

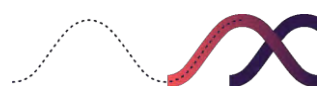
638 Limited

638 Cambridge Road, Te Awamutu

General Civils & Three Waters Report

September 2025





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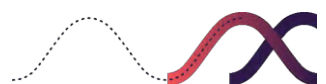
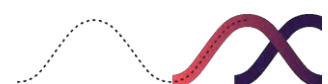


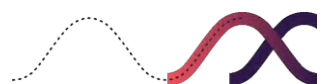
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1. Introduction and Project Overview

1.1 Purpose of the Report

The purpose of this report is to provide a comprehensive assessment of a proposal to rezone the site at 638 Cambridge Road, Te Awamutu, from Residential to Commercial, to enable the development of a large format retail store on the site. It serves as a technical document that evaluates site suitability, infrastructure requirements, and compliance with regulatory standards, while also addressing environmental and operational considerations.

This report aims to ensure that all aspects of the development enabled by the rezoning—from stormwater and wastewater management to civil works, utilities, and environmental protection—can be provided for in alignment with the Waipa District Plan, Waikato Regional Plan, and national guidelines. It integrates findings from geotechnical, ecological, and environmental investigations to present a holistic framework for decision-making.

1.2 Scope of the Report

This assessment aligns with the following national, regional, and local standards and guidelines:

- NZS 4404:2010 – Land Development and Subdivision Infrastructure: Ensuring best-practice infrastructure design for water, wastewater, and stormwater systems.
- Waikato Regional Infrastructure Technical Specifications (RITS): Local design requirements for infrastructure servicing.
- Waikato Regional Council (WRC) Guidelines: Hydrology, flood hazard management, and water quality treatment standards.
- SNZ PAS 4509:2008: New Zealand Firefighting Water Supplies Code of Practice.
- Waipa District Plan: Rules for infrastructure servicing, flood hazard management, and environmental compliance.

The outcomes presented herein form the technical basis for infrastructure feasibility and provide confidence for development approval under the Waipa District Plan.



1.3 Project Description

The Applicant is proposing to rezone the site from Residential to Commercial, and to expand and update the Large Format Retail Overlay to the east to cover the subject site. The proposed plan change will facilitate the development of a large-format retail store (Mitre 10) on a 4.05-hectare site located at 638 Cambridge Road, Te Awamutu, refer to Figure 1. Key elements of the development include:

- A 13,000 m² gross floor area (GFA) commercial building.
- Associated car parking, vehicle accessways, and pedestrian pathways.
- Supporting three waters infrastructure: stormwater, potable water, and wastewater systems.
- Integration of flood mitigation and stormwater quality treatment features.

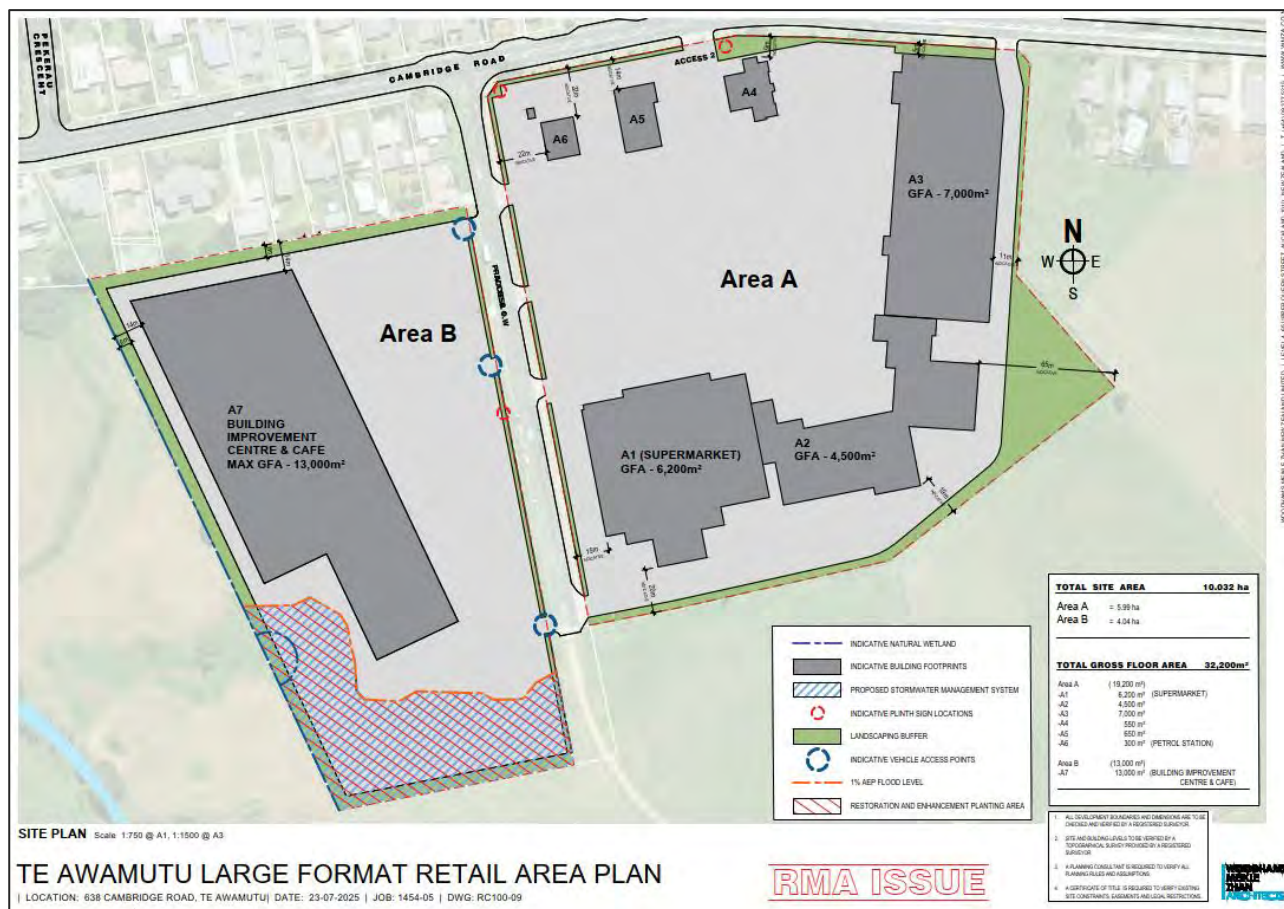


Figure 1. Proposed development layout

1.4 Site Location and Context

The subject site is located approximately 1.5 km northeast of the Te Awamutu town centre. It is adjacent to the Mangaohoi Stream floodplain, which influences site hydrology and drainage. It is positioned north of a significant residential area, and west of existing Te Awamutu Large Format Retail Centre.

Site Boundaries:

- Northern boundary: Cambridge Road (urban arterial route).
- Southern boundary: Grassland transitioning to the Mangaohoi Stream floodplain.
- Eastern boundary: Commercial.
- Western boundary: Agricultural properties.





Figure 2. Site location

The site is identified within the T11 Growth Cell under the Waipa District Growth Strategy, earmarked for residential and commercial development.

The site is bordered to the east by the Te Awamutu Large Format Retail Centre, which includes the existing Mitre 10 and other large-format retail outlets. For the purposes of this report, this area is referred to as Area A. Area A is relatively flat, with hardstand surfaces that appear to be graded toward isolated low points within the carpark and accessways. While the area is understood to be serviced by public water and wastewater networks, no detailed stormwater reticulation plans or discharge records have been made available for this infrastructure. Flood modelling undertaken as part of this assessment confirms that the 1% AEP flood extent associated with the Mangaohoi Stream does not extend into Area A. Minor ponding predicted during large storm events is attributed to localised surface depressions and is not a result of overtopping or backing up from the adjacent stream.

1.5 Objectives of the Development

The objective of the proposed Plan Change is to facilitate the establishment of a large-format retail facility. In addition to its commercial goals, the project prioritizes environmental sustainability and compliance with regulatory requirements. Key objectives include integrating effective stormwater management systems, ensuring ecological protection and enhancement, and adhering to best practices in civil infrastructure design.

A critical objective is the alignment of the development with regional and district planning frameworks. This includes securing all necessary consents, addressing ecological sensitivities, and meeting the long-term operational demands of the facility. Through these efforts, the project seeks to deliver a functional, sustainable, and community-focused asset that supports the strategic vision for Te Awamutu.



1.6 Structure of the Report

This report is structured to provide a comprehensive analysis of the proposed Plan Change, addressing all key aspects required for its successful delivery. The chapters are organized as follows:

1. Introduction: Outlines the project's background, purpose, and objectives.
2. Site Description and Context: Provides an overview of the site's location, existing conditions, and surrounding context.
3. Stormwater Management: Discusses the design and implementation of stormwater infrastructure, including attenuation, treatment, and compliance with regulatory standards.
4. Potable Water Supply: Examines the water supply design, including domestic and firefighting requirements, and evaluates its compliance with relevant guidelines.
5. Wastewater Management: Addresses the design and capacity of the wastewater system and its integration with the existing network.
6. General Civil Works and Site Layout: Describes the earthworks, pavements, parking provisions, and overall site layout, including grading and access design.
7. Utilities and Services: Covers power, telecommunications, gas supply, and lighting infrastructure, ensuring adequate capacity for operational needs.
8. Conclusion and Recommendations: Summarizes the findings, offers recommendations, and highlights key actions for successful project completion.

This structure ensures a logical progression from site analysis and design considerations to implementation and compliance, providing a robust framework for decision-making.



2. Site Description and Conditions

2.1 Topography and Surface Drainage

The site features gently sloping terrain, with elevations ranging from approximately RL 48.5m in the northeast to RL 46.0m in the southwest. Surface water flows naturally toward the southern boundary, where it enters a low-lying floodplain connected to the Mangaohoi Stream. The gradients are moderate and manageable for development.

A 450mm stormwater pipe crosses the site, conveying water intercepted from the access road along the eastern boundary to a wetland located to the west of the site. A field sump has been constructed within the site to collect and drain water from a local depression point into this pipe.

The location of this stormwater pipe intersects the proposed development and will require assessment to determine if realignment or capacity adjustments are necessary. Any changes will need to comply with Waipa District Council standards to ensure continued functionality.

2.2 Subsurface and Ground Conditions

Geotechnical investigations, as detailed in the CMW Preliminary Geotechnical Report, reveal that the site is underlain by Hinuera Formation soils, which are typical of the Waikato region. The soil profile consists of the following:

- A thin topsoil layer, measuring between 0.2m and 0.3m, composed of silty clay with organic material. This layer is soft and will require stripping during earthworks.
- Beneath the topsoil, silty sands and clays extend to depths of up to 8m. These soils exhibit low permeability and moderate compressibility, requiring careful consideration for foundation design.
- Localized zones of uncontrolled fill were identified, with depths ranging between 1m and 2m. The fill is variable in composition, including sands, gravels, and clay, posing a risk of differential settlement.

Groundwater was encountered at depths ranging from 0.9m to 2.5m below ground level (BGL). Fluctuations are expected during wet seasons, which may impact excavation activities and foundation design. Dewatering strategies may be necessary during the construction phase to manage shallow groundwater.

2.3 Flood Hazard

The site's southern boundary lies adjacent to the Mangaohoi Stream floodplain, which influences flood risk for part of the site. Flood hazard assessments indicate that the 1% Annual Exceedance Probability (AEP) flood level at the site boundary is approximately RL 46.95m (47.17m in Moturiki Datum).

Finished Floor Levels (FFLs) for the proposed buildings have been set at RL 48.5 m. This provides a total of 1.55 m of freeboard above the modelled 1% AEP flood level (RL 46.95 m), satisfying Waipa District Plan's 500 mm minimum requirement for habitable floor levels.

Additionally, climate change allowances require increasing rainfall intensities by 10–20%, a factor that will have to be incorporated into stormwater design calculations.



2.4 Existing Infrastructure

The site is served by key infrastructure located along Cambridge Road.

A 200mm water main runs parallel to the north side of Cambridge Rd, providing sufficient capacity to meet the domestic water supply and firefighting requirements for the commercial development of the site. Similarly, a 150mm gravity sewer main is located adjacent to the site and has been assessed to accommodate the projected wastewater flows.

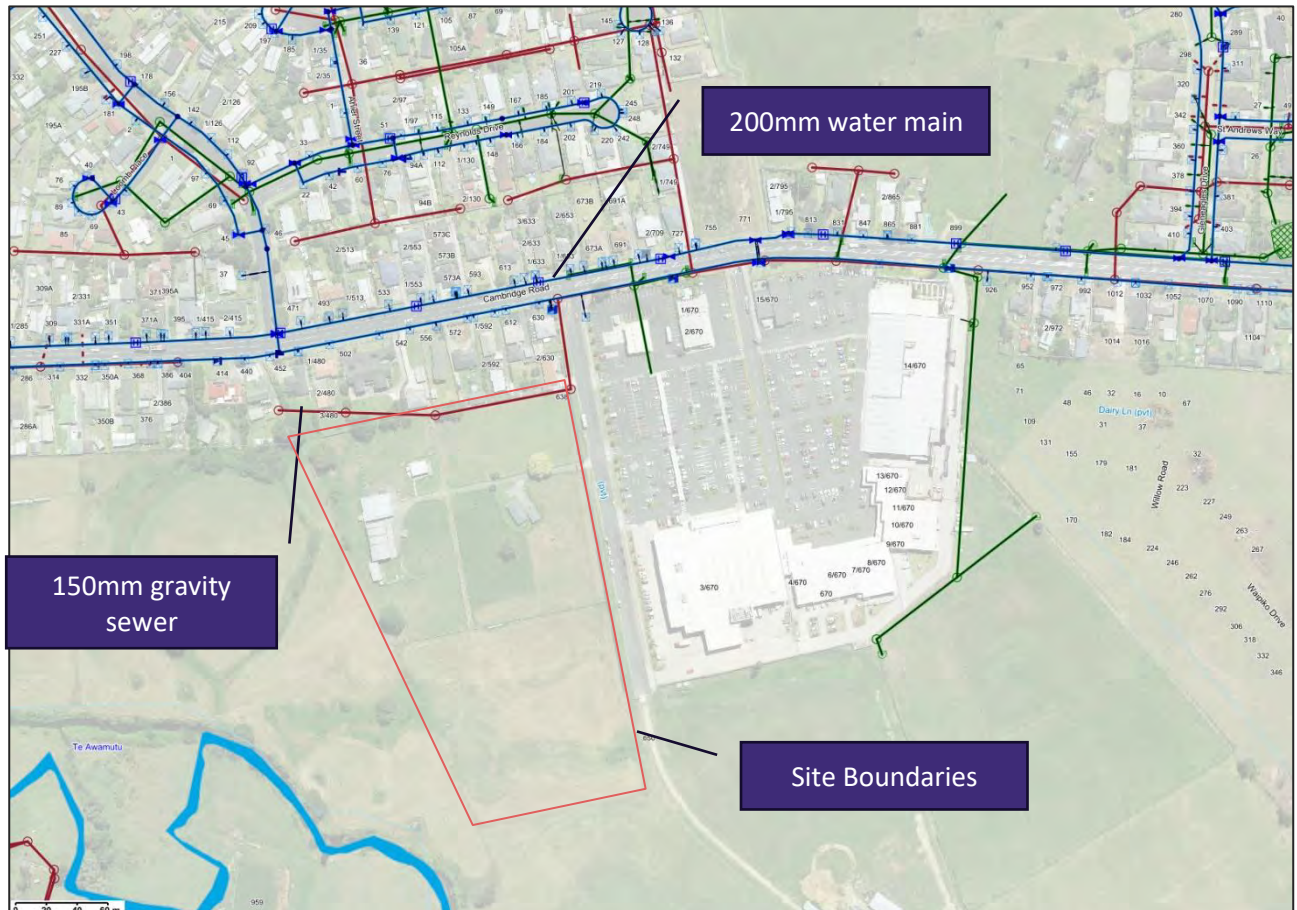


Figure 3. Existing services

Stormwater infrastructure is limited to the existing 450mm stormwater pipe crossing the site, which conveys intercepted runoff from the eastern access road to the wetland at the western boundary. A field sump within the site drains a local depression point into this pipe.





The proximity of these networks minimizes the need for off-site infrastructure upgrades, simplifying servicing of the development. Further assessments will confirm the adequacy of these utilities to meet the development’s demands and identify any required modifications to integrate with the proposed layout.



3. Stormwater Management

3.1 Overview

The commercial rezoning of the site will significantly increase impervious surfaces, altering the site's hydrology and stormwater runoff. A comprehensive stormwater management system has been designed to mitigate these effects by attenuating peak flows, ensuring water quality treatment, and addressing flood risks in compliance with NZS 4404:2010, Waikato RITS, and Waikato Regional Council (WRC) guidelines.

3.2 Existing Stormwater Conditions

The site at 638 Cambridge Road has no formal on-site stormwater infrastructure, apart from the 450mm stormwater pipe that crosses the site and conveys water intercepted from the eastern access road to the wetland on the western boundary. This pipe is connected to a field sump located within the site, which drains a localized depression point to prevent ponding.

Surface runoff currently occurs as sheet flow, following the site's gentle slope of 1–2% from the northeast corner at RL 48.5m toward the southwest at RL 46.0m. The flow naturally drains into the adjacent Mangaohoi Stream floodplain, which serves as the receiving environment during storm events.

Analysis of the overland flow regime shows that the site is influenced by upstream catchments, particularly from the northeast and east. Contributing flows traverse the site, concentrating in natural depressions, including the area serviced by the existing sump. The western and southern portions of the site serve as collection points where flows converge before discharging into the adjacent floodplain and wetland. These flow paths are visible as blue flow lines and indicate that the site plays a role in conveying not only its own runoff but also upstream flows.

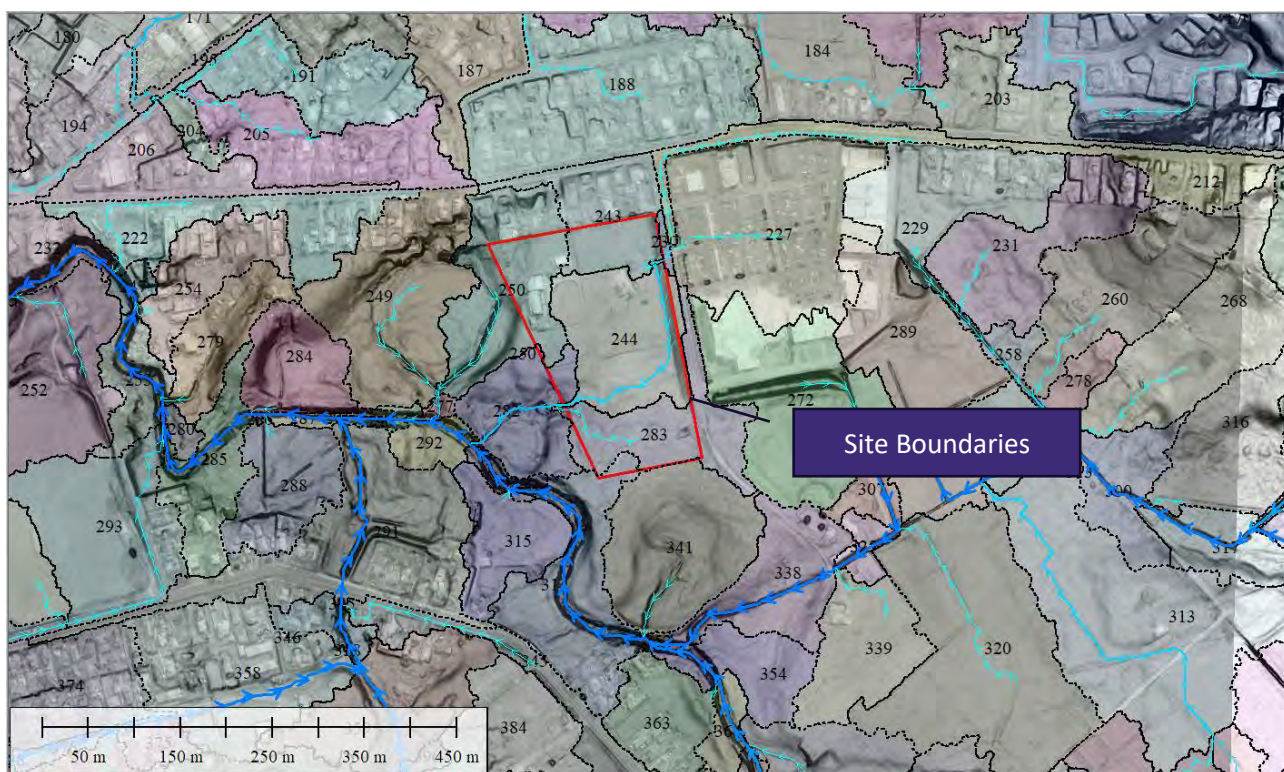


Figure 5. Stormwater catchment and overland flow paths delineation for existing conditions.



The existing ground cover, which consists predominantly of grassland, provides moderate permeability and slows runoff, helping to reduce peak flow velocities. However, the underlying silty clay soils limit infiltration during prolonged or heavy rainfall, resulting in increased surface runoff volumes.

The combination of sheet flow runoff, upstream overland flow paths, and the lack of formal on-site attenuation infrastructure highlights the need for an integrated stormwater management system as part of the development. This system will need to address both on-site runoff and conveyance of upstream flows while mitigating impacts to the downstream wetland and Mangaohoi Stream.

3.3 Design Criteria

The stormwater design will need to adopt the principles outlined in NZS 4404:2010 and Waikato RITS, ensuring effective management of stormwater quantity, quality, and flow paths. The design considers:

1. **Peak Flow Attenuation:** Post-development runoff will need to be attenuated to match pre-development flows for storm events up to the 1% AEP (100-year) flood.
2. **Water Quality Treatment:** Contaminant removal can be achieved through a treatment wetland.
3. **Climate Change Allowances:** A 2.3°C temperature increase, corresponding to the RCP6 climate change scenario, has been incorporated into the system design rainfall to address future scenarios.
4. **Flood Hazard Mitigation:** Development levels and runoff management will ensure no adverse impacts on the adjacent floodplain.

3.4 Stormwater Management System

3.4.1 General

A two-stage treatment train approach that includes a treatment swale, raingardens, and a stormwater treatment wetland with detention capacity has been modelled to support the Plan Change application. This design is intended to reduce peak flows and improve water quality. The necessity for a two-stage treatment train approach arises from the classification of the parking area as having a high contaminant load profile because it will exceed the threshold of 750m² set by Waikato RITS (tables 4-4 and 4-6).

Runoff from the trafficked and parking areas will be conveyed via kerb and channel into raingardens where it will receive a first-stage treatment (pre-treatment), where the gross and coarse pollutants will be filtered out. The runoff will be then conveyed to the stormwater treatment wetland via a proposed stormwater reticulation network.

The runoff from the internal access road network on the western side of the building will flow into a proposed stormwater treatment swale that runs parallel to the site's western boundary. The swale will be planted to enhance stormwater treatment through biological uptake. At the end of the swale, the treated runoff will be discharged into a scruffy dome and then reticulated into the proposed wetland.

The wetland will be constructed on the southern portion of the site, where the natural gradient facilitates runoff collection. The detention component of the wetland is sized for the 100-year event, with a total storage volume of 4,400 m³. Flow release will be controlled via a composite outlet structure to restrict post-development discharges to pre-development levels.

In addition to detention, the wetland provides water quality treatment through a forebay and shallow marsh zones. The forebay traps coarse sediments, while marsh zones, planted with native vegetation, promote filtration and removal of fine particles and contaminants. A permanent pool within the wetland further buffers flows and enhances treatment.



The design also maintains existing overland flow paths, ensuring runoff from extreme events can safely pass through the wetland without compromising flood protection measures.

3.4.2 Roof Runoff – Initial Abstraction

Initial abstraction (I_a) represents the volume of rainfall retained on the ground surface before runoff begins, encompassing water lost through surface storage, infiltration, and interception by vegetation. For the site at 638 Cambridge Road, this is a critical parameter for stormwater management, as it influences runoff generation and informs the design of mitigation measures. Detailed calculations of I_a using the NRCS Curve Number (CN) methodology are provided in **Appendix C**.

Based on the site's characteristics and the weighted CN of 78.93, the I_a for the development is calculated as 3.39 mm. This calculation follows the formula:

$$I_a = (200/CN) - 2$$

The site spans 4.05 hectares (40,500 m²), and the total volume of rainfall corresponding to initial abstraction is determined using the formula:

$$V_{\text{storage}} = A_{\text{site}} \times I_a$$

Substituting the values:

$$V_{\text{storage}} = 40,500 \text{ m}^2 \times 0.00339 \text{ m} = 137.3 \text{ m}^3$$

This volume represents the required retention to comply with the Regional Infrastructure Technical Specifications (RITS) and Waikato Regional Council's Stormwater Management Guideline (TR20-07), which emphasize the need for developments to account for the initial abstraction to mitigate the impacts of urbanization on downstream environments.

Site-Specific Factors Affecting Initial Abstraction

The site's existing conditions significantly influence the calculation and management of I_a . The ground cover, primarily grassland, provides moderate permeability, slowing surface runoff and allowing for infiltration. However, the site's underlying silty clay soils exhibit limited infiltration rates during heavy or prolonged rainfall. The gentle slope of 1–2% promotes sheet flow but may lead to localized ponding in low-lying areas, such as the depression serviced by the existing field sump. The planned development introduces impervious surfaces, including a 13,000 m² roof, parking areas, and accessways, which will significantly reduce the site's natural capacity for initial abstraction.

Proposed Rain Tanks for Initial Abstraction

To address the reduction in natural abstraction, the proposed stormwater management system integrates rain tanks as a primary retention strategy. These tanks will capture runoff from the roof area but will be designed to manage the entire site's initial abstraction volume of 137.3 m³, ensuring compliance with RITS requirements. The tanks also offer secondary benefits, including water reuse for non-potable applications such as irrigation and operational uses.

The rain tanks will include the following design features:

- **Capacity and Scalability:** Modular systems will allow for flexible storage configurations to meet site-specific requirements.
- **Overflow Management:** Integrated overflow structures will direct excess water into the detention basin or stormwater network during heavy rainfall.



- **Pre-Filtration Systems:** These systems will reduce sediment and debris entry, minimizing maintenance needs and prolonging tank life.

Geotechnical and Groundwater Considerations

The geotechnical investigation identified several constraints for underground tank installation. Groundwater levels, observed at depths of 1.5 to 2.0 meters, may cause buoyancy risks for buried tanks, particularly during high water table conditions. Additionally, the site's silty clay soils exhibit slow drainage rates, which could exacerbate waterlogging around the tanks. To mitigate these challenges, the following strategies are proposed:

- **Tank Anchoring and Materials:** Concrete tanks are recommended for underground installations due to their structural stability and resistance to buoyancy. Proper anchoring or weighting systems will be implemented as needed.
- **Drainage Systems:** Subsoil drainage will be incorporated around the tanks to manage hydrostatic pressure and prevent waterlogging.
- **Alternative Configurations:** Partially buried or above-ground tanks offer a feasible alternative, reducing excavation requirements and addressing buoyancy concerns.

Benefits and Compliance

The proposed system effectively retains initial abstraction, reducing immediate runoff and mitigating peak flows. By capturing the first 3.39 mm of rainfall:

- **Runoff Volume:** Immediate discharge to the downstream wetland and Mangaohoi Stream is reduced.
- **Water Quality:** Pollutants from the initial flush of runoff are captured, improving the quality of water entering downstream environments.
- **Flood Mitigation:** Retaining initial abstraction delays runoff generation, flattening the peak flow curve and reducing flood risks.

The rain tanks also align with sustainability goals, providing a source of non-potable water and reducing demand on the municipal supply. The design ensures compliance with both RITS and the Waikato Regional Plan, contributing to the development's environmental stewardship.

3.4.3 Stormwater treatment swale

A stormwater treatment swale along the western boundary of the site can be formed to have trapezoidal shape, with a 0.5m wide bed and 3:1 bank slope. The total length of the swale can be approximately 270m, with longitudinal slope of 0.4% towards the south of the site.

3.4.4 Raingardens

Raingardens, also known as biofiltration gardens, are sustainable stormwater management devices designed to improve water quality and manage runoff. They are composed of several key components, including a specialized soil mix, a ponding area, vegetation, and an overflow system. The soil mix, typically sandy loam or loamy sand is crucial as it filters pollutants from the stormwater. The ponding area holds the stormwater runoff temporarily, allowing it to seep through the soil mix and into the underdrain system. Vegetation in the raingarden not only enhances its aesthetic appeal but also plays a vital role in the filtration process by absorbing and filtering contaminants.



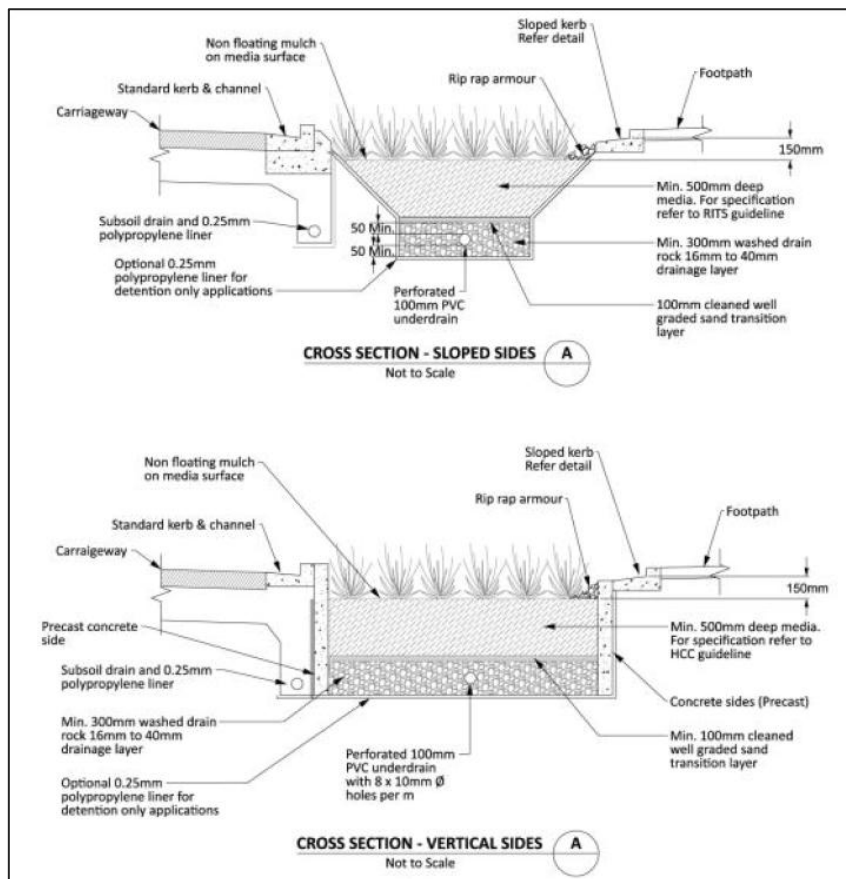


Figure 6. Typical raingarden details as per Waikato RITS.

The primary function of raingardens is to manage stormwater runoff from impervious surfaces such as roads, and driveways. When it rains, stormwater flows into the raingarden, where it is temporarily stored in the ponding area. The water then infiltrates through the soil mix, which acts as a natural filter, removing pollutants such as sediments, nutrients, and heavy metals. The filtered water either infiltrates into the ground or is collected by an underdrain system and directed to nearby water bodies or stormwater systems. This process not only reduces the volume of runoff but also improves the quality of water that eventually reaches rivers, lakes, and oceans.

Treatment in raingardens is achieved through a combination of physical, chemical, and biological processes. The soil mix physically filters out larger particles and sediments, while chemical processes within the soil help to bind and neutralize pollutants. The vegetation in the raingarden absorbs nutrients and other contaminants, further purifying the water. Additionally, microbial activity in the soil breaks down organic pollutants, enhancing the overall treatment efficiency. By incorporating these natural processes, raingardens provide an effective and sustainable solution for managing stormwater and improving water quality.

Scruffy domes incorporated in the raingardens' layout will allow flows larger than the water quality storm to be diverted into the reticulation network to avoid overwhelming of the raingardens' treatment capacity.

3.4.5 Stormwater Reticulation

Stormwater reticulation can be designed to efficiently manage runoff across the site by integrating new infrastructure with the existing 450 mm stormwater pipe. This existing pipe, located near the southern portion of the site, can be diverted into the new network to ensure hydraulic continuity and accommodate flows from the re-shaped site. The reticulation system would consist of 450 mm and larger diameter pipes that are strategically positioned to align with the proposed earthworks layout. The network layout ensures efficient flow collection and conveyance across the site, directing stormwater towards downstream discharge points while minimizing hydraulic losses and disruptions.



The reticulation network would be centred along the site's eastern boundary, following the proposed finished ground levels and connecting key inflow points. A combination of primary and secondary branches converges at critical junctions, ensuring smooth flow transitions. The main stormwater conduits run through the site, intersecting at multiple points to collect runoff generated by the re-graded surfaces and proposed development. By integrating the existing 450 mm pipe with the new network, the system ensures seamless flow management while accounting for the significant modifications to the ground levels. Carefully designed gradients and invert levels are incorporated to maintain efficient gravity-driven flow across the network, preventing ponding and minimizing the risk of blockages.

The redesigned stormwater reticulation network channels flows towards the designated discharge points (where raingardens will be located) in a controlled manner, ensuring compliance with stormwater management requirements. The combination of new infrastructure and the diversion of the existing 450 mm pipe allows for a robust system that accommodates runoff from the proposed earthworks and development layout. With adequately sized pipes, optimized gradients, and strategically placed junctions, the network is capable of handling peak flow conditions while providing efficient and reliable stormwater conveyance throughout the site. The pipes have been sized to convey the climate-adjusted 10-year ARI design storm peak flow without surcharge, as per RITS requirements.

3.4.6 Stormwater Treatment Wetland

The proposed stormwater treatment wetland includes a 2,200m² permanent water level pond, providing approximately 550m³ of permanent water volume. According to HIRDS v.4 data, the design Water Quality (WQ) depth corresponding to one-third of the 2-year/24-hour storm is 25.52mm. Based on this WQ depth, the permanent water volume is adequate to accommodate an impervious area of 21,552m² for treatment purposes. The development of the site is anticipated to have about 16,150m² of contaminant generating impervious area, which will consist of internal access tracks and parking areas. Thus, it is clear that the wetland has been sized to manage higher contaminant loads than typically required by RITS standards.

Additionally, the wetland has been designed to include Extended Detention Volume (EDV), allowing it to accommodate only 50% of the WQ volume within its permanent storage. This design effectively doubles the capacity of the wetland, enabling it to treat up to 43,100m² of impervious trafficked areas. Consequently, the proposed wetland will be capable of providing additional treatment for untreated runoff originating from the upstream catchments of the eastern access road, as well as sections of Cambridge Rd and the parking area of the commercial hub to the east of the site, including Pak n Save and the existing Mitre 10. As a result, the overall water quality conditions for the downstream receiving waters are significantly improved.

The planting of the stormwater treatment wetland will be carefully planned to comply with the Waikato Regional Infrastructure Technical Specifications (RITS). The wetland planting palette will include a diverse selection of native species that are well-suited to the local climate and hydrological conditions. These species will be chosen for their ability to thrive in wetland environments, provide habitat for native wildlife, and enhance the treatment performance of the wetland.

The planting zones will be delineated according to the varying water depths and inundation frequencies within the wetland. Emergent plants, such as *Carex secta*, *Juncus edgariae*, and *Schoenoplectus tabernaemontani*, will be established in the shallow marsh areas to stabilize the soil and improve water quality through sediment trapping and nutrient uptake. Submerged and floating-leaved species, including *Myriophyllum propinquum* and *Potamogeton cheesemanii*, will be designated for the deeper, permanent water zones to promote oxygenation and support aquatic life.

In addition to the functional benefits, the planting design will aim to create a visually appealing landscape that enhances the aesthetic value of the site. The use of native vegetation will not only support biodiversity but also contribute to the ecological resilience of the wetland system. Regular maintenance and monitoring



will be carried out to ensure the health and establishment of the plantings, thereby ensuring the long-term success of the stormwater treatment wetland.

3.4.7 Extended Detention Volume (EDV)

Extended Detention Volume (EDV) is a critical component of the stormwater treatment wetland designed to comply with the Waikato Regional Infrastructure Technical Specifications (RITS) and Waikato Regional Council (WRC) Stormwater Guidelines. The proposed wetland incorporates an EDV strategy that allows for the temporary storage of stormwater runoff, effectively enhancing the wetland's capacity to manage water quality and quantity.

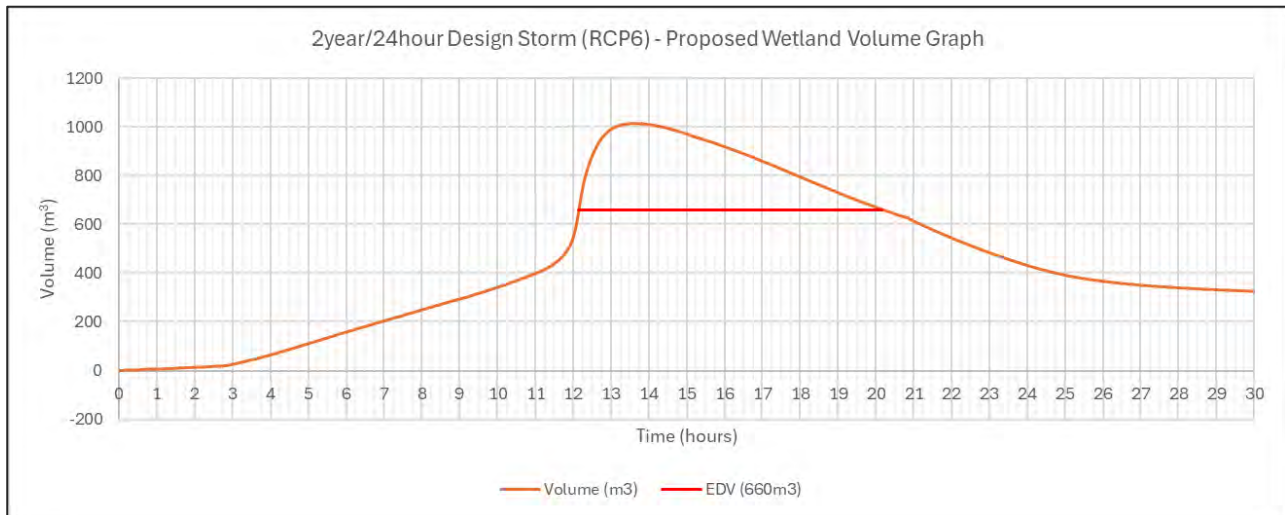


Figure 7. 2-year ARI volume graph of the proposed wetland.

The EDV is designed to be 1.2 times the Water Quality (WQ) volume within the permanent storage of the wetland. This capacity ensures that the wetland can handle the increased runoff from impervious areas, including internal access tracks and parking areas, while also providing additional treatment for runoff from upstream catchments. The EDV must be released within 24 hours or more, which helps in reducing peak flow rates and mitigating downstream erosion risks.

3.4.8 Stormwater Volume and Attenuation

The proposed stormwater treatment wetland features a geometry designed for both functionality and compliance with hydrological standards. With embankments sloping at 4:1, the wetland forms a stable basin capable of retaining and treating stormwater effectively.

The wetland is strategically positioned as an extension to the existing wetland at the western boundary of the site, providing a seamless integration into the surrounding drainage system. Its design includes approximately 4,400 m³ of attenuation volume, which allows the overall stormwater system to reduce peak discharge flows to pre-development conditions.



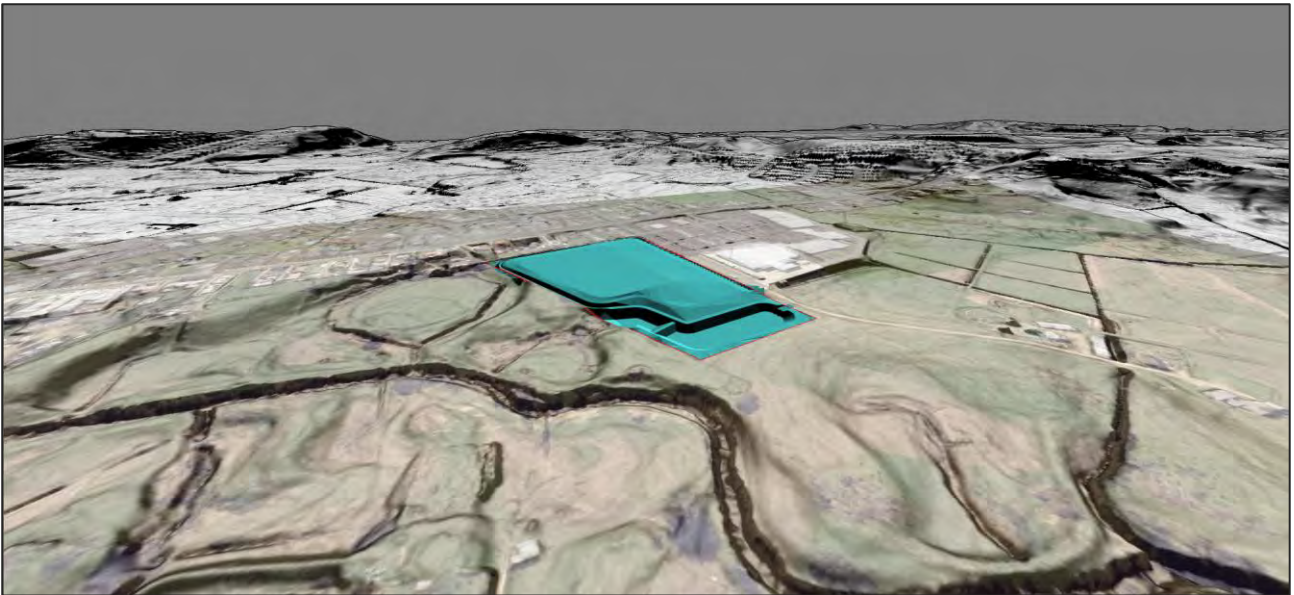


Figure 8. Isometric view of the proposed wetland and earthworks design.

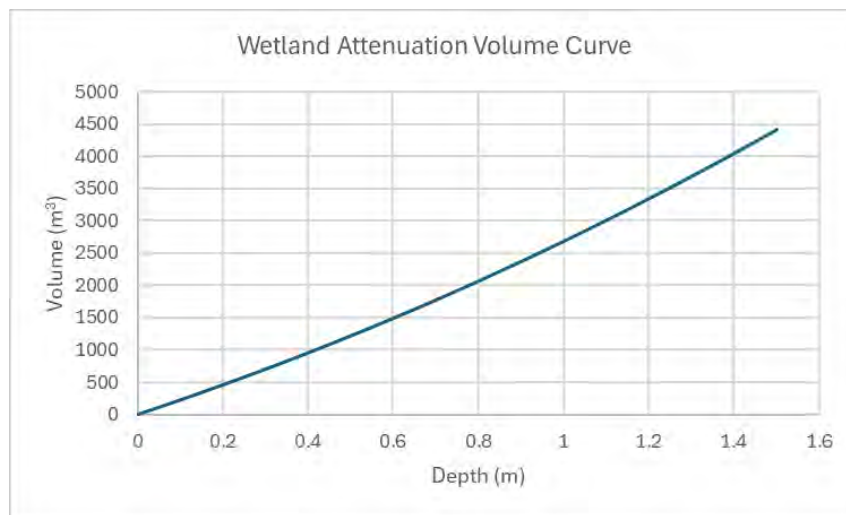


Figure 9. Proposed wetland attenuation volume curve.

A key element of the design is the outlet control structure, which plays a critical role in regulating flow and ensuring proper attenuation. At this preliminary stage, the outlet structure is proposed to consist of a 1400 mm manhole accommodating a 225 mm orifice for extended detention and control of the 2-year ARI flow. Additionally, a 250 mm weir set at RL 43.35 m is intended to manage the 10-year ARI flow, while a 400 mm weir set at RL 43.50 m will handle the 100-year ARI flow. This multi-tiered outlet structure ensures the system can effectively manage varying storm events.

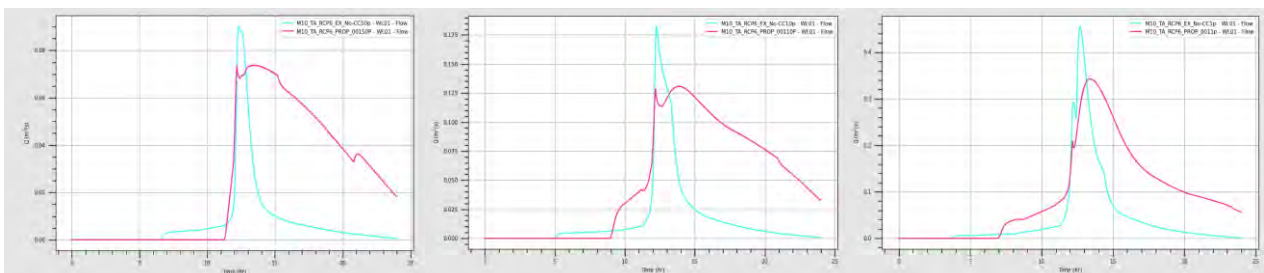


Figure 10. Post-development outflow hydrographs (2-year, 10-year and 100-year from left to right) showing that the proposed wetlands attenuates flow to lower peak rates than the pre-development conditions. Pre-development flows in cyan.



The basin layout, which currently reflects only the permanent water surface, will be further refined to include detailed features such as the wetland bed, forebay, and treatment pools in future design stages. The embankments and overall geometry meet standard safety and stability requirements while accommodating sufficient space for detention and treatment. Once the additional features are finalized, the wetland will fully align with performance criteria for stormwater attenuation and treatment, ensuring robust functionality and compliance with regulatory standards.

3.4.9 Stormwater discharge

Treated and attenuated flows will discharge into the existing wetland at the site's western boundary, using the current 450mm stormwater outlet to avoid disturbance. The design retains the last 10m of the stormwater line as a culvert. Upstream, a wetland swale will transition the water from the stormwater wetland to the existing one, dissipating energy and further polishing the treated water. Modelling shows the retained pipe won't be overtopped during design storms, preventing erosion or sediment transport risks.

Implementing this design is important for maintaining the ecological balance of the area. Discharging treated water into the wetland through a planned system ensures that the wetland habitat is preserved while managing stormwater effectively. The wetland swale upstream provides an additional stage of filtration and energy dissipation, reducing the velocity of the water flow and ensuring high-quality water entering the existing wetland.

Protecting the last 10 meters of the stormwater line as a culvert minimizes the need for extensive construction work, thereby reducing environmental impact and maintaining the structural integrity of the current setup. This approach balances human needs with environmental conservation. The application of this model can serve as a reference for similar projects aiming to integrate natural and engineered systems for better water management and environmental protection.

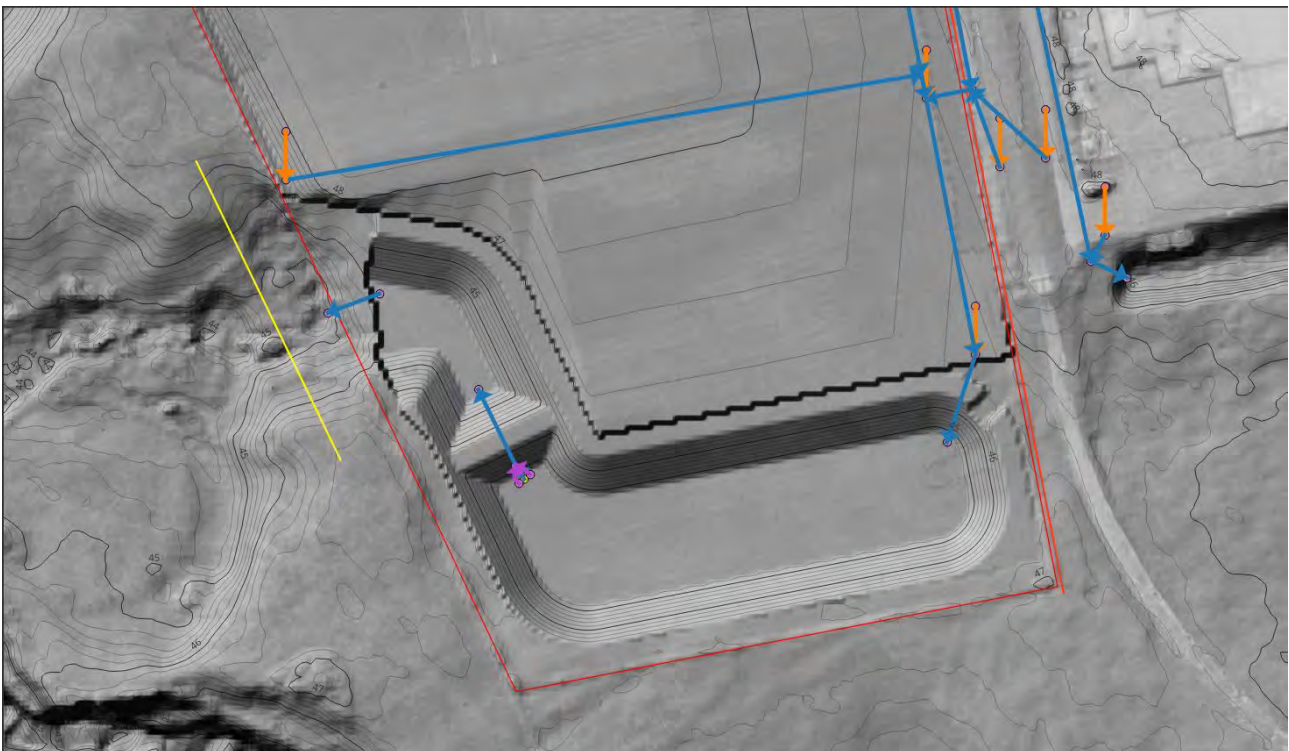


Figure 11. Inlet and outlet features of the proposed wetland, as modelled in TUFLOW.



3.5 Pre- and Post-Development Flow Analysis

3.5.1 Hydraulics and Hydrology Model

TUFLOW Classic/HPC (Ver 2023-03-AF) was used to model stormwater hydrology and hydraulics. TUFLOW Classic/HPC is a 1D network and 2D fixed grid-based software for simulating flood and tidal flow and was chosen due to its exceptional capability to simulate complex hydro-dynamic interactions in catchments, ensuring high-resolution representation of flood extents and depths. It supports quadtree and sub-grid sampling functions. The TUFLOW model allows for direct rainfall to be applied to each cell in the 2D grid or mesh, translates excess rainfall into surface runoff (also known as the as the rain-on-grid modelling approach), and routes the surface water using the 2D hydraulic solver. For the existing conditions, a DEM file was produced based on 2021 Waikato LIDAR 1m DEM from LINZ. For the proposed conditions, a combination of the LIDAR with the project's TIN was used.

In general, an 8m x 8m fixed grid was used for the model, while in the areas where more detailed modelling was needed, such as the proposed development and nearby features, neighbouring waterways etc, a square grid size ranging from 4m to 1m was applied. The sub-grid sampling and quadtree function of TUFLOW enabled accurate modelling and representation of the stormwater-related features such as existing depressions and minor drains.

Rainfall intensities from the High Intensity Rainfall Design System (HIRDS) were used to model 24-hour duration storms. The 24-hour design storms modelled included the 2-year, 10-year, and 100-year. All design storm events were generated from rainfall depths based on the RCP6 scenario interpolated for the year 2100. The rainfall intensities were converted into temporal data for the 24-hour design storms using WRC Runoff modelling guideline temporal pattern. Figure 12 below shows the 24-hour rainfall depths used in this model.

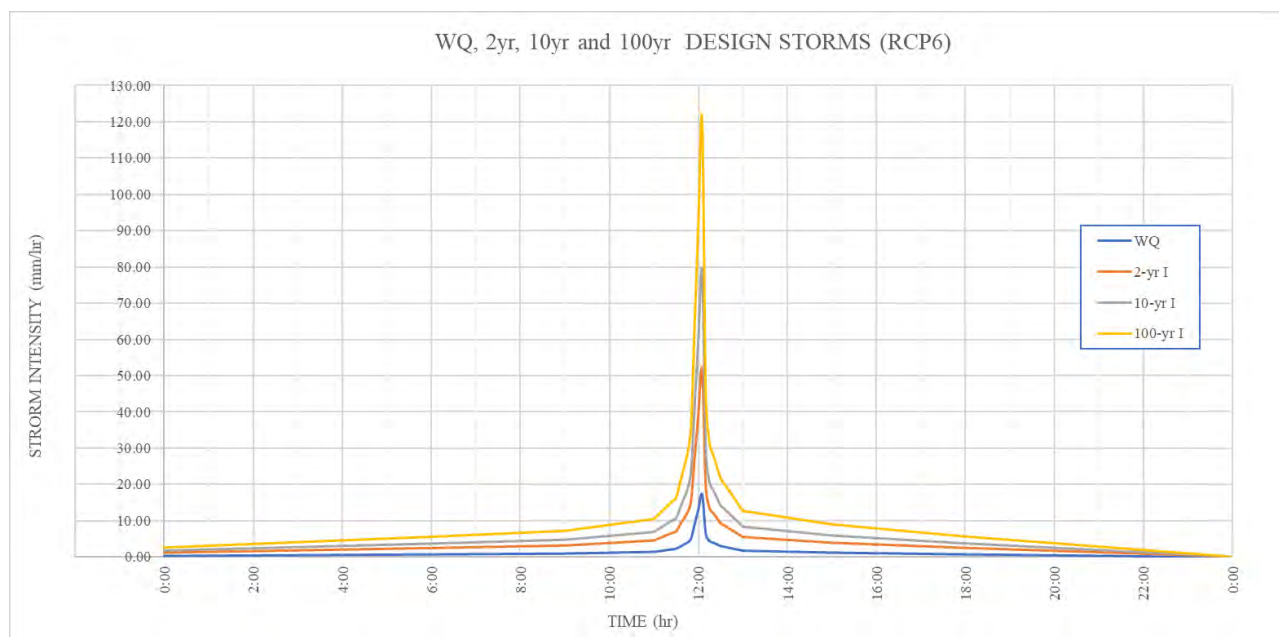


Figure 12. Design rainfall curves.

The infiltration method applied was the Horton's Infiltration Equation. Horton's Equation uses infiltration rates for typical soil types in the sub-catchment. This method uses an initial infiltration rate, adjusted for an appropriate antecedent moisture condition, and decreases it exponentially to a final infiltration rate for saturated soil conditions. The rate that the infiltration is decreased by is determined by a decay rate. Infiltration was estimated based on typical hydraulic characteristics for typical soil texture classes, taken from the EPA SWMM-5 Manual and Rawls et al. (1983).

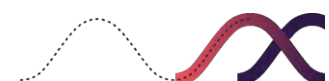


Figure 13 below shows a typical plot of infiltration versus time, using Horton's Equation, highlighting that the infiltration rate reaches saturated soil conditions long before the peak of the 24-hour design storm events. This infiltration function only applies to pervious areas. Depression storage was input at 5mm for pervious areas and 2mm for impervious areas. For the surface of the proposed building, a 10.5mm depression storage was applied, to account for the proposed initial abstraction retention ($10.5\text{mm} \times 13,000\text{m}^2 = 136.5\text{m}^3$ of storage to be collected and stored for reuse).

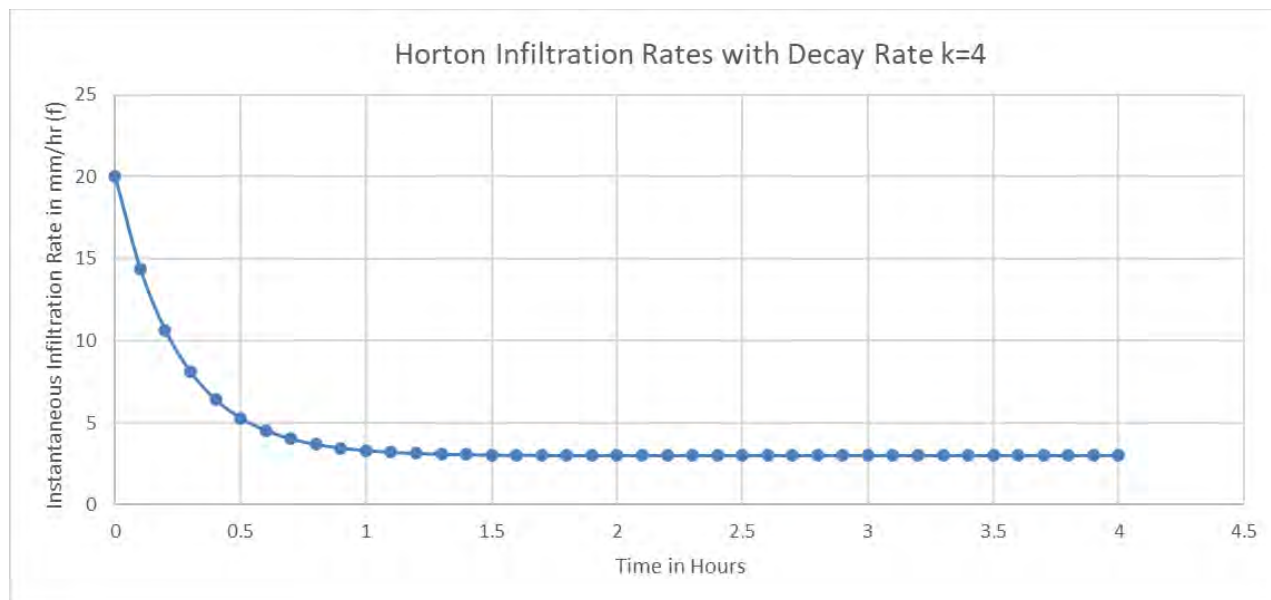


Figure 13. Example of Horton's infiltration rate curve.

Land use distribution for the existing and proposed conditions were created using the aerial information, the land cover database (LCDB version 5.0) obtained from the LRIS portal of Manaaki Whenua Landcare Research, and indicative roading layout. Manning's roughness coefficient was assigned for each land use (Table 1).

Table1. Hydraulic roughness used

Material ID	Description	Manning's n
1	Grass	0.1 for depth less than 0.15m and 0.05 for depth more than 0.60m
1	Roads	0.025
3	Buildings	1
4	Ponds and other water	0.015
5	Forest	0.12
6	Shrubs	0.07
7	Rock and gravel	0.05

The Manning's roughness values used were based on recommendations by Chow (1959)¹ and ARR (2012)².

The scenarios modelled for the project include both existing conditions as well as post-development conditions to assess any adverse effects of the proposed works to the receiving waters. Additionally, two separate downstream boundary conditions were modelled: One with normal flow conditions and another where the maximum water level of RL 46.95m that corresponds to the 1% Annual Exceedance Probability (AEP) flood level according to the WSP report.

¹ Chow, V.T. (1959). Open Channel Hydraulics. McGraw Hill Book Company, Inc

² Australian Rainfall & Runoff (ARR) (2012). Project 15 Two-dimensional modelling in urban and rural floodplains. Stage 1 & 2 report. Engineers Australia.



3.5.2 Results

Table 2 below presents the results of the hydrological and hydraulic analysis performed with TUFLOW modelling. The proposed stormwater infrastructure effectively captures, directs, and treats runoff from the development, resulting in reduced discharge flows compared to pre-development conditions. This ensures that the impact on downstream water bodies is minimized, providing both environmental and community benefits.

Table2. Modelling results. Discharge flows (m³/s) towards the existing wetland

Design Storm	Existing Conditions without Climate Change	Existing Conditions with Climate Change (RCP 6)	Post-Development Conditions with Climate Change (RCP 6)
2-year ARI	0.09	0.11	0.077
10-Year ARI	0.182	0.219	0.152
100-year ARI	0.455	0.646	0.413

Appendix B includes flood maps showing the maximum water depth and velocity for the modelled scenarios. These maps demonstrate the capacity of the proposed design to manage stormwater flood flows and volumes without inducing adverse effects to the surround properties and features.

3.6 Compliance with Standards

The stormwater management system has been designed to fully comply with:

- NZS 4404:2010, which specifies attenuation of peak flows, controlled discharge, and water quality treatment.
- Waikato RITS, ensuring appropriate system sizing, outlet controls, and maintenance provisions.
- WRC Hydrology Guidelines, incorporating climate change allowances and flood hazard mitigation strategies.
- Waipa District Plan, addressing stormwater discharge into the Mangaohoi Stream and ensuring no adverse environmental effects.



4. Potable Water Supply

4.1 Overview

The potable water supply can be provided from the existing 200mm water main located along the site's northern boundary. The water main will service both the domestic water demand and firefighting requirements for the development, which has an anticipated gross floor area (GFA) of 13,000m². Two fire protection options have been considered to meet compliance with SNZ PAS 4509:2008 and the New Zealand Building Code (C/AS2):

1. Option 1: Fire cells ≤2,000m² with no sprinkler system (FW2 classification).
2. Option 2: Larger fire cells with a Type 7 automatic sprinkler system.

Each option's flow rates, fire water volumes, and network feasibility are assessed below.

4.2 Domestic Water Demand

Water demand is calculated based on the updated GFA of 13,000 m², with an assumed occupancy of 1 person per 50 m² and a daily consumption rate of 30 L/person/day.

Occupancy:

$$\begin{aligned}\text{Occupancy} &= \text{GFA} / (\text{Area per Occupant}) \\ \text{Occupancy} &= 13,000\text{m}^2 / (50\text{m}^2/\text{person}) = 260 \text{ persons}\end{aligned}$$

Daily Demand:

$$\begin{aligned}\text{Daily Demand} &= \text{Occupancy} \times \text{Usage Rate} \\ \text{Daily Demand} &= 260 \times 30 = 7,800\text{L/day} \text{ (7.8m}^3\text{/day)}\end{aligned}$$

Peak Hourly Flow:

Applying a peak factor of 5 for commercial developments, the peak hourly flow is:

$$\begin{aligned}\text{Peak Hourly Flow} &= (\text{Daily Demand} \times \text{Peak Factor}) / 24 \\ \text{Peak Hourly Flow} &= (7.8\text{m}^3\text{/day} \times 5) / 24 = 1.63\text{m}^3\text{/hour}\end{aligned}$$

The calculated peak hourly demand of 1.63m³/hour represents the upper domestic usage for the site.

A comparative analysis of water demand has also been undertaken using standard population density assumptions. The Business Zone population density (30 persons per hectare) generates significantly lower water demand compared to a General Residential Zone (45 persons per hectare). The proposed Mitre 10 produces a reduced demand relative to a residential development over an equivalent area. Supporting calculations are included in Appendix F.



4.3 Firefighting Water Supply

4.3.1 Fire Flow Requirements

Under SNZ PAS 4509:2008, buildings with fire cells $\leq 2,000\text{m}^2$ require:

Fire Flow Rate: 12.5 L/s.

Duration: 30 minutes.

The firefighting water volume is calculated as follows:

Fire Volume = Flow Rate $\times$ Duration (seconds)

Fire Volume = $12.5\text{L/s} \times (30 \times 60) = 22,500\text{L} (22.5\text{m}^3)$

4.3.2 Combined Flow Demand

The total combined flow demand, including domestic use and firefighting requirements, is:

Combined Flow = Domestic Peak Hourly Flow + Fire Flow Rate

Combined Flow = $1.63\text{m}^3/\text{hour} + (12.5 \times 3.6) = 46.63\text{m}^3/\text{hour}$

4.4 Option 2: Larger Fire Cells with Type 7 Sprinkler System

4.4.1 Fire Flow Requirements

For buildings with fire cells larger than $2,000\text{m}^2$, a Type 7 sprinkler system (NZS 4541 compliant) is required. This reduces reliance on external hydrants by suppressing fires early. The fire flow requirements are as follows:

- Sprinkler System Flow Rate: 5.0 L/s.
- Hydrant Flow Rate: Reduced to 6.25 L/s (50% of FW2).
- Sprinkler Duration: 60 minutes.
- Hydrant Duration: 30 minutes.

1. Sprinkler Water Volume:

Sprinkler Volume = Sprinkler Flow Rate $\times$ Duration (seconds)

Sprinkler Volume = $5.0\text{L/s} \times (60 \times 60) = 18,000\text{L} (18.0\text{m}^3)$

2. Hydrant Water Volume:

Hydrant Volume = Hydrant Flow Rate $\times$ Duration (seconds)

Hydrant Volume = $6.25\text{L/s} \times (30 \times 60) = 11,250\text{L} (11.25\text{m}^3)$

3. Combined Fire Volume:

Total Fire Volume = $18.0 + 11.25 = 29.25\text{m}^3$

4.4.2 Combined Flow Demand

The total combined flow demand for domestic use, sprinkler operation, and hydrants is:

Combined Flow = Domestic Peak Hourly Flow + Sprinkler Flow Rate + Hydrant Flow Rate

Combined Flow = $1.63 + (5.0 \times 3.6) + (6.25 \times 3.6) = 42.13\text{m}^3/\text{hour}$



4.5 Network Capacity Assessment

The 200mm water main along Cambridge Road operates at a typical pressure range of 400–600 kPa, with a design flow capacity of 50–80 m³/hour.

Scenario	Combined Flow (m ³ /hour)	Capacity Impact
Option 1: No Sprinklers	46.63	Well within capacity.
Option 2: With Sprinklers	42.13	Better margin for safety.

Both options fall within the estimated capacity of the 250mm water main. Option 2, however, reduces peak hydrant demand by supplementing firefighting requirements with the sprinkler system, creating additional margin for pressure and flow variability.

4.6 Fire Hydrant Coverage

4.6.1 Placement and Spacing Requirements

Fire hydrants must be located within 135 meters of any part of the building, as required by SNZ PAS 4509:2008. Existing hydrants along Cambridge Road, spaced at 120–130 meters, meet this requirement. Additional on-site hydrants will be installed to ensure full site coverage and redundancy.

4.6.2 Option 1: Fire Cells ≤2,000 m² (No Sprinkler System)

At least three on-site hydrants will be required to supplement existing hydrants along Cambridge Road, ensuring all parts of the building are within coverage. Each hydrant must supply the full 12.5 L/s, with pressure and flow verified during detailed design.

4.6.3 Option 2: Larger Fire Cells with Type 7 Sprinkler System

Hydrant demand is reduced to 6.25 L/s due to the sprinkler system's early fire suppression capabilities. Two additional on-site hydrants will ensure sufficient coverage and provide redundancy near sprinkler pump connections. Option 2 imposes a lower network demand, offering greater operational flexibility compared to Option 1.



5. Wastewater Management

5.1 Overview

The wastewater generated by the commercial development of the site will discharge to the existing 150mm gravity sewer main located at the north of the site. This chapter outlines the estimated wastewater flow rates, assesses the network's capacity, and evaluates compliance with Waikato Regional Infrastructure Technical Specifications (RITS) and NZS 4404:2010.

5.2 Wastewater Flow Calculations

The daily wastewater flow is estimated based on the building's gross floor area (GFA), the assumed occupancy, and typical wastewater generation rates for commercial developments.

1. Assumptions:

- Occupancy Rate: 1 person per 50 m² (consistent with potable water demand).
- Wastewater Generation Rate: 80% of daily water demand.

2. Daily Wastewater Flow:

$$\begin{aligned}\text{Daily Wastewater Flow} &= \text{Daily Water Demand} \times 0.8 \\ \text{Daily Wastewater Flow} &= 7.8\text{m}^3/\text{day} \times 0.8 = 6.24\text{m}^3/\text{day}\end{aligned}$$

3. Peak Hourly Flow:

Using a peak factor of 2.5 for wastewater:

$$\begin{aligned}\text{Peak Hourly Flow} &= (\text{Daily Wastewater Flow} \times \text{Peak Factor})/24 \\ \text{Peak Hourly Flow} &= (6.24\text{m}^3/\text{day} \times 2.5)/24 = 0.65\text{m}^3/\text{hour}\end{aligned}$$

The peak hourly wastewater flow is therefore 0.65 m³/hour.

A similar comparative assessment of wastewater demand has been undertaken using standard zone-based population densities from the RITS manual. Results show that the peak wastewater flows expected from the Mitre 10 are lower than those of a typical General Residential development over the same area. The comparison is provided in Appendix F.

5.3 Connection to Existing Sewer Network

The wastewater will discharge into the 150mm gravity sewer main at the north of the site, which flows toward the municipal wastewater treatment system.

Key Design Considerations:

- The 150mm sewer main typically supports flows up to 12–20 L/s under gravity, depending on the gradient and depth of flow.
- The estimated peak hourly flow of 0.65 m³/hour (0.18 L/s) represents a minimal load on the existing network, well below its capacity.
- A direct connection into an existing manhole will be constructed to tie the development's internal wastewater system into the existing sewer main, ensuring minimal disruption to the public network.



5.4 Compliance with Standards

The wastewater design adheres to the following standards:

- NZS 4404:2010: Ensures proper sizing, gradients, and layout of wastewater infrastructure to prevent surcharging or blockages.
- Waikato RITS: Requires hydraulic capacity verification for both the private system and the downstream public network to handle peak flows.
- Waipa District Plan: Where feasible, the treatment of the wastewater to be at the municipal wastewater treatment facility.

5.5 Wastewater System Design

The internal wastewater system for the development will consist of:

- Gravity Sewer System: Collecting wastewater from the building and directing it toward the Cambridge Road sewer main.
- Inspection Points: Manholes or rodding points installed at key locations to facilitate maintenance and inspection.
- Minimum Grades: Pipes will be laid at grades ensuring self-cleansing velocities, consistent with NZS 4404:2010 standards.



6. General Civil Works

6.1 Overview

The commercial development of the site will involve significant civil works to establish the 13,000 m² building footprints, internal accessways, and surrounding infrastructure. These works include site grading, earthworks, pavement construction, parking provisions, and landscaping. The design will comply with NZS 4404:2010, Waikato RITS, and recommendations from the Geotechnical Report and Preliminary Site Investigation Report.

6.2 Earthworks

6.2.1 Site Grading and Levels

The site slopes gently from an elevation of RL 48.5m in the northeast to RL 46.0m in the southwest. The proposed finished levels will establish the building platform at RL 48.5m, ensuring flood protection and appropriate drainage gradients. Parking and paved areas will be graded with a 2.5% crossfall, directing surface runoff toward the stormwater detention system at the southern boundary.

6.2.2 Cut and Fill Volumes

High-level earthworks analysis indicates that the development will require a significant balance of cut and fill to achieve the proposed levels. Based on the digital elevation comparison, the total earthworks volume is 32,143.9 m³, with a net deficit of 18,059.2 m³, highlighting the need for imported fill. Approximately 7,042 m³ will be cut from areas of higher elevation, while 25,101 m³ of engineered fill will be required to raise site levels.

The cut and fill activities will span an area of 40,316 m², with cut areas covering 5,483 m² and fill extending across 33,336 m². Elevation changes range from a maximum of 2.31m to a minimum of -1.80m, averaging a vertical adjustment of 0.45m across the site.

6.2.3 Indicative Earthworks Methodology

Earthworks will begin with the stripping of 100–200mm of topsoil, which will be stockpiled on-site for reuse in landscaping areas. Subgrade improvement will involve excavating soft soils to depths of 0.5–1.0m, particularly in areas requiring higher load-bearing capacity, such as under the building footprint and truck access routes.

To ensure long-term stability, the subgrade will be reinforced with engineered fill compacted to 95% MDD (Maximum Dry Density). In high-load zones, geogrid reinforcement may be introduced as an additional measure. Any unsuitable material encountered during excavation will be removed and replaced with structural fill.

Groundwater, observed at depths of 1.5–2.0m, will require temporary dewatering during construction, particularly in the southwest corner. Subsoil drainage will be installed in fill areas to manage groundwater ingress and maintain stability over time.

6.2.4 Erosion and Sediment Control

To minimize sediment discharge during construction, erosion control measures will include a sediment retention pond located at the southwest corner to capture runoff from disturbed areas. Silt fences will be installed along the southern and western boundaries to intercept sediment-laden runoff, while a stabilized construction entrance will prevent sediment tracking onto Cambridge Road. Dust suppression measures, such as water carts or sprinklers, will manage airborne dust during dry conditions.



7. Utilities and Services

7.1 Overview

The commercial development of the site will integrate essential utility services, including power, telecommunications, gas supply, and site lighting, to ensure operational efficiency and compliance with infrastructure standards. These services will be coordinated with local providers and designed in accordance with NZS 4404:2010, Waikato RITS, and utility network specifications.

7.2 Power Supply

The site will require a reliable and sufficient power supply to meet the building's electrical demands for lighting, HVAC systems, and general operations. Power will be sourced from the existing distribution network along Cambridge Road, which may involve the installation of a dedicated on-site transformer or substation to manage high loads.

To maintain site safety and aesthetics, the electrical supply will be reticulated underground within protective ducts, connecting key areas such as the main building, car parks, and external lighting systems. The local electricity provider will confirm load demands, connection points, and transformer specifications during the detailed design phase.

On-site distribution will incorporate load-balancing measures to ensure efficient energy delivery. Backup provisions, such as emergency power supply points or connections for temporary generators, will also be considered to maintain operations during outages.

7.3 Telecommunications

Telecommunication infrastructure will provide connectivity for voice, data, and internet services, enabling efficient retail operations and administrative functions. The existing network along Cambridge Road will be extended underground to service the site, ensuring reliability and future-proofing through spare conduit installations.

The design will accommodate high-speed broadband services and ensure seamless integration with the wider telecommunications network. Service trenches will be coordinated with other underground utilities to minimize site disruption during installation.

Final specifications, including access points and redundancy options, will be confirmed in consultation with the local telecommunications provider.

7.4 Gas Supply

If gas is required for heating, hot water, or operational needs, a connection will be established from the nearest gas network. The service will be reticulated underground with appropriate safety measures, including pressure regulation, emergency shutoff valves, and compliance with AS/NZS 4645 standards for gas distribution systems.



Coordination with the gas network provider will determine capacity, connection feasibility, and layout requirements. Any on-site gas infrastructure, such as meters and supply lines, will be designed to meet operational safety and accessibility needs.

7.5 Approvals and Compliance

All utility services will be designed and installed in compliance with the following regulations and specifications:

- NZS 4404:2010: Subdivision and infrastructure design.
- Waikato RITS: Local standards for utility connections and underground service installations.
- Utility Provider Standards: Requirements for electricity, telecommunications, and gas infrastructure.
- Health and Safety Regulations: Ensuring safe construction, installation, and long-term operation.
- Approvals from relevant network providers and Waipa District Council will be secured before any utility installations commence. Final utility designs will be reviewed to ensure capacity, accessibility, and alignment with future operational needs.



8. Conclusion and Recommendations

638 Limited are seeking to rezone the site at 638 Cambridge Road from Residential to Commercial, to facilitate the establishment of a large format retail offering on the site.

Pre and post development modelling and analysis of flooding and stormwater has been undertaken, which indicates that commercial development of the site can be undertaken in a manner that avoids flood risk both within the subject site and with respect to neighbouring sites. Further the establishment of a wetland at the southern end of the site will provide the required level of attenuation of stormwater flows and stormwater quality treatment, while also providing opportunity for ecological enhancement as described in the report by Ecology New Zealand.

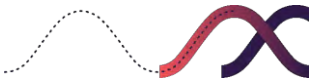
There is adequate capacity within the public wastewater and water supply lines to cater for the commercial development of the site, and utility services are available.

Standard greenfield earthworks operations will be required to develop the site, with no significant geotechnical impediments raised in the report by CMW.

Overall, there are no civil engineering impediments precluding the rezoning of the site at 638 Cambridge Road from Residential to Commercial.



Appendix A – Plans



100mm
SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY
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Version 4.0 - March 2020



NOTES:	
BUILDING AREA	13,000 m ²
MANTAINANCE ACCESS	1,103 m ²
CARPARK AREA	12,349 m ²
GARDEN	506 m ²
PATH AREA	2,200 m ²
LANDSCAPE AREA	11,344 m ²
TOTAL LOT AREA	40,502 m ²
TOTAL PERCENT PERMIABLE	29 %
TOTAL PERCENT IMPERMIABLE	71 %

1:1500 (A3) 0 30 60 90m

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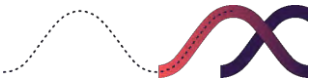
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Document Set ID: 11541079
Version: 1, Version Date: 29/09/2025



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@enviro

Appendix B – Flood maps



C:\12ds\data\10.7.120.14\148140_5397\07 Water Resources\TUFLOW\M10_TA.agz EX_2_ARI_NO_CC_D CRS: NZGD2000 / New Zealand Transverse Mercator 2000 cfokianos 20/12/2024 07:11 PM

LEGEND

M10_TA_RCP6_EX_No-CC10p_PLOT_L

Chan [C]

Proposed Reticulation

2D PO

Control Line

Depths (m)

M10_TA_RCP6_EX_No-CC50p_d_HR_Max

<= 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.25

1.25 - 1.50

> 1.50

MODEL PARAMETERS

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato LIDAR
Vertical Datum: NZVD2016

NOTE:
Depths under 100mm have been excluded from the map as per standard practise

OVERVIEW MAP

DESIGNED CHECKED DRAWN APPROVED mx model version				bbo 638 Limited	MITRE 10 TE AWAMUTU EXISTING CONDITIONS 2-YEAR ARI (50% AEP) FLOOD DEPTHS NO CLIMATE CHANGE		STATUS NOT APPROVED NOT INFORMATION	
A 20/12/2024 FIRST ISSUE ISSUE/REVISION DETAIL CF - - BY CHK APPR					DATE 20/12/2024 SCALE (ORIGINAL SIZE A3) 1:2,500 MAP NUMBER 148140-FM-0101 REVISION A			

Document Set ID: 11541079 Version: 1, Version Date: 29/09/2025

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LEGEND

M10_TA_RCP6_EX50p_PLOT_L

Chan [C]

Proposed Reticulation

2D PO

Control Line

Depths (m)

M10_TA_RCP6_EX50p_d_HR_Max

<= 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.25

1.25 - 1.50

> 1.50

MODEL PARAMETERS

Model Used: TUFLOW HPC

Model Version: 2023-03-AF

Sub-Grid Sampling: Yes

Grid Size: 20m

Quadtree Configuration: 8m/4m/2m/1m

Model Elevation Grid: 1m 2021 Waikato LIDAR

Vertical Datum: NZVD2016

NOTE:

Depths under 100mm have been excluded from the map as per standard practise

OVERVIEW MAP

				DESIGNED		CHECKED			638 Limited	MITRE 10 TE AWAMUTU EXISTING CONDITIONS 2-YEAR ARI (50% AEP) FLOOD DEPTHS RCP6 FOR THE YEAR 2100	STATUS				
				DRAWN		APPROVED					DATE	SCALE (ORIGINAL SIZE A3)			
				mx model version							20/12/2024	1:2,500			
											MAP NUMBER	REVISION			
											148140-FM-0102	A			
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LEGEND

M10_TA_RCP6_PROP_0011p_PLOT_L

Chan [C]

Proposed Reticulation

2D PO

Control Line

Depths (m)

M10_TA_RCP6_PROP_0011p_d_HR_Max

<= 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.25

1.25 - 1.50

> 1.50

MODEL PARAMETERS

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato LIDAR
Vertical Datum: NZVD2016

NOTE:
Depths under 100mm have been excluded from the map as per standard practise

OVERVIEW MAP

DESIGNED CHECKED DRAWN APPROVED mx model version				bbo 638 Limited	MITRE 10 TE AWAMUTU PROPOSED CONDITIONS 2-YEAR ARI (50% AEP) FLOOD DEPTHS RCP6 FOR THE YEAR 2100	STATUS DRAFT COPY NOT APPROVED NOT INFORMATION													
<table><tr><td colspan="2">DATE</td><td colspan="2">SCALE (ORIGINAL SIZE A3)</td></tr><tr><td colspan="2">20/12/2024</td><td colspan="2">1:2,500</td></tr><tr><td colspan="2">MAP NUMBER</td><td colspan="2">REVISION</td></tr><tr><td colspan="2">148140-FM-0103</td><td colspan="2">A</td></tr></table>						DATE		SCALE (ORIGINAL SIZE A3)		20/12/2024		1:2,500		MAP NUMBER		REVISION		148140-FM-0103	
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20/12/2024		1:2,500																	
MAP NUMBER		REVISION																	
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LEGEND

M10_TA_RCP6_EX_No-CC10p_PLOT_L

Chan [C]

Proposed Reticulation

2D PO

Control Line

Depths (m)

M10_TA_RCP6_EX_No-CC10p_d_HR_Max

<= 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.25

1.25 - 1.50

> 1.50

MODEL PARAMETERS

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato LIDAR
Vertical Datum: NZVD2016

NOTE:
Depths under 100mm have been excluded from the map as per standard practise

OVERVIEW MAP

DESIGNED CHECKED DRAWN APPROVED mx model version				bbo 638 Limited	MITRE 10 TE AWAMUTU EXISTING CONDITIONS 10-YEAR ARI (10% AEP) FLOOD DEPTHS NO CLIMATE CHANGE	STATUS DRAFT COPY NOT APPROVED NOT INFORMATION													
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DATE		SCALE (ORIGINAL SIZE A3)																	
20/12/2024		1:2,500																	
MAP NUMBER		REVISION																	
148140-FM-0104		A																	

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LEGEND

M10_TA_RCP6_EX50p_PLOT_L

Chan [C]

Proposed Reticulation

2D PO

Control Line

Depths (m)

M10_TA_RCP6_EX10p_d_HR_Max

<= 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.25

1.25 - 1.50

> 1.50

MODEL PARAMETERS

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato LIDAR
Vertical Datum: NZVD2016

NOTE:
Depths under 100mm have been excluded from the map as per standard practise

OVERVIEW MAP

DESIGNED CHECKED DRAWN APPROVED mx model version				bbo 638 Limited	MITRE 10 TE AWAMUTU EXISTING CONDITIONS 10-YEAR ARI (10% AEP) FLOOD DEPTHS RCP6 FOR THE YEAR 2100	STATUS DRAFT COPY NOT APPROVED DATE 20/12/2024 MAP NUMBER 148140-FM-0105 SCALE (ORIGINAL SIZE A3) 1:2,500 REVISION A
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LEGEND

M10_TA_RCP6_PROP_0011p_PLOT_L

Chan [C]

Proposed Reticulation

2D PO

Control Line

Depths (m)

M10_TA_RCP6_PROP_0011p_d_HR_Max

<= 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.25

1.25 - 1.50

> 1.50

MODEL PARAMETERS

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato LIDAR
Vertical Datum: NZVD2016

NOTE:
Depths under 100mm have been excluded from the map as per standard practise

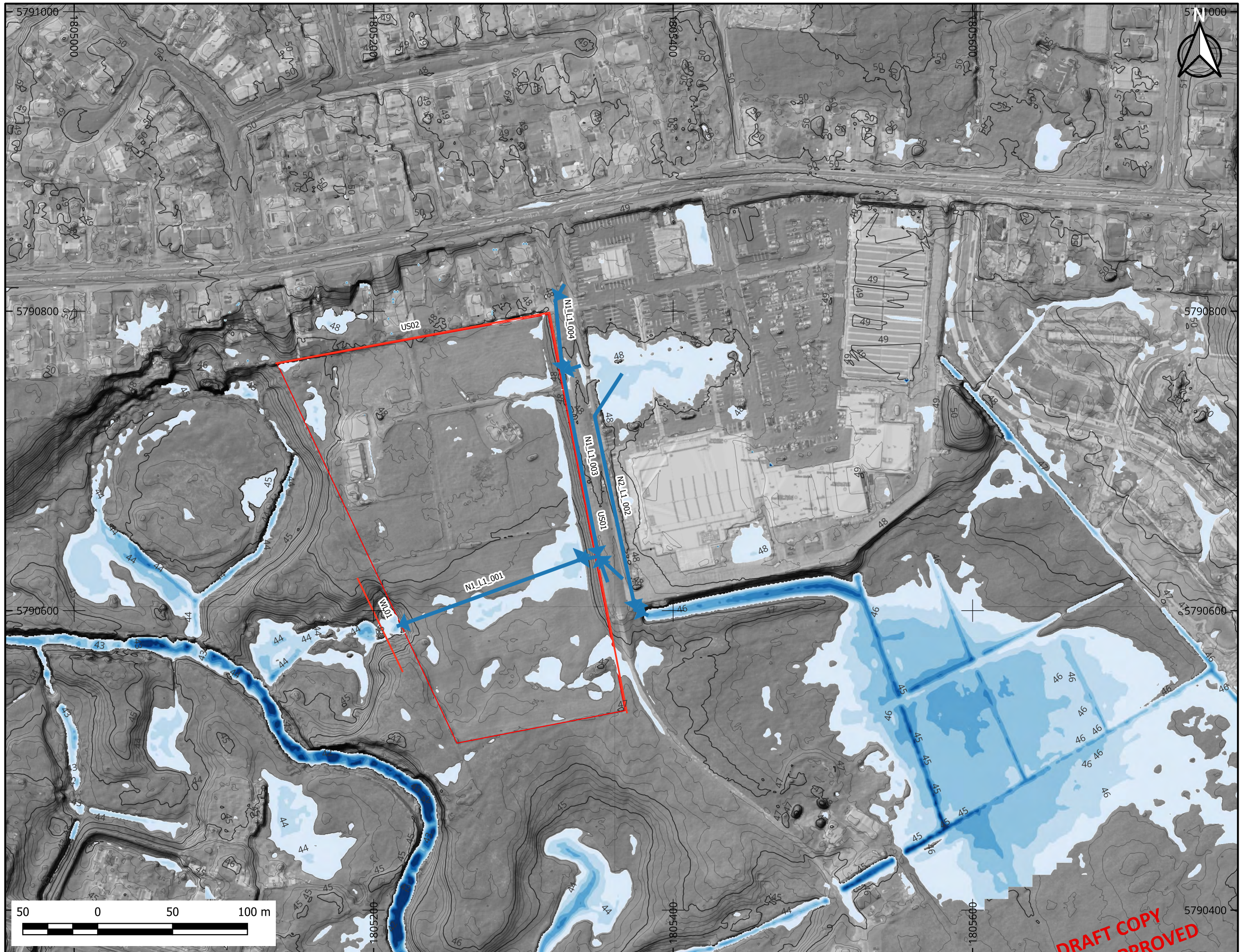
OVERVIEW MAP

DESIGNED CHECKED DRAWN APPROVED mx model version				bbo 638 Limited	MITRE 10 TE AWAMUTU PROPOSED CONDITIONS 10-YEAR ARI (10% AEP) FLOOD DEPTHS RCP6 FOR THE YEAR 2100	STATUS DRAFT COPY NOT APPROVED NOT INFORMATION					
<table><tr><td colspan="2">DATE 20/12/2024</td><td colspan="2">SCALE (ORIGINAL SIZE A3) 1:2,500</td></tr><tr><td colspan="2">MAP NUMBER 148140-FM-0106</td><td colspan="2">REVISION A</td></tr></table>						DATE 20/12/2024		SCALE (ORIGINAL SIZE A3) 1:2,500		MAP NUMBER 148140-FM-0106	
DATE 20/12/2024		SCALE (ORIGINAL SIZE A3) 1:2,500									
MAP NUMBER 148140-FM-0106		REVISION A									

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■ > 1.50

Depths under 100mm have been excluded from the map as per standard practise



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A	20/12/2024	FIRST ISSUE	CF	-	-
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Set ID: 1541070					



638 Limited

MITRE 10 TE AWAMUTU
EXISTING CONDITIONS
100-YEAR ARI (1% AEP) FLOOD DEPTHS
NO CLIMATE CHANGE

STATUS		NOT Airtel NOT INFORMATION
DATE 20/12/2024	SCALE (ORIGINAL SIZE A3) 1:2,500	
MAP NUMBER 148140-FM-0107		REVISION A

■ ≥ 1.50

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LEGEND

M10_TA_RCP6_EX50p_PLOT_L

Chan [C]

Proposed Reticulation

2D PO

Control Line

Depths (m)

M10_TA_RCP6_EX_PWL1p_d_HR_Max

<= 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.25

1.25 - 1.50

> 1.50

MODEL PARAMETERS

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato LIDAR
Vertical Datum: NZVD2016

NOTE:
Depths under 100mm have been excluded from the map as per standard practise

OVERVIEW MAP

DESIGNED CHECKED DRAWN APPROVED mx model version				bbo 638 Limited	MITRE 10 TE AWAMUTU EXISTING CONDITIONS 100-YEAR ARI (1% AEP) FLOOD DEPTHS RCP6 FOR THE YEAR 2100 1% AEP BOUNDARY CONDITIONS	STATUS DRAFT COPY NOT APPROVED NOT INFORMATION					
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DATE 20/12/2024		SCALE (ORIGINAL SIZE A3) 1:2,500									
MAP NUMBER 148140-FM-0110		REVISION A									

Document Set ID: 11541079
Version: 1, Version Date: 29/09/2025

LEGEND

M10_TA_RCP6_PROP_0011p_PLOT_L

 Chan [C] Proposed Reticulation

 2D PO Control Line

Depths (m)

M10_TA_RCP6_PROP_PWL1p_d_HR_Max

	<= 0.10
	0.10 - 0.30
	0.30 - 0.50
	0.50 - 0.75
	0.75 - 1.00
	1.00 - 1.25
	1.25 - 1.50
	> 1.50

Depths (m)

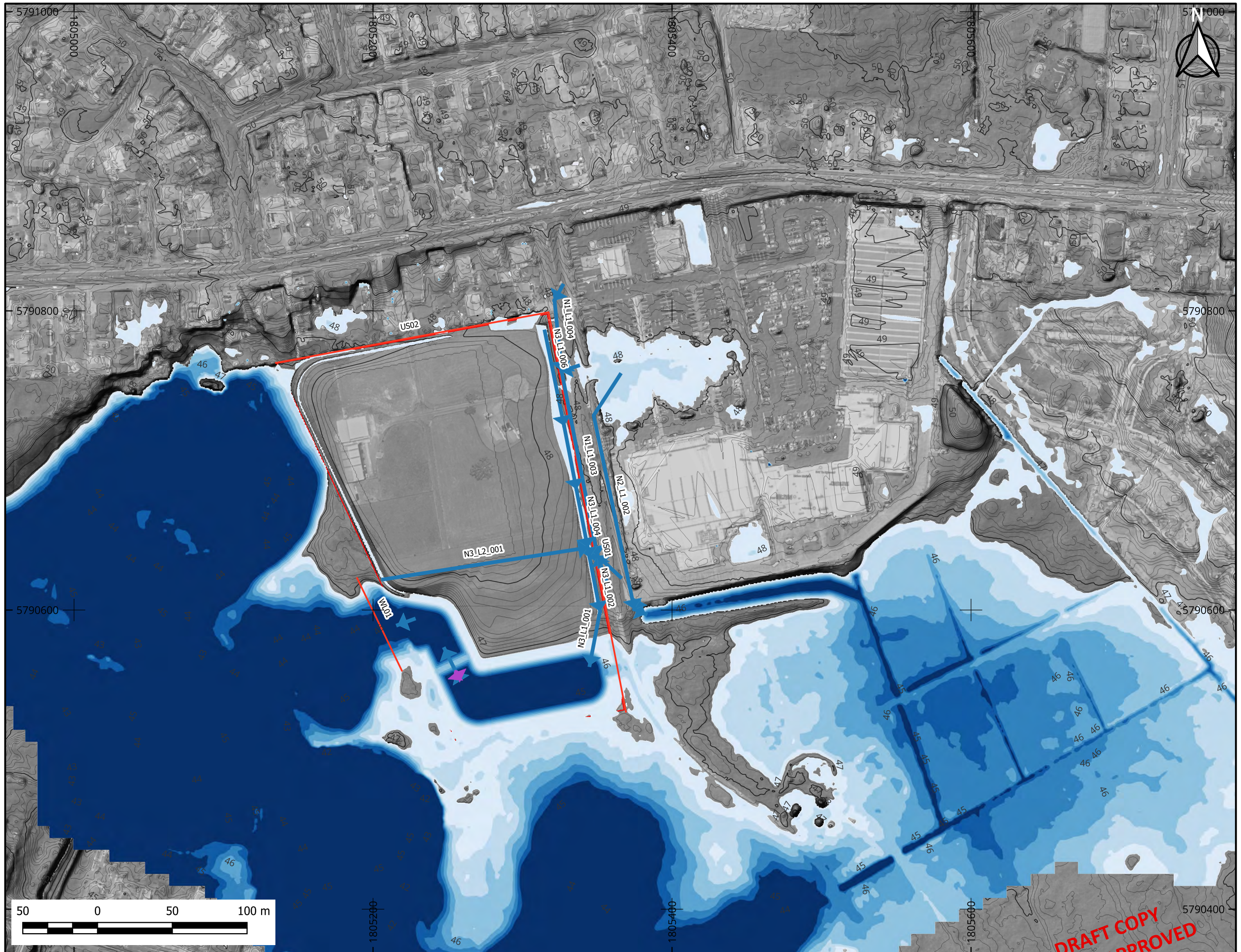
M10_TA_RCP6_PROP_PWL1p_d_HR_Max

	<= 0.10
	0.10 - 0.30
	0.30 - 0.50
	0.50 - 0.75
	0.75 - 1.00
	1.00 - 1.25
	1.25 - 1.50
	> 1.50

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato
LIDAR
Vertical Datum: NZVD2016

NOTE:
Depths under 100mm have been excluded
from the map as per standard practise

OVERVIEW MAP

[illegible]

638 Limited

**MITRE 10 TE AWAMUTU
PROPOSED CONDITIONS
100-YEAR ARI (1% AEP) FLOOD DEPTHS
RCP6 FOR THE YEAR 2100
1% AEP BOUNDARY CONDITIONS**

STATUS		NOT APPROVED	
NO INFORMATION			
DATE		SCALE (ORIGINAL SIZE A3)	
13/01/2025		1:2,500	
MAP NUMBER		REVISION	
148140-FM-0111		A	

**DRAFT COPY
NOT APPROVED**

LEGEND

M10_TA_RCP6_EX_No-CC10p_PLOT_L

 Chan [C] Proposed Reticulation

 2D PO Control Line

Velocity (m/s)

M10_TA_RCP6_EX_No-CC50p_V_Max_rem

	<= 0.10
	0.10 - 0.20
	0.20 - 0.30
	0.30 - 0.40
	0.40 - 0.50
	0.50 - 1.00
	1.00 - 1.50
	1.50 - 2.00
	2.00 - 2.50
	2.50 - 3.00
	> 3.00

→ Chan [C] Proposed Reticulation

Velocity (m/s)

■ ≤ 0.10

0.10 - 0.20

0.20 - 0.30

0.30 - 0.40

0.40 - 0.50

0.50 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

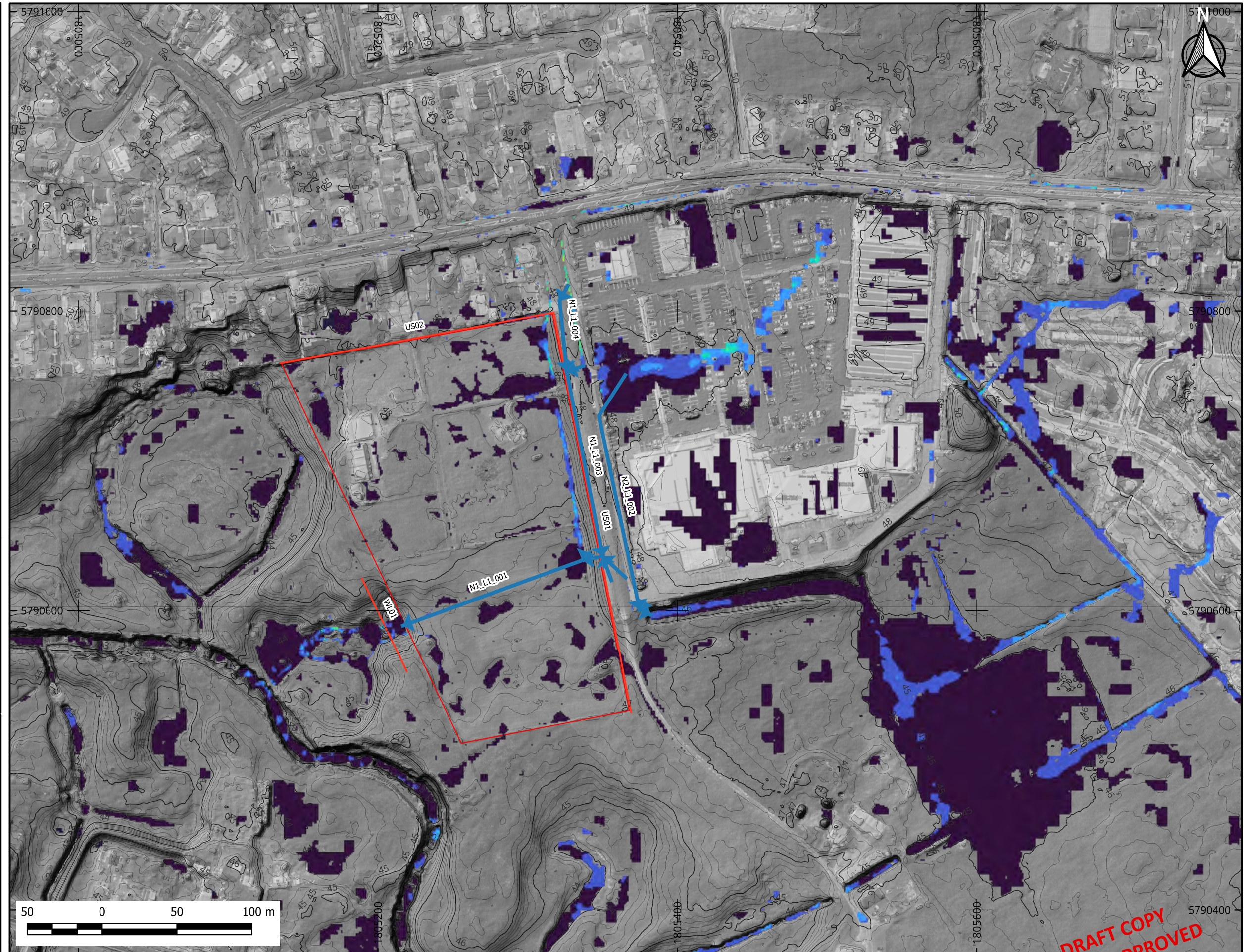
2.50 - 3.00

■ > 3.00

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato
LIDAR
Vertical Datum: NZVD2016

OVERVIEW MAP

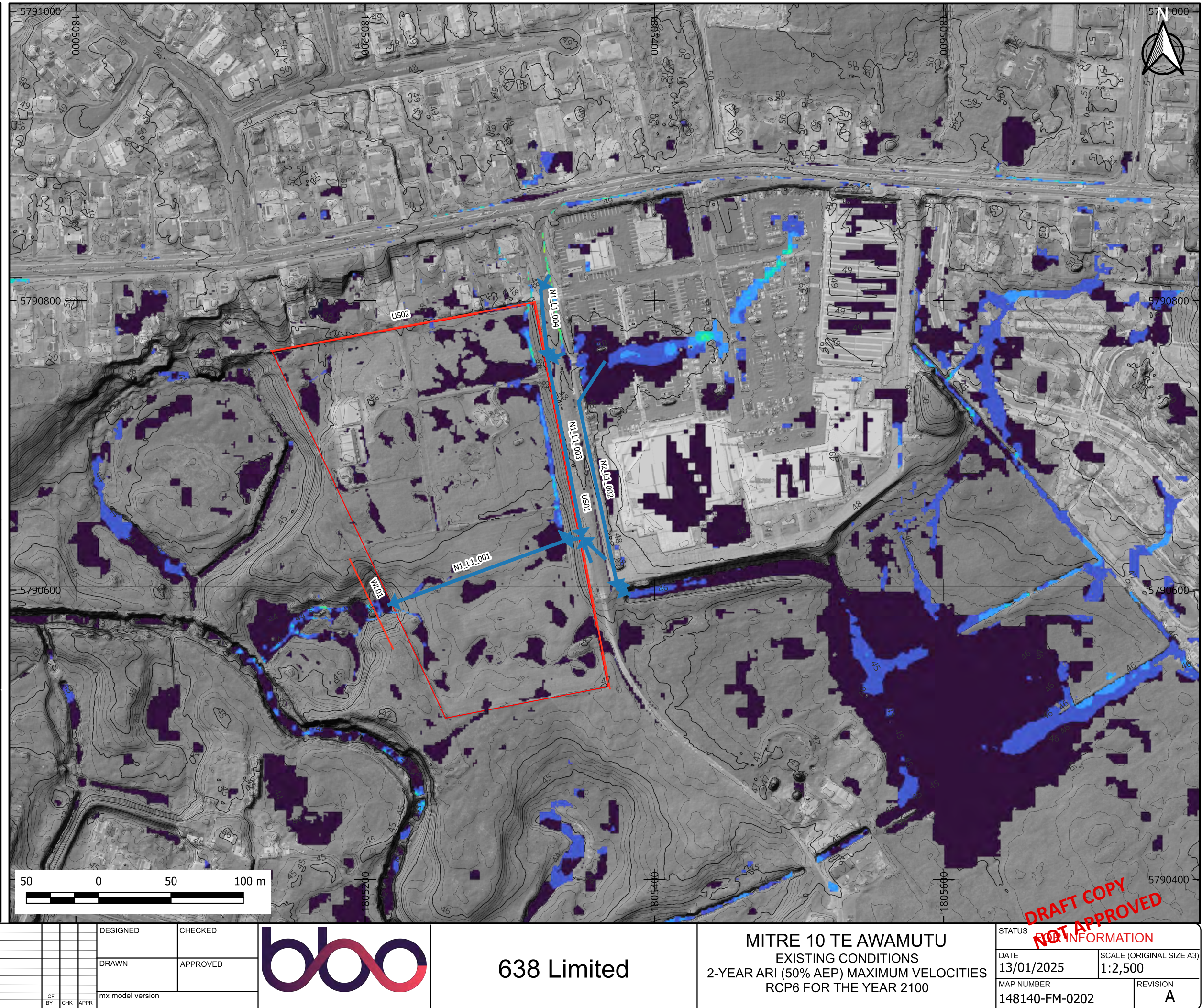
This is a grayscale aerial photograph of a landscape. A red rectangle is drawn in the center, highlighting a specific area of interest. The landscape features a mix of terrain, including what appears to be a river or stream on the left, a road network, and various land use patterns. The text "OVERVIEW MAP" is printed in a bold, sans-serif font at the top of the image.

[illegible]

638 Limited

MITRE 10 TE AWAMUTU
EXISTING CONDITIONS
2-YEAR ARI (50% AEP) MAXIMUM VELOCITIES
NO CLIMATE CHANGE

STATUS		NOT A PUBLIC INFORMATION	
DATE 20/12/2024		SCALE (ORIGINAL SIZE A3) 1:2,500	
MAP NUMBER 148140-FM-0201		REVISION A	



LEGEND

M10_TA_RCP6_PROP_0011p_PLOT_L

→ Chan [C] Proposed Reticulation

— 2D PO Control Line

Velocity (m/s)

M10_TA_RCP6_PROP_00150p_V_Max_re

A vertical color scale legend for velocity in m/s. It consists of 11 colored squares, each followed by a velocity range. The colors transition from dark purple at the bottom to dark red at the top.

<= 0.10
0.10 - 0.20
0.20 - 0.30
0.30 - 0.40
0.40 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
2.00 - 2.50
2.50 - 3.00
> 3.00

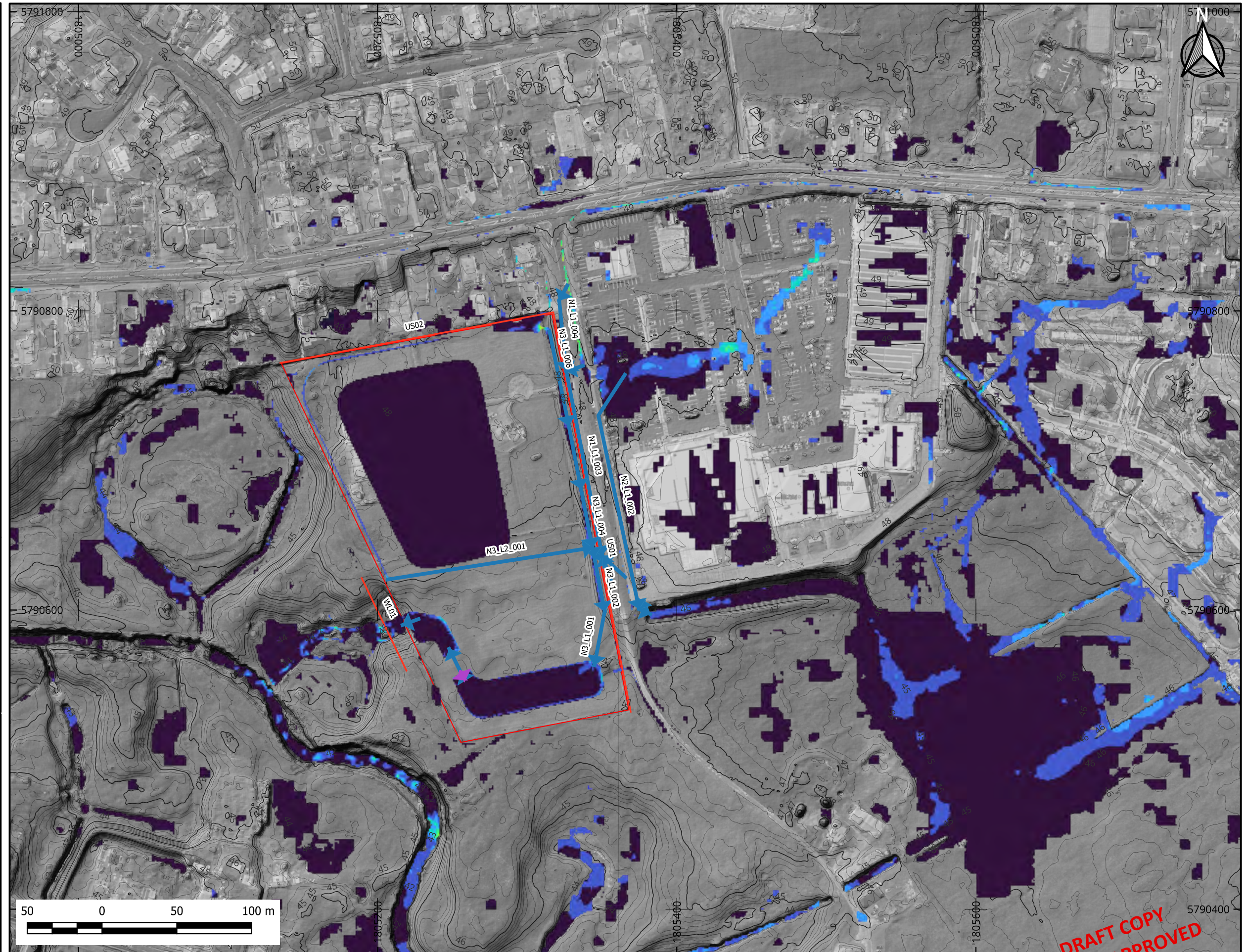
 Chan [C] Proposed Reticulation
 2D PO Control Line

 <= 0.10
 0.10 - 0.20
 0.20 - 0.30
 0.30 - 0.40
 0.40 - 0.50
 0.50 - 1.00
 1.00 - 1.50
 1.50 - 2.00
 2.00 - 2.50
 2.50 - 3.00
 > 3.00

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato
LIDAR
Vertical Datum: NZVD2016

OVERVIEW MAP

This is a grayscale aerial photograph showing a landscape with a red rectangular box highlighting a specific area. The text "OVERVIEW MAP" is printed in bold, black, uppercase letters at the top center of the image. The landscape features a mix of terrain, including what appears to be a river or stream winding through the left side, and various land parcels or fields. The red box is positioned in the center-left of the image, enclosing a region that includes some of the winding water features and adjacent land parcels.

[illegible]

638 Limited

MITRE 10 TE AWAMUTU
PROPOSED CONDITIONS
2-YEAR ARI (50% AEP) MAXIMUM VELOCITIES
RCP6 FOR THE YEAR 2100

STATUS		NOT A PART OF INFORMATION	
DATE 20/12/2024		SCALE (ORIGINAL SIZE A3) 1:2,500	
MAP NUMBER 148140-FM-0203		REVISION A	

C:\12ds\data\10.7.120.14\148140_5397\07 Water Resources\TUFLOW\M10_TA.agz EX_10_ARI_NO_CC_V CRS: NZGD2000 / New Zealand Transverse Mercator 2000 cfoklanos 20/12/2024 07:03 PM

LEGEND

M10_TA_RCP6_EX_No-CC10p_PLOT_L

Chan [C]

Proposed Reticulation

2D PO

Control Line

Velocity (m/s)

M10_TA_RCP6_EX_No-CC10p_V_Max_rem

<= 0.10

0.10 - 0.20

0.20 - 0.30

0.30 - 0.40

0.40 - 0.50

0.50 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

2.50 - 3.00

> 3.00

MODEL PARAMETERS

Model Used: TUFLOW HPC

Model Version: 2023-03-AF

Sub-Grid Sampling: Yes

Grid Size: 20m

Quadtree Configuration: 8m/4m/2m/1m

Model Elevation Grid: 1m 2021 Waikato LIDAR

Vertical Datum: NZVD2016

OVERVIEW MAP

				DESIGNED		CHECKED			638 Limited	MITRE 10 TE AWAMUTU EXISTING CONDITIONS 10-YEAR ARI (10% AEP) MAXIMUM VELOCITIES NO CLIMATE CHANGE	STATUS				
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				mx model version							20/12/2024	1:2,500			
											MAP NUMBER	REVISION			
											148140-FM-0204	A			

Document Set ID: 11541079
Version: 1, Version Date: 29/09/2025

[illegible]

638 Limited

MITRE 10 TE AWAMUTU
EXISTING CONDITIONS
10-YEAR ARI (10% AEP) MAXIMUM VELOCITIES
RCP6 FOR THE YEAR 2100

STATUS		NOT A FOR INFORMATION	
DATE 20/12/2024		SCALE (ORIGINAL SIZE A3) 1:2,500	
MAP NUMBER 148140-FM-0205		REVISION A	

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LEGEND

M10_TA_RCP6_PROP_0011p_PLOT_L

 Chan [C]

Proposed Reticulation

 2D PO

Control Line

Velocity (m/s)

M10_TA_RCP6_PROP_00110p_V_Max_ren



<= 0.10



0.10 - 0.20



0.20 - 0.30



0.30 - 0.40



0.40 - 0.50



0.50 - 1.00



1.00 - 1.50



1.50 - 2.00



2.00 - 2.50



2.50 - 3.00



> 3.00

MODEL PARAMETERS

Model Used: TUFLOW HPC

Model Version: 2023-03-AF

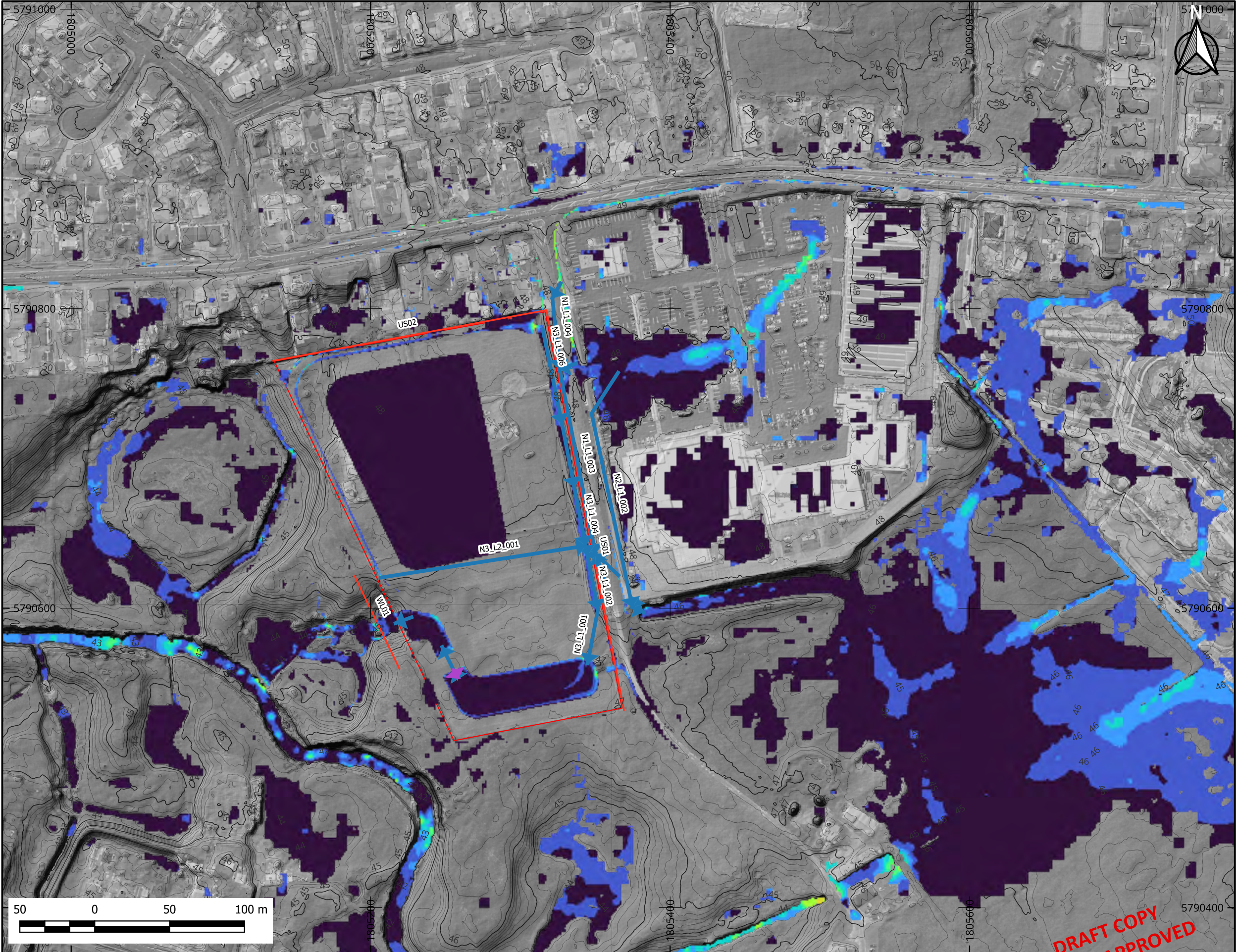
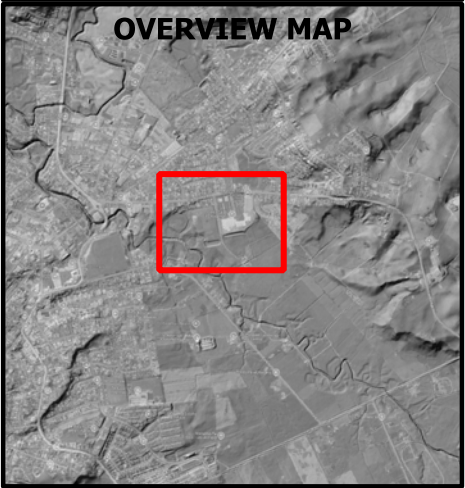
Sub-Grid Sampling: Yes

Grid Size: 20m

Quadtree Configuration: 8m/4m/2m/1m

Model Elevation Grid: 1m 2021 Waikato LIDAR

Vertical Datum: NZVD2016



				DESIGNED		CHECKED			638 Limited	MITRE 10 TE AWAMUTU PROPOSED CONDITIONS 10-YEAR ARI (10% AEP) MAXIMUM VELOCITIES RCP6 FOR THE YEAR 2100	STATUS				
				DRAWN		APPROVED					DATE	SCALE (ORIGINAL SIZE A3)			
				mx model version							20/12/2024	1:2,500			
				BY	CHK	APPR					MAP NUMBER	REVISION			
											148140-FM-0206	A			

LEGEND

M10_TA_RCP6_EX_No-CC10p_PLOT_L

 Chan [C] Proposed Reticulation

 2D PO Control Line

Velocity (m/s)

M10_TA_RCP6_EX_No-CC1p_V_Max_remain

	<= 0.10
	0.10 - 0.20
	0.20 - 0.30
	0.30 - 0.40
	0.40 - 0.50
	0.50 - 1.00
	1.00 - 1.50
	1.50 - 2.00
	2.00 - 2.50
	2.50 - 3.00
	> 3.00

→ Chan [C] Proposed Reticulation

Velocity (m/s)

■ ≤ 0.10

0,20 - 0,30

0.30 - 0.40

0.40 - 0.50

0.50 - 1.00

1.00 - 1.50

1.50 2.00

2.00 2.50

2.12

MODEL PARAMETERS

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato
LIDAR
Vertical Datum: NZVD2016

Model Version: 2023-03-AF

Sub-Grid Sampling: Yes

Grid Size: 20m

Quadtree Configuration: 8m/4m/2m/1m

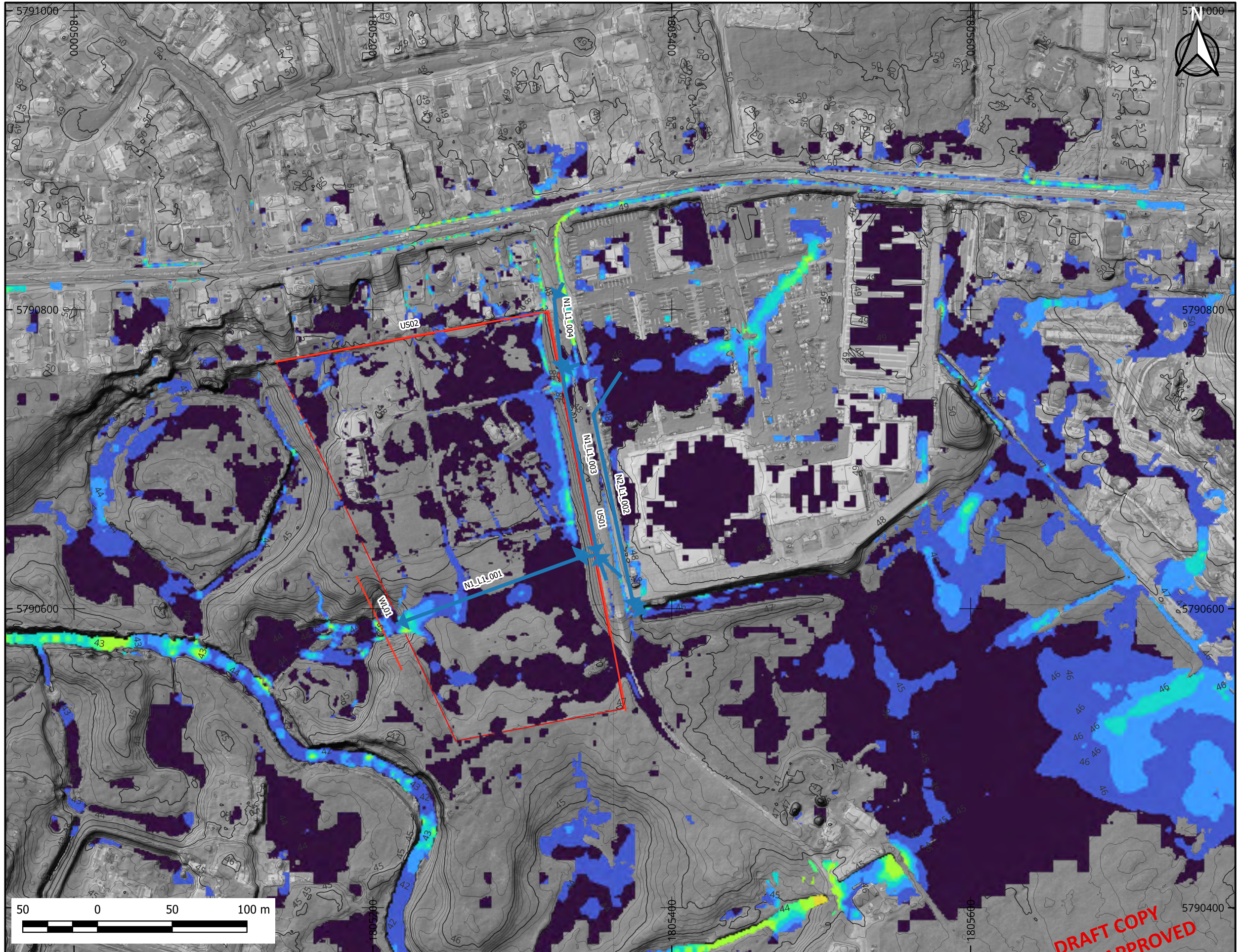
Model Elevation Grid: 1m 2021 Waikato

LIDAR

Vertical Datum: NZVD2016

OVERVIEW MAP

This grayscale aerial photograph provides a regional context for the study area. A prominent black line represents the Tiber River, which flows from the upper left towards the lower right. A red rectangular box is superimposed on the map, indicating the specific location of the study site within the broader landscape of the Tiber Valley. The terrain is characterized by a mix of agricultural fields, forested areas, and some built-up regions.



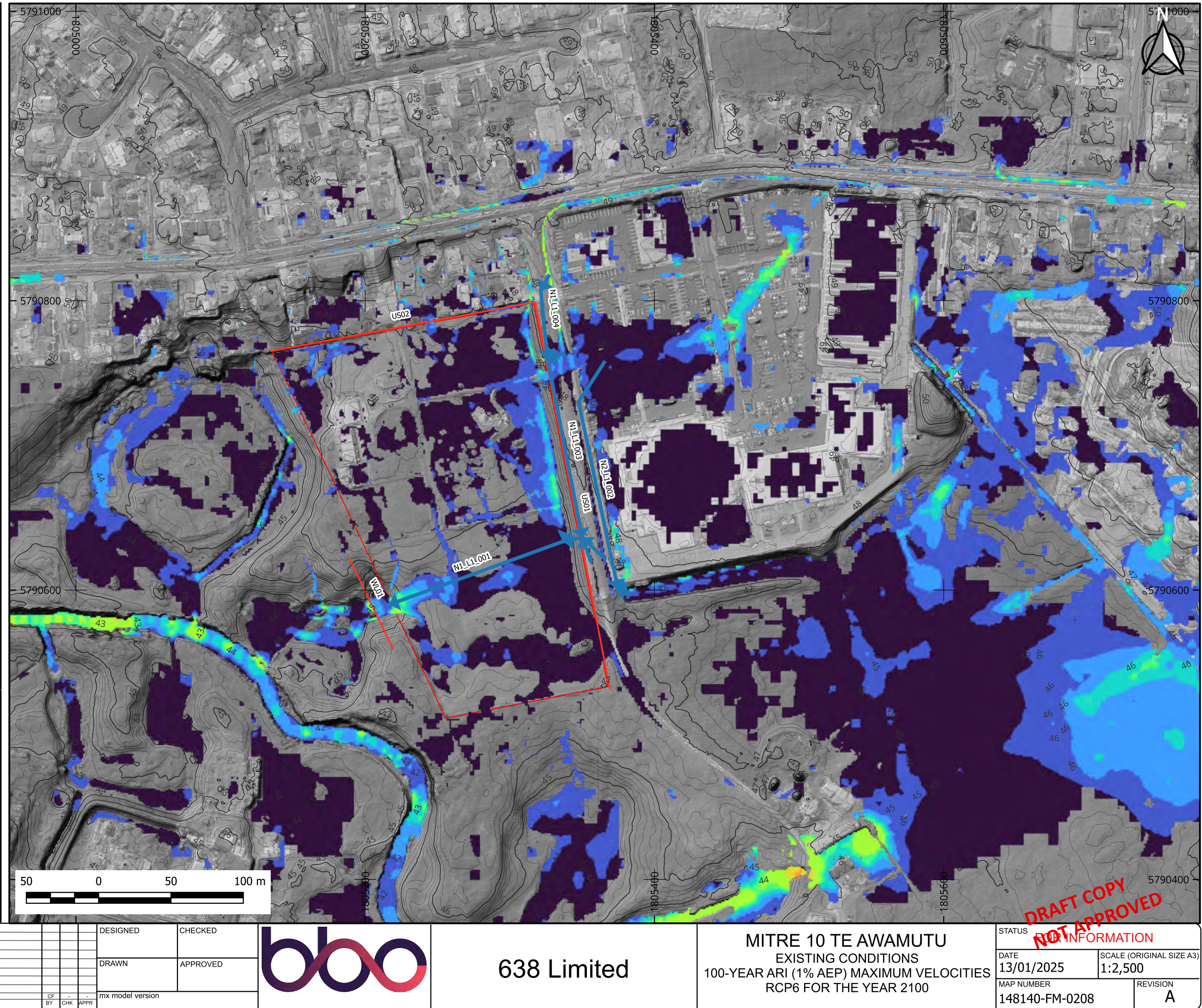
DRAFT COPY
NOT APPROVED
FOR INFORMATION

[illegible]

638 Limited

MITRE 10 TE AWAMUTU
EXISTING CONDITIONS
100-YEAR ARI (1% AEP) MAXIMUM VELOCITIES
NO CLIMATE CHANGE

STATUS		NOT A CONFIDENTIAL INFORMATION	
DATE 20/12/2024		SCALE (ORIGINAL SIZE A3) 1:2,500	
MAP NUMBER 148140-FM-0207		REVISION A	



LEGEND

M10_TA_RCP6_PROP_0011p_PLOT_L

→ Chan [C] Proposed Reticulation

— 2D PO Control Line

Velocity (m/s)

M10_TA_RCP6_PROP_0011p_V_Max_remainder

Velocity Range (m/s)	Color
<= 0.10	Dark Purple
0.10 - 0.20	Blue-Purple
0.20 - 0.30	Blue
0.30 - 0.40	Cyan
0.40 - 0.50	Green
0.50 - 1.00	Light Green
1.00 - 1.50	Yellow
1.50 - 2.00	Orange
2.00 - 2.50	Dark Orange
2.50 - 3.00	Red
> 3.00	Dark Red

→ Chan [C] Proposed Reticulation

Velocity (m/s)

■ ≤ 0.10

■ 0.10 - 0.20

■ 0.20 - 0.30

0.30 - 0.40

0.40 - 0.50

0.50 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

■ 2.50 - 3.00

■ > 3.00

MODEL PARAMETERS

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato
LIDAR
Vertical Datum: NZVD2016

Model Used: TUFLOW HPC

Model Version: 2023-03-AF

Sub-Grid Sampling: Yes

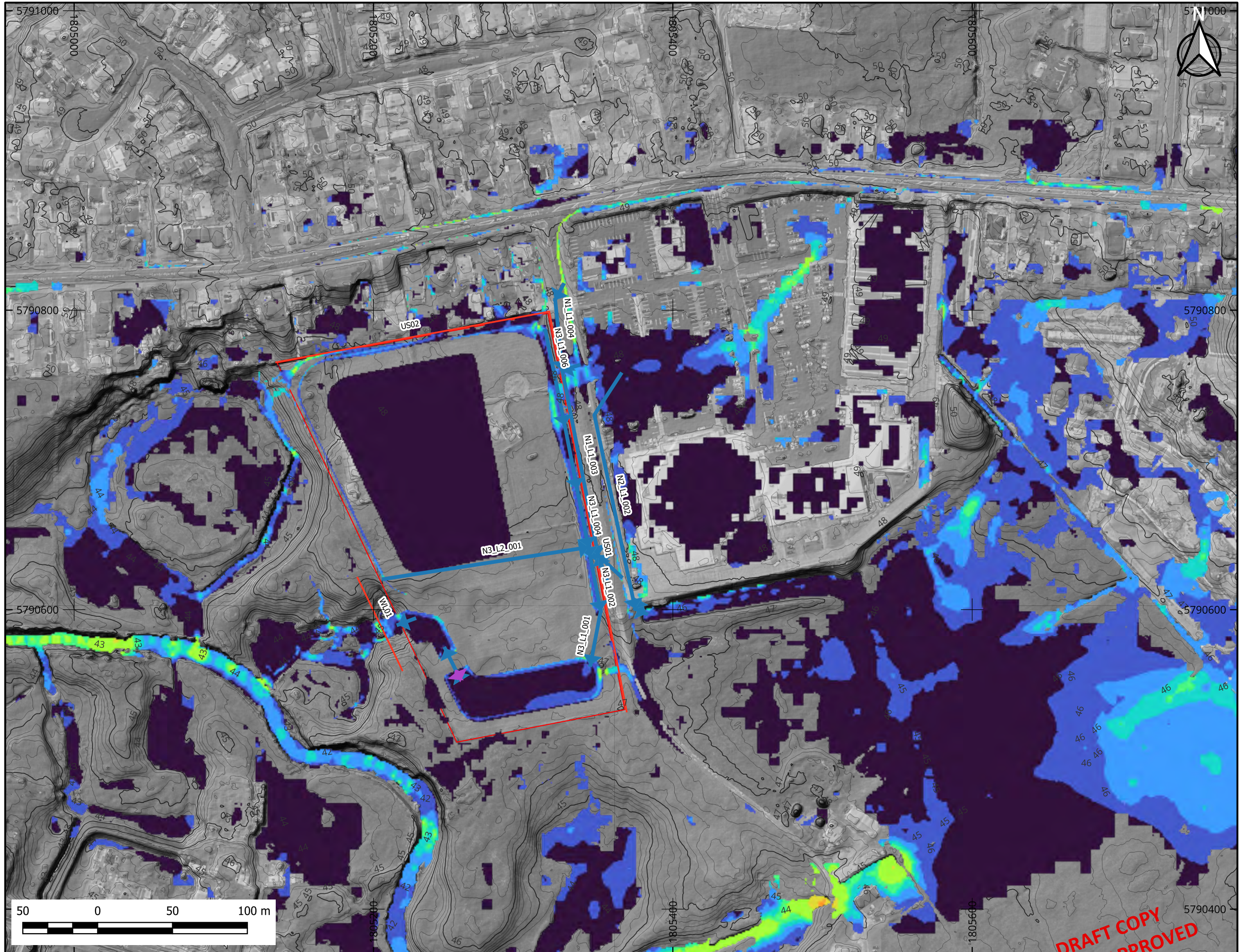
Grid Size: 20m

Quadtree Configuration: 8m/4m/2m/1m

Model Elevation Grid: 1m 2021 Waikato

LIDAR

Vertical Datum: NZVD2016



DRAFT COPY
NOT APPROVED
FOR INFORMATION

[illegible]

638 Limited

MITRE 10 TE AWAMUTU
PROPOSED CONDITIONS
100-YEAR ARI (1% AEP) MAXIMUM VELOCITIES
RCP6 FOR THE YEAR 2100

STATUS		NOT APPLICABLE	
DATE		SCALE (ORIGINAL SIZE A3)	
20/12/2024		1:2,500	
MAP NUMBER		REVISION	
148140-FM-0209		A	

LEGEND

M10_TA_RCP6_EX50p_PLOT_L

 Chan [C] Proposed Reticulation

 2D PO Control Line

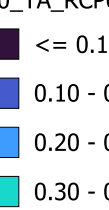
Velocity (m/s)

M10_TA_RCP6_EX_PWL1p_V_Max_remap

	<= 0.10
	0.10 - 0.20
	0.20 - 0.30
	0.30 - 0.40
	0.40 - 0.50
	0.50 - 1.00
	1.00 - 1.50
	1.50 - 2.00
	2.00 - 2.50
	2.50 - 3.00
	> 3.00

Velocity (m/s)

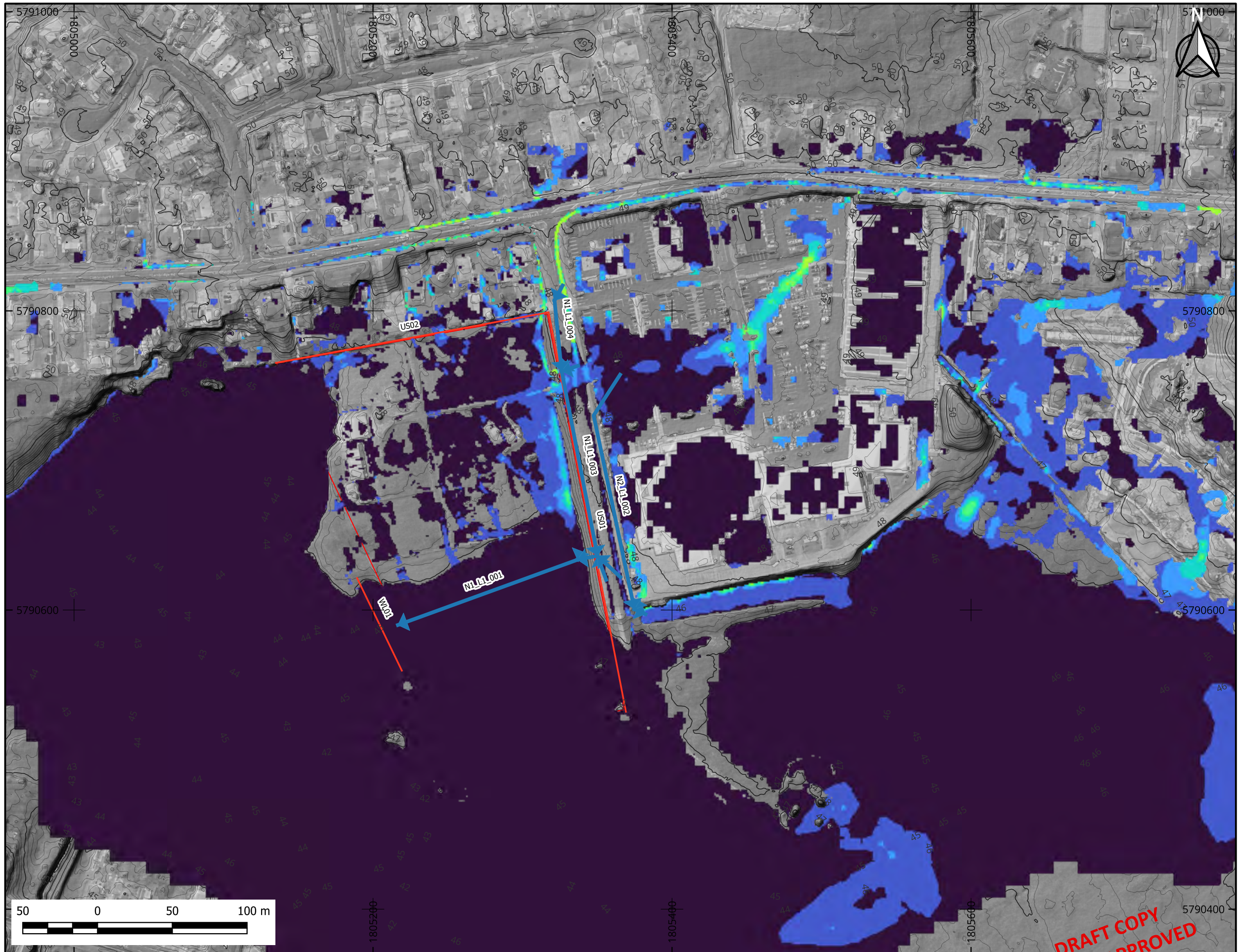
M10_TA_RCP6_EX_PWL1p_V_Max_remap



A vertical color scale legend for velocity in m/s. It consists of 10 colored squares, each followed by a velocity range. The colors transition from dark purple at the bottom to dark red at the top. The ranges are: <= 0.10, 0.10 - 0.20, 0.20 - 0.30, 0.30 - 0.40, 0.40 - 0.50, 0.50 - 1.00, 1.00 - 1.50, 1.50 - 2.00, 2.00 - 2.50, and > 3.00.

<= 0.10
0.10 - 0.20
0.20 - 0.30
0.30 - 0.40
0.40 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
2.00 - 2.50
2.50 - 3.00
> 3.00

Model Used: TUFLOW HPC
Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato
LIDAR
Vertical Datum: NZVD2016

[illegible]

MITRE 10 TE AWAMUTU
EXISTING CONDITIONS
100-YEAR ARI (1% AEP) MAXIMUM VELOCITIES
RCP6 FOR THE YEAR 2100
1% AEP BOUNDARY CONDITIONS

STATUS		NOT APT INFORMATION	
DATE	20/12/2024	SCALE (ORIGINAL SIZE A3)	1:2,500
MAP NUMBER		REVISION	
148140-FM-0210		A	

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NOT APPROVED
FOR INFORMATION

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LEGEND

M10_TA_RCP6_PROP_0011p_PLOT_L

Chan [C]

Proposed Reticulation

2D PO

Control Line

Velocity (m/s)

M10_TA_RCP6_PROP_PWL1p_V_Max_rem

<= 0.10

0.10 - 0.20

0.20 - 0.30

0.30 - 0.40

0.40 - 0.50

0.50 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

2.50 - 3.00

> 3.00

MODEL PARAMETERS

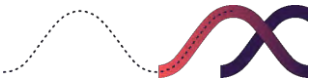
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Model Version: 2023-03-AF
Sub-Grid Sampling: Yes
Grid Size: 20m
Quadtree Configuration: 8m/4m/2m/1m
Model Elevation Grid: 1m 2021 Waikato LIDAR
Vertical Datum: NZVD2016

OVERVIEW MAP

				DESIGNED		CHECKED			638 Limited	MITRE 10 TE AWAMUTU PROPOSED CONDITIONS 100-YEAR ARI (1% AEP) MAXIMUM VELOCITIES RCP6 FOR THE YEAR 2100 1% AEP BOUNDARY CONDITIONS	STATUS		NOT APPROVED				
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				mx model version							MAP NUMBER	148140-FM-0211	REVISION	A			
A				20/12/2024	FIRST ISSUE			CF	-	-	ISSUE/REVISION DETAIL						
Set ID: 11541079				BY	CHK	APPR											

Document Set ID: 11541079
Version: 1, Version Date: 29/09/2025

Appendix C – Initial Abstraction Calculation



Appendix C: Initial Abstraction Calculation Report

1. Introduction

This report outlines the calculation of the **initial abstraction (Ia)** for the site located within the area outlined in red on the provided S-Map soil drainage map. The methodology follows the **Waikato Stormwater Runoff Modelling Guideline (TR20-06)**, specifically Section 5.1, which utilizes the NRCS Curve Number (CN) method.

The initial abstraction represents the amount of rainfall retained before runoff occurs, accounting for soil infiltration and surface storage. This calculation is a critical step in stormwater runoff modeling and helps determine the volume of water that must be managed to mitigate flooding and environmental impacts.

2. Site Information

Location: Outlined area on the S-Map Online Map

Total Area: 4.05 hectares (ha)

Soil Drainage Classification:

Soil Drainage Class	Area (ha)	Proportion (%)
Poorly Drained	1.61	40%
Imperfectly Drained	1.61	40%
Well Drained	0.83	20%

3. Methodology

The calculation follows these key steps:

1. Assign Curve Numbers (CN): Based on land use and soil group.
2. Calculate Weighted CN: Combine CN values based on soil drainage proportions.
3. Determine Soil Storage (S): Using CN to compute potential maximum retention.
4. Calculate Initial Abstraction (Ia): Derived as 5% of S.

4. Calculations

4.1 Weighted Curve Number (CN)

The weighted CN is determined using the proportion of each soil class:

$CN_{weighted} = (CN_D * A_D) + (CN_{C/D} * A_{C/D}) + (CN_B * A_B)$

Where:

- CN_D = Curve Number for poorly drained soils (84)
- CN_C/D = Curve Number for imperfectly drained soils (79)
- CN_B = Curve Number for well-drained soils (69)
- A_D, A_C/D, A_B = Proportions of respective soil drainage classes

Substitute values:

$CN_{weighted} = (84 * 0.399) + (79 * 0.399) + (69 * 0.201)$

$CN_{weighted} = 33.52 + 31.52 + 13.89 = 78.93$

Result: Weighted CN = 78.93

4.2 Soil Storage Parameter (S)

The soil storage parameter is calculated using the formula:

$$S = ((1000 / CN) - 10) * 25.4$$

Where:

- CN = Curve Number
- S = Soil Storage (mm)

Substitute CN = 78.93:

$$S = ((1000 / 78.93) - 10) * 25.4$$

$$S = 67.82 \text{ mm}$$

Result: Soil Storage (S) = 67.82 mm

4.3 Initial Abstraction (Ia)

The initial abstraction is calculated as:

$$Ia = 0.05 * S$$

Where:

- Ia = Initial Abstraction (mm)
- S = Soil Storage Parameter (mm)

Substitute S = 67.82:

$$Ia = 0.05 * 67.82 = 3.39 \text{ mm}$$

Result: Initial Abstraction (Ia) = 3.39 mm

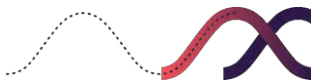
5. Results Summary

Parameter	Value
Total Site Area	4.03 ha
Weighted Curve Number (CN)	78.93
Soil Storage Parameter (S)	67.82 mm
Initial Abstraction (Ia)	3.39 mm

6. Conclusion

Using the Waikato Stormwater Runoff Modelling Guideline (TR20-06), Section 5.1, the initial abstraction for the outlined area was determined to be 3.39 mm. This value reflects the weighted contributions of soil drainage classes across the site and provides a robust input for further stormwater management calculations.

Appendix D – Geotechnical Report



19 September 2025

Document Ref: HAM2023-0058AD | Rev 2

Bloxam Burnett & Olliver (BBO)
4/18 London Street
Hamilton, 3204

Attention: Constantinos Fokianos

Dear Constantinos

RE: PRELIMINARY GEOTECHNICAL REPORT – MITRE 10 **638 CAMBRIDGE ROAD, TE AWAMUTU**

1.0 INTRODUCTION

CMW Geosciences (CMW) was engaged by Bloxam Burnett & Olliver (BBO) to carry out a geotechnical assessment of a site located at 638 Cambridge Road, Te Awamutu, to support a plan change application to have the site rezoned as commercial/industrial.

The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced HAM2023-0058AC, Rev2 VO1 dated 4 October 2024.

2.0 SITE DESCRIPTION

2.1 Site Location

The proposed development site “the Site” is located on Cambridge Road, Te Awamutu, as shown in **Figure 1**.



Figure 1. Site Location Plan (Source: Waipa District Maps, 2021)

The Site comprises an area of approximately 4ha and is currently used for agricultural purposes.

It is bordered by residential properties to the north, the Te Awamutu Large Format Retail Centre to the east, and grassed agricultural land to the south and west.

2.2 Landform

The Site is predominantly gently sloping, with existing ground levels ranging from approximately RL48m to RL48.5m at the northern end to RL47m at the southern end.

The northern site boundary is at the toe of low rolling hills located to the north of the site. The maximum elevation of the hills is approximately RL51m.

The land to the south and west of the site falls to approximately RL44m to RL45m.

The nearest watercourse is the Mangaohoi Stream, which at its closest, is approximately 35m from the southwestern site boundary. The stream channel is incised approximately 4m below the Site to approximately RL43m to RL44m. We understand that the stream is prone to flooding.

2.3 Site History

In addition to the infilled relict stream channels, there appears to be a depression to the northwest of the Site. This depression appears to have been infilled over time and is also shown indicatively on ***Drawings 01 and 02***.

A review of the available Retrolens and Google Earth aerial imagery from the period 1944 to 2023 was undertaken. Copies of the photographs reviewed are provided in ***Appendix A*** along with a summary of the changes observed within the Site and its surrounds, presented in ***Table A1***. In summary:

- The Site has been used for agricultural purposes since the 1940s.
- Various earthworks have historically been carried out across the Site and the surrounding area including infilling or partial infilling of relict stream channels. Approximate extents of the infilled channels are shown in ***Drawing 01, with a geological section provided in Drawing 02***.
- The course of the meandering Mangaohoi Stream changed most significantly before 1958 and has remained largely unchanged since then.
- Various buildings have come and gone from within the Site.
- There have been minor changes to vegetation within the Site.
- Development of the area to the east of the Site, currently the Te Awamutu Large Format Retail Centre, commenced sometime between 1944 and 1958. The initial development was next to Cambridge Road but extended to the south over time. We understand that the Site was operated as a sawmill. The sawmill appears to have shutdown sometime between 1974 and 1995. Development of the Te Awamutu Large Format Retail Centre had commenced by 2010.

3.0 PROPOSED DEVELOPMENT

The site plan by Woodhams Meikle Zhan Architects (***Appendix B***) shows a building with a 13,000m² floor area covering the western side of the Site, which we assume will be a single-story warehouse building, similar to other Mitre 10 stores.

The proposed building is shown to be offset approximately 14m from the western boundary and 7m from the northern boundary. A 6m wide landscape strip is shown along the north, south, and west boundaries. It is assumed that the remainder of the site will comprise hardstand and car parking.

At the time of writing this report, cut and/or fill plans have not been provided. However, there is currently an approximate drop in level of 1.5m between the north end of the site and the south end, therefore cut and/or fill will be required to provide a level building platform.

4.0 INVESTIGATION SCOPE

4.1 Desktop Study

The desktop study undertaken for the site by CMW included review of relevant historic aerial photographs and geological mapping¹.

4.2 Field Investigation

Following a dial before you dig search, the field investigation was carried out on 18 October 2024. Fieldwork was carried out by CMW Geosciences in general accordance with the NZGS specifications² and logged in accordance with NZGS guidance³.

The scope of the fieldwork was completed as follows:

- A walkover survey of the site to assess the general landform, site conditions and adjacent structures / infrastructure.
- An onsite services search was carried out by a specialist contractor to identify the presence of any underground obstructions or hazards prior to the field investigation program commencing.
- Eight Hand Auger boreholes (HA), denoted HA-01 and HA-08 were drilled using a 50mm diameter auger below existing ground levels to visually observe the near surface soil profile and to facilitate vane shear strength testing. HA01 to HA04 were terminated at depths of 1.9m to 3.6m below ground level due to hole collapse/no retrieval, prior to reaching the target depth of 5m. HA06 to HA08 were terminated at depths of 1.2m to 1.7m below ground level due to refusal on hard ground, prior to reaching the target depth of 5m. HA05 was terminated at a depth of 5m below ground level, reaching target depth. Engineering logs of the hand auger boreholes, together with peak and remoulded vane shear strengths are presented in **Appendix C**.
- Dynamic cone (Scala) penetrometer (DCP) tests were carried out adjacent to each hand auger borehole in granular soils, to a depth of 5m below ground level, to provide soil density profiles. Graphical results of the DCP testing are presented in the borehole logs in **Appendix C**.
- Two standpipe piezometers (piezo), denoted Piezo1 and Piezo2 were installed to allow for monitoring of perched groundwater. Piezo1 was terminated at 2m below ground level and Piezo2 was terminated at 3m below ground level, due to reaching target depth. Engineering logs of installed piezometers are presented in **Appendix C**.

The approximate locations of the respective investigation sites referred to above are shown in the appended Site Investigation Plan (**Drawing 01**).

¹ GNS Geological Map 1:250,000 scale Geological Map No 4 'Waikato'. SW Edbrooke et al.

² NZ Geotechnical Society (2017) NZ Ground Investigation Specification, Volume 1 – Master Specification.

³ NZ Geotechnical Society (2005), Field Description of Soil and Rock, Guideline for the field classification and description of soil and rock for engineering purposes.

5.0 GROUND MODEL

5.1 Published Geology

Published geological maps¹ for the area indicate the Site to be predominantly underlain by cross-bedded pumice sand, silt, gravel and interbedded peat of the Hinuera Formation (Late Pleistocene age river deposits). Recent gully alluvium and colluvium, comprised of sand, silt, mud and clay with local gravel and peat beds (Holocene age river deposits) is mapped in and around the Mangaohoi Stream channel. This alluvium is shown as extending into the southwest corner of the Site.

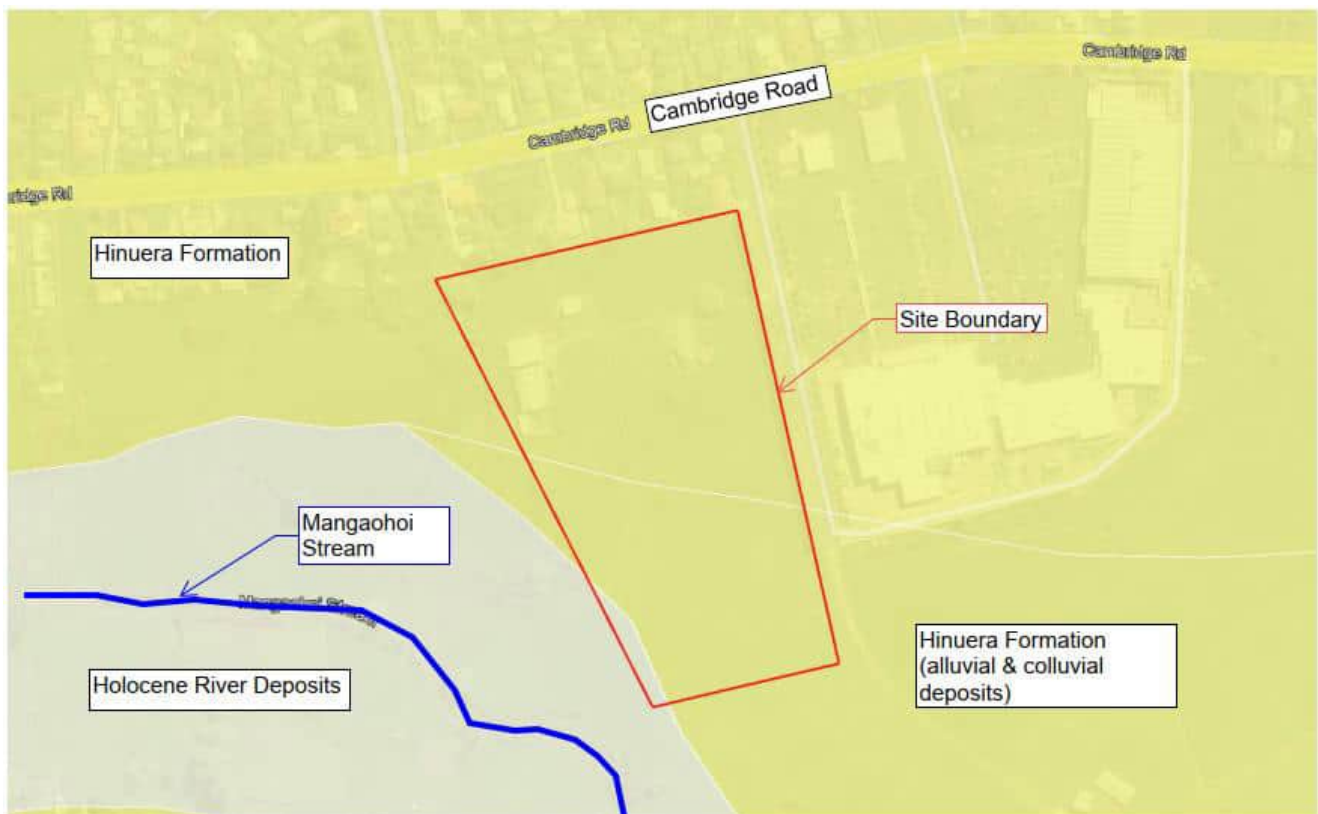


Figure 2. Published Geology (Source: Edbrooke, 2005)

Based on our knowledge of local geology, the extents of Hinuera and Piako units will be dictated by historic stream channel alignments and are expected to be highly irregular.

Based on the known history of the Site and surrounding land levels, uncontrolled fill of variable thickness is expected to be present across much of the Site due to previous earthworks.

5.2 Stratigraphic Units

The ground conditions encountered and inferred from the investigation were considered to be generally consistent with the published geology mapping for the area.

The site is predominantly underlain by crossed-bedded river deposits of the Hinuera Formation. Uncontrolled fill was encountered within the northwest corner of the site and within the infilled relict stream channels.

The distribution of the various units encountered is presented in the appended **A-A Geological Section** in **Drawing 02** and in **Table 1** below.

Table 1: Summary of Strata Encountered

Unit	Depth to base (m)		Thickness (m) ¹	
	Min	Max	Min	Max
Topsoil	0.2		0.2	
Uncontrolled Fill – Loose to Medium Dense Silty SAND / Sandy SILT / SILT ²	0.5	0.8	0.2	0.6
Uncontrolled Fill –WOOD SHAVINGS ²	0.9		0.4	
Uncontrolled Fill –Organic SILT with minor/some wood fragments and trace/some sand (Fill) ²	>1.2	1.6	>0.2	0.7
Uncontrolled Fill – Sandy Organic SILT / Organic Silt with trace sand / Organic Silty SAND ³	0.4	>1.7	0.2	>1.5
Loose to Dense Silty SAND / Stiff Sandy SILT / Stiff to very Stiff SILT / Very Stiff Silty CLAY (Hinuera Formation) ⁴	>1.9	>5.0	>0.8	>4.6
Stiff to Hard Clayey SILT / SILT (Walton Subgroup – Puketoka Formation) ⁵	10	11.5	3.5	5.5
Dense to Very Dense Primary & Reworked Ignimbrite (Walton Subgroup) ⁵	>15	>17	>4.5	-
Notes: 1. Thickness only recorded where base of strata has been confirmed. 2. Encountered in HA01 and HA06. Likely come from the sawmill previously on the site to the east. 3. Encountered in HA05, HA07, HA08 and Piezo1. 4. Encountered in HA01, HA02, HA03, HA04, HA05, Piezo 1 and Piezo2. 5. Interpreted from nearby CPTs.				

5.3 Groundwater

During the investigation, which was completed in mid-spring conditions (October 2024), groundwater was encountered within the HA boreholes and piezometers at the depths provided in **Table 2**.

Table 2: Depth of Groundwater Encountered

Borehole Location	Groundwater Depth (m)	Date of Test
HA01	1.5	18/10/2024
HA02	1.3	18/10/2024
HA03	1.3	18/10/2024
HA04	1.8	18/10/2024
HA05	0.9	18/10/2024
HA06	Not encountered	18/10/2024
HA07	1	18/10/2024

Table 2: Depth of Groundwater Encountered

Borehole Location	Groundwater Depth (m)	Date of Test
HA08	1.5	18/10/2024
Piezo1	1.3	18/10/2024
Piezo2	2.5	18/10/2024

Based on our knowledge of local ground conditions it is considered likely that the groundwater levels presented in **Table 2** most likely represent perched groundwater rather than the regional water table. Perched groundwater is expected to be extensively present across the site within discrete layers of the Hinuera Formation, above the regional groundwater table.

The depth to the permanent regional water table may be over 3m and is likely to draw down to the Mangaohoi Stream where its depth may increase as the ground level rises towards Cambridge Road.

Seasonal fluctuations in groundwater should be expected. It is commonly assumed that the depth to the regional water table may vary by nominally 1m between summer and winter conditions for sites across the Hamilton Basin.

6.0 GEOHAZARDS ASSESSMENT

6.1 Fault Rupture

The nearest active fault is the Kerepehi fault approximately 40km to the northeast. The Site is therefore not considered to be at risk of fault rupture on the basis that there are no mapped active faults in the area.

6.2 Liquefaction

The loose to medium dense sands of the Hinuera Formation and the Holocene Alluvium are susceptible to liquefaction and free-field liquefaction induced settlements during a ULS seismic event. The magnitude of liquefaction induced settlement is likely to vary across the Site and differential settlement should be anticipated.

Based on liquefaction assessments on the neighbouring site, the induced ULS total free-field settlement for Importance Level 2 (IL2) structures with a design life of 50years may be up to approximately 100mm. Differential settlements are often estimated as 1/2 to 2/3 of the total settlement over the width of the building. Settlements of this order of magnitude for large portal frame structures (ie. future Mitre 10 building) can typically be accommodated in their structural design.

The free-field settlement estimate does not account for surface expression of liquefaction or load induced shear settlements that may result in additional settlement where shallow groundwater is present. These possible sources of settlement should be considered during detailed design, although based on our knowledge of local ground conditions we do not expect these to pose a significant risk to the proposed development.

Liquefaction induced settlement is highly dependent on the location of the groundwater table – both perched and regional. The groundwater model for the Site will need to be refined at later stages of the project through further geotechnical investigation and groundwater monitoring, and a site-specific quantitative liquefaction assessment carried out.

6.3 Cyclic Softening

The fine-grained Holocene alluvium, while not liquefiable due to its high plasticity, may be susceptible to some strength loss, referred to as cyclic softening, during a ULS seismic event. This should be evaluated as part of detailed design when considering global stability and lateral spread.

6.4 Lateral Spread

Following the onset of liquefaction, the liquefied soils behave as a very weak undrained material, which can give rise to lateral spreading where a free face is present or where proposed cut and fill batters are proposed over or within liquefied soils.

Free-faces are present along the south and west sides of the Site where the ground level falls towards the Mangaohoi Stream. Free-faces are also present along the Mangaohoi Stream and its relict channels and a manmade drain near the northwestern site boundary.

In cases where flow failure is not predicted to occur, the maximum extent of lateral stretch is typically taken as 4 times the free-face height measured back from the slope crest. Based on this, the currently proposed building setbacks from the Site boundary are expected to be adequate to address lateral spread risk.

The extent and magnitude of lateral spreading that may occur following liquefaction is highly dependent on both the extent and depth of liquified soils, the steepness of the slopes and the setback of any loads applied near the slope crest. Lateral spreading will need to be assessed in more detail once deep geotechnical investigation data is available. Recommendations on mitigating lateral spread are provided in Section 7.2.

6.5 Slope Stability

Based on the site topography and our knowledge of local ground conditions, the existing natural slopes at the Site are not considered at risk of slope instability during static (non-seismic) conditions.

6.6 Load Induced Settlement

Based on the preliminary investigation results and our experience with similar projects across the region, the underlying Hinuera or Puketoka Formation soils have a moderate susceptibility the undergoing settlement when exposed to fill embankment and building loads. The magnitude of those settlements is dictated by the thickness of compressible silt layers and the magnitude of load applied.

Settlements will be assessed at the detailed design stage when fill depths and building loads are known and when appropriate deep geotechnical investigations have been undertaken.

The uncontrolled fill within the infilled gullies and north-western corner is of relatively poor quality and is expected to present greater load induced settlement and therefore differential settlement relative to the adjacent natural ground areas.

Recommendations for mitigation of load induced settlement are provided in Section 7.6.

6.7 Erosion

Given the general site gradient, runoff is expected to flow from north to south. The predominantly silty and sandy silts of the near surface Hinuera Formation soils, are prone to erosion due to surface water flow. Rill and channel erosion are to be expected where the stripped subgrade is left exposed during the winter months.

6.8 Sensitive Soils

The silty soils of the Hinuera Formation can be sensitive and rapidly lose strength if they get wet or are disturbed, for example through trafficking. The Puketoka Formation soils underlying the Hinuera Formation

soils are typically very sensitive. The sensitivity of these soils needs specific consideration in selecting suitable earthworks methodologies.

7.0 GEOTECHNICAL RECOMMENDATIONS

7.1 Seismic Site Subsoil Category

Based on a joint study by the University of Auckland and University of Waikato⁴, the fundamental site period is expected to be greater than 0.6s, therefore, structural designers working on this site should assess seismic parameters in accordance with NZS1170:2004 and assuming Site Subsoil Class D.

7.2 Liquefaction and Lateral Spread Mitigation

Liquefaction induced settlement magnitudes, the risk of surface expression of liquefaction, and lateral stretch magnitudes will need to be assessed in detail once appropriate site-specific geotechnical investigation, including confirmation of groundwater levels, has been undertaken. The investigation will need to include assessment of a site specific Vs30 (average shear wave velocity within the top 30m) for use in seismic assessment. Structural design should consider both total and differential liquefaction induced settlements.

For lateral spread, where the predicted extent and magnitudes are small, the risk may be mitigated through sufficient setback of buildings and critical infrastructure from the free face.

Where more extensive lateral spreading is predicted, or where vertical liquefaction settlements exceed design tolerances, ground improvement may be required. Options that may be suitable include drainage to lower groundwater levels, or installation of Rammed Aggregate Pier (RAP) ground improvement.

7.3 Slope Stability Management

Due to the low slope heights, it is expected that any risk of static slope instability could be mitigated through sufficient setback of buildings from the site slope crest. Current proposed building setback are appropriate based on the information available. A quantitative slope stability assessment is recommended to confirm the building setbacks once more detailed site investigation data is available.

7.4 Settlement Mitigation

Where it is determined at the detailed design stage that post-construction load induced total and/or differential settlements exceed structural design tolerances, mitigation measures can be adopted. Ground improvement options that could be considered include:

- Undercutting and replacement or reworking of pre-existing uncontrolled fill and / or soft ground.
- Construction of temporary surcharge fills (pre-loading) for several months to over consolidate any compressible layers to reduce post construction settlements to tolerable magnitudes.
- Installation of deep ground improvement, comprising Rammed Aggregate Piers (RAPs), drilled or driven displacement rigid inclusions or conventional piles.

We consider that it will be possible to address static and seismic settlement risks for the development through appropriate geotechnical investigation, analysis, and design during subsequent stages of the development.

7.5 Earthworks

Preparation of the stiff to very stiff subgrade beneath the any proposed fill areas should comprise stripping of all vegetation, topsoil, any pre-existing fill materials or weak colluvium followed by benching of the exposed

⁴ (Jeong & Wotherspoon, 2019)

subgrade where natural slopes beneath the fill exceed gradients of nominally 1:5 (vertical to horizontal). The subgrade should then be scarified and moisture conditioned where necessary and then proof rolled to verify the subgrade stiffness and consistency. Where any particularly weak materials are encountered that weave excessively during the proof rolling process, they should be undercut and removed prior to placing engineered fill.

The Hinuera Formation soils are generally suitable for reuse as engineered fill. The silts can be sensitive and lose strength when they are disturbed or allowed to get wet. Discing and drying is typically required when re-working Hinuera Formation silts as engineered fill.

The Holocene alluvium and Puketoka formation silts may be encountered in the southern end of the site. These silts are typically highly sensitive and can experience significant strength loss when re-worked. This can make them particularly challenging to earthwork. These materials can sometimes be used within engineered fills, by adopting appropriate construction methods.

Uncontrolled fill in the relict stream channels and depressions will need to be undercut and replaced with engineered fill. Groundwater will likely to be encountered while undercutting and the use of temporary underfill drainage will likely be required to enable fill placement.

Groundwater may also be encountered at shallow depth within excavations and temporary dewatering may be required for shallow excavations such as for building footings and service trenches. Sacrificial/temporary subsoils may be required to facilitate earthworks.

7.6 Foundation Bearing Capacity

All uncontrolled fill is to be removed and replaced with engineered fill. Geotechnical ultimate bearing capacity for engineered fill is expected to be 300kPa.

For the natural subsoils (Holocene Alluvium, Hinuera Formation, Puketoka Formation soils), the very loose to loose sand lenses will limit the limit foundation loads due to settlement. In areas where these loose sandy soils form the foundation subgrade, geotechnical ultimate bearing capacity may be limited to 200kPa. Geotechnical ultimate bearing capacity may be improved in these areas by removing the loose subgrade and recompacting or replacing with flowable fill.

The natural cohesive subgrade is stiff to very stiff and the geotechnical ultimate foundation bearing capacity in these soils is expected to be 300kPa.

Further geotechnical investigation, particularly at proposed foundation locations is needed to confirm the available bearing capacity.

8.0 FURTHER WORK

- Further geotechnical investigation, including CPTs and deep test pits, for use in refining the ground model, and informing detailed geohazard assessment, selection of geotechnical design parameters, and design and construction recommendations. Investigation to include assessment of a site specific Vs30 (average shear wave velocity within the top 30mbgl) for use in seismic assessment.
- Geotechnical analysis and reporting, suitable to support future project stages including resource consent application, detailed design, and building consent application.
- Design of ground improvement if necessary to mitigate load or liquefaction induced settlement, or lateral spread.

9.0 CLOSURE

Additional important information regarding the use of your CMW report is provided in the 'Using your CMW Report' document attached to this report.

This report has been prepared for use by BBO in relation to the Mitre 10, Te Awamutu project in accordance with the scope, proposed uses and limitations described in the report. Should you have further questions relating to the use of your report please do not hesitate to contact us.

Where a party other than BBO seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

For and on behalf of CMW Geosciences

Prepared by:



Caitlyn Gillard
Engineering Geologist MEngNZ

Reviewed and authorised by:



Aine Colson
Associate Geotechnical Engineer, CMEngNZ, CPEng

Distribution: 1 electronic copy to Bloxam Burnett & Olliver (BBO) via email
Original held at CMW Geosciences

Attachments: Drawing 01 - Site Investigation Plan

Drawing 02 - A-A Cross Section

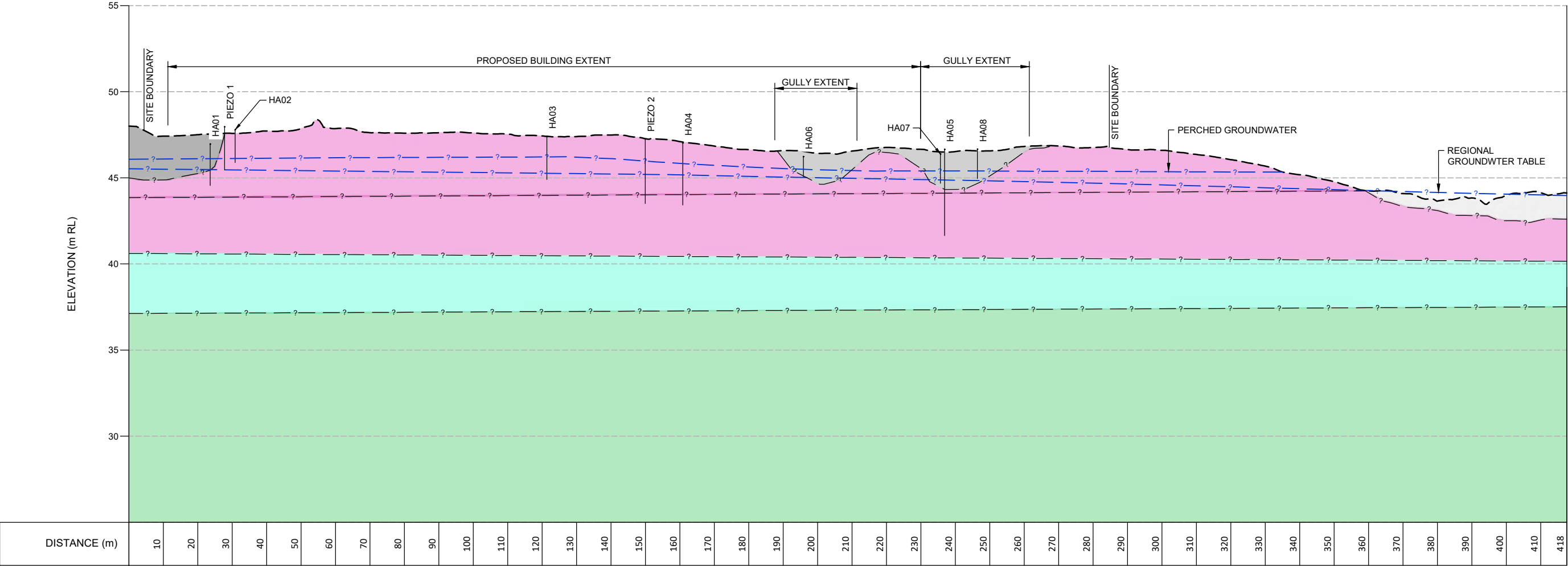
Appendix A – Historical Aerial Photographs

Appendix B – Site Plan

Appendix C – Hand Auger Borehole Logs



DRAWINGS

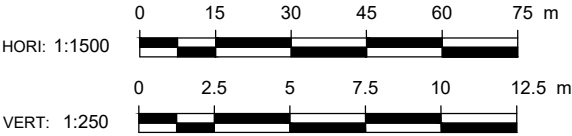


LEGEND:

- EXISTING GROUND PROFILE
- INFERRED GEOLOGY BOUNDARY
- GROUND WATER LEVEL
- SANDY SILT / ORGANIC SILT (UNCONTROLLED FILL)
- ORGANIC SILT AND WOOD SHAVINGS (UNCONTROLLED FILL)
- RECENT ALLUVIUM
- PIAKO SUBGROUP - HINUERA FORMATION
- WALTON SUBGROUP - PUKETOKA FORMATION
- WALTON SUBGROUP - PRIMARY & REWORKED IGNIMBRITES

NOTES:

- EXISTING GROUND PROFILE ADAPTED FROM LINZ WAIKATO LiDAR 1m DEM (2021).
- VERTICAL DATUM IN TERMS OF NZVD 2016.
- TEST LOCATIONS ARE INDICATIVE ONLY.
- ALL STRATA BOUNDARIES ARE INDICATIVE BASED ON KNOWLEDGE OF LOCAL GROUND CONDITIONS. THE RL OF THE STRATA BOUNDARIES IS EXPECTED TO VARY ACROSS THE SITE.
- GROUNDWATER LEVELS ARE INDICATIVE LEVELS BASED ON KNOWLEDGE OF LOCAL GROUND CONDITIONS AND THE PRELIMINARY GEOTECHNICAL INVESTIGATION.
- PERCHED GROUNDWATER MAY BE ENCOUNTERED AT SHALLOWER DEPTHS THAN THOSE RECORDED IN THE HAND AUGER BOREHOLES.
- THIS SECTION IS NOT SUITABLE FOR USE IN DETAILED DESIGN.



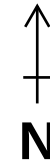
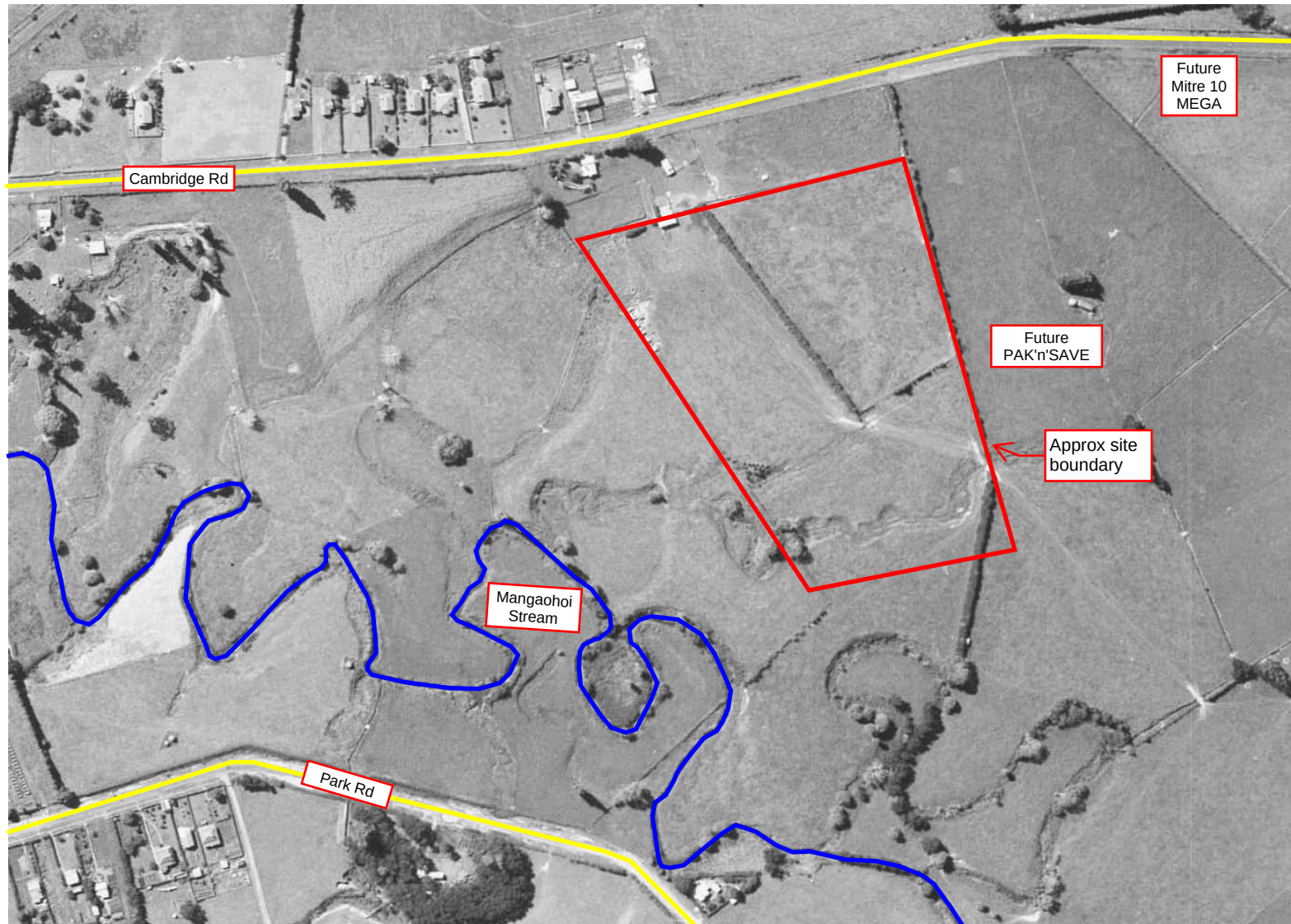
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PROJECT:	MITRE 10, TE AWAMUTU		CHECKED:	CG	DRAWING:	02
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TITLE:	PRELIMINARY GEOLOGICAL CROSS SECTION		DATE:	14/11/2024	SHEET:	A3 L

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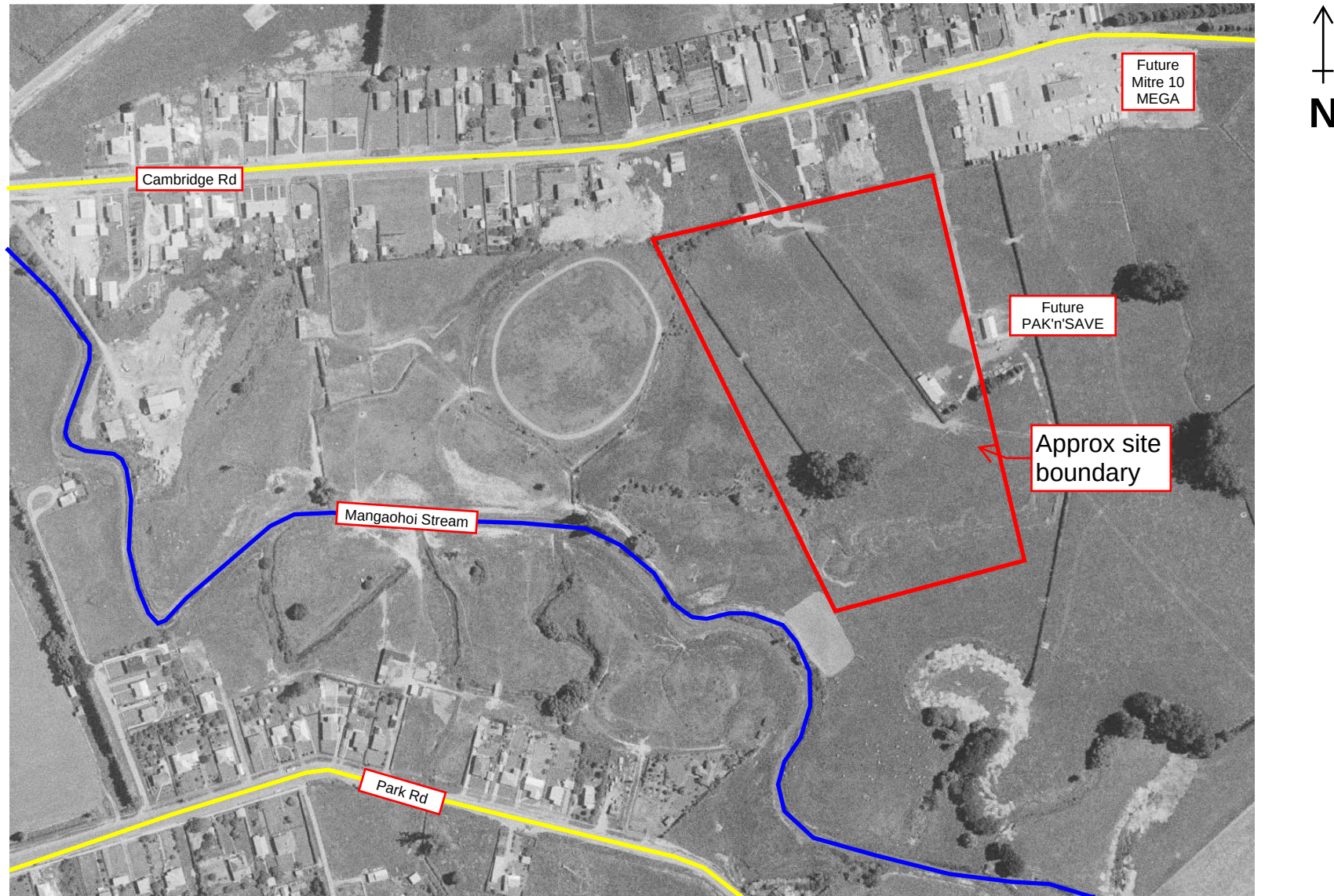
APPENDIX A

Historical Aerial Photographs

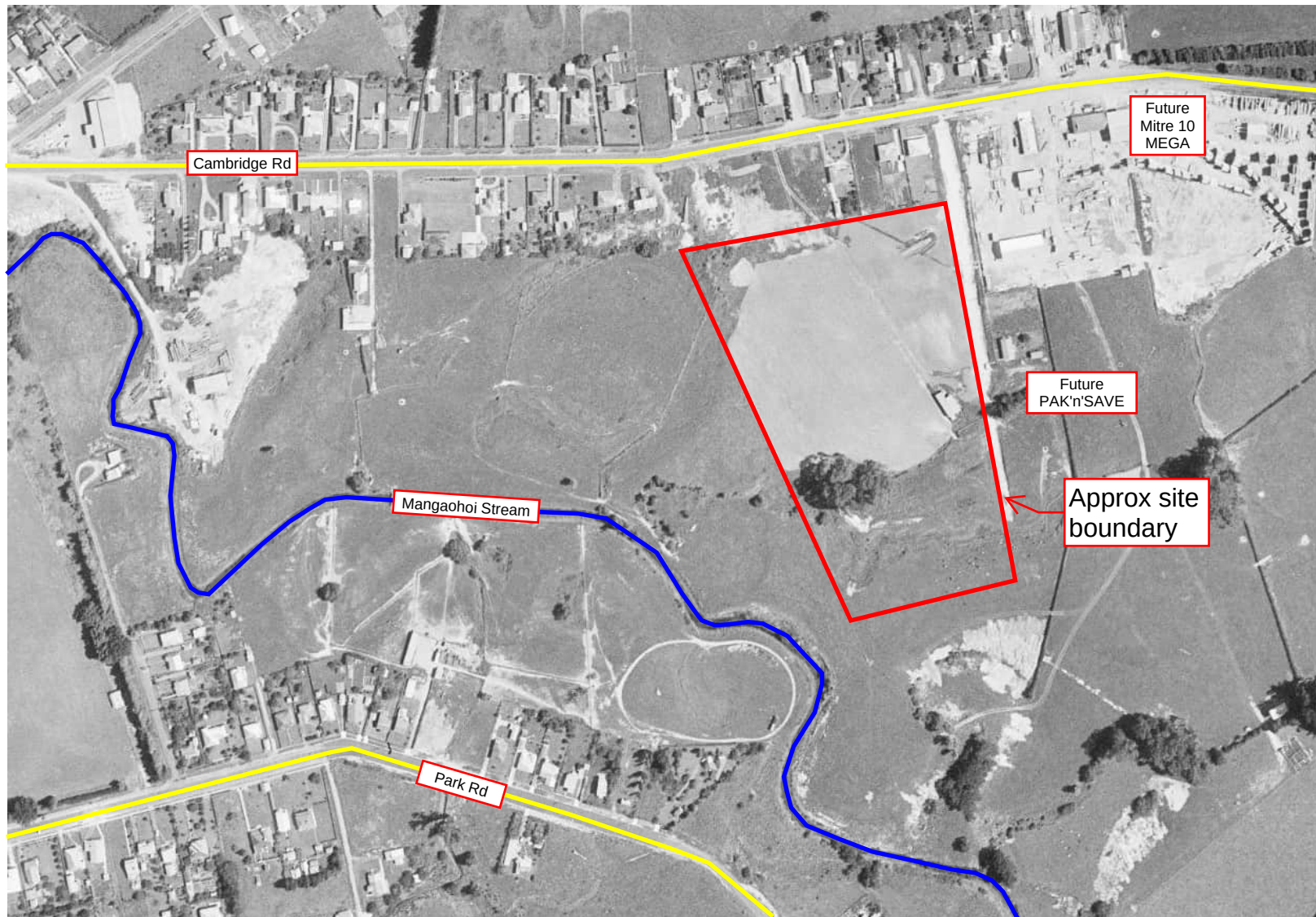
Historical Aerial - 1944 (Retrolens)



Historical Aerial - 1958 (Retrolens)



Historical Aerial - 1966 (Retrolens)



Historical Aerial - 1971 (Retrolens)



Historical Aerial - 1974 (Retrolens)



Historical Aerial - 1995 (Retrolens)



Historical Aerial - 2008 (Google Earth)



Historical Aerial - 2010 (Google Earth)



Historical Aerial - 2014 (Google Earth)



Historical Aerial - 2015 (Google Earth)



Historical Aerial - 2018 (Google Earth)



Historical Aerial - 2021 (Google Earth)



Historical Aerial - 2023 (Google Earth)



APPENDIX B

Draft Site Plan



SITE PLAN Scale 1:750 @ A1, 1:1500 @ A3

TE AWAMUTU LARGE FORMAT RETAIL AREA PLAN

Location: 1580 CAMBRIDGE ROAD, TE AWAMUTU | DATE: 23-07-2025 | JOB: 1454-05 | DWG: RC100-09
Version: 1, Version Date: 29/09/2025

RMA ISSUE

TOTAL SITE AREA		10.032 ha
Area A	=	5.99 ha
Area B	=	4.04 ha
TOTAL GROSS FLOOR AREA		32,200m²
Area A	(19,200 m²)	
-A1	6,200 m²	(SUPERMARKET)
-A2	4,500 m²	
-A3	7,000 m²	
-A4	550 m²	
-A5	650 m²	
-A6	300 m²	(PETROL STATION)
Area B	(13,000 m²)	
-A7	13,000 m²	(BUILDING IMPROVEMENT CENTRE & CAFE)

1. ALL DEVELOPMENT BOUNDARIES AND DIMENSIONS ARE TO BE CHECKED AND VERIFIED BY A REGISTERED SURVEYOR.
2. SITE AND BUILDING LEVELS TO BE VERIFIED BY A TOPOGRAPHICAL SURVEY PROVIDED BY A REGISTERED SURVEYOR.
3. A PLANNING CONSULTANT IS REQUIRED TO VERIFY ALL PLANNING RULES AND ASSUMPTIONS.
4. A CERTIFICATE OF TITLE IS REQUIRED TO VERIFY EXISTING SITE CONSTRAINTS, EASEMENTS AND LEGAL RESTRICTIONS.

APPENDIX C

Hand Auger Boreholes

Client: BBO
Project: 638 Cambridge Road - Mitre 10 Plan Change
Site Location: 638 Cambridge Road, Te Awamutu
Project No.: HAM2023-0058
Date: 18/10/2024



Sheet 1 of 1

Borehole Location: Refer to Site Plan

Logged by: WD

Checked by: MM

Scale: 1:25

Sheet 1 of 1

Position: 450280.0mE; 674657.0mN

Projection: Mount Eden 2000

Datum: Moturiki 1953

Survey Source: Hand-held GPS

Termination Reason: Hole collapse/no retrieval.

Shear Vane No: 3434

DCP No:

17B

Remarks: Groundwater encountered at 1.5m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

CMW Geosciences
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Sheet 1 of 1

Survey Source: Hand-held GPS

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA03

Client: BBO

Project: 638 Cambridge Road - Mitre 10 Plan Change

Site Location: 638 Cambridge Road, Te Awamutu

Project No.: HAM2023-0058

Date: 18/10/2024

Borehole Location: Refer to Site Plan

Logged by: WD

Checked by: MM

Scale: 1:25

Sheet 1 of 1



Position: 450380.3mE; 674592.7mN

Projection: Mount Eden 2000

Datum: Moturiki 1953

Survey Source: Hand-held GPS

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Dynamic Cone Penetrometer (Blows/100mm)		
	Depth	Type & Results							5	10	15
8-10-2024	0.3	Peak = 121kPa Residual = 32kPa		1		OL: Organic SILT: brown. No plasticity. (Topsoil)	M	VSt			
						CH: Silty CLAY: light orange grey. High plasticity. Moderately sensitive. (Hinuera Formation)					
						SP: Silty Fine SAND: light orange grey. Poorly graded. (Hinuera Formation)	W	VL to L	2		
						... from 0.90m to 1.00m, lens of silt with some fine sand: light grey			2		
						Silty Fine to medium SAND: grey streaked greyish brown. Poorly graded. (Hinuera Formation)	S	MD to D	1		
						... at 1.70m, becoming orange brown, slightly iron stained.			1		
						... at 1.90m, becoming grey.			2		
						SP: Silty Fine SAND: grey speckled dark brown. Poorly graded. (Hinuera Formation)			2		
						Borehole terminated at 2.5 m			3		
									3		
									2		
									2		
									3		
									3		
									2		
									2		
									3		
									3		
									2		
									2		

Termination Reason: Hole collapse/no retrieval.

Shear Vane No: 3434

DCP No:

17B

Remarks: Groundwater encountered at 1.3m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA04

Client: BBO

Project: 638 Cambridge Road - Mitre 10 Plan Change

Site Location: 638 Cambridge Road, Te Awamutu

Project No.: HAM2023-0058

Date: 18/10/2024

Borehole Location: Refer to Site Plan

Logged by: WD

Checked by: MM

Scale: 1:25

Sheet 1 of 1



Position: 450358.4mE; 674536.9mN

Projection: Mount Eden 2000

Datum: Moturiki 1953

Survey Source: Hand-held GPS

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Dynamic Cone Penetrometer (Blows/100mm)		
	Depth	Type & Results							5	10	15
						OL: Organic SILT: brown. No plasticity. (Topsoil)					
	0.3	Peak = 145kPa Residual = 30kPa				ML: SILT: orange brown. Low plasticity. Moderately sensitive. (Hinuera Formation)		St to VSt			
	0.6	Peak = 78kPa Residual = 27kPa				... at 0.60m, becoming light orange brown.	M		2		
						SP: Silty Fine SAND: light orange grey. Poorly graded. (Hinuera Formation)			1		
						... from 1.10m to 1.20m, becoming orange brown, slightly iron stained.		L	2		
						... at 1.40m, becoming light grey streaked light orange grey.			3		
						ML: SILT: with trace fine sand. Light grey. Low plasticity. Dilatant. (Hinuera Formation)	W		2		
	1.7	Peak = 78kPa Residual = 30kPa				... at 2.00m, poor retention.		St	1		
	2.0	Peak = 54kPa Residual = 32kPa				SP: Silty Fine to medium SAND: light grey. Poorly graded. (Hinuera Formation)			1		
						ML: SILT: light grey. Low plasticity. (Hinuera Formation)	S		2		
									2		
									1		
									3		
									3		
									4		
	2.9	Peak = 94kPa Residual = 43kPa						F to St			
	3.3	Peak = 40kPa Residual = 40kPa				SP: Silty Fine SAND: grey. Poorly graded. (Hinuera Formation)		MD	4		
						Borehole terminated at 3.6 m			6		
									4		
									7		
									4		
									5		
									4		
									3		
									5		
									4		
									5		
									4		
									4		
									4		

Termination Reason: Hole collapse/no retrieval.

Shear Vane No: 3434

DCP No:

17B

Remarks: Groundwater encountered at 1.8m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA05

Client: BBO

Project: 638 Cambridge Road - Mitre 10 Plan Change

Site Location: 638 Cambridge Road, Te Awamutu

Project No.: HAM2023-0058

Date: 18/10/2024

Borehole Location: Refer to Site Plan

Logged by: LA

Checked by: MM

Scale: 1:25

Sheet 1 of 1



Position: 450466.9mE; 674498.0mN

Projection: Mount Eden 2000

Datum: Moturiki 1953

Survey Source: Hand-held GPS

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Dynamic Cone Penetrometer (Blows/100mm)		
	Depth	Type & Results							5	10	15
▼	0.3	Peak = UTP			OL: Organic SILT: black. No plasticity. (Topsoil)		M	H			
					OL: Sandy Organic SILT: dark brown. Low plasticity (Uncontrolled Fill)						
	0.7	Peak = 69kPa Residual = 25kPa			ML: Medium Sandy SILT: dark orange brown. Low plasticity, moderately sensitive. (Hinuera Formation)			St			
							W				
	1.2	Peak = 144kPa Residual = 25kPa		1	SP: Medium Silty SAND: light greyish brown. Poorly graded, subrounded. (Hinuera Formation)			MD	3		
					ML: SILT: light brownish grey. Low plasticity, moderately sensitive to sensitive. (Hinuera Formation)			4			
	1.5	Peak = 88kPa Residual = 28kPa									
	1.8	Peak = 94kPa Residual = 31kPa									
	2.1	Peak = 78kPa Residual = 38kPa		2							
	2.4	Peak = 78kPa Residual = 34kPa									
	2.7	Peak = 113kPa Residual = 41kPa						St to VSt			
	3.0	Peak = 66kPa Residual = 38kPa		3			S				
	3.3	Peak = 97kPa Residual = 44kPa									
	3.6	Peak = 75kPa Residual = 31kPa									
	3.9	Peak = 128kPa Residual = 50kPa		4							
	4.2	Peak = 94kPa Residual = 31kPa			ML: SILT: grey. Low plasticity, moderately sensitive. (Hinuera Formation)						
	4.5	Peak = 125kPa Residual = 47kPa						St to VSt			
	4.9	Peak = 109kPa Residual = 50kPa		5							
Borehole terminated at 5.0 m											

Termination Reason: Target depth reached.

Shear Vane No: 2993

DCP No:

25

Remarks: Groundwater encountered at 0.9m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA06

Client: BBO

Project: 638 Cambridge Road - Mitre 10 Plan Change

Site Location: 638 Cambridge Road, Te Awamutu

Project No.: HAM2023-0058

Date: 18/10/2024

Borehole Location: Refer to Site Plan

Logged by: LA

Checked by: MM

Scale: 1:25

Sheet 1 of 1



Position: 450366.6mE; 674501.5mN

Projection: Mount Eden 2000

Datum: Moturiki 1953

Survey Source: Hand-held GPS

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Dynamic Cone Penetrometer (Blows/100mm)		
	Depth	Type & Results							5	10	15
						OL: Organic SILT: black. No plasticity. (Topsoil)					
						ML: Fine Sandy SILT: light brownish grey mottled orange brown. Low plasticity. (Uncontrolled Fill)					
						OL: Organic SILT: black. Low plasticity. (Uncontrolled Fill)					
				1		OL: Organic SILT: with some fine to coarse sand and minor wood chips. Dark brown mottled black. Low plasticity (Uncontrolled Fill)					
						Borehole terminated at 1.2 m					
				2							
				3							
				4							
				5							

Termination Reason: Refusal on hard ground.

Shear Vane No:

DCP No:

Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA07

Client: BBO

Project: 638 Cambridge Road - Mitre 10 Plan Change

Site Location: 638 Cambridge Road, Te Awamutu

Project No.: HAM2023-0058

Date: 18/10/2024

Borehole Location: Refer to Site Plan

Logged by: LA

Checked by: MM

Scale: 1:25

Sheet 1 of 1



Position: 450422.8mE; 674720.4mN

Projection: Mount Eden 2000

Datum: Moturiki 1953

Survey Source: Hand-held GPS

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Dynamic Cone Penetrometer (Blows/100mm)		
	Depth	Type & Results							5	10	15
▼						OL: SILT: black. No plasticity. (Topsoil)					
						OL: Organic SILT and SILT: with trace sand. Dark brown mottled orange brown. Low plasticity. (Uncontrolled Fill)	M				
				1		... at 1.00m, becoming dark brown	S				
						Borehole terminated at 1.7 m					
				2							
				3							
				4							
				5							

Termination Reason: Refusal on hard ground.

Shear Vane No:

DCP No:

Remarks: Groundwater encountered at 1.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA08

Client: BBO
 Project: 638 Cambridge Road - Mitre 10 Plan Change
 Site Location: 638 Cambridge Road, Te Awamutu
 Project No.: HAM2023-0058
 Date: 18/10/2024



Borehole Location: Refer to Site Plan Logged by: LA Checked by: MM Scale: 1:25 Sheet 1 of 1

Position: 450438.6mE; 674477.2mN Projection: Mount Eden 2000

Datum: Moturiki 1953

Survey Source: Hand-held GPS

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Dynamic Cone Penetrometer (Blows/100mm)		
	Depth	Type & Results							5	10	15
▼						OL: Organic SILT: dark brown. (Topsoil)	M				
						OL: Organic SILT: with trace coarse sand. Dark brown mottled orange brown. Low plasticity. (Uncontrolled Fill)					
						ML: SILT: orange brown. Low plasticity. (Uncontrolled Fill)					
						OL: Organic SILT and SILT: with trace medium sand. Dark brown mottled orange brown. Low plasticity. (Uncontrolled Fill)					
				1		OL: Organic SILT: dark brown. Low plasticity. (Uncontrolled Fill)	S				
						Borehole terminated at 1.7 m					
				2							
				3							
				4							
				5							

Termination Reason: Refusal on hard ground.

Shear Vane No: DCP No:

Remarks: Groundwater encountered at 1.5m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - Piezo1

Client: BBO

Project: 638 Cambridge Road - Mitre 10 Plan Change

Site Location: 638 Cambridge Road, Te Awamutu

Project No.: HAM2023-0058

Date: 18/10/2024

Borehole Location: Refer to Site Plan

Logged by: LA

Checked by: MM

Scale: 1:25

Sheet 1 of 1



Position: 450338.8mE; 674708.2mN

Projection: Mount Eden 2000

Datum: Moturiki 1953

Survey Source: Hand-held GPS

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)		
	Depth	Type & Results									
									5	10	15
1				1		OL: Organic SILT: black. No plasticity. (Topsoil)	M				
						OL: Fine to coarse Organic Silty SAND: with trace fine gravel. Dark brown. No plasticity. (Uncontrolled Fill)					
						ML: SILT: orange brown. No plasticity (Hinuera Formation)					
						ML: Fine Sandy SILT: light orange brown mottled dark orange brown. Low plasticity. (Hinuera Formation)	M to W				
						ML: SILT: light brownish grey. Low plasticity. (Hinuera Formation)	W				
							S				
2				2	Borehole terminated at 2.0 m						
3				3							
4				4							
5				5							

Termination Reason: Target depth reached.

Shear Vane No:

DCP No:

Remarks: Groundwater encountered at 1.3m. Piezometer installed.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - Piezo2

Client: BBO

Project: 638 Cambridge Road - Mitre 10 Plan Change

Site Location: 638 Cambridge Road, Te Awamutu

Project No.: HAM2023-0058

Date: 18/10/2024

Borehole Location: Refer to Site Plan

PRELIMINARY



Scale: 1:25

Sheet 1 of 1

Position: 450358.4mE; 674536.9mN

Projection: Mount Eden 2000

Datum: Moturiki 1953

Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Dynamic Cone Penetrometer (Blows/100mm)		
	Depth	Type & Results							5	10	15
						OL: Organic SILT: brown. No plasticity. (Topsoil)					
						ML: SILT: orange brown. Low plasticity. Moderately sensitive. (Hinuera Formation)					
						SP: Silty Fine SAND: light orange grey. Poorly graded. (Hinuera Formation)	M				
						ML: SILT: with trace fine sand. Light grey. Low plasticity. Dilatant. (Hinuera Formation)					
							W				
								S			
				3		Borehole terminated at 3.0 m					
				4							
				5							

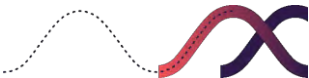
Termination Reason: Target depth reached.

Shear Vane No: DCP No:

Remarks: Groundwater encountered at 2.5m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

Appendix E – Ecology Report





Te Awamutu Large Format Retail Centre

Ecological Impact Assessment

Prepared for BBO



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Document Control

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EXECUTIVE SUMMARY

The proposed activity at 638 Cambridge Road includes changing the zoning from medium residential to commercial to facilitate the development of a new Te Awamutu Large Format Retail Centre. As part of the enabling works, most of the site will require vegetation clearance and earthworks.

The site's main ecological feature was extensive areas of low-value exotic pasture grasses and scattered exotic trees. Ecological values for fauna include low value habitat for common and introduced avifauna, and moderate value habitat for lizards and bats. Approximately 2m of wetland encroached within the site boundary from a neighbouring property.

The main Impact associated with the proposal include loss of the majority of pasture grassland, loss of common bird habitat, loss of some lizard habitat and potential risk of bats being harmed whilst clearing five trees that were identified as having high at roosting potential.

No lizards were identified on site despite thorough searches of suitable habitats so the actual risk of the proposal having an impact on lizards is not high.

No bat activity was recorded during acoustic monitoring surveys of the site. The lack of activity would suggest that bats, if they visit the site at all would do so only infrequently. The low frequency of activity on site would also reduce the likelihood of bats being harmed whilst felling the trees.

To reduce the risk of the proposal having an impact on fauna protected by the wildlife act 1953 recommendations including checks for nesting birds prior to the removal of vegetation during the nesting bird season, and ensuring that identified bat roost trees are removed following the Vegetation Removal Protocols outlined by the Department of Conservation.

The proposal will have an overall positive impact on wetland habitat onsite as livestock grazing will cease. Native vegetation planting has been recommended to enhance the wetland and other areas of the site. This should benefit all native fauna and increase the overall ecological value of the site. It is recommended that a planting plan incorporating vegetation that benefits native fauna such as birds, bats, and lizards be prepared.

1. INTRODUCTION

This report¹, prepared by Ecology New Zealand Limited (ENZL) provides an Ecological Impact Assessment (EclA) associated with the proposed re-zoning and development of the site at 638 Cambridge Road, Te Awamutu. The report includes details of the proposed activity and assesses the impact of the activity on any identified ecological features. Where significant impacts are anticipated, ecological management measures are recommended to reduce the level of effect to a level below what is regarded as significant by the EIANZ guidelines²

1.1. Proposed Activity

The proposed activity at 638 Cambridge Road includes changing the zoning from medium residential to commercial to facilitate the development of a Large Format Retail Centre. As part of the enabling works, most of the site will require vegetation clearance and earthworks.

The site totals c.4ha in area; of which 3.0ha will be developed with hard landscaping, structures, roads and car parking. A 6m landscaping strip is proposed along the north and western boundary. The remaining c.1ha will remain undeveloped from hardscaping as it falls within the 100-year flood risk area. It is proposed within the flood risk zone a stormwater retention pond will be created to manage water flow from impermeable surfaces both on and off-site. Stormwater retention ponds and surrounding areas are to be enhanced through native revegetation planting. See Appendix C for a site drawing provided by the client.

1.2. Site Location, Description and Ecological Context

The site is located within a mixed-use landscape in the eastern fringe of the Te Awamutu township (Figure 1). The surrounding land use is a mixture of productive farmland, commercial buildings, residential housing, and fragments of indigenous and exotic vegetation. The Mangahoi Stream and associated tributaries run through a neighbouring property immediately southwest of the site. The site itself contains six existing buildings and an associated accessway. Much of the site is occupied by productive pasture which has historically been utilised for stock grazing.

¹ This report is subject to the Report Limitations provided in Appendix A.

² Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. 2018. Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.



Figure 1: Drawing showing the location of 638 Cambridge Road

2. METHODOLOGY

ENZL ecologists undertook a site assessment on October 24th 2024. This assessment aimed to confirm the adequacy of existing ecological information and to complete appropriate surveys to address gaps in information necessary to complete an EclA. The following sections outline the methodologies used for the assessment.

2.1. Terrestrial Ecological Survey

Searches of national and regional ecosystem databases³, and threatened species databases⁴ were completed to ascertain existing information on ecosystems and threatened flora and fauna.

Databases and reference documents utilised included:

- Waikato Regional Pest Management Plan 2022-2032,
- Department of Conservation Bat Database 2022,
- Department of Conservation Herpetofauna Database 2023,
- eBird New Zealand,
 - iNaturalist New Zealand,
 - Waipa District ePlan.

During the site assessment, all vegetation across the site was classified to ecosystem level and mapped with its associated composition, value, structure and integrity recorded. All rare and threatened flora species encountered were documented.

All birds heard and observed on-site were documented during assessments to provide a snapshot of on-site bird diversity. Habitat for birds was further documented, emphasising nesting and roosting availability and a high-level documentation of the presence of year-round food sources.

Lizard habitat assessments focused on habitat suitability for the known diversity of species within the Waikato Region. During the assessment, systematic searches for ground-dwelling lizard species were undertaken, focussing on searches under organic and inorganic debris items found on-site. Survey effort consisted of a total of four hours searching suitable habitat across the site.

A high-level assessment of native bat habitat was undertaken at the site. Specifically, this included review of the presence of larger (diameter at breast height [DBH] > 15cm) mature trees, which could provide roosting habitat for this threatened species⁵.

Five Acoustic Bat Monitors (ABMs) were also deployed on site. These were positioned along potential bat features including trees and flyways which bats may utilise Appendix D. The ABMs were deployed for 19 nights between the 24th of October to 12th of November. The data

³ The Land Environments of New Zealand (LENZ) the land cover database (LCDB4) are available for download from <http://lris.scinfo.org.nz/>. Regional ecosystem mapping e.g. Indigenous terrestrial and wetland ecosystems of Auckland. Singers et al. 2017

⁴ NZ Threat Classification System <https://www.doc.govt.nz/about-us/science-publications/conservation-publications/nz-threat-classification-system/>

⁵ Borkin K.M. 2010: Ecology of New Zealand long-tailed bat (*Chalinolobus tuberculatus*) in exotic plantation forest. Unpublished PhD thesis. University of Auckland, Auckland, New Zealand

collected from ABMs was processed using DOC Batsearch 3.2.3 software and data analysed by an ecologist with DOC competency 3.1. The data was used to provide information on how often bats utilised the site during the period surveyed and identify any potentially important bat features that may be used for roosting or foraging habitat.

The wetland assessment was undertaken using vegetation community characterisation in accordance with the Ministry for the Environment's Wetland Delineation Protocols⁶ and, where required, hydric soils assessment as per the Ministry for the Environment's Wetland Hydric Soil Protocols⁶. The following steps were undertaken for the assessment at this site:

1. The rapid test for improved pasture/ obligate hydrophytic composition dominance was undertaken
2. In areas where the dominant species were not pasture species, each stratum's dominant species were identified (*i.e.* tree, sapling/shrub, herb), and the relevant delineation tests were undertaken⁸.
3. Representative 2x2 vegetation plots were utilised. The size of the plot was chosen to represent the vegetation type best.
4. Where the vegetation tests failed to identify the area as a wetland, this was generally due to the presence of non-normal circumstances⁹, and therefore the hydric soil assessments were undertaken.
5. The hydrology tool was also implemented where vegetation and soil tests were inconclusive.

2.2. Impact Assessment

The Environment Institute of Australia and New Zealand's guidelines for undertaking Ecological Impact Assessments (EclA; EIANZ 2018⁷) were used to assess the impacts of the proposed development. The guidelines provide criteria to assess ecological values using the matters: 'representativeness', 'rarity/distinctiveness', 'diversity and pattern', and 'ecological context.' Based on the designated values for each matter, the ecological aspects of the site are then assessed using the attributes matrix in Appendix 10 of the EIANZ guidelines. Chapter 6 of the EIANZ guidelines provides criteria for determining the magnitude of effects.

The level of effect can then be determined by combining the value of the ecological feature/attribute with the score or rating for the magnitude of effect to create criteria for describing the level of effects. Cells with low or very low levels of effect represent a low risk to ecological values rather than low ecological values. A 'moderate' level of effect requires careful assessment and analysis of the individual case. These effects could be managed through avoidance, design, or appropriate management actions.

6 Ministry for the Environment. 2022. Wetland delineation protocols. Wellington: Ministry for the Environment.

7 Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. 2018. Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

Impacts were primarily assessed at the catchment scale within this report. After consideration at the catchment scale, assessment at the site, regional, and national scales were regarded to inform the overall assessment where applicable.

3. ECOLOGICAL ASSESSMENT

3.1. Terrestrial Ecology

3.1.1. General Vegetation

Vegetation across the majority of the site was dominated by exotic pasture species such as Yorkshire fog (*Holcus lanatus*), perennial ryegrass (*Lolium perenne*), sweet vernal grass (*Anthoxanthum odoratum*) creeping buttercup (*Ranunculus repens*) and dock (*Rumex* spp). A c.4m tall leylandii (*Cupressus × leylandii*) hedgerow was present along the eastern boundary of the site and some mature scattered exotic trees including crack willow (*Salix × fragilis*), pin oak (*Quercus palustris*), cherry (*Prunus* sp.) and elm (*Ulmus* spp.) were also present. Terrestrial vegetation across the site is typical of productive pastureland in the Waikato Region and is not representative of any recognised indigenous ecosystem. Overall, the value of terrestrial vegetation on-site is considered to be 'Low' due to the absence of any mature or complex indigenous vegetation and the prevalence of maintained exotic pasture grasses.



Figure 2: Exotic pasture grasses were the dominant vegetation on site



Figure 3: Evidence of livestock grazing on site

3.1.2. Avifauna

Site and desktop assessments were used in combination to assess the potential diversity of bird species utilising and occupying the site. The nearest bird 'hotspot' record is located approximately 3.8km northwest of the site at Ngaroto Road. The land use at this point is comparable to that of the project site. As such, these bird records are expected to be informative of the diversity of species utilising the site. Table 1: Bird records and species likely to be using the site. The 5-minute bird counts were used to detect what species were present at

the time of the site visit with these results also shown in Table 1 below as confirmed detection on site.

Table 1 Records of birds from a nearby bird hotspot taken from the desktop study and which species were detected on site

Latin Name	Maori Name	Common Name	Threat Status ³	Detected on site
<i>Gerygone igata</i>	Hirorirori	Grey warbler	Not Threatened	
<i>Hirundo neoxena neoxena</i>		Welcome Swallow	Not Threatened	✓
<i>Porphyrio melanotus melanotus</i>		Pukeko	Not Threatened	✓
<i>Prosthemadera novaeseelandiae novaeseelandiae</i>	Koko	Tui	Not Threatened	
<i>Vanellus miles</i>		Spur-winged Plover	Not Threatened	✓
<i>Zosterops lateralis lateralis</i>	Hiraka	Silvereye	Not Threatened	✓
<i>Circus approximans</i>		Swamp harrier	Not Threatened	
<i>Acridotheres tristis</i>		Myna	Introduced and Naturalised	✓
<i>Anas platyrhynchos</i>		Mallard	Introduced and Naturalised	
<i>Carduelis carduelis</i>		Goldfinch	Introduced and Naturalised	✓
<i>Columba livia</i>		Rock Pigeon	Introduced and Naturalised	✓
<i>Gymnorhina tibicen</i>		Australian Magpie	Introduced and Naturalised	✓
<i>Passer domesticus</i>		House Sparrow	Introduced and Naturalised	✓
<i>Platycercus eximius</i>		Eastern Rosella	Introduced and Naturalised	
<i>Streptopelia chinensis tigrina</i>		Spotted Dove	Introduced and Naturalised	

<i>Sturnus vulgaris</i>		Starling	Introduced and Naturalised	✓
<i>Turdus merula</i>		Blackbird	Introduced and Naturalised	✓
<i>Turdus philomelos</i>		Song Thrush	Introduced and Naturalised	✓
<i>Pavo cristatus</i>		Peafowl	Introduced and Naturalised	
<i>Emberiza citrinella</i>		Yellowhammer	Introduced and Naturalised	
<i>Carduelis flammea</i>		Redpoll	Introduced and Naturalised	

Nesting and foraging habitat on site was limited and sparsely distributed, with suitable nest sites being limited to the larger mature exotic trees and leylandii hedgerow. Suitable habitat for ground nesting species was generally absent as pasture on site has been maintained in short condition via grazing/mowing. Birds utilising available on-site habitat are therefore expected to be limited to common introduced and Not-Threatened native species, typical of assemblages occupying highly modified, mixed-use agricultural landscapes in the Waikato Region

3.1.3. Herpetofauna

Few herpetofauna records are available surrounding the site and the Te Awamutu area, with most records immediately surrounding the site being limited to unidentified exotic frog species (*Ranoidea* sp.), which are likely introduced golden bell frogs (*Ranoidea aurea*). The closest indigenous lizard species recorded are copper skinks (*Oligosoma aeneum*), 4km north of the site.

The majority of the site was heavily managed through stock grazing and mowing making the sward short and no layers of old grass/thatch had developed. The intensive management across the site reduces the likelihood of copper skink presence particularly within the areas of pasture.

Some limited habitat for copper skinks was identified within areas of rank grass along the fence lines along the northern, west and southern site perimeter, and beneath a hedgerow of Leylandii along the site's eastern boundary (Figure 4). The suitable habitat along perimeter fences and hedgerow base was systematically searched by ENZL ecologists for c. 4 hours and no skinks were observed.



Figure 4 showing the Leylandii hedgerow with its base identified as potential lizard habitat.

Elegant geckos (*Naultinus elegans*) have been recorded across the surrounding landscape (nearest record 10.5km), however these records all date prior to 1970 and are not expected to be representative of modern distributions. Furthermore, habitat suitable for indigenous arboreal lizards was extremely limited on site, as mature vegetation was restricted to isolated, exotic trees within an area of productive pasture which is not contiguous with any fragments of indigenous vegetation which may support resident populations, arboreal lizard presence is highly unlikely.

Copper Skink is an At-Risk - Declining species⁸ whose population has fallen across their range. Due to their threat status, they have a High ecological value.

3.1.4. Chiropteran Fauna

Long-tailed bats (*Chalinolbus tuberculatus*) have been recorded in the surrounding landscape in close proximity to the project site, with the closest records c.0.5km away from the site's southern boundary. Records indicate bat activity associated with the reach of the Mangahoi Stream, which is likely being used as a commuting and foraging corridor by local populations. The stream's closest point is c.35m from the sites south-western corner. The proximity of these records and the stream suggest the site likely supports some level of bat activity; however it remains unknown whether this activity is limited to foraging and traversing or whether roosting bats are present on site.

⁸ Hitchmough, R.A.; Barr, B.; Knox, C.; Lettink, M.; Monks, J.M.; Patterson, J.B.; Reardon, J.T.; van Winkel, D.; Rolfe, J.; Michel, P. 2021. Conservation status of New Zealand reptiles, 2021. New Zealand Threat Classification Series 35. Department of Conservation, Wellington. 15 p.

Acoustic bat monitoring surveys conducted between 24th October to 12th of November did not identify any bat activity on the Site. A limitation of the relatively short duration of the survey is that it may not account for temporal variation in habitat use throughout the year. Bats may infrequently forage or commute in the area and records within 500m well within the average home range of c.0.8-c.7.3km for this species in the Hamilton/Waikato area^{9,10}. The lack of records during this survey period suggests that the site is not a primary feeding or roosting area and is not likely to be an important commuting corridor.

High-level roost risk assessments were undertaken from the ground for all mature trees with a DBH (Diameter at Breast Height) above 150mm present on site. Five trees were identified within the site boundary with a DBH above 150mm of these trees three had potential roost features and were recorded as high-risk bat trees. The remaining two trees had no obvious features but due to their size were identified as moderate-risk. Table 2 below shows both the High and Moderate risk bat trees. The drawing in Appendix D shows the location of the bat risk trees.

Long-tailed bats are listed as a critically vulnerable species¹¹ and therefore in terms of their rarity and pattern they have a very high ecological value.

Table 2 Showing the results of the bat roost tree risk rating assessment

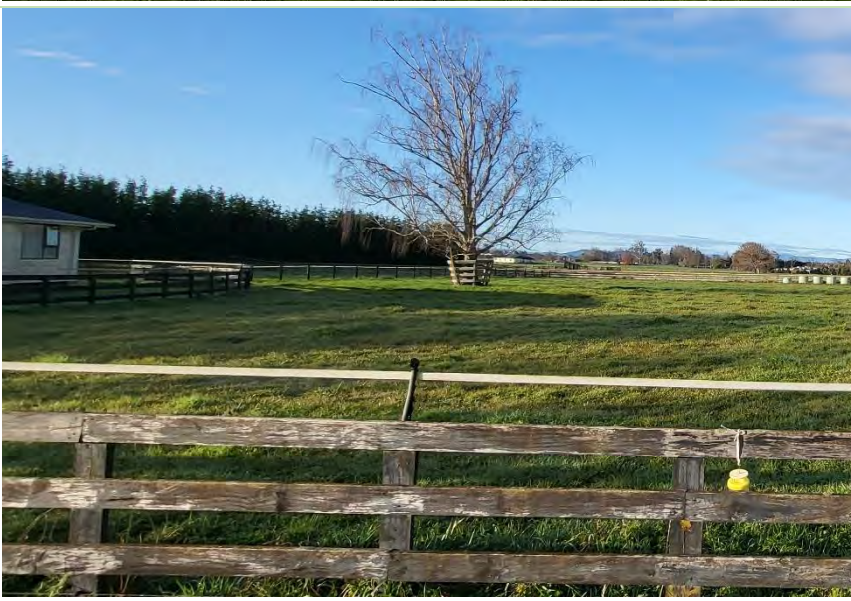
Risk Rating	Description of bat trees	Photograph of trees with high/low-risk rating for roosting bats
High	Elm tree with welded leaders forming a potential shelter for bats at c.4m. near to the entrance of the site.	

⁹ Dekrout A.S. 2009: Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. Unpublished PhD thesis. University of Auckland, Auckland, New Zealand. 168 pp.

¹⁰ Davidson-Watts Ecology (Pacific) Ltd. 2019 Long-tailed bat trapping and radio tracking baseline report. Southern Links, Hamilton. Report for AECOM, Auckland.

¹¹ O'Donnell, C.F.J.; Borkin, K.M.; Christie, J.; Davidson-Watts, I.; Dennis, G.; Pryde, M.; Michel, P. 2023: Conservation status of bats in Aotearoa New Zealand, 2022. New Zealand Threat Classification Series 41. Department of Conservation, Wellington. 18 p.

High	Crack willow tree with multiple failure points creating cavities for bats. Northwest of the site	
High	Crack willow tree with multiple failure points creating cavities for bats. The northwestern corner of the site	

Moderate	Unidentified tree species with no obvious features but due to its size could present opportunities for sheltering bats in the future	
Moderate	Unidentified tree species with no obvious features but due to its size could present opportunities for sheltering bats in the future	

3.2. Wetland Assessment

3.2.1. Desktop study

Aerial imagery, both historic and more recent, were used to identify potential wetland areas on site that would require further investigation. Figure 5 below shows three potential wetland areas, Potential wetland area 1 was identified within the site boundary and was assessed through the MFE wetland delineation protocols on 24th October 2024. The potential wetland areas on the neighbouring property were observed over the fence but no detailed investigations were undertaken.

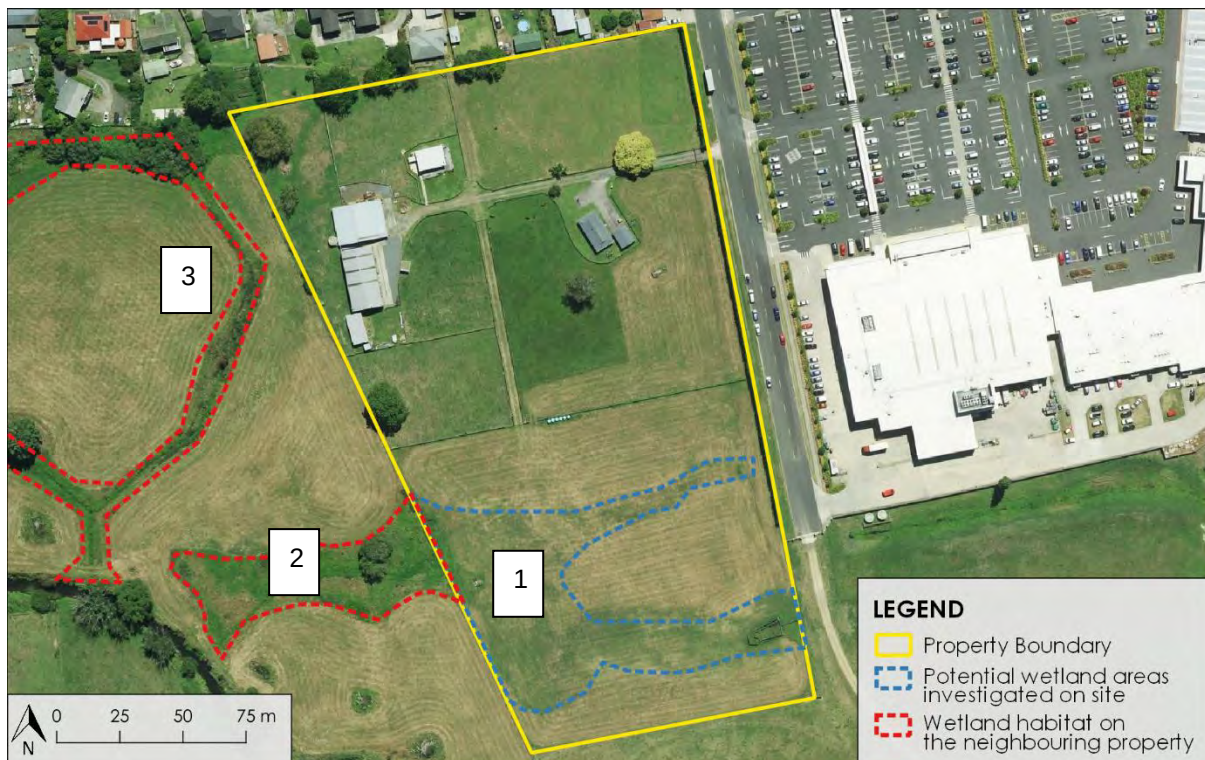


Figure 5 Location of potential wetland in relation to the site boundary

3.2.2. Potential wetland area 1

Based on the findings following the wetland delineation protocols, see Appendix E for details, the on-site extent of this wetland was limited, encroaching only c.2m over the western boundary from the neighbouring property, outside of which the vegetation rapidly transitioned into productive pasture. The Table below summarises the wetland delineation tests undertaken within Potential Wetland Area 1. The drawing in Appendix D shows the actual location of the wetland habitat on-site following the results of the wetland delineation protocols. As can be seen in Appendix D the actual area of wetland encroachment on site has been greatly reduced from the potential wetland areas identified from the desktop survey. The wetland habitat encroaching onto site was poached by livestock and some water pooling at the lowest points. This area was identified as a wetland based on the hydrophytic vegetation dominance test and hydric soil and hydrology tests.

Table 4: Summary of Wetland delineation protocol tests Potential Wetland Area 1

Result	Plot One	Plot Two	Plot Three
Rapid	Fail	Fail	Fail
Pasture exclusion applies	Fail	Pass	Pass
Dominance	Pass	N/A	N/A
Prevalence	Fail	N/A	N/A

Hydric Soil	Pass	N/A	N/A
Hydrology test	Pass	N/A	N/A

Historic imagery of the site shows that the landscape has changed markedly over time with an increase in the amount of drainage ditches created in the wider landscape. Changes to the drainage regime have likely changed the water table on site. The earliest photograph from aerial imagery shows an overland flow and potential wetland within the areas investigated as part of Potential wetland area 1 (Figure 6). Evidence of draining on site was evident with the presence of a manhole cover and drain within the potential wetland area. The presence of the historic wetland and flow path has likely left behind geomorphological variations compared to their surroundings making the Potential Wetland 1 Area stand out when compared to the rest of the site when observed on more recent imagery. The actual area of wetland habitat appears to have been greatly reduced from its historical extent and now only encroached c.2m over the western boundary of the site as shown in Appendix D.



Figure 6 Yellow area indicates the approximate location of Potential Wetland Area 1 in a historical context

3.2.3. Neighbouring wetland areas

During the on-site investigation, it was clear that wetland habitat was present on the neighbouring property to the west of the site (Figure 7). Water was visibly pooling on the surface and vegetation was dominated by soft rush (*Juncus effusus* var. *effusus*), spearwort (*Ranunculus flammula*) and creeping bent grass (*Agrostis stolonifera*) which are facultative wetland species and fairly reliable indicators of wetland habitat.



Figure 7: Image showing the wetland area on the neighbouring property to the west of the Site.

4. ECOLOGICAL VALUES ASSESSMENT

Consideration of ecological values are undertaken at a site and catchment scale, with consideration to any factors relevant at regional and national scale. Assessment criteria include the ecological values 'representativeness', 'rarity/distinctiveness', 'diversity and pattern', and 'ecological context'¹². Table 4 below summarises the ecological values for the terrestrial features assessed on site and the criteria met for each.

Table 4: Ecological Values Assessment

Ecological Feature	Assessment of ecological feature against criteria: 1- Representativeness 2- Rarity/distinctiveness 3- Diversity and pattern 4- Ecological context	Summary of Assessment against criteria:	Overall Value
terrestrial Vegetation	- Not representative of natural indigenous ecosystem - Very common across the Waikato and Nationally - Low diversity dominated by monocultures or sown/planted exotic species - Absence of mature and complex indigenous habitat	- Low - Low - Low - Low	Low

¹² Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. 2018. Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition. (See report Appendix 2)

Birds	1. Species assemblage is not representative of the natural indigenous ecosystem 2. Nationally and locally common indigenous species 3. Low Indigenous species diversity only the most resilient species present 4. There are some more common indigenous species present that may stand out from neighbouring urban areas.	1- Low 2- Low 3- Low 4- Moderate	Low
Herpetofauna	1. Species assemblage is not representative of the natural indigenous ecosystem species present have adapted to exotic species dominated ecosystem • At-risk declining species may be present in low numbers • Low species diversity and fairly typical of habitats present and in surrounding landscape 2. At-risk indigenous species within a landscape dominated by exotic and introduced flora/fauna	1- Low 2- High 3- Low 4- Low	Moderate
Chiropteran fauna	1. Species assemblage is not representative of the natural indigenous ecosystem species present have adapted to exotic species-dominated ecosystem • Nationally critical species may be present in low numbers infrequently • Low numbers on site and likely visit the site infrequently • Potentially nationally critical species present but in low numbers and infrequently	1- Low 2- Very High 3- Low 4- moderate	High
Wetland vegetation	1. Species assemblage is not representative of the natural indigenous ecosystem 2. Wetlands are underrepresented regionally and nationally and have declined from historic extent 3. Some natural diversity but dominated by exotic species. 4. Underrepresented habitat type plays an important ecological function filtration, flood alleviation	1- Low 2- High 3- Low 4- High	High

5. ASSESSING EFFECTS OF ACTIVITIES ON ECOLOGICAL VALUES

The nature and level of actual or potential effects of activities for which consent is being sought are addressed. Positive and adverse effects, cumulative effects and residual effects are considered, and the assessment informs the nature and scale of impact management required.

5.1. Terrestrial Vegetation

The proposed development of the site will require exotic grass pasture and exotic trees to be removed and replaced by hard landscaping. Some soft landscaping in the form of vegetation planting around a 6m buffer strip around the perimeter of the site. Of the c.4ha site, c.0.6 ha will be retained as a no build area as it lies within the 100-year flood risk zone identified in the Waikato Regional Plan.

Vegetation as habitat for fauna and assessed under the Wildlife Act, 1953, is considered in Sections 5.2 - 5.4 below.

Given the loss of extent of vegetation across the site to be replaced by hand landscaping, the pre-management magnitude of effect is considered Low.

5.2. Avifauna

Loss of some habitat for common indigenous birds and introduced species will result from the proposed site clearance. Habitat enhancement in the form of vegetation planting has been included in the site plans. The planting will replace the habitat that has been lost once it has reached maturity. Using a mix of native plant species that offer forage for indigenous birds will improve the value of habitat once it has matured. Given the loss of low quality habitat within the site, the pre-management magnitude of effect is considered Low.

5.3. Herpetofauna

The proposal will result in a loss of a small area of low-quality potential habitat for copper skink. Risk of individual lizards being harmed during vegetation clearance and earthworks is considered negligible given that no lizards were identified during intensive manual habitat searches, indicating that, if present, they are present in very low density. Considering the low likelihood of copper skinks being present and the small area of potential habitat to be removed, the pre-management magnitude of effect is considered Low.

5.4. Chiropteran fauna

The proposal will result in the loss of five potential bat roost trees and a loss of low-value foraging and commuting habitat. Given that the ABM survey detected no bat activity, frequency of bat activity on site is likely to be low. There is a risk that bats may be present within identified high and moderate rated bat trees during clearance works, however due to the low frequency of activity on site the risk is low. Given the effects summarised above the pre-management magnitude of effect is considered Low.

5.5. Wetland habitat

Earthworks and vegetation clearance within 10m of the wetland identified on-site will be avoided as this area falls within the 100yr flood no build zone shown in the site drawings in Appendix C.

It is anticipated that the impact of constructing the Building Improvement Area will not have an adverse impact on the function of the wetland on-site and on the wetlands identified on the neighbouring property. The removal of stock from the site will likely reduce the impact on the wetland by reducing the amount of poaching and nutrient enrichment. Additional sedimentation as a result of the development may occur without appropriate sediment controls.

Given the effects described above, the pre-management magnitude of effect is considered Moderate.

5.6. Summary of the Level of Effects – Pre-management

The ecological values, effects, and magnitude of effects (pre-management) are summarised below (Table 3) and the level of effects (pre-management) are determined as per the EIANZ guidelines.

Table 3: Evaluation of the level of effects summary pre-management at the site.

Feature	Ecological Value	Effect	Magnitude of Effect (un-managed)	Level of Effect (un-managed)
Terrestrial vegetation	Low	Removal of low value mostly exotic pasture	Low	Low
Avifauna	Low	- Temporary loss of habitat for introduced and common indigenous species. - Planting around the perimeter of the site will likely enhance availability of habitat for avifauna.	Low	Very low
Herpetofauna	High	- Area of actual habitat lost is likely to be low with majority being retained - Negligible risk of individual lizards being harmed	Low	Low
Chiropteran	High	Loss of five potential roost trees in habitat with likely low frequency of	Low	Low

		bat activity value		
		• Low risk of individual bats being harmed during tree felling operations		
Wetland habitat	High	• Earthworks and vegetation clearance within 10m of wetland to be avoided • Earthworks within 100m of the site unlikely to have an impact on wetland • Reduced stock levels on site will likely improve wetland condition on site. • Risk of sedimentation of wetland without appropriate controls	Moderate	High

6. EFFECTS AND IMPACT MANAGEMENT

The overall level of effect under EIANZ is to be used as a “*guide to the extent and nature of the ecological management response required (including the need for biodiversity offsetting)*”. Where Regional or District Plans do not provide specific guidance for the management of effects a suggested guide is:

- For Very High levels of effect:
 - “...unlikely to be acceptable on ecological grounds alone (even with compensation proposals). Activities having very high adverse effects should be avoided.”
- For High or Moderate levels of effect:
 - Such an effect could be managed through avoidance, design, or extensive offset or compensation actions. Wherever adverse effects cannot be avoided, no net loss of biodiversity values would be appropriate.
- For Low or Very Low levels of effect:
 - “...should not normally be of concern, although normal design, construction and operational care should be exercised to minimise adverse effects.”

Practical measures are proposed to address moderate/high ecological effects at the site. The amount of enhancement effort and activity needed for this site is guided by the Waipa District and Waikato Regional Plans and the significance of ecological values adversely affected, level of ecological effects, feasibility of implementation, and costs/ benefits and likelihood of success of impact management. Even though the level of effects for avifauna may be below that which is of concern under the EIANZ guidelines, practical management measures are recommended for native bats, lizards, and birds given their protection under the Wildlife Act

(1953). The Waikato Regional Plan requirements with regard to sediment and erosion control are still valid even with a low level of effect. Recommendations to avoid and manage adverse ecological effects potentially arising from the proposed development are outlined below.

6.1. Terrestrial Vegetation

A Low level of effect has been identified as below the level at which EIANZ guidelines consider significant therefore no action is required to mitigate the effects. While the level of effect on Terrestrial vegetation is below what the EIANZ guidelines consider significant, boundary buffer planting will result in increased native flora abundance and diversity within the site. As such, the post-management magnitude of effects on terrestrial vegetation is considered Positive.

6.2. Avifauna

Despite the level of effect being below what EIANZ guidelines considers as significant, most indigenous birds and their nests are protected under the Wildlife Act (1953). Practical measures will be required to avoid direct impacts on indigenous birds and their nests. Recommendations to avoid impacts on nesting birds are provided in Section 7.

6.3. Herpetofauna

Based on surveys to confirm native lizard presence/absence on site it is likely that lizards are either absent or present in negligible density only and therefore no management of the site for lizards is required.

Enhancement of the site through native vegetation planting along the site perimeter and within the 100-yr flood risk area may encourage lizards to colonise the site from suitable habitat off site in the future.

Considering the above, the post-management magnitude of effects on lizards is considered Negligible.

6.4. Chiropteran fauna

It is advised that vegetation removal protocols are implemented for the removal of the five trees that were identified as potential roosting habitat. The vegetation removal protocols (VRPs) must be implemented under the guidance and supervision of a suitably qualified ecologist with the relevant DOC bat competencies (3.1 and 3.3). Implementing the VRPs will greatly reduce the risk of individual bats being harmed during vegetation clearance works on site. Loss of marginal habitat on the urban fringe in an area with likely infrequent bat activity will have minimal impact on bats in the wider landscape. Considering the above management recommendation, the post-management magnitude of effects on bats is considered Low.

6.5. Wetland habitat

The level of unmitigated impact on wetland habitat has been identified as moderate and therefore mitigation is required to further reduce the impact of the proposal. To reduce the impact of the proposal on wetland habitat it is recommended that the areas of wetland

habitat on site and within the 100-year flood risk zone are enhanced through native species planting. This will greatly reduce the impact of the proposal and provide opportunities to enhance the site for birds, bats and potentially lizards.

It is recommended that a sediment and erosion control plan is in place during the construction phase of the proposal to avoid the risk of sediments entering the wetland habitat.

Considering the above management recommendation, the post-management magnitude of effects on bats is considered Positive.

6.6. Summary of the Level of Effects – Post-management

The ecological values, their impacts and management have been summarised below and the post-management level of effect has been determined as per the EIANZ guidelines.

Table 4: Evaluation of the level of effects summary post-management at 638 Cambridge Road

Feature	Ecological Value	Effect	Management required	Post-management magnitude of effects	Post-management level of effect
Terrestrial Vegetation	Low	Loss of majority of low-value habitat	No	Low	Very Low
Avifauna	Moderate	- Loss of low-value habitat - Risk to common indigenous nesting species.	- Measures should be applied to avoid impacts on Indigenous bird nests. - Native plants included in planting plans	Low	Negligible
Herpetofauna	High	- Potential loss of low value habitat - Low risk of harm to individual lizards	No	Low	Low
Chiropteran fauna	Very High	- Loss of likely low use bat habitat - Risk of bats harmed	Vegetation Removal protocols must be followed to avoid low risk	Low	Low

Feature	Ecological Value	Effect	Management required	Post-management magnitude of effects	Post-management level of effect
		during removal of bat potential trees Planting scheme will likely benefit bats	of bats being harmed		
Wetland Habitat	High	- No loss of extent anticipated - Removal of livestock	- Enhancement planting of the wetland habitat and the 100-year flood risk zone - Sediment and erosion control plan	Positive	Net gain

7. RECOMMENDATIONS SUMMARY

The following ecological management measures are recommended to ensure that any foreseeable ecological effects associated with the works are adequately managed:

■ Restoration Plan of wetland and 100 year flood risk zone

A restoration plan should be prepared to guide management planting and pest animal and plant management. This plan should include, but not be limited to:

- o Map of planting locations
- o Site preparation details
- Weed control plan, control methodologies and timeframes
- o Revegetation planting plan:
 - Eco-sourced species list from the Waipa Ecological District
- Plant quantities, sizes and planting density
 - Planting units (flood plain, upper bank etc)
 - Planting methodologies
- o Monitoring and maintenance plan for at least 5 years

■ Protection of nesting birds:

If undertaking vegetation clearance during the nesting bird season (1st of September – 28th of February) then bird nest checks must be carried out by a suitably qualified ecologist prior to vegetation clearance. No bird management is required if clearance is outside of the bird activity window and this is encouraged, however additional fauna constraints may dictate if this is practical.

Bird nest checks include checking vegetation, tree cavities and hollows for nesting birds (e.g. morepork, kingfisher). Should any nesting be observed, a minimum 10-metre buffer of vegetation shall be required to remain around the nest site until an approved and experienced ecologist or ornithologist has confirmed that the nest has failed, or the chicks have hatched and naturally left the natal site.

■ Bat Management Protocols

A suitably qualified and experienced ecologist with the appropriate DOC bat competencies for will implement vegetation removal protocols. Following the VRPs will greatly reduce the risk of bats being harmed.

■ Fauna Management Timeframes

Table 5 below provides the time frames in which fauna management must be carried out. Clearance of bird habitat should be avoided during the bird nesting season between 1st of September and 28th of February. If that is not practical, bird nest checks must be carried out by a suitably qualified ecologist prior to vegetation clearance. No bird management is required if clearance is outside of the bird activity window.

The removal of the identified bat trees must only occur within the bat activity window with appropriate bat management measures.

Table 5: Fauna management timetable.

Fauna	Timeframes	Fauna Activity	Restriction/Management Required for habitat clearance
Birds*	1st of September to 28th of February	Nesting season	Pre-clearance bird nest checks
	1st of March to 31st of August	Non-nesting season	No management required
Bats*	1st of October to 30 th April	Higher activity	Bat management measures
	1st of May to 30 th September	Lower activity	No habitat clearance of high-risk trees permitted

**Dates may vary within consent conditions.*

■ Sediment and Erosion Control Plan

Appropriate erosion, sediment and containment controls should be installed prior to the commencement of works to reduce the risk of any sediment and/or containments entering the stream environment. This should be guided by a plan prepared by a suitably qualified and experienced professional and should remain in place until construction has been completed and the site has been deemed stabilised by a suitably qualified environmental professional or RMA compliance officer.

Where machinery is used on-site during works, care should be taken to avoid hydrocarbon spills, especially within the riparian and aquatic environments. No fuels should be stored within

20m from any watercourses. Best practice procedures should be followed to prevent contamination or spills.

8. CONCLUSION

This report provides an Ecological Impact Assessment associated with the proposed re-zoning and development of the site at 638 Cambridge Road. The Impact associated with the proposal on ecological features range from moderate to very low pre-mitigation effect level

With the implementation of ecological measures outlined in this report, the post management effect level associated with the proposal ranged from Low to providing a net gain for ecological values on site. the inclusion of freshwater habitat in the form of a stormwater pond, incorporating native species planting will provide a net gain for ecological values on site.

A number of recommendations have been made to ensure that no indigenous species protected under the wildlife act 1953 are harmed during the enabling and construction phases of the proposal and to ensure that plans are in place to enhance habitat on site.

APPENDIX A

Report Limitations

This Report/Document has been provided by Ecology New Zealand Limited (ENZL) subject to the following limitations:

- i) This Report/Document has been prepared for the particular purpose outlined in ENZL's proposal and no responsibility is accepted for the use of this Report/Document, in whole or in part, in other contexts or for any other purpose.
- ii) The scope and the period of ENZL's services are as described in ENZL's proposal and are subject to restrictions and limitations. ENZL did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Report/Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by ENZL in regards to it.
- iii) Conditions may exist which were undetectable given the limited nature of the enquiry ENZL was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Report/Document. Accordingly, if information in addition to that contained in this report is sought, additional studies and actions may be required.
- iv) The passage of time affects the information and assessment provided in this Report/Document. ENZL's opinions are based upon information that existed at the time of the production of the Report/Document. The Services provided allowed ENZL to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.
- v) Any assessments, designs and advice made in this Report/Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Report/Document.
- vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by ENZL for incomplete or inaccurate data supplied by others.
- vii) The Client acknowledges that ENZL may have retained sub-consultants affiliated with ENZL to provide Services for the benefit of ENZL. ENZL will be fully responsible to the Client for the Services and work done by all of its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from ENZL and not ENZL's affiliated companies. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against ENZL's affiliated companies, and their employees, officers and directors.
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- ix) Where lengths or other measurements have not been provided by a surveyor, ENZL has used basic GIS mapping and measurement systems to estimate these numbers. These should not be taken as surveyor-level accuracy for the purposes of decision making.

APPENDIX B

ASSESSING ECOLOGICAL VALUES (from EcIA Guidelines 2nd Ed.)

Table 4 Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community. (Page 64)

Matters	Attributes to be considered
Representativeness	Criteria for representative vegetation and aquatic habitats: • Typical structure and composition • Indigenous species dominate • Expected species and tiers are present • Thresholds may need to be lowered where all examples of a type are strongly modified Criteria for representative species and species assemblages: • Species assemblages that are typical of the habitat • Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/distinctiveness	Criteria for rare/distinctive vegetation and habitats: • Naturally uncommon, or induced scarcity • Amount of habitat or vegetation remaining • Distinctive ecological features • National priority for protection Criteria for rare/distinctive species or species assemblages: • Habitat supporting nationally Threatened or At Risk species, or locally¹⁹ uncommon species • Regional or national distribution limits of species or communities • Unusual species or assemblages • Endemism
Diversity and Pattern	• Level of natural diversity, abundance and distribution • Biodiversity reflecting underlying diversity • Biogeographical considerations – pattern, complexity • Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation
Ecological context	• Site history, and local environmental conditions which have influenced the development of habitats and communities • The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in RMA) • Size, shape and buffering • Condition and sensitivity to change • Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material • Species role in ecosystem functioning – high level, key species identification, habitat as proxy

5.2 Assigning value to terrestrial areas

Table 5 Factors to consider in assigning value to terrestrial species for EcIA (Pg. 67)

Determining factors	
Nationally Threatened species, found in the ZOI either permanently or seasonally	Very High
Species listed as At Risk – Declining, found in the ZOI, either permanently or seasonally	High
Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally	Moderate
Locally (ED) uncommon or distinctive species	Moderate
Nationally and locally common indigenous species	Low
Exotic species, including pests, species having recreational value	Negligible

5.2.2 Assessing terrestrial sites or areas using EclA data

Table 6. Scoring for sites or areas combining values for four matters in Table 4. (Pg. 69)

Value	Description
Very High	Area rates High for 3 or all of the four assessment matters listed in Table 4. Likely to be nationally important and recognised as such.
High	Area rates High for 2 of the assessment matters, Moderate and Low for the remainder, or Area rates High for 1 of the assessment matters, Moderate for the remainder. Likely to be regionally important and recognised as such.
Moderate	Area rates High for one matter, Moderate and Low for the remainder, or Area rates Moderate for 2 or more assessment matters Low or Very Low for the remainder Likely to be important at the level of the Ecological District.
Low	Area rates Low or Very Low for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates Very Low for 3 matters and Moderate, Low or Very Low for remainder.

5.3 Assigning value to freshwater habitats

Table 7. Matters that may be considered when assigning ecological value to a freshwater site or area (Pg.70)

Matters	Attributes to be assessed
Representativeness	- Extent to which site/catchment is typical or characteristic - Stream order - Permanent, intermittent or ephemeral waterway - Catchment size - Standing water characteristics
Rarity/distinctiveness	- Supporting nationally or locally Threatened, At Risk or uncommon species - National distribution limits - Endemism - Distinctive ecological features - Type of lake/pond/wetland/spring
Diversity and Pattern	- Level of natural diversity - Diversity metrics - Complexity of community - Biogeographical considerations - pattern, complexity, size, shape

Ecological context	• Stream order • Instream habitat • Riparian habitat • Local environmental conditions and influences, site history and development • Intactness, health and resilience of populations and communities • Contribution to ecological networks, linkages, pathways • Role in ecosystem functioning – high level, proxies
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Table 10. Criteria for describing level of effects (Pg. 84)

Ecological Value→ Magnitude↓	Very high	High	Moderate	Low	Negligible
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	Net gain	Net gain	Net gain	Net gain	Net gain

APPENDIX C

The location of proposed development on site is indicative and subject to change to avoid sensitive ecological features.

APPENDIX D

Location of the proposed stormwater wetland is indicative and subject to change to avoid sensitive ecological features.

APPENDIX E

Wetland Delineation protocol results

Potential Wetland area 1

Plot 1 Rapid test

Table 1: Plot One Rapid Test – (2x2m Plot)

Vegetation species	% Cover	Wetland Indicator Rating ¹³	Status
Tree Stratum			
N/A	-	-	
Sapling/Shrub Stratum			
N/A	-	-	
Herb Stratum (All Non – Woody Plants)			
Ranunculus repens	50*	FAC	
Holcus lanatus (P)	20*	FAC	
Dactylis glomerata (P)	15	FACU	
Juncus effusus	10	FACW	
Rumex obtusifolius	5	FAC	
Total % cover	100		
Total % improved pasture species ¹⁴ (P) indicates improved pasture species	35		
Total % cover of OBL and/or FACW species	10		
Are all Dominant Species FACW or OBL (Rapid Test Met)? (*) indicates dominant species calculated by the 50:20 rule.	50: 1 20: 1 No - Fail		

Plot 1 Dominance test

Table 2: Plot One Dominance Test

Vegetation species	% Cover	Wetland Indicator Rating	StatusDominant Species?
Herb Stratum			
Ranunculus repens	50*	FAC	Y
Holcus lanatus (P)	20*	FAC	Y
Dactylis glomerata (P)	15	FACU	
Juncus effusus	10	FACW	
Rumex obtusifolius	5	FAC	
Total % cover	100		

No. dominant species that are OBL, FACW or FAC (Following the 50/20 rule)	50 (50) = 1 20 (20) = 1
Total number of dominant species across all strata (Dominant as calculated by this test)	2
% Dominant species that are OBL, FACW or FAC	70%
Dominance Test Pass? (<i>Hydrophytic vegetation is present if more than 50% of the total number of dominants are FAC or wetter.</i>)	Yes – but all FAC

Plot 1 Prevalence Test

Table 3: Plot One Prevalence Test.

Rating	Total % Cover of:	X	Prevalence Rating
OBL species	0	x1=	0
FACW species	10	x2=	20
FAC species	75	x3=	225
FACU species	15	x4=	60
UPL species	0	x5=	0
Column Total	A: 100		B: 305
Prevalence Index = B/A	305/100 = 3.05		
Prevalence Test Pass? (PI≤3.0)	No		

Plot 2

Table 1: Plot Two Rapid Test – (2x2m Plot)

Vegetation species	% Cover	Wetland Indicator Rating ¹³	Status
Tree Stratum			
N/A	-	-	
Sapling/Shrub Stratum			
N/A	-	-	
Herb Stratum (All Non – Woody Plants)			
Ranunculus repens	30*	FAC	
Anthoxanthum odoratum (P)	25*	FACU	
Lolium perenne (P)	25*	FACU	
Holcus lanatus (P)	10	FAC	
Dactylis glomerata (P)	10	FACU	
Total % cover	100		
Total % improved pasture species ¹⁴ (P) indicates improved pasture species	70		
Total % cover of OBL and/or FACW species	0		
Are all Dominant Species FACW or OBL (Rapid Test Met)? (*) indicates dominant species calculated by the 50:20 rule.	50: 0 20: 3 No - Fail		
Pasture exclusion test: $(70/100) \times 100 = 70\%$ PASS pasture species = $\geq 50\%$ coverage			

Plot 3

Table 1: Plot Three Rapid Test – (2x2m Plot)

Vegetation species	% Cover	Wetland Indicator Rating ¹³	Status
Tree Stratum			
N/A	-	-	
Sapling/Shrub Stratum			
N/A	-	-	
Herb Stratum (All Non – Woody Plants)			
Lolium perenne (P)	30*	FACU	
Anthoxanthum odoratum (P)	25*	FACU	
Ranunculus repens	20*	FAC	
Holcus lanatus (P)	10	FAC	
Dactylis glomerata (P)	10	FACU	
Total % cover	100		
Total % improved pasture species ¹⁴ (P) indicates improved pasture species	75		
Total % cover of OBL and/or FACW species	0		
Are all Dominant Species FACW or OBL (Rapid Test Met)? (*) indicates dominant species calculated by the 50:20 rule.	50: 0 20: 3 No - Fail		

Pasture exclusion test: $(75/100) \times 100 = 75\%$ PASS pasture species = $\geq 50\%$ coverage
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Table 1: Plot Four Rapid Test – (2x2m Plot)

Vegetation species	% Cover	Wetland Indicator Rating ¹³	Status
Tree Stratum			
N/A	-	-	
Sapling/Shrub Stratum			
N/A	-	-	
Herb Stratum (All Non – Woody Plants)			
Lolium perenne (P)	30*	FACU	
Ranunculus repens	30*	FAC	
Anthoxanthum odoratum (P)	20*	FACU	
Holcus lanatus (P)	10	FAC	
Dactylis glomerata (P)	10	FACU	
Total % cover	100		
Total % improved pasture species ¹⁴ (P) indicates improved pasture species	70		
Total % cover of OBL and/or FACW species	0		
Are all Dominant Species FACW or OBL (Rapid Test Met)? (*) indicates dominant species calculated by the 50:20 rule.	50: 0 20: 3 No - Fail		
Pasture exclusion test: $(70/100) \times 100 = 70\%$ PASS pasture species = $\geq 50\%$ coverage			

Plot 1 Hydrology test

An assessment using the hydrology tool was undertaken for Plot 1 in Potential Wetland Area 1. To confirm the presence of wetland hydrology using this tool, the following are required:

- o one primary indicator, or
- o two secondary indicators.

Table 13: Hydrology tool for plot 1 potential wetland area 1.

Assessment Indicator	Met?	Comments
Primary		
Surface Water	Yes	Surface water observed, very muddy underfoot evidence of poaching

<i>Sediment Deposit</i>	Yes	Evidence of sediment deposits on leaves on the ground layer and against the fence
<i>Iron deposits</i>	Yes	Reddish wet material observed just on the ground surface.
<i>Inundation visible on aerial imagery</i>	Yes	Some differences in vegetation is seen on aerial imagery.
<i>Sparsely vegetated concave surface</i>	Yes	Some bare earth and ground is concave
<i>Water-stained leaves</i>	Yes	Leaves had evidence of staining
<i>Reduced iron</i>	Yes	Observed in the soil plot
Secondary		
<i>Water-stained leaves</i>	Yes	Leaves had evidence of staining
<i>Saturation visible on aerial imagery</i>	Yes	Some differences in vegetation are visible on aerial imagery.
<i>Geomorphic position</i>	Yes	Low lying area compared to surroundings

Plot 1 hydric soil test

Evidence of hydric soils was identified within the vicinity of Plot 1. There was clear evidence of gleyed soil with a pale low chroma 5/1* and reddish mottling at a depth of c.200-300mm within the soil plot a restricting layer was observed below the gleyed horizon. The presence of the above soil features indicated that the soil is saturated for at-least part of the year and therefore passes the hydric soil test.



Appendix F – Comparative Servicing Demand Summary



				Water Demand Calculation		Mitre 10		Te Awamutu			21-Mar-2024		
RITS standard residential water consumption and population equivalents													
Residential - Water Consumption				260		litres per person per day				RITS Section 6.2.3			
Individual dwelling				2.7		persons per dwelling				RITS TABLE 5-3 Population Equivalent			
General Residential, Medium Density Residential, Temple View, Special Heritage, Special Residential Zones				45		persons per hectare				RITS TABLE 5-3 Population Equivalent			
All Business Zones, Community Facilities Zone				30		persons per hectare				RITS TABLE 5-3 Population Equivalent			
All Industrial Zones, City Centre Zone, Major Facilities Zone				45		persons per hectare				RITS TABLE 5-3 Population Equivalent			
Residential Intensification Zone				120		persons per hectare				RITS TABLE 5-3 Population Equivalent			
School - Primary				45		persons per hectare				RITS TABLE 5-3 Population Equivalent			
School - Secondary				150		persons per hectare				RITS TABLE 5-3 Population Equivalent			
Catchment/Lot	Number of Dwellings	Number of Super Lot	Catchment Area (m²)	Zone	Population	Consumption			On demand factor	Peak Domestic Demand	Comments		
						(l/day)	(l/s)	(m³/day)		(l/s)			
New Mitre 10 based on proposed GFA (RITS)			10200	Business	31	7956	0.092	7.956	5.0	0.460	Catchment area based on proposed new GFA. Consumption based on RITS Business zone (30 pph)		
New Mitre 10 based on proposed GFA (water flow meter)			10200	Business	31	11318	0.131	11.318	5.0	0.655	Catchment area based on proposed new GFA. Consumption taken from max water reading.		
Back calculation from existing Mitre 10 water flow meter			6140	Business	18	6813	0.079	6.813	5.0	0.394	Catchment area based on existing Mitre 10 GFA. Consumption taken from max water reading.		
Residential Zone Development per hectare			40500	General Res	182	47385	0.548	47.385	5.0	2.742	Catchment area based on site boundaries. Consumption based on RITS Residential zone (45 pph)		
Business Zone Development per hectare			40500	Business	122	31590	0.366	31.590	5.0	1.828	Catchment area based on site boundaries. Consumption based on RITS Business zone (30 pph)		

			Wastewater Flow Calculation		Mitre 10			Te Awamutu			21-Mar-2024			
Standard Values used														
Domestic Average Daily Wastewater Flow			200	litres per person per day					RITS SECTION 5.2.4.2					
Infiltration Allowance			2250	litres per hectare per day					RITS SECTION 5.2.4.2					
Surface Water Ingress Allowance			16500	litres per hectare per day					RITS SECTION 5.2.4.2					
Individual dwelling			3	persons per household (RITS Table 5-7)					RITS TABLE 5-3 Population Equivalent					
General Residential and Medium Density Residential Zone			45	persons per hectare					RITS TABLE 5-3 Population Equivalent					
Residential Intensification Zone			120	persons per hectare					RITS TABLE 5-3 Population Equivalent					
Business Zones			30	persons per hectare					RITS TABLE 5-3 Population Equivalent					
Industrial Zone			30	persons per hectare					RITS TABLE 5-3 Population Equivalent					
Schools - Primary			45	persons per hectare					RITS TABLE 5-3 Population Equivalent					
Schools - Secondary			150	persons per hectare					RITS TABLE 5-3 Population Equivalent					
Catchment/Lot	Number of Dwellings	Number of Super Lot	Catchment Area (m²)	Zone	Population (P)	Consumption (l/day)	P/A Ratio (F) (Peaking Factor)	Infiltration (l/ha/day)	SWI (l/ha/day)	ADF (m³/day)	PDF (l/sec)	PWWF (l/sec)	COMMENTS	
New Mitre 10 based on proposed GFA (RITS)			10200	Business	31	6120	7.94	2295	16830	8.42	0.59	0.78		Catchment area based on proposed new GFA. Consumption based on RITS Business zone (30 pph)
New Mitre 10 based on proposed GFA (flow meter)			10200	Business	31	8706	7.76	2295	16830	11.00	0.81	1.00		Catchment area based on proposed new GFA. Consumption based 77% of water meter reading.
Back calculation from existing Mitre 10 water flow meter			6140	Business	18	5241	9.97	1382	10131	6.62	0.62	0.74		Catchment area based on existing Mitre 10 GFA. Consumption based 77% of water meter reading.
Residential Zone Development per hectare			40500	General Res	182	36450	4.31	9113	66825	45.56	1.93	2.70		Catchment area based on site boundaries. Consumption based on RITS Residential zone (45 pph)
Business Zone Development per hectare			40500	Business	122	24300	4.3	9,113	66,825	33.41	1.31	2.08	Catchment area based on site boundaries. Consumption based on RITS Business zone (30 pph)	