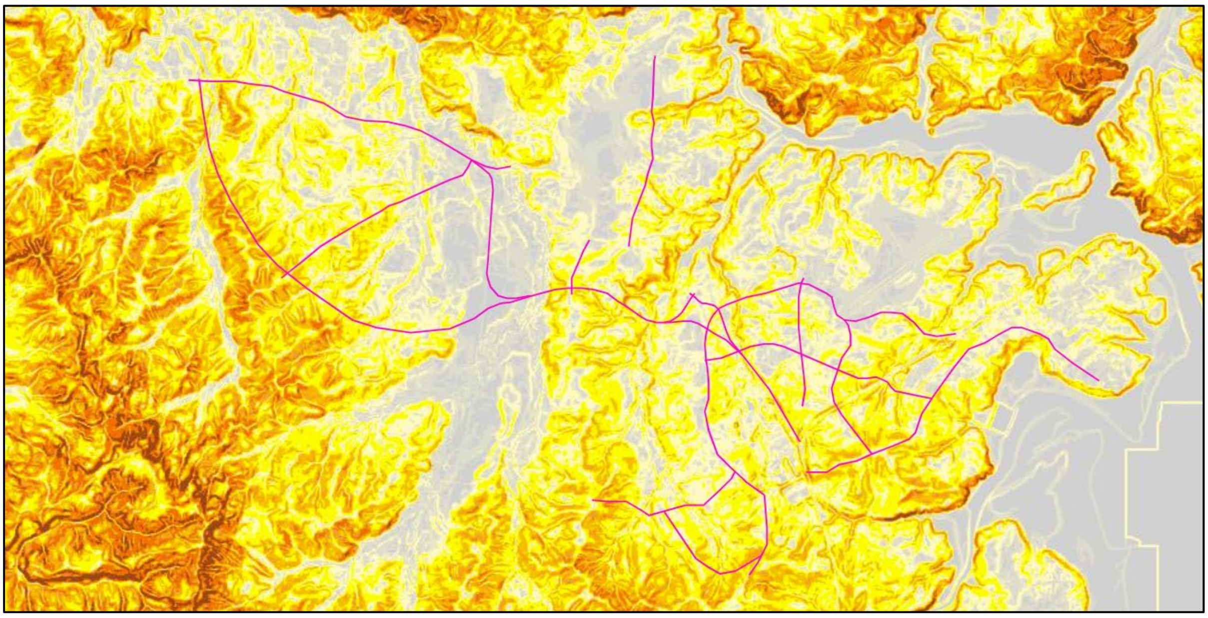


Figure 20: Map showing slope within the Study Area

11.0 Natural Resources and Ecology

Freshwater

The natural resources and ecology of the wider Study Area include significant freshwater ecosystems and habitat. This includes Te Waitematā, Te Wai ō Pareira (Henderson Creek), Wai Whauwhaupaku (Swanson Stream), Manutewhau awa (Massey-West Harbour), Wai huruhuru manawa (Massey), Wai Totora (Westgate), Wai Whakataratara (Westgate), Ngongetepara awa (Westgate-Whenuapai), Waiteputa (Westgate-Massey West), Taketakemanu awa (Westgate-Taupaki), Rawawaru (Whenuapai), Te Waiarohia ō Ngariki (Whenuapai), Pītoitoi awa (Brigham Creek), Te Wai Roa ō Kahu (Upper Waitematā Harbour), Rangitōpuni awa (Riverhead), Pakinui awa (Taupaki), Te Awa Kumeū, Ahukāramuramu awa (Waimauku), Waikoukou Awa (Waimauku), and the Te Awa Kaipara. In addition there are likely to be numerous wetland areas across the Study Area and Site. Freshwater and marine SEAs in the Study Area include SEA-M2-57b, SEA-M2-55a, and SEA-M2-56a.

The Site directly crosses a large number of (around 26 notable) rivers, streams or major tributaries most notably Te Waiarohia ō Ngariki, Wai Totora, Ngongetepara awa, Kumuū awa, and Ahukāramuramu awa.

The freshwater ecosystems within these waterways and waterbodies is not yet assessed (at the time of writing an ecological assessment was not available) but it is possible to include:

- indigenous fishes including tuna (eel), toitoi (bully), Īnanga, and kokopu
- indigenous freshwater invertebrates including mayflies, mud snails, dragonflies, freshwater mussels (kākahi), kōura (freshwater crayfish), and many others

Terrestrial

The natural resources and ecology of the wider Study Area include significant terrestrial ecosystems and habitat. This includes the Waitākere Ranges indigenous forest (Te Wao Nui ā Tiriwa) to the south and smaller pockets of vegetation Significant Ecological Area to the west and northwest. The Waitākere SEAs include old growth broadleaf and conifer forest of high biodiversity and habitat value across many endemic plant, fungi, invertebrate and vertebrate species. SEAs include: SEA_T_7036, SEA_T_2650, SEA_T_6381, SEA_T_6674, SEA_T_6743, SEA_T_2648, SEA_T_4866, and SEA_T_6540. There are also a number of scheduled trees within the Study Area and along the Site corridors including pohutakawa, kauri, rimu, tōtora, and karaka.

Generally, however the area is typified by exotic vegetation including large areas of ryegrass, kikuyu grass, and other pasture grasslands, as well as exotic trees including poplars, willow and other species but particularly pine at Riverhead.

The terrestrial ecosystems across the area are not yet assessed (at the time of writing an ecological assessment was not available) but it is possible to include:

- indigenous plants including tī kōuka, harakeke (flax), kauri, mānuka, kānuka, kahikatea, rārahu (braken fern), ponga, tōtora, rimu, pohutakawa, karaka, miro, tawa, mosses, liverworts and hornworts
- indigenous fungi including wood ear, sooty black mould, blue mushroom, and puffball
- indigenous herpetofauna including green gecko, forest gecko, copper skink, ornate skink, and although unlikely the Hochstetter's frog is found in the adjacent Waitākere Ranges

- indigenous invertebrates including earthworms (including giant North Auckland variety), wētā, grasshopper and many others

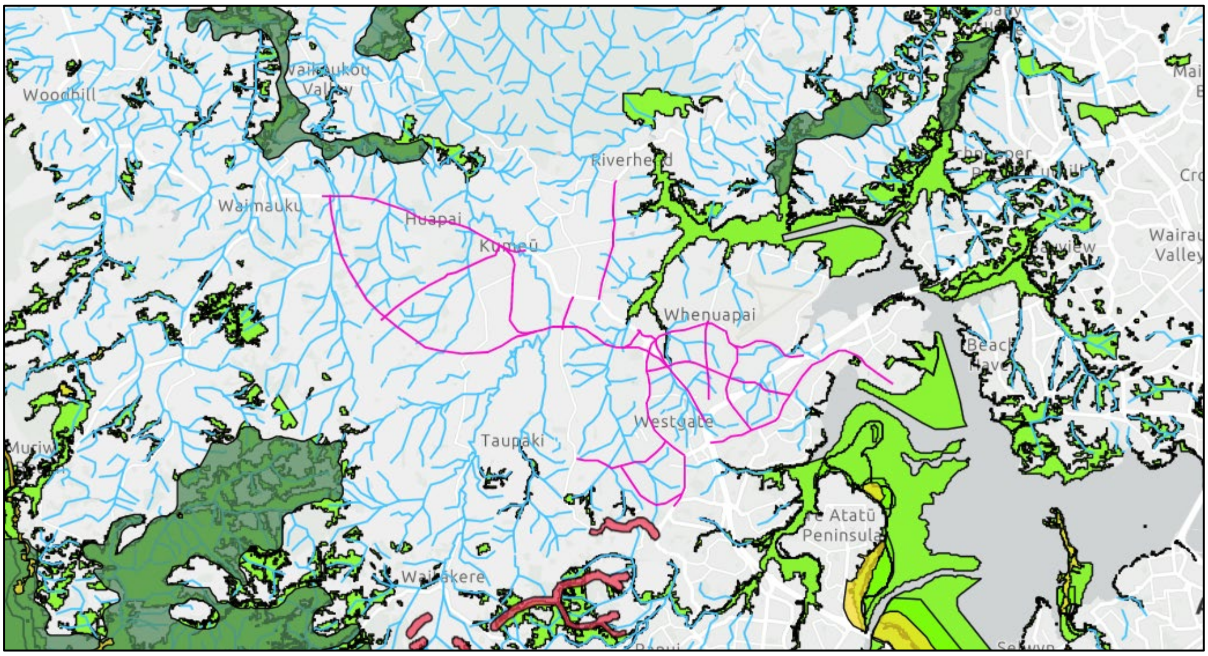


Figure 21: Map showing streams, significant ecological areas, and other natural features

Avifauna

As the Study Area covers marine, freshwater, forest, low-land plains, and hillcountry there are a wide variety of bird species as well as the native long-tailed bat (pekapeka) that interact with the area. The forested slopes of the Waitākere Ranges and Riverhead provide important roosting opportunity for bats as noted in the preliminary bat assessment carried out by the Client within a 10km radius of the Site. There are even several recordings of bats within the area we know as Ahipekapeka (west of Brigham Creek). The indigenous forest and SEAs to the south and west provide habitat for native birds such as tui, pīwakawaka, kereu, and ruru. The hillcountry and open plains provide habitat for kahu. The streams and coastal areas provide habitat for species such as tarāpuka (gull), takapu (gannet), kōtare (kingfisher), tōrea-pango (oystercatcher), poaka (stilts), pūtangitangi (paradise duck) and pūkeko. Importantly, several kawau (black shag or cormorant) have been spotted around Waimauku, Westgate, and the Upper Waitematā Harbour. The kawau is considered the kaitiaki of Te Kawerau's rohe.

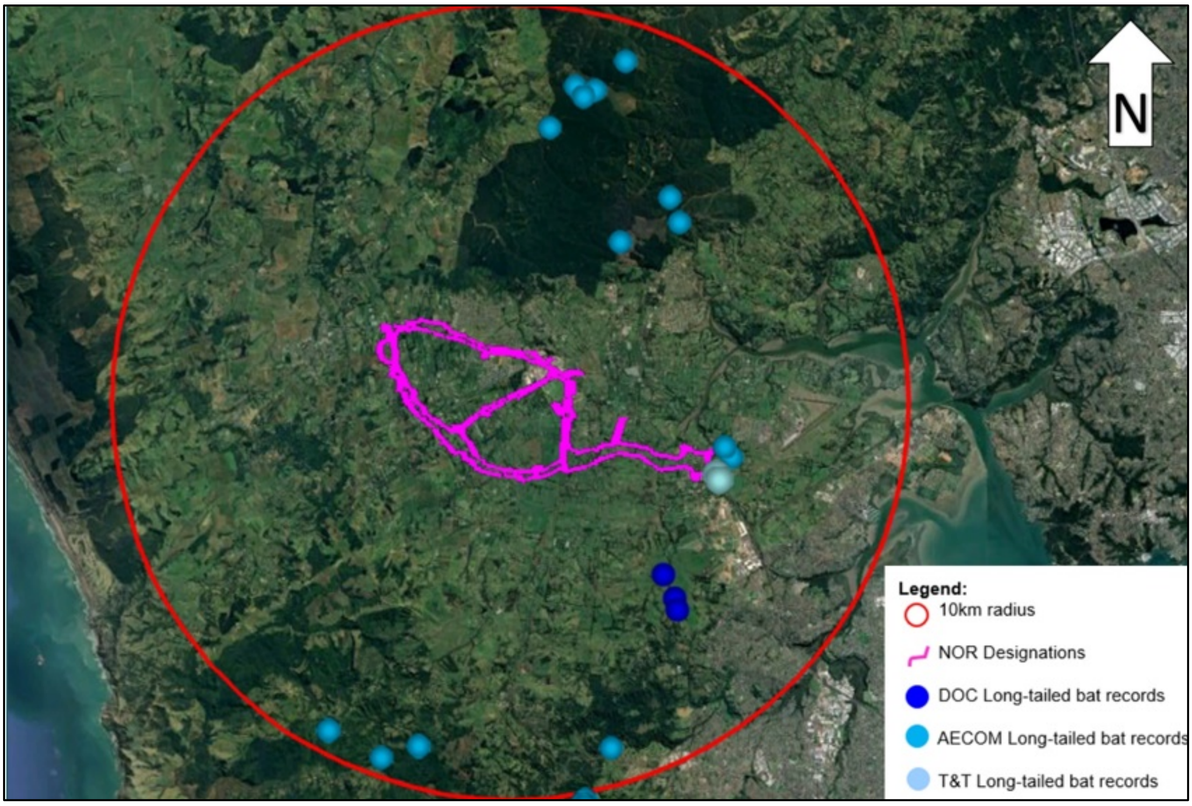


Figure 22: Map showing bat sightings within 10km of the Site (supplied by Client)


Figure 23: Image of a kawau (from NZ Birds Online)

15.0 Potential Direct Impacts

Direct impacts are likely to occur from bulk earthworks (permanent adverse), stream realignment (permanent adverse), works within a waterway (temporary and permanent adverse), construction and operational discharges to waterways (temporary and permanent adverse and beneficial), vegetation clearance (temporary and permanent adverse), noise pollution during construction of the Site network and operation of the ASH (temporary and permanent adverse), light pollution (permanent adverse), and changes to the setting of cultural sites (permanent adverse and beneficial),

16.0 Potential Indirect Impacts

Indirect impacts are likely to occur from vegetation clearance causing erosion (temporary adverse), severing habitat for terrestrial species during operation of ASH (permanent adverse), and subsequent large-scale urban intensification of the catchment enabled by the ASH (permanent adverse).

17.0 Potential Cumulative Impacts

Cumulative impacts are likely to occur from hydrological changes to the catchment (permanent adverse), net changes in stormwater contaminant discharges or quality (permanent adverse and beneficial), changes to the setting of and between wāhi tohu (permanent adverse), subsequent large-scale urban intensification of the catchment enabled by the ASH (permanent adverse), light pollution (permanent adverse), changes to the cultural landscape (permanent adverse and beneficial), and increased walking and cycling opportunities linked to human access and health and emissions (permanent beneficial).

18.0 Summary of Effects

Specific potential impacts identified as relating to the proposed project are included in Table 3 below:

Table 3: Summary of potential cultural impacts

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
Waimauku-Whenuapai Cultural Landscape	Direct, indirect and cumulative permanent adverse construction and operation impacts arising from ASH including: Built form of ASH within rural setting Changes to the setting of and between wāhi tohu (visual, artificial lighting at night, audial, aural, spiritual)	Major Adverse	Large Adverse	Urban and Landscape Design Management Plan Cut and fill batters shaped to a natural profile. Boundary fences and planting to be reinstated for partially affected properties. A planting plan, including limiting removal of noteworthy trees	Moderate Adverse direct effects but Large Adverse indirect and cumulative effects	Cultural Design Plan including funding for implementa tion. Scheduling (schedule 12 AUP) all identified Māori Sites of Significanc e within Study Area through a Private

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	Changes to the rural character necessitated through subsequent large-scale urban intensification of the catchment enabled by the ASH …………………… Potential direct permanent beneficial operation impacts arising from Local Network (Don Buck Rd, Fred Taylor Dr, Coatesville-Riverhead HWY, Brigham Creek Rd, Hobsonville Rd, New Spedding Rd, Mamari Rd, Trig Rd) and existing corridor Strategic Network (Main Rd, RTC, Access Rd) upgrades that can contribute cultural design, place naming, and walking and cycling access opportunities	………….. Potential Negligible Beneficial (Non-ASH)	……………….. Potential Minor Beneficial (Non-ASH)	and vegetation where practicable. Where practicable retaining stockpiles and reusing soil on site. Construction Noise and Vibration Management Plan. Site Specific Construction Management Schedule Pre and Post Building Condition Survey where vibration may exceed certain criteria. Road surface material, option that reduces noise at the source Best practise rail design and installation Installation of noise barriers Building modification mitigation should above mitigation not achieve desired outcome Ecological and landscape planting will help integrate the corridors with rural areas. Alongside the limited access points, the ecological and landscaping will		Plan Plan Change. Establishment of a Cultural Heritage and Offset fund and trust be established for the benefit of TKāM and NWōK with regard to the conservation, interpretation, and education regarding taonga within the Study Area. Permanent exclusion of urban intensification (Rural Zone) west of ASH and low density east of ASH (CSL Zone) RFR in favour of TKaM placed on any land within the Designation that may eventually be disposed of by NZTA

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
				create a green buffer which will reinforce rural areas and will help avoid future development in rural areas.		
Whenua (productive soils)	Direct, indirect and cumulative permanent adverse construction impacts arising from: Bulk earthworks primarily from ASH but also from the wider Strategic and Local Network Removal of regionally significant high productivity soils (mauri) necessitated through subsequent large-scale urban intensification of the catchment enabled by the ASH	Major Adverse	Large Adverse	Where practicable retaining stockpiles and reusing soil on site. Cut and fill batters shaped to a natural profile.	Large Adverse	Topsoil Conservation Plan Permanent exclusion of urban intensification (Rural Zone) west of ASH and low density east of ASH (CSL Zone)
Wai Māori (fresh water)	Direct, indirect and cumulative temporary and permanent adverse construction and operation impacts arising from: Earthworks within proximity to watercourses (particularly ASH) Vegetation clearance along watercourse embankments Significantly increased impervious area within sensitive receiving water	Moderate Adverse	Large Adverse	Construction Environmental Management Plans. Operational impacts worked through and resolved during detailed design by optimising the design of culverts and bridges and new channels to minimise flood effects upstream and downstream of crossings. Vegetated swales Stormwater wetlands	Moderate Adverse	Permanent exclusion of urban intensification (Rural Zone) west of ASH and low density east of ASH (CSL Zone)

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	environment (primarily ASH) Changes to hydrology of the catchment resulting from new roads and culverts (primarily ASH) Increased risk of operational discharges of heavy metals and other contaminants from traffic enabled by the ASH Changes to the landuse and discharge type necessitated through subsequent large-scale urban intensification (and net impervious area) of the catchment enabled by the ASH …………………… Potential direct and cumulative permanent beneficial impacts relating to the Local Network (Don Buck Rd, Fred Taylor Dr, Coatesville-Riverhead HWY, Brigham Creek Rd, Hobsonville Rd, New Spedding Rd, Mamari Rd, Trig Rd) and existing corridor Strategic Network (Main Rd, RTC, Access Rd) upgrades arising from: Improved stormwater management upgrades including swales, wetlands,	………….. Minor Beneficial (Non-ASH)	………………. Moderate Beneficial (Non-ASH)	Stormwater ponds Tree pits/rain gardens on routes with walking/cycling Use of bridges where possible (instead of culvert-reclamation systems)		

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	ponds, and tree pits/rain gardens					
Waitematā ō Kahumatamomoe	No change to low potential negligible net or cumulative adverse impact resulting from works within catchment. On balance likely neutral once up-stream mitigations in place.	Neutral	Neutral	Nil	Neutral	Nil
Te Wai Roa ō Kahu	No change to low potential negligible net or cumulative adverse impact resulting from works within catchment. On balance likely neutral once up-stream mitigations in place.	Neutral	Neutral	Nil	Neutral	Nil
Wai ō Pareira	No change to low potential negligible net or cumulative adverse impact resulting from works within catchment. On balance likely neutral once up-stream mitigations in place.	Neutral	Neutral	Nil	Neutral	Nil
Te Awa Mānutewhau	Direct temporary and permanent construction and operation adverse impact from: Upgrades to Don Buck Rd Wetland 2 occurring directly within awa Slight increase in net impervious surface	Minor Adverse	Moderate Adverse	Refer to 'Wai Māori' mitigations above	Minor Adverse	Riparian planting for 200m in both directions from impact Mauri health monitoring for 5 years
Te Waiarohia ō Ngariki	Direct and cumulative permanent construction and	Minor Adverse	Moderate Adverse	Refer to 'Wai Māori' mitigations above	Minor Adverse	Riparian planting for 200m in both

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	operation adverse impacts resulting from upgrades to southeast end of Brigham Creek Road and Trig Road upgrades from: Construction earthworks in proximity to the awa Works within the awa to install new culverts Permanent fill batter slopes adjacent to the awa Increase in impervious surface Construction of Hobsonville Rd Wetland 4					directions from impact Mauri health monitoring for 5 years
Wai Rawawaru	No change	Neutral	Neutral	Nil	Neutral	Nil
Wai Totara	Direct and cumulative permanent construction and operation adverse impacts resulting from upgrades to southeast end of Brigham Creek Road and RTC/RAMC from: Construction earthworks in proximity to the awa Permanent fill batter slopes adjacent to the awa New section of road (New Spedding Rd and RTC) and net	Minor Adverse	Moderate Adverse	Refer to 'Wai Māori' mitigations above New bridges over the span of the awa thus avoiding direct works in stream bed/banks	Minor Adverse	Cultural Design Riparian planting for 200m in both directions from impact Mauri health monitoring for 5 years

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	increase in impervious surface					
Te Awa Ngongetepara	Direct and cumulative temporary and permanent construction and operation adverse impacts resulting from upgrades to northwest end of Brigham Creek Road and from new RTC alignment from: Construction earthworks in proximity to the awa Site compound, stockpile, sediment pond, and lay-down area adjacent to awa Permanent fill batter slopes adjacent to the awa Increase in impervious surface from RTC	Minor Adverse	Moderate Adverse	Refer to 'Wai Māori' mitigations above Proposed new RTC overbridge to avoid works within stream	Minor Adverse	Cultural design Riparian planting for 200m in both directions from impact Mauri health monitoring for 5 years
Waiteputa	Direct permanent construction and operation adverse impacts resulting from the new Redhills Arterial from: Construction earthworks in proximity to the awa Permanent fill batter slopes adjacent to the awa New section of road and net increase in impervious surface	Minor Adverse	Moderate Adverse	Refer to 'Wai Māori' mitigations above Lighting design to reduce light spill, buffer planting,	Minor Adverse	Cultural Design Riparian planting for 200m in both directions from impact Mauri health monitoring for 5 years

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
Te Awa Pītoitoi	Direct and cumulative temporary and permanent construction and operation adverse impacts resulting from upgrades to northwest end of Brigham Creek Road from: Construction earthworks in proximity to the awa Site compound, stockpile, sediment pond, and lay-down area adjacent to awa Increase in impervious surface	Negligible Adverse	Minor Adverse	Refer to 'Wai Māori' mitigations above	Negligible Adverse	Riparian planting for 200m in both directions from impact Mauri health monitoring for 5 years
Te Awa Rangitōpuni	No change	Neutral	Neutral	Nil	Neutral	Nil
Te Awa Pakinui	Direct permanent operation adverse impact to the setting of the awa and its context which will be changed with the introduction of the new RTC and bridge about 250m to the north.	Negligible Adverse	Minor Adverse	Urban and Landscape Design Management Plan	Minor Adverse	Cultural design
Te Awa Kumeū	Direct and cumulative construction and operation adverse impacts from: Works within the awa and its tributaries may impact the taniwha RTC and ASH new alignment significant earthworks in proximity to the	Major Adverse	Large Adverse	Refer to 'Wai Māori' mitigations above Proposed new RTC/ASH overbridge to avoid works within stream	Large Adverse	Avoid realignment of river Minimise earthworks in proximity Constructio n compounds set back 500m from river Cultural design

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	awa, particularly cut on east side RTC and ASH permanent fill batter slopes adjacent to the awa ASH stormwater wetland 4, 5 and 6, and Main Rd/RTC Wetland 2 in close proximity to awa RTC and ASH construction compounds in proximity to the awa Main Rd construction compound near east side of existing SH16 bridge RTC and ASH setting impacts from new bridge structures over the awa Works in awa for SH16 temporary road realignment, deconstruction of existing bridge, and construction of new bridge RTC and ASH new alignment net increase in impervious surface					Riparian planting for 500m in both directions from impact Mauri health monitoring for 5 years Establishment of a Cultural Heritage and Offset fund and trust be established for the benefit of TKāM and NWōK with regard to the conservation, interpretation, and education regarding taonga within the Study Area.
Te Awa Ahukāramuramu	Direct and cumulative permanent construction and operation adverse impacts resulting from upgrades to ASH/RTC/Main Rd from:	Minor Adverse	Moderate Adverse	Refer to 'Wai Māori' mitigations above Proposed new RTC/Main Rd bridge to avoid works within stream	Minor Adverse	Cultural Design Riparian planting for 200m in both directions from impact

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	Construction earthworks in proximity to the awa Permanent fill batter slopes adjacent to the awa Increase in impervious surface Construction of RTC/SH Wetland 10 and ASH Wetland 15					Mauri health monitoring for 5 years
Waikoukou	No change	Neutral	Neutral	Nil	Neutral	Nil
Te Awa Kaipara	Indirect and cumulative permanent adverse impacts from up-stream discharges and unlocking further urban intensification	Minor Adverse	Moderate Adverse	Refer to 'Wai Māori' mitigations above	Minor Adverse	Mauri health monitoring for 5 years
Native Ngahere and Rākau	No change	Neutral	Neutral	Nil	Neutral	Nil
SEA and Rakau within or adjacent to Site Footprint	Direct permanent construction adverse impacts relating to works near Brigham Creek SEA and other native vegetation along stream corridors	Minor Adverse	Minor Adverse	A planting plan, including limiting removal of noteworthy trees and vegetation where practicable.	Neutral	Nil
Native Fungi within or adjacent to Site Footprint	Direct permanent construction adverse impacts relating to earthworks, although scale of impact unknown as no assessments	Negligible Adverse	Negligible Adverse	Nil	Negligible Adverse	Include fungi identification in ecological assessments
Native Fishes within or adjacent to Site Footprint	Direct and cumulative temporary and permanent construction and operation adverse impacts from:	Moderate Adverse	Moderate Adverse	Nil	Moderate Adverse	Fresh water ecological management plan Use of fish passage design

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	Works within waterways that could cause injury, death or displacement Realignment of Kumeū river could cause injury, death or displacement Installation of culverts Sediment and other construction discharges Increase in impervious surface and related discharges					Mauri health monitoring for 5 years
Native Invertebrates within or adjacent to Site Footprint	Direct permanent construction and operation adverse impacts relating to: Earthworks Light pollution although scale of impact unknown as no assessments	Negligible Adverse	Negligible Adverse	Nil	Negligible Adverse	Include terrestrial invertebrate identification in ecological assessments
Native herpetofauna within or adjacent to Site Footprint	Direct permanent construction and operation adverse impacts relating to: Earthworks that could cause injury, death or displacement, Removal of vegetation including rank grasses that could cause displacement Segmentation of the landscape/habitats	Moderate Adverse	Minor Adverse	Nil	Minor Adverse	Lizard management plan

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	by the ASH, although scale of impact unknown as no assessments					
Native Avifauna within or adjacent to Site Footprint	Direct, indirect and cumulative temporary and permanent construction and operation adverse impacts from: Removal of trees and vegetation along Site corridor leading to displacement Bird strike from ASH in proximity to Waitākere Ranges Light pollution from ASH and subsequent urban intensification Loss of open habitat for Kahu (Hawks)	Minor Adverse	Minor Adverse	Impact management for TAR birds incl. North Island fernbird, banded rail and spotless crake to be incorporated into detailed design.	Minor Adverse	Bird Manageme nt Plan Permanent exclusion of urban intensificati on (Rural Zone) west of ASH and low density east of ASH (CSL Zone)
Native Bats	Direct, indirect and cumulative temporary and permanent construction and operation adverse impacts from: Removal of trees and vegetation along Site corridor leading to displacement Light pollution from ASH and subsequent urban intensification	Minor Adverse	Minor Adverse	Bat management plan to be developed and incorporated into detailed design. Significant ecological planting to mitigate impacts on bats has been incorporated into the designation footprint. This will lead to the enhancement of riparian areas and will green much of the corridor.	Minor Adverse	Bat manageme nt plan
Nga Rau Pou ā Maki (northern ridgeline)	Direct and cumulative permanent operation adverse impacts to the setting of the	Moderate Adverse	Large Adverse	Urban and Landscape Design Management Plan	Large Adverse	Establishm ent of a Cultural Heritage fund and trust be

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	northern ranges from ASH and the subsequent urban intensification of the lands below					established for the benefit of TKāM and NWōK with regard to the conservation, interpretation, and education regarding taonga within the Study Area. Permanent exclusion of urban intensification (Rural Zone) west of ASH and low density east of ASH (CSL Zone)
Te Ara Pukewhakataratara	Direct and cumulative permanent construction adverse impacts arising from Don Buck Rd further earthworks and modification of Pukewhakataratara Ridgeline	Negligible Adverse	Minor Adverse	Nil	Minor Adverse	Cultural design plan to recognise the site
Pukewhakataratara	Direct and cumulative permanent construction adverse impacts arising from Don Buck Rd further earthworks and modification of Pukewhakataratara	Minor Adverse	Moderate Adverse	Nil	Moderate Adverse	Minimise earthworks Cultural design plan to recognise the site Enter the site in Schedule 12 as a Māori Site of Significance

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
Wai ō Pareira Kāinga	No change	Neutral	Neutral	Nil	Neutral	Nil
Te Mānutewhau Kāīnga	No change	Neutral	Neutral	Nil	Neutral	Nil
Te Rawawaru Kāīnga	No change	Neutral	Neutral	Nil	Neutral	Nil
Te Ngongetepara Kāīnga	No change to negligible adverse direct and cumulative effects from earthworks and unlocking further urban intensification	Negligible Adverse	Minor Adverse	Nil	Minor Adverse	Cultural design
Te Ahipekapeka	Direct and cumulative permanent construction and operation adverse impacts arising from Coatesville-Riverhead HWY further earthworks and impervious surface	Negligible Adverse	Minor Adverse	Nil	Minor Adverse	Cultural design plan to recognise the site
Turanga ō Kawau	No change	Neutral	Neutral	Nil	Neutral	Nil
Maraeroa	No change	Neutral	Neutral	Nil	Neutral	Nil
Pītoitoi Kāīnga	No change	Neutral	Neutral	Nil	Neutral	Nil
Taurangatira	No change	Neutral	Neutral	Nil	Neutral	Nil
Te Tōangaroa	No change	Neutral	Neutral	Nil	Neutral	Cultural design
Wai paki i rape ō Ruarangi	Direct temporary construction adverse impacts from: Main Rd construction compound near east side of existing SH16 bridge	Major Adverse	Large Adverse	Nil	Large Adverse	Cultural design

Name	Summary of impact	Level of Impact	Significance of effect	Proposed mitigation	Residual effect	Offsetting
	Main Rd/RTC Wetland 2 in close proximity to awa Works in awa for SH16 temporary road realignment, deconstruction of existing bridge, and construction of new bridge					
Tuuraki awatea	No change to negligible adverse setting and temporary down-stream impacts.	Negligible Adverse	Minor Adverse	Refer to 'Wai Māori' mitigations above	Neutral	Nil
Pukeharakeke	No change	Neutral	Neutral	Nil	Neutral	Nil
Te Ihumatāo	No change to negligible adverse cumulative effects from unlocking further urban intensification	Neutral	Neutral	Nil	Neutral	Nil
Te Patumāhoe Kāīnga	No change	Neutral	Neutral	Nil	Neutral	Nil
Kahutōpuni	No change	Neutral	Neutral	Nil	Neutral	Nil
Te Ara Rimu	No change	Neutral	Neutral	Nil	Neutral	Nil
Waimauku	No change to negligible adverse cumulative effects from unlocking further urban intensification within a flood-prone area	Negligible Adverse	Minor Adverse	Nil	Minor Adverse	Permanent exclusion of urban intensification (Rural Zone) west of ASH and low density east of ASH (CSL Zone)
Taumata	No change to negligible adverse setting impacts.	Neutral	Neutral	Nil	Neutral	Nil
Kāhukurī	No change	Neutral	Neutral	Nil	Neutral	Nil
Treaty Settlement Land	No change	Neutral	Neutral	Nil	Neutral	Nil

Table 4: Summary of Cultural Effects

Measures	Count
Significance of Effect ::	
Neutral	25
Negligible Beneficial	0
Minor Beneficial	1*
Moderate Beneficial	1*
Large Beneficial	0
Negligible Adverse	3
Minor Adverse	15
Moderate Adverse	3
Large Adverse	5

*Beneficial impacts were noted for the non-ASH elements in terms of landscape and water assuming all mitigations and offsets implemented, but overall (with ASH) the impact was adverse.

CONCLUSION

The North West Project proposes to upgrade and develop new sections of the local and strategic transport network extending from Hobsonville/Whenuapai through Westgate and Brigham Creek to Kumeū, Taupaki and Waimauku. A significant element of the project is the Alternative State Highway (ASH) from Brigham Creek to western Huapai. The project aims to support urban growth in the area and to provide people with genuine travel choices, to address climate change by achieving transformative mode shift, and to address transport safety issues. The project sits within and across an important cultural landscape at the crossroads between the Hikurangi, Waitematā, and Kaipara Valley takiwa. It is the northern part of Te Kawerau ā Maki's heartland and contains a number of significant cultural sites and resources from our most ancient traditions through to our major Treaty settlement redress. Sited between Nga Rau Pou ā Maki (the Waitākere Ranges) and Rangitōpuni (Riverhead Forest) on the alluvial plains of the Kumeū and Kaipara valleys, the project covers an area of numerous streams and the most productive soils in the northern half of the Auckland region. The valley is also protected by the taniwha Tangihua.

This CIA identified a total of 51 cultural sites and resources, ranging in relative value from low to predominantly high, and encompassing productive soil, rivers, landmarks, sacred sites, historical sites, traditional walking routes, and flora and fauna. The project was assessed against these sites and resources resulting in the documenting of eight significant adverse effects, 15 minor adverse effects, three negligible adverse effects, one potential significant beneficial effect*, one minor beneficial effect*, and 25 neutral effects. Where adverse effects were identified offsets (or further mitigation) were suggested. The significant adverse effects relate to the removal of productive topsoil, impacts to fresh water (including the taniwha), impacts to the Kumeū River (including the taniwha), impacts to fish species, setting impacts to Nga Rau Pou ā Maki, impacts to Pukewhakataratara, impacts to Wai paki i rape ō Ruarangi, and impacts to the cultural landscape.

While some of the cumulative impacts identified and measured, in particular future urban intensification, cannot be tied singularly to the project, it is reasonable to include them in this CIA given the strategic scope of the project and its aspirations to unlock urban development and support urban growth. Many harms can be mitigated to some degree or offset or compensated. However, at a strategic level, it is reasonable to question the wisdom of supporting urban growth in a flood prone catchment that holds the most regionally significant topsoils in northern Auckland, and that (through the ASH) places high risk of urbanising the fringes of the northern Waitākere Ranges. The destruction of a food bowl for the benefit of more concrete warehouses seems to be the opposite of sustainability or forward planning. The removal of highly organic topsoils at such a scale certainly is at odds with the project aim of addressing climate change. It is the role of iwi to be kaitiaki of the mauri of the resources in their rohe for the inter-generational benefit of all. The sensitivity of the receiving environment here is witnessed by the fact we hold there to be a taniwha protecting it. Te Kawerau ā Maki has maintained for half a decade now that the Crown (in all its varying forms including Council and NZTA) would be better off working with us to plan for growth at Riverhead where the soils are far less productive and flood prone and we have the scale of land to strategically plan for inter-generational wellbeing. It is frustrating to watch more of our taonga risk disappearing due to the acts of the Crown.

Due to the sensitivities of the landscape, we are not supportive of the ASH component of the project. We would prefer that the existing SH16 corridor be widened. This is a choice between existing homes and the environment. We choose to support te taiao. Should it (the ASH) proceed against our opposition and advice we have suggested limits and offsets to what that might look like. Our preference is for the Crown to work with Te Kawerau ā Maki on strategic and inter-generational growth in ways where we both benefit and where the environmental impacts are lower.

RECOMMENDATIONS

Table 5: Recommendations and outcome alignment

No.	Recommendation	TKaM Strategic Value alignment	IMP policy alignment	Legislative alignment	AUP policy alignment	Other policy alignment
1	Te Kawerau ā Maki do not oppose the proposal, with the exception of the ASH component which we do oppose (and prefer SH16 be widened instead), otherwise provided that the mitigations and offsets discussed are incorporated – we desire notice of the outcome of the application and the final designation conditions	Mana Motuhake				
2	Undertake further discussions and work to enable TKaM participation in design, construction and operation phases of the project e.g. through project board position and/or MOU and including procurement or training opportunities	Mana Motuhake, Kaitiakitanga, Whanaungatanga, Auaha	2.2 (integration of tikanga)	RMA 6(e), 7(a), 8	B6.2.2(1) (participation), B6.3.2(1) (identify values) B6.3.2(2) (integrate tikanga), B6.3.2(3) (AEE to include CIA), B6.3.2(6) (decisions to reflect cultural impacts), B6.5.2(7) (cultural landscapes in structure plans), B6.5.2(9) (cultural design of infrastructure)	UNDRIP, NPSFW, NZCPS, ICOMOS
3	Avoid realignment of the Kumeū River as a matter of spiritual integrity	Kaitiakitanga	2.2 (integration of tikanga), 4.2.2 (cultural heritage)	RMA 6(e), 7(a)	B6.3.2(2) (integrate tikanga), B6.3.2(6) (decisions to reflect cultural impacts)	UNDRIP, ICOMOS, NPSFW
4	Should the ASH proceed against our advice, permanent exclusion of urban intensification (Rural Zone to remain) west of ASH and low density east of ASH (CSL Zone) should be provided	Kaitiakitanga	2.2 (integration of tikanga), 4.1.2 (cumulative effects),	RMA 6(e), 7(a), 8	B6.3.2(1) (identify values) B6.3.2(2) (integrate tikanga),	UNDRIP

No.	Recommendation	TKaM Strategic Value alignment	IMP policy alignment	Legislative alignment	AUP policy alignment	Other policy alignment
			4.2.2 (cultural heritage), 4.7.2 (landscape)		B6.3.2(6) (decisions to reflect cultural impacts), B6.5.2(7) (cultural landscapes in structure plans)	
5	Avoid where possible significant earthworks on the areas of cultural value (sites) identified in this report, and where not possible, work with TKaM on design and construction monitoring that incorporates our tikanga	Kaitiakitanga	2.2 (integration of tikanga), 4.2.2 (cultural heritage), 4.3.2 (koiwi), 4.9.2 (cultural design)	RMA 6(e), 7(a), 8; HNZPTA s45	B6.2.2(1) (participation), B6.3.2(2) (integrate tikanga), B6.5.2(9) (cultural design of infrastructure), E11 and E12 rules (ADP)	UNDRIP, ICOMOS
6	Cultural Heritage and Offset fund and trust be established for the benefit of TKāM and NWōK with regard to the conservation, interpretation, and education regarding taonga within the Study Area. The budget for this fund will need to be negotiated but must be meaningful	Kaitiakitanga	2.2 (integration of tikanga), 4.2.2 (cultural heritage), 4.9.2 (cultural design)	RMA 6(e)	B6.2.2(1) (participation), B6.3.2(1) (identify values) B6.3.2(2) (integrate tikanga), B6.5.2(7) (cultural landscapes in structure plans), B6.5.2(9) (cultural design of infrastructure)	UNDRIP, ICOMOS
7	Work with TKaM on water sensitive design that incorporates our tikanga, noting the importance of not mixing waters and soil and plant filtration, and giving effect to Mana ō te Wai, and including elements such as riparian planning buffers and long-term mauri monitoring	Kaitiakitanga, Mātauranga	2.2 (integration of tikanga), 4.4.2 (management of water), 4.5.2 (coastal)	RMA 6(e), 7(a), 8	B6.2.2(1) (participation), B6.3.2(1) (identify values) B6.3.2(2) (integrate tikanga), B6.5.2(9) (cultural design of infrastructure)	UNDRIP, NPSFW, NZCPS

No.	Recommendation	TKaM Strategic Value alignment	IMP policy alignment	Legislative alignment	AUP policy alignment	Other policy alignment
8	Work with TKaM on ecologically sensitive design that incorporates our tikanga, including eco-sourced vegetation, a 100% native plant commitment, habitat enhancement, fish passages, and green corridors, and ensure and ecological offsetting framework is designed in partnership with TKaM	Kaitiakitanga, Mātauranga	2.2 (integration of tikanga), 4.7.2 (landscape), 4.8.2 (flora and fauna), 4.9.2 (cultural design)	RMA 6(e), 7(a), 8	B6.2.2(1) (participation), B6.3.2(1) (identify values) B6.3.2(2) (integrate tikanga)	UNDRIP
9	Develop in conjunction with TKaM an ecological restoration and management plan for the wetlands and streams that removes pests, monitors water, biodiversity and mauri quality including with cultural indicators, and includes enhancements such as native riparian planting	Kaitiakitanga	2.2 (integration of tikanga), 4.4.2 (management of water), 4.7.2 (landscape), 4.8.2 (flora and fauna), 4.9.2 (cultural design)	RMA 6(e), 7(a), 8	B6.2.2(1) (participation), B6.3.2(1) (identify values) B6.3.2(2) (integrate tikanga)	UNDRIP, NPSFW, NZCPS
10	Work with TKaM on a darkness sensitive design that incorporates our tikanga, and limits the degree of light pollution generated	Kaitiakitanga	2.2 (integration of tikanga), 4.1.2 (cumulative effects), 4.7.2 (landscape)	RMA 6(e), 7(a)	B6.2.2(1) (participation), B6.3.2(1) (identify values) B6.3.2(2) (integrate tikanga)	UNDRIP, NZCPS
11	Work with TKaM on cultural design incorporation and interventions, such as ensuring inter- and intra- cultural site visibility and settings is maintained, undertaking place naming and educational and physical (artistic) interpretation of cultural sites and history, and opportunity to input to the built form of elements of the project (e.g. bridges)	Kaitiakitanga, Auaha, Mātauranga	2.2 (integration of tikanga), 4.1.2 (cumulative effects), 4.2.2 (cultural heritage), 4.7.2 (landscape), 4.9.2 (cultural design)	RMA 6(e)	B6.2.2(1) (participation), B6.3.2(1) (identify values) B6.3.2(2) (integrate tikanga), B6.5.2(9) (cultural design of infrastructure)	ICOMOS
12	Actively support aspirations of TKaM to enter cultural sites within the Study Area onto the Auckland Council schedule of Sites of Significance to Mana Whenua, potentially through a private plan change	Kaitiakitanga	4.2.2 (cultural heritage), 4.7.2 (landscape)	RMA 6(e), 7(a), 8	B6.3.2(1) (identify values), B6.5.2(7) (cultural landscapes in structure plans/plan changes)	ICOMOS

No.	Recommendation	TKaM Strategic Value alignment	IMP policy alignment	Legislative alignment	AUP policy alignment	Other policy alignment
13	Develop and implement a Topsoil Conservation Plan	Kaitiakitanga	2.2 (integration of tikanga), 4.1.2 (cumulative effects)	RMA 6(e), 7(a), 8	B6.3.2(1) (identify values) B6.3.2(2) (integrate tikanga), B6.3.2(6) (decisions to reflect cultural impacts), B6.5.2(7) (cultural landscapes in structure plans), B6.5.2(9) (cultural design of infrastructure)	UNDRIP
14	In addition to the ecological management plan and topsoil management plan, TKāM should co-develop an urban/landscape design management plan and heritage management plan	Kaitiakitanga	4.2.2 (cultural heritage), 4.7.2 (landscape)	RMA 6(e), 7(a), 8	B6.2.2(1) (participation), B6.3.2(2) (integrate tikanga), B6.3.2(6) (decisions to reflect cultural impacts), B6.5.2(7) (cultural landscapes in structure plans)	UNDRIP, ICOMOS
15	Cultural monitoring, including pre-works cultural inductions, and the monitoring of cultural sites and resources for the construction period of the project, should be resourced at the cost of the Client	Kaitiakitanga, Whanau Mātauranga Māori	2.2 (integration of tikanga)	RMA 6(e), 7(a)	B6.2.2(1) (participation), B6.3.2(2) (integrate tikanga)	UNDRIP
16	Any lands within the designation that NZTA may wish to dispose of in the future should first be offered to TKaM to provide opportunity to re-acquire whenua alienated from TKaM	Mana Motuhake				

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Murdoch, G. (2011). *Te Kawerau ā Maki Claim Overview Report*. Unpublished Report.

Taua, T.W. (2009). *He kohikohinga korero mo Hikurangi.* In F. Macdonald and R. Kerr (ed). West – The History Of Waitakere. Random House.