ANDREW MCALLISTER

29 September 2023

TRAM ROAD BLOCK A, SWANNANOA
FLOOD RISK ASSESSMENT

e2 environmental
CONSULTING CIVIL ENGINEERS

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Project Personnel

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1 Summary

Andrew McAllister is investigating a potential rezoning of a 16.36 ha block of land at the corner of Tram Road and Two Chain Road in Swannanoa. This block of land includes the properties detailed in Table 1, and will collectively be referred to as Block A. The site has been identified through flood modelling by Waimakariri District Council (WDC) as having a minor overland flow path which runs through a portion of the site. Figure 1 below shows the site (highlighted in yellow), with the peak water depths shown for the 0.5% AEP[1] flood event (equivalent to the 200-year average recurrence interval) including the effects of climate change[2].

Overall, and from a flood risk perspective, Block A has been assessed to be appropriate for development. Recommendations have been provided to manage the on-site flood risk.

Table 1 Properties included in Block A

Site Address	Legal Description	Owner
1379 Tram Road	LOT 1 DP 323637	WDC
1401 Tram Road	LOT 5 DP 321133	Andrew McAllister
1419 Tram Road	LOT 7 DP 321133	Andrew McAllister
937 Two Chain Road	LOT 2 DP 323637	WDC

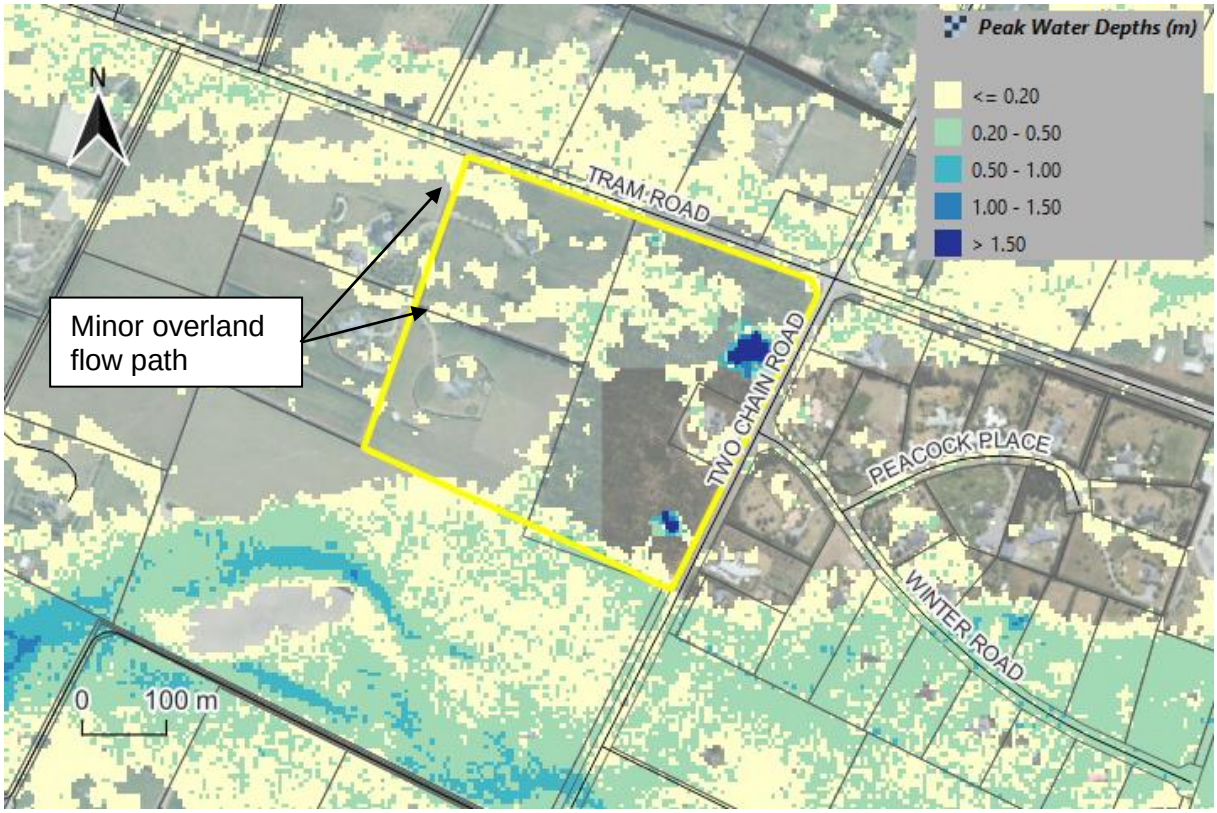


Figure 1 Proposed rezoning of Block A in Swannanoa (highlighted in yellow) with peak flood depths shown for the 0.5% AEP flood event

[1] Annual exceedance probability.
[2] Note that all flood events discussed in this report include the effects of climate change.

1.1 Scope

The purpose of this report is to:

- Describe and detail our current understanding of flood risk in the existing undeveloped situation, and including the effects of climate change;
- Review requirements by WDC with respect to this flood risk;
- Review any other legislative policy with respect to this flood risk;
- Propose options to mitigate on-site flood risk so that development can safely occur, or if required, determine what land is unsuitable for development;
- Propose options to ensure overland flow paths are not diverted, impeded, or obstructed by any potential future development; and
- Undertake a section 106 assessment of flood hazard.

2 WDC Access Requirements

WDC have the following access requirements for any new lots in rural areas:

- The accessway to the building platform shall not be inundated in a 20% AEP flood event;
- Culverts must be designed to the 10% AEP flood event;
- The accessway must be passable in a 2% AEP flood event, with water depths over the waterway to be no more than 300 mm; and
- Culverts across overland flow paths or waterways need to be designed so that if they are blocked, then the accessway is still passable (i.e., have a water depth over it of less than 300 mm), and do not create a flood hazard for neighbouring properties.

3 Overview of the Site's Catchment

3.1 Site Overview

The 16.36 ha site is gently sloping with an approximate grade of 1 in 187 falling in an east-south-easterly direction. There is also a water race located near the south side of Block A. This has recently been realigned with approval from WDC. This water race is now offset 1 – 2 m from the south boundary of 1419 Tram Road (see Figure 2 below), and is located on / adjacent to the south side of the south boundary of 1379 Tram Road.

Aerial, topographical, and flood maps of the site are provided in Appendix A for reference.

Figure 2 *Recently realigned water race at southern edge of property boundary (photo taken during site visit on 22nd September 2023)*

3.2 Upstream Catchment Information

Block A has a local catchment upstream of the site estimated to have the following parameters:

- Area = 43.7 ha
- Length = 1.6 km
- Soil drainage = moderately well drained soils
- Catchment slope = 0.6% (1 in 171)
- Estimated time of concentration = 2 - 6 hours[4]

3.3 WDC Model Results

WDC has undertaken flood modelling for the 1% AEP, 0.5% AEP and 0.2% AEP flood events including the effects of climate change. Results from WDC flood modelling are available to the public. The peak water depths in the 0.5% AEP flood event are presented in Appendix A. Flow rates at key locations were also requested from WDC (see Table 2 and Figure 3 below). Key points from these model results, also shown in Figure 1, include:

- A significant overland flow path encroaches on the south side of Block A, typically by up to 30 m from the southern site boundary;

[4] Calculated using the Friend equation

- A moderate overland flow path to the north of Block A has a small breakout which flows across the northern half of the site in a minor overland flow path;
- Flow velocities across site are generally less than 0.4 m/s, and commonly below 0.2 m/s; and
- The site is otherwise predominantly dry (excluding small shallow low points which become inundated with the model's rain on grid approach).

Table 2 Total peak flow rates in the minor overland flow path at the upstream end of Block A

Location	1% AEP	0.5% AEP	0.2% AEP
Minor overland flow path	1.2 m³/s	1.8 m³/s	2.5 m³/s

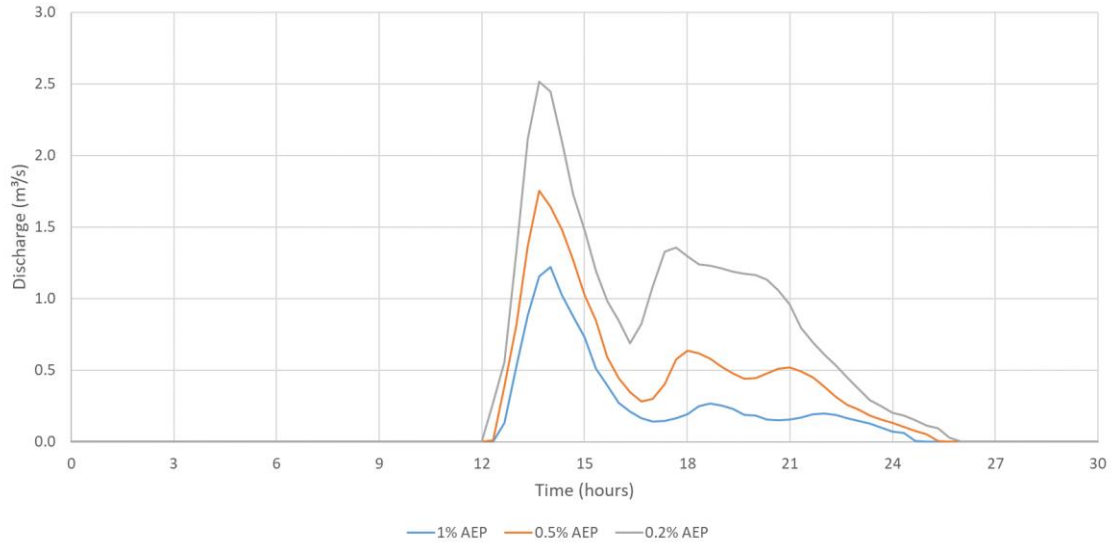


Figure 3 Catchment runoff onto Block A in large flood events, as modelled by WDC

3.4 Catchment Hydrology

As the WDC flood model has not been simulated for flood events less than the 1% AEP flood event (i.e., the 20% and 10% AEP flood events), peak flow rates have been calculated for the local catchment upstream of Block A using the Rational Method for the 20% and 10% AEP flood events. These flow rates are for a 2-hour duration rainfall event with rainfall intensities sourced from HIRDS V4, and an assumed runoff coefficient of 0.25. The 1% AEP flow detailed below has been extracted from the WDC model results and will be used in place of the 2% AEP flood event. This is due to the uncertainty of the runoff volumes and the capacity of the upstream drainage network to divert flows away from our site.

Estimated peak flow rates from the upstream catchment onto Block A:

- 20% AEP flood event including the effects of climate change = 0.425 m³/s
- 10% AEP flood event including the effects of climate change = 0.525 m³/s
- 1% AEP flood event including the effects of climate change = 1.2 m³/s

We note that upstream of 1401 Tram Road (i.e., the northwestern lot) there is a right-of way along the property boundary that would divert at least a portion of the 20% AEP and 10% AEP flows towards Tram Road away from Block A. We therefore consider the flows detailed above to be conservative.

3.5 On-Site Stormwater Management

On-site stormwater management will be required to manage flows coming off the proposed development. Dependent upon site specific groundwater levels, these could be managed either via soak holes or rainwater roof tanks. Overall, we consider that it will be possible to effectively manage the post-development stormwater runoff so that flood risk either on, or off-site, is not increased.

4 Policy Review

The Canterbury Regional Policy Statement (CRPS) policy 11.3.1 describes the requirements in relation to new subdivision, use and development of land in high hazard areas unless key conditions can be met. “High hazard areas”, in this context, are flood hazard areas subject to inundation events where the water depth (metres) x velocity (metres per second) is greater than or equal to 1, or where depths are greater than 1 metre, in a 0.2% AEP flood event.

A review of the WDC model results indicates that there are only two areas on Block A which have water depths greater than 1 m in a 0.2% AEP flood event. These are located on 1379 Tram Road which is a historic gravel pit, now operating as a small pine wood lot. These two areas of higher water depth are located at two of these historic gravel pits, which are 2 – 3 m deep. In reality, the water would infiltrate to ground faster than the model is likely predicting as it would be accessing the deeper gravels[5], and we expect that these would also be filled in, effectively eliminating these areas of higher water depths.

Overall, we consider that any development on Block A will be able to meet the requirements of CRPS policies on high hazard areas.

5 Overview of Predicted Flood Risk

Based on the site’s flood risk described above in section 3, the predicted flood risk can be summarised as:

- Generally having slow moving floodwaters across the property;
- Having areas of shallow inundation (less than 200 mm water depth), with some relatively minor areas of moderate inundation (200 mm to 500 mm water depth); and
- Having some areas where development will need to consider flood risk during future design stages.

In summary, it is our view that Block A is suitable for development.

[5] Refer to wells M35/9653, M35/9655 and M35/18638

6 Recommendations to Manage On-Site Flood Risk

6.1 Site Access

Accessway Design

Accessway road levels are proposed to be set no more than 300 mm below the 1% AEP flood level. This will ensure that there is less than 300 mm of water depth above the accessway in a 2% AEP flood event, and so the accessway would remain passable. Any raised accessways should not be located against the upstream property boundary so that they do not increase flood hazard on neighbouring properties.

Flow velocities over the accessway are expected to be much less than 3 m/s based on modelled flow velocities in the area.

Culvert Design

Depending on the proposed subdivision layout, culverts may be required on accessways to prevent minor overland flow path(s) from being blocked, and to ensure that no overtopping occurs in the 20% AEP rainfall event. If culvert(s) are required, they're expected to be small and would not be a major component of the subdivision design. However, this would need to be confirmed during subdivision design once the subdivision layout is known.

6.2 Building Platforms

Building Platform Locations

In general, building platforms should not be located within any overland flow paths. However, provided floodwaters can flow around the building platform (potentially with swales), they can be located in areas with depths up to 200 mm.

The minor overland flow path on the northern half of the site could be modified into a well-defined swale to minimise its extent across site. This would also make it easier to cross with culverts at well-defined locations to ensure no inundation of the accessway occurs in the 20% AEP rainfall event. Building platform locations should also avoid the significant overland flow path at the south end of the site, and so it is recommended that no earthworks occur within 15 m of the southern property boundary (see the black hatched area below in Figure 4). This provision would also protect any overflows from the water race in large flood events. We expect this provision could be enforced with an appropriate legal instrument if required.

Building platform level requirements are discussed further below.

The above advice does not take into account any planning requirements, which will also need to be taken into account.

More specific building platform location advice can be provided if required.

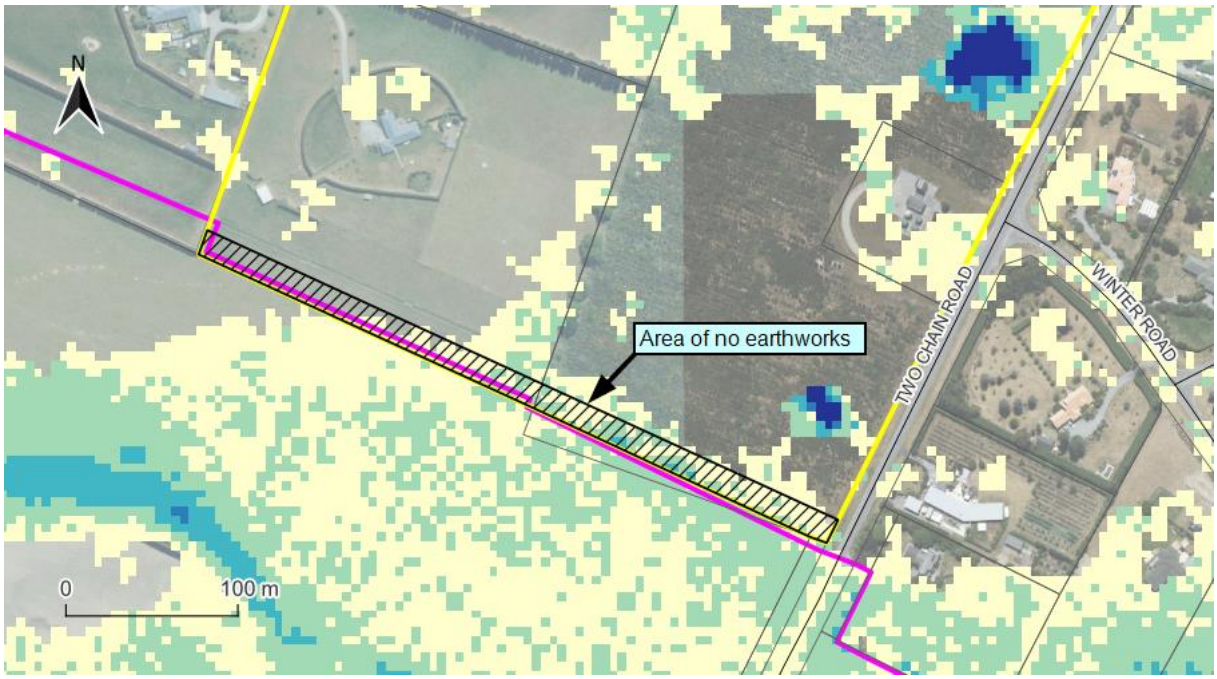


Figure 4 Black hatched area where no earthworks is to occur

Building Platform Levels

Building platform levels and their associated building floor levels should be based upon the chosen location of the building platform and the highest modelled 0.5% AEP flood level intersecting the building platform. Building platform levels are to be set as equivalent to this 0.5% AEP flood level.

At minimum, the floor levels will need to be 400 mm above the highest ground level intersecting the building footprint, and with 500 mm of freeboard above the 0.5% AEP flood level in inundated areas. We recommend selected floor levels are confirmed by WDC in due course.

7 Section 106 Assessment of Flood Hazard

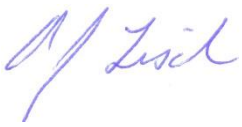
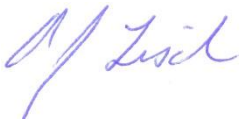
See Table 3 below for a Section 106 assessment of flood hazard for the site of the proposed rezoning. The result of this assessment confirms that Block A is suitable for development with appropriate flood hazard mitigations.

Table 3 Section 106 assessment of flood hazard

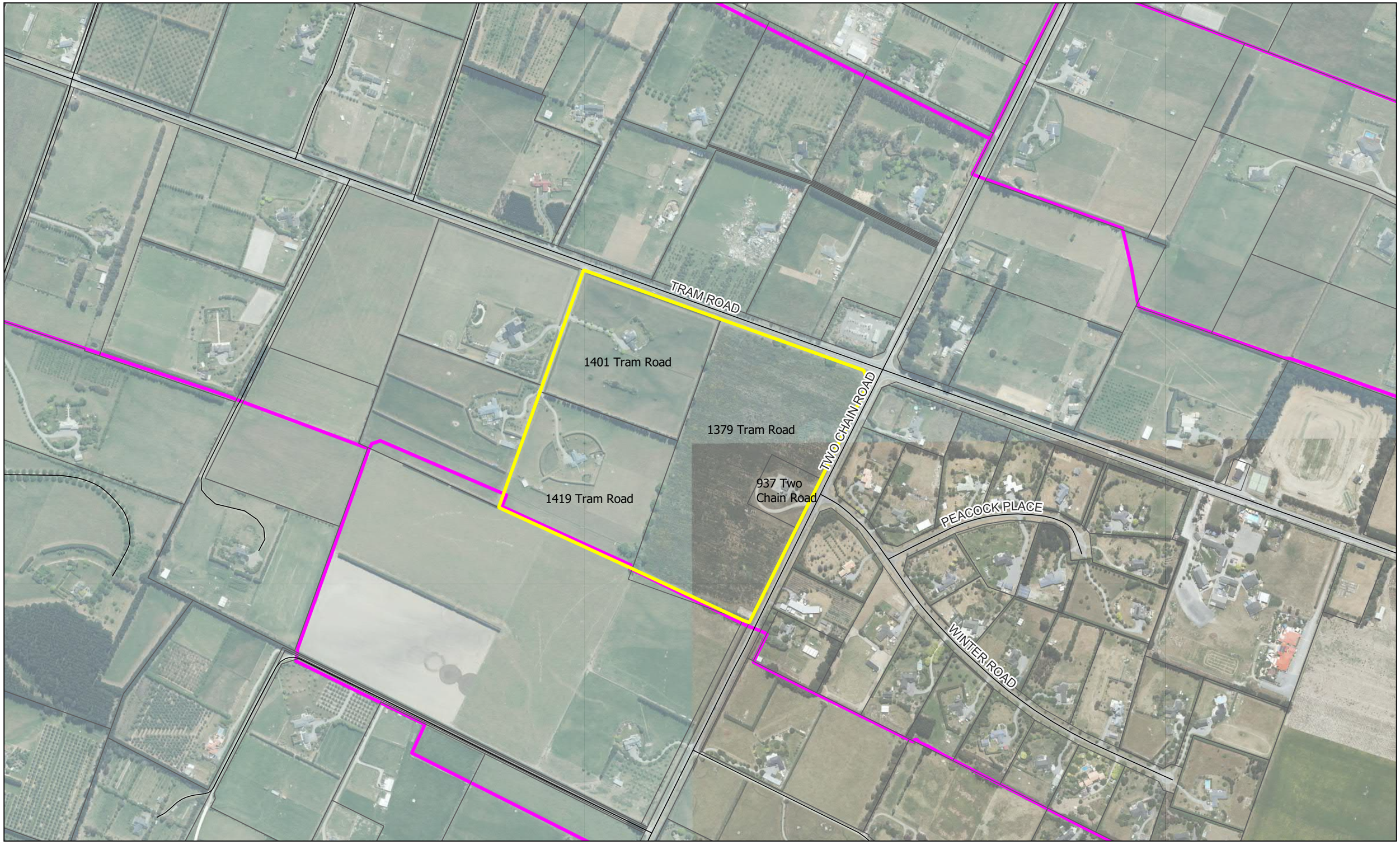
106 Consent authority may refuse subdivision consent in certain circumstances		
Clause	**Assessment**	**Complies (yes/no)**
A consent authority may refuse to grant a subdivision consent, or may grant a subdivision consent subject to conditions, if it considers that— (a) there is a significant risk from natural hazards; or (b) *[Repealed]* (c) sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision.	We have assessed that future residents will be able to have access to their lots and building platforms, and that these can be designed and constructed in a way that there is not significant risk to people or property from natural flood hazard.	Yes
(1A) For the purpose of subsection (1)(a), an assessment of the risk from natural hazards requires a combined assessment of— (a) the likelihood of natural hazards occurring (whether individually or in combination); and (b) the material damage to land in respect of which the consent is sought, other land, or structures that would result from natural hazards; and (c) any likely subsequent use of the land in respect of which the consent is sought that would accelerate, worsen, or result in material damage of the kind referred to in paragraph (b).	The likelihood of flood hazard occurring at this site has been assessed. The material damage to land or structures at this site from flood hazard has been assessed. The use of land for the proposed development would not accelerate, worsen, or result in material damage.	Yes
(2) Conditions under subsection (1) must be— (a) for the purposes of avoiding, remedying, or mitigating the effects referred to in subsection (1); and (b) of a type that could be imposed under section 108.	Conditions could be placed on the proposed development in regards to the design of the accessway to each proposed lot, and / or to the location of the building platforms on each proposed lot.	Yes

8 Report Approvals

This report has been:

Task	Initial	Signature	Date
Prepared by:	Daniel McMullan, e2		29 September, 2023
Reviewed by:	Andrew Tisch, e2		29 September, 2023
Approved by:	Andrew Tisch, e2		29 September, 2023

Appendix A – Site Plans



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Legend

- Block A Extent
- Drainage channels & water races

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Andrew McAllister
Tram Road Block A Plan Change Application

Site plan

Job Number	23036
Revision	1
Date	29/09/2023

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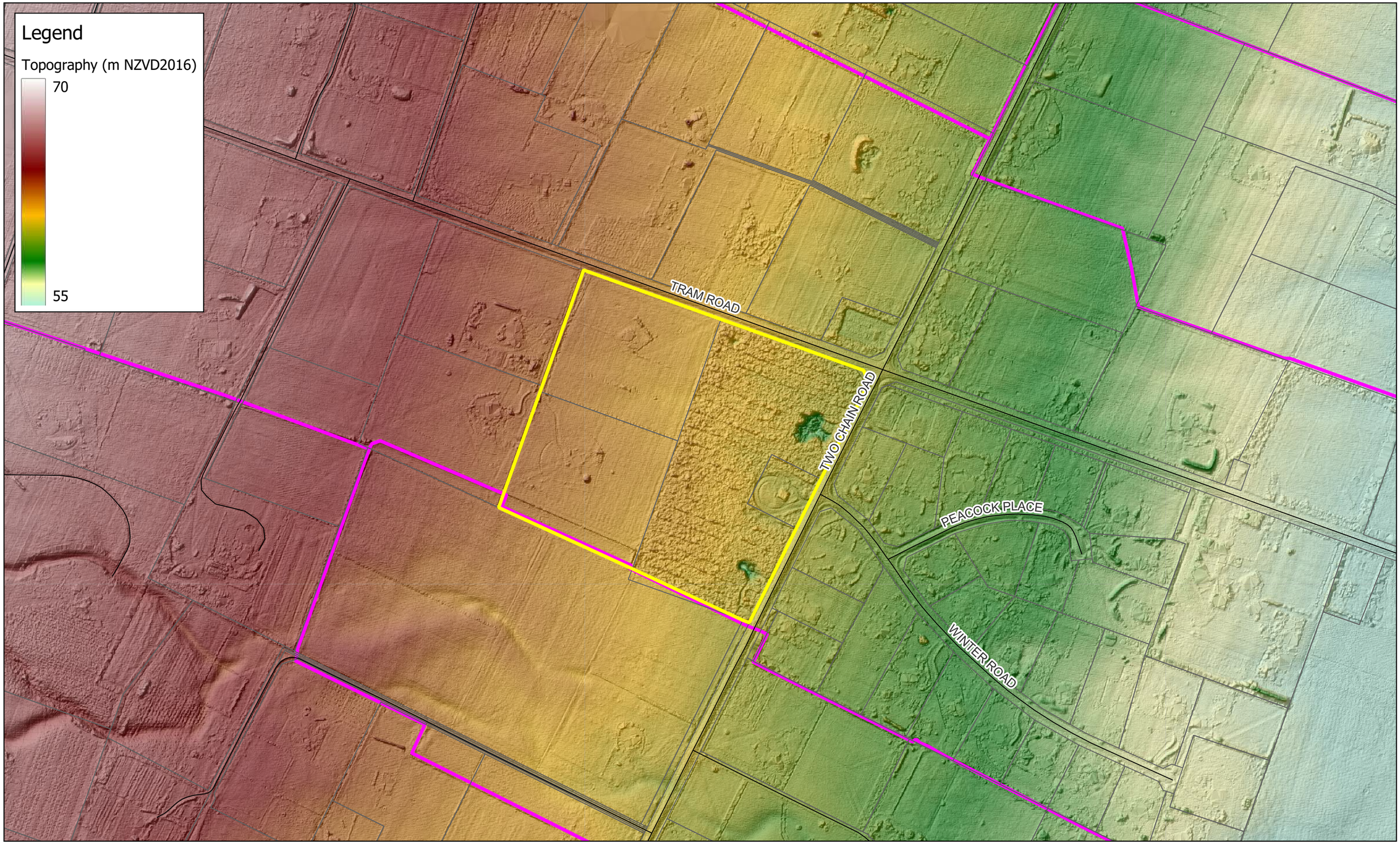

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Tram Road Block A Plan Change Application

Site Topography

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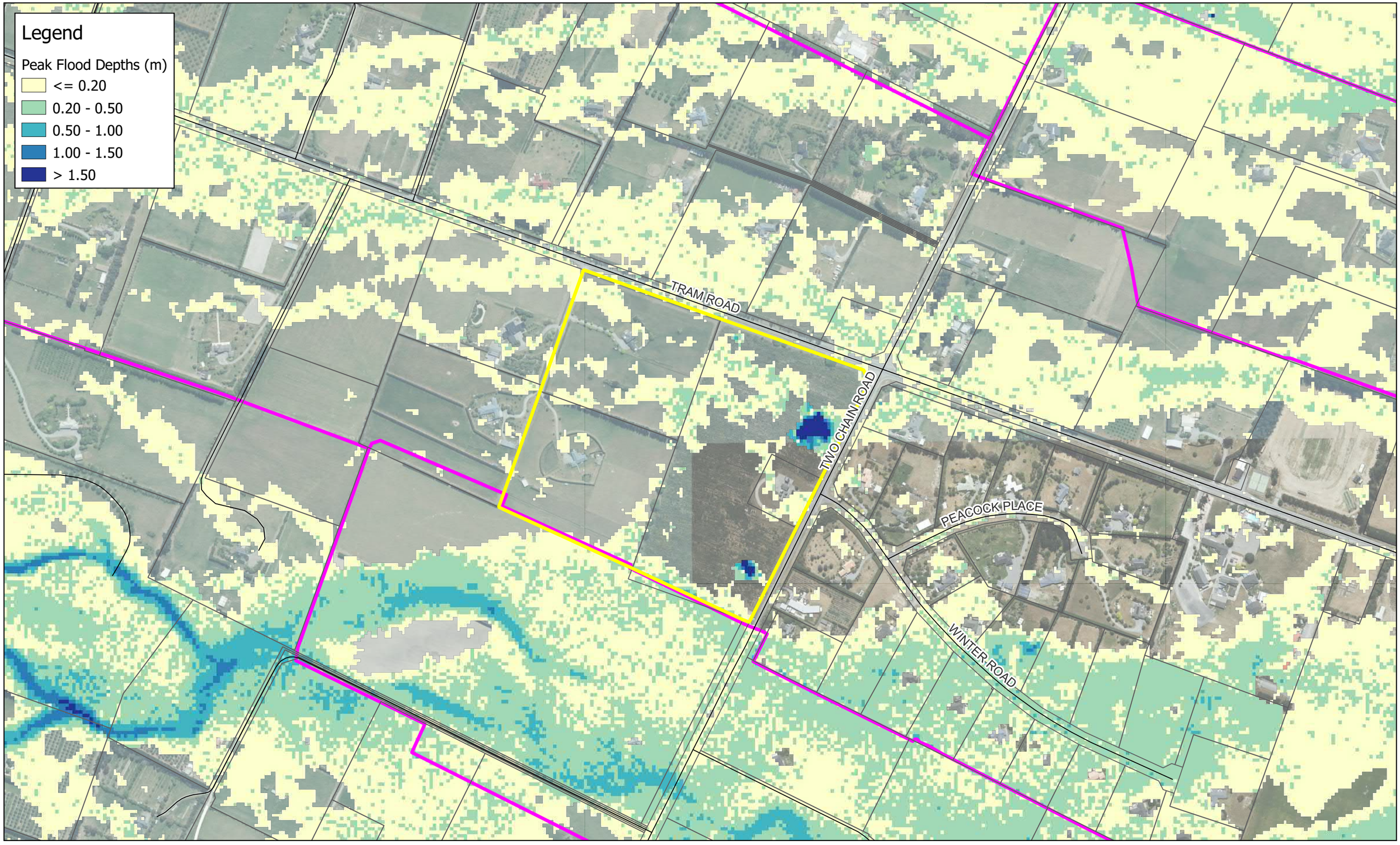

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- Drainage channels & water races

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Andrew McAllister
Tram Road Block A Plan Change Application

Peak flood depths in a 0.5% AEP flood event including the effects of climate change (WDC model results)

Job Number	23036
Revision	1
Date	29/09/2023

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