

# Assessment of Operational Stormwater and Flooding Effects

Alternative to the Brynderwyn Hills – Brynderwyn Hills section

2 April 2026

Revision A

10722-PTA-2B0-PE-RPT-0017

## Copyright information

Copyright ©. This copyright work is licensed under the Creative Commons Attribution 4.0 International licence. In essence, you are free to copy, distribute and adapt the work, as long as you attribute the work to NZ Transport Agency Waka Kotahi (NZTA) and abide by the other licence terms. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

# Table of Contents

1	INTRODUCTION .....	1
1.1.	Purpose and Scope of this report .....	1
1.2.	Qualifications and Experience .....	1
1.3.	Code of Conduct .....	2
2	ASSESSMENT METHODOLOGY .....	3
2.1.	Stormwater Assessment Methodology .....	3
2.2.	Stormwater Design Philosophy .....	3
2.2.1.	Design approach .....	4
2.2.2.	Water Quality .....	4
2.2.3.	Water Quantity .....	5
2.3.	Key elements of the Indicative Stormwater Design .....	5
2.3.1.	Hydrology for Cross Culverts and Road Catchment .....	5
2.3.2.	Bridges and Viaducts .....	5
2.3.3.	Cross Drainage and Overland Flow Paths .....	5
2.3.4.	Edge Collection Systems .....	6
2.4.	Flood Assessment Methodology .....	7
2.4.1.	Te Hana to Whangārei (THTW) Flood Models Overview .....	7
2.4.2.	Flood Assessment Overview .....	9
2.5.	Relevant Standards and Guidelines .....	9
2.6.	Alignment changes within the Proposed Designation .....	10
3	EXISTING ENVIRONMENT .....	11
3.1.	Description of Existing Infrastructure .....	11
3.2.	Stormwater Catchment Description .....	11
3.3.	Existing Scenario - Flooding Overview .....	12
4	ASSESSMENT OF OPERATIONAL STORMWATER EFFECTS .....	16
4.1.	Water Quantity .....	16
4.2.	Water Quality .....	16
4.3.	Ecological Effects .....	17
4.4.	Stormwater Related Effects on Water Users .....	17
4.5.	Residual Effects .....	17
5	ASSESSMENT OF FLOODING EFFECTS .....	19
5.1.	Overview .....	19
5.2.	Overview of Flood Effects with 1% AEP with Climate Change (RCP6, 2110) .....	19
5.3.	Flood Effects outside the Proposed Designation .....	21
5.3.1.	Waipū Interim Tie-in (CH 8400 – 9700) .....	21
5.3.2.	SH1 South of Glenmohr Road Intersection (CH 14800 to 15200) .....	25
5.3.3.	SH12 Interchange (CH 21700 to 24100) .....	27

5.3.4.	Pukekaroro Stream (CH 26200) .....	29
<b>5.4.</b>	<b>Design Changes and Predicted Flood Effects .....</b>	<b>31</b>
5.4.1.	Waipū Interchange Area .....	31
5.4.2.	SH12 Interchange .....	32
6	RECOMMENDATIONS .....	33
<b>6.1.</b>	<b>Operational Stormwater .....</b>	<b>33</b>
<b>6.2.</b>	<b>Flooding .....</b>	<b>33</b>
7	CONCLUSION.....	34

## Appendices

### APPENDIX A

#### Stormwater Plans

### APPENDIX B

#### Flood Model Result Figures

### APPENDIX C

#### Indicative Culvert, Treatment Device and Drainage Diversion Schedules

### APPENDIX D

#### D1 Sensitivity Analysis

#### D2 Sensitivity Analysis Figures

## Figures

Figure 1: THTW Flood Models Extents Map for the Brynderwyn Hills

Figure 2: Proposed Designation, Rivers, and Streams in Proximity to the Project

Figure 3: Existing flooding across the Project (1% AEP with CC (RCP6.0, 2110))

Figure 4: Maximum Flood Depth south of the Brynderwyn Hills for Existing Scenario during 1% AEP with CC (RCP6.0 2110)

Figure 5: Maximum Flood Depth at Brynderwyn Hills for Existing Scenario during 1% AEP with CC (RCP6.0 2110)

Figure 6: Maximum Flood Depth north of the Brynderwyn Hills for Existing Scenario during 1% AEP with CC (RCP6.0 2110)

Figure 7: Flood level difference map for the Project (1% AEP with CC (RCP6.0, 2110))

Figure 8: Flood level difference map for the proposed Waipū Interim Tie-in (1% AEP with CC (RCP6.0, 2110))

Figure 9: Flood level difference map for the proposed Waipū Interim Tie-in (10% AEP WITH CC RCP6.0 (2110))

Figure 10: Peak flow analysis for different location at Waipū Interim tie in during 1%AEP with CC

Figure 11: Flood level difference map near SH1-Glenmohr Road intersection (1% AEP WITH CC RCP6.0 (2110))

Figure 12: Flood level difference map near SH1-Glenmohr Road intersection (10% AEP WITH CC RCP6.0 (2110))

Figure 13: Flood level difference map within the SH12 Interchange (1% AEP WITH CC RCP6.0 (2110))

Figure 14: Flood level difference map within the SH12 Interchange (10% AEP WITH CC RCP6.0 (2110))

Figure 15: Peak flow analysis for different locations downstream of the SH12 Interchange during a 1%AEP with CC event

Figure 16: Flood Level Difference Map at Pukekaroro Stream (1% AEP with CC (RCP6.0, 2110))

Figure 17: Flood Level Difference Map at Pukekaroro Stream (10% AEP with CC (RCP6.0, 2110))

Figure 18: Peak flow analysis for different locations at the southern end of the Project during 1%AEP with CC

Figure 19: Waipū interchange as modelled (pink) and Indicative Alignment (violet), Nov 2025 Design scenario, showing the Indicative Alignment tie-in does not greatly influence, and is not greatly influenced by, flooding of the major watercourses

Figure 20: SH12 Interchange as modelled (pink) and Indicative Alignment (violet) Nov 2025 Design scenario

## Tables

Table 1: Flood Assessment Table for 1% AEP with CC (RCP6, 2110)

Table 2: Number of buildings with predicted increase in the maximum flood level at the building location during 1% AEP with CC (RCP6.0, 2110)

Table 3: Predicted increase in maximum flood level outside the Proposed Designation for locations at Waipū Interim Tie-in

Table 4: Number of buildings with predicted increase in maximum flood level outside the Proposed Designation during 1% AEP with CC (RCP6.0 2110)

Table 5: Number of buildings with predicted increase of flood level outside Proposed Designation during 10% AEP with CC (RCP6.0 2110)

Table 6: Culvert Schedule

Table 7: Constructed Wetland Schedule

# Glossary of Acronyms and Abbreviations

The glossary of acronyms and abbreviations tables in Volume A and B of the Substantive Application apply to this report and should be referred to in addition to the abbreviations and terms below.

Abbreviation / Acronym	Term
2D	Two-dimensional
AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
BPO	Best Practicable Option
CN	Curve Number
DDF	Rainfall Depth -duration -frequency
DEM	Digital Elevation Model
GIS	Geographic information system
ha	Hectares
HIRDS	High Intensity Rainfall Design System
hrs	Hours
IPCC	Intergovernmental Panel on Climate Change
kg	Kilograms
kg/yr	Kilograms per year
km <sup>2</sup>	Square kilometres
m	Metres
m <sup>2</sup>	Square metres
m <sup>3</sup>	Cubic metres
m <sup>3</sup> /s	Cubic meters per second
MPD	Maximum Probable Development
n	Manning's Roughness Coefficient
NIWA	National Institute of Water and Atmospheric Research (now Earth Sciences NZ)
NSE	Nash-Sutcliffe efficiency
SWTS	NZTA Stormwater Treatment Standard for State Highway Infrastructure
THTW	Te Hana to Whangārei
TP108	Technical Publication 108 of Auckland Regional Council (1999)

# 1 Introduction

## 1.1. Purpose and Scope of this report

This report provides an assessment of the actual and potential stormwater and flooding effects associated with the operation of the Brynderwyn Hills section of the Alternative to the Brynderwyn Hills project (the Project).

This assessment forms part of a suite of technical assessments prepared for New Zealand Transport Agency Waka Kotahi (NZTA) to inform the Substantive Application under the Fast-track Approvals Act 2024 (FTAA) for the Project. This report should be read in conjunction with Volume A of the Substantive Application.

The scope of the assessment includes a description of the methodology applied in preparing the assessment, determination of the potential effects generated by the Project, and details of the proposed measures to manage and mitigate adverse effects.

Whilst there may be similarities in the way stormwater and flood flows are managed during construction, the assessment of effects in relation to both construction stormwater and flooding during construction activities is contained within the Construction Water Assessment attached as Appendix D10, Volume B of the Substantive Application.

## 1.2. Qualifications and Experience

### **Dr. Nariman Valizadeh:**

I am a Chartered Professional Engineer (CPEng, IntPE NZ) and Senior Civil Engineer at Aurecon New Zealand Limited, with over 12 years of professional experience in flood risk assessment, stormwater management, hydrological analysis, and hydraulic flood modelling across transport infrastructure, urban developments, and catchment-scale projects.

I hold a Doctor of Philosophy (PhD) in Civil Engineering from the University of Auckland, with specialist research in resilience of stormwater systems, hydrology, and the hydraulic performance of urban stormwater systems.

I have extensive expertise in flood modelling, catchment hydrology, and flood mitigation design using industry-standard tools. My work routinely supports resource consent applications, infrastructure planning and detailed design, and regulatory compliance across New Zealand.

My experience relevant to this assessment includes numerous residential subdivision and industrial development flood impact assessments across the Auckland and Waikato regions; flood risk assessments for major rail infrastructure projects including the City Rail Link, Drury Stations and Henderson Station upgrades; involvement in the Papamoa City-Wide Stormwater Model for Tauranga City Council and an independent technical review of the Oteha Catchment City-Wide Stormwater Model for Auckland Council.

### **Warren Bird:**

I am a Chartered Professional Engineer (CPEng, CMEngNZ) and Technical Principal – Stormwater at WSP (NZ) Limited, with over 43 years of professional experience in stormwater design associated with linear projects (highways and railways).

I hold a Bachelor of Engineering (Civil) from the University of Canterbury, with specialist experience in civil engineering, stormwater treatment, catchment management and urban flood protection.

My experience in more than 30 highway and 10 rail upgrading design projects include being drainage design lead for the highly successful Waikato Expressway Huntly section (which won an ACENZ Silver Award of Merit) and Stormwater Technical Lead for Auckland's City Rail Link. I was recognised by Industry peers with the 2023 Stormwater Professional of the Year award.

My career has paralleled the development of "modern" stormwater management, from a focus on flooding (including by participating in the development of the first ever catchment management plans for the

Papakura-Drury area in the 1990s, and the flood protection works that followed), to focusing on water quality and, more latterly to a more holistic water and culturally-sensitive, ecologically friendly stormwater design.

### **1.3. Code of Conduct**

Although this Project is not being considered before the Environment Court, we confirm that we have read the Code of Conduct for expert witnesses as contained in section 9 of the Environment Court Practice Note 2023. We agree to comply with that Code. We are satisfied that the matters which we address in this assessment are within our area of expertise, except where we state that we are relying on information provided by another person or expert. We have not omitted to consider material facts known to us that might alter or detract from the opinions we express.

## 2 Assessment Methodology

Sections 2.1 to 2.3 provide an overview of the stormwater assessment methodology, including the stormwater design philosophy.

Section 2.4 outlines the flood assessment methodology adopted for this study, including the flood model assumptions, limitations, and key differences between modelling scenarios.

Section 2.5 summarises the relevant standards, guidelines and design criteria adopted for the indicative stormwater design and assessment.

Section 2.6 describes how potential refinements to the Indicative Alignment during detailed design can be incorporated while ensuring the effects of the Project do not go beyond the level as assessed in this report.

### 2.1. Stormwater Assessment Methodology

This section summarises the methodology that has been applied to assess the Project's operational stormwater effects (the assessment methodology applied to flooding is outlined in Section 2.4). This section covers effects relating to water quality, effects on water users, and residual effects.

We have identified key design principles to inform development of an indicative operational stormwater design, which incorporates currently accepted industry best practice.

The indicative stormwater design for the Indicative Alignment is shown in the drawings attached in **Appendix A** and described in Section 2.3. The indicative design was informed by the relevant standards referenced in Section 2.5. The indicative stormwater design infrastructure includes treatment and extended detention devices, measures for culverting or diverting<sup>1</sup> watercourses while preserving or recreating habitat, and measures for managing surface water without erosion or flooding. This assessment of the Project's operational stormwater effects is based on these stormwater measures being in place.

Specific device locations, configurations, areas, and dimensions are likely to change through the detailed design process for the Project. However, we consider that the residual effects of the final design will be no greater than those assessed here, subject to implementation of the recommendations outlined in Section 6.

Using the indicative stormwater design, we have undertaken a desktop assessment<sup>2</sup> of the Project's potential stormwater and flooding effects to recommend appropriate management measures.

### 2.2. Stormwater Design Philosophy

Operational water management refers to the management of stormwater flows during the operational phase (i.e. post construction period).

In the context of the Project, rainfall onto impervious surfaces (and rainfall and groundwater from unavoidably connected areas, such as cut batters) will be collected and conveyed to stormwater treatment devices prior to discharge to streams, which ultimately drain to estuaries and harbours.

Rainfall onto surrounding land (including fill batters) will be diverted away from the road formation and discharged to existing streams and watercourses.

Streams and watercourses that intersect the Indicative Alignment are passed under the road alignment by culverts or bridges. The Project's location and associated culverts will require stream diversions to facilitate construction of the road. In some circumstances, the Project's fill embankments will occupy existing floodplains.

---

<sup>1</sup> In this assessment we use the generic expression "drainage diversions" to denote streams, watercourses, farm drains or drainage paths requiring diversion.

<sup>2</sup> Some key areas were also inspected on site where access was available, including the indicative Piroa Stream culvert location and the indicative Waihoihoi River diversion location.

### 2.2.1. Design approach

The design approach for this Project aims to manage potential stormwater-related effects caused by increased flows, volumes, and contaminants arising from the road. To achieve this, the design follows these key principles:

- **Best practice:** The stormwater design will apply industry best practice design principles.
- **Whole-of-life planning:** Stormwater systems will be designed to function throughout the life of the Project. These systems include pipes, drains, treatment devices, culverts, and stream diversions.
- **Environmental awareness:** The design will consider the existing environment and aim to reduce any negative impacts where practicable.
- **Flood risk reduction:** The design will endeavour to avoid making current flooding problems worse.
- **Stream habitat:** Stream realignments will be designed, where relevant and appropriate, to provide similar morphology, flows and depths, benthic conditions, riparian conditions, velocities and climbing structures, similar to what existed before the Project.
- **Road flood protection:** New highway levels will be set above the expected 1% AEP flood level. Stormwater from the road will be managed to keep the road safe during heavy rain.
- **Outfall and erosion control:** During detailed design, each stormwater outlet will be checked, and erosion control will be added if needed, without blocking fish movement where applicable (see bullet below).
- **Fish passage:** Culverts will be designed and built to allow indigenous fish to move through permanent and intermittent streams where suitable upstream habitat is available as determined by the Project's Freshwater Ecologist and where practicable.
- **Overland flow paths:** During detailed design, consideration will be given to flow paths that will activate in the event of blockage or super-design events. Where necessary specific flow paths will be provided.
- **Water Sensitive Design (WSD):** The design will include features such as constructed wetlands, wetland swales or treatment swales to help manage water flow and improve water quality.
- **Removing contaminants:** To the extent practicable, stormwater treatment measures will be designed to remove sediment and contaminants such as zinc and copper.

Our indicative design is informed by the following water quality and quantity philosophy.

### 2.2.2. Water Quality

Roads generate contaminants such as sediment, heavy metals, and hydrocarbons. The *NZTA Stormwater Treatment Standard for State Highway Infrastructure (May 2010)* outlines standards for treatment of these contaminants through devices like wetlands, wetland swales, and treatment swales. Key aspects of our indicative stormwater design approach informed by the standards listed in Section 2.5 include:

- All impervious trafficable areas along the Indicative Alignment including mainline carriageway, bridges, interchanges and ramps will be treated by wetlands or wetland swales.
- Currently untreated local roads will remain untreated except where significant re-construction of the local road occurs, and traffic volumes on that road are significant.
- Clean stormwater runoff from non-contaminant generating surfaces such as batters will be diverted away from the treatment devices where practicable.

### 2.2.3. Water Quantity

Stormwater runoff and groundwater from cuts will be collected from the new and reformed impervious surfaces associated with the Indicative Alignment and conveyed to stormwater management devices where it will undergo extended detention prior to being released into the environment.

Increased peak flows, or indeed any increased flows above the erosive threshold of the receiving stream, are likely to cause increased erosion. Therefore, the following additional measures will be applied to limit increased erosion:

- Runoff will be retained in its existing catchments (where possible) to avoid adding additional flows to adjacent catchments.
- Major stream diversions will aim to achieve similar length, gradient and sinuosity to the channels they replace. Where this is not possible, suitable armouring or armoured grade control structures will be applied.
- Open channels and overland flow paths (stream diversions, cut-off drains) will be designed to cater for the 1% AEP rainfall event.
- Stormwater collection and conveyance systems will be provided in accordance with NZTA's P46 Stormwater Management Standard (2025) (P46).

Extended detention is the only form of water quantity control proposed (i.e. no peak flow attenuation or intermediate flow control) as per the NZTA's *Stormwater Treatment Standard for State Highway Infrastructure*<sup>3</sup>.

## 2.3. Key elements of the Indicative Stormwater Design

The following section describes the sources of data used to inform the stormwater design for the Indicative Alignment and assessment of the Project's effects.

### 2.3.1. Hydrology for Cross Culverts and Road Catchment

Hydrology parameters for the indicative stormwater design have been sourced from the same data used in the flood modelling, where appropriate and applicable. However, the hydrology approach differs, since the drainage design approach focuses on individual assets, while the flood modelling assesses at a catchment-scale.

### 2.3.2. Bridges and Viaducts

The indicative stormwater design aims to avoid non-bridge drainage crossing over bridges. A treatment device has generally been located upstream of the bridge abutment to cut off and treat stormwater runoff. This approach will also help retain stormwater runoff in its natural catchment.

### 2.3.3. Cross Drainage and Overland Flow Paths

Cross drainage structures such as culverts have been designed to allow the continued flow of existing watercourses and overland flow paths with minimal hydrological changes to the surrounding environment.

In rural areas where the highway discharges to existing pipes, drains or channels, those existing assets have been assumed to have sufficient capacity to receive highway runoff, although in a few cases in Zone 1 the Indicative Alignment assumes farm drains will be enlarged within the Proposed Designation to mitigate flood effects.

#### ***Culverts (pipe or box)***

Culvert crossings have been designed to preserve the natural drainage patterns of the contributing catchment wherever possible, endeavouring to ensure that existing flooding is not worsened and new flooding issues are not created. The hydraulic modelling of the culverts is done using HY-8 culvert design

---

<sup>3</sup> This is consistent with the decision tree in Fig 7-3 of the Stormwater Treatment Standard for State Highway Infrastructure.

software<sup>4</sup>. All culverts for the Indicative Alignment have been designed to meet the following hydraulic criteria:

- Convey the 1% AEP storm event flow without surcharging the pipe more than 2 metres above the pipe soffit, while ensuring a minimum 500mm freeboard from the peak water level to the outer road edge level for the MPD RCP6.0 scenario.
- Mannings value of 0.013 for concrete pipes in accordance with P46.
- The culvert design is carried out for MPD RCP6.0 2110 in accordance with P46.
- Culverts to have 1 m minimum cover under traffic lanes in accordance with P46 where possible. A few culverts are unable to meet this cover requirement and will require the “specific design” exception provided for by P46.
- Cross culverts in wooded or urban catchments must be checked for blockage risk in accordance with the Australian Rainfall & Runoff (2015), Blockage of Hydraulic Structures — Blockage Guidelines.
- Where the debris potential is determined to be medium or high, debris counter measures will be provided.
- Where a culvert inlet headwall is not practicable due to site constraints (such as being in cut areas), drop inlets are proposed.
- Culverts are designed for both hydraulic capacity and to meet the requirements for fish passage based on the estimated stream width, where appropriate and feasible.

### **Hydrology for Bridges**

No new bridges across watercourses are proposed as part of the Project.

### **Fish Passage**

Culvert fish passage has been provided in the Indicative Design where determined necessary and practicable as advised by the Project Ecologist (refer to Culvert Schedule, **Appendix C**).

Where provided within the design, fish passage has followed the *NZ Fish Passage Guidelines* (v2, 2024) to ensure minimal disruption to aquatic ecosystems while facilitating natural fish movement.

Substrate material, usually combined with baffles or spat ropes, will be the standard approach in lowland or low-gradient culverts requiring fish passage. At specific locations where a drop inlet serves as the primary inlet for the culvert (such as spoil fill sites or at “hanging valleys”), no fish passage is offered. In multi-barrel culverts, fish passage will only be provided for one of the culverts.

### **Overland Flow Paths**

Runoff has been retained in existing catchments where possible to avoid flow increases that could cause erosion. Overland flow paths have generally been designed to convey the 1% AEP rainfall event.

## **2.3.4. Edge Collection Systems**

### **Longitudinal Drainage Systems**

Longitudinal drainage systems for the Indicative Alignment have been designed to collect and convey stormwater runoff along the road corridor to suitable treatment/detention devices. For most of the Indicative Alignment, this collection is achieved through open roadside drains, which manage runoff from the road pavement and adjacent cut slopes.

Across the Waipū alluvial plains an alternative approach has been adopted to permit the highway to be constructed at a lower level. In this area pavement runoff will spill down the low embankment into low-gradient wetland swales along the base. Flow will be discharged to local watercourses following treatment/detention.

---

<sup>4</sup> US Department of Transportation Federal Highway Administration

## Stormwater Treatment

The indicative stormwater system has been designed to ensure all runoff from the mainline carriageway surface and ramps will be treated in accordance with the *NZTA Stormwater Treatment Standard for State Highway Infrastructure* (2010). This treatment comprises discrete treatment/extended detention wetlands for most of the section. Across the alluvial Waipū plains wetland swales will be used to reduce earthworks by allowing the highway to be constructed at a lower level. Discrete areas like ramps, tie-ins and high-traffic local roads will have treatment swales.

It is challenging finding/creating flat platforms for stormwater wetlands in the rugged terrain of the Brynderwyn Hills. In the northern part of the Brynderwyn Hills this has been addressed by installing wetlands on top of spoil fill sites. In the southern part, runoff will be conveyed (via pipes or open channels) to a treatment wetland at the base of the hill on the south side of the Piroa Stream.

## Cut-off Drains

Cut-off drains have been installed at the top of cut slopes where there is sheet flow or any form of flow path toward the cut. The purpose of these drains is to intercept and divert surface water away from the road corridor, reducing scouring of the cut batter and reducing the quantum of extraneous water entering the highway treatment wetlands.

## 2.4. Flood Assessment Methodology

### 2.4.1. Te Hana to Whangārei (THTW) Flood Models Overview

This assessment uses the Te Hana to Whangārei (THTW) Flood Models, developed to assess the flood impacts of the Indicative Alignment relative to existing conditions for the 1% and 10% Annual Exceedance Probability (AEP) rainfall event, including the effect of Climate Change (1% AEP with CC and 10% AEP with CC) for RCP6.0 2110 climate change scenario.

For the purposes of the Project, the THTW Flood Models have been adapted from the 2020 Northland Regional Council (NRC) nationwide flood models (NRC Flood Models), as outlined below:

- **M17 Flood Model**, which includes the Ahuroa, North, Ruakākā, and Waihoihoi catchments, covering the northern parts of the Project.
- **M08 Flood Model**: which consists of the Hakaru catchment, covering the southern part of the Project.

Figure 1 below shows the model extents in relation to the Indicative Alignment.

The THTW flood models were developed using TUFLOW modelling software.

Two model scenarios were applied for the flood assessment:

- **Existing (without-Project) scenario (Existing Scenario)**: Represents existing ground level and key existing hydraulic structures and assumes Maximum Probable Development (MPD) land use of the catchment, without consideration of the Indicative Alignment.
- **Design (with-Project) scenario (Design Scenario<sup>5</sup>)**: Incorporates the proposed road earthworks, structures (culvert and bridge structures) and revised impervious areas associated with the Indicative Alignment.

Each scenario of the THTW flood models was run for four design rainfall durations (1-hour, 6-hour, 12-hour and 24-hour) to ensure the critical duration was captured in the assessment.

The flood assessment is based on the maximum flood levels and extents across all four durations for each event.

---

<sup>5</sup> There are minor differences between the design assessed in the flood model and the final design presented in the Substantive Application. These differences are outlined in Section 2.5.

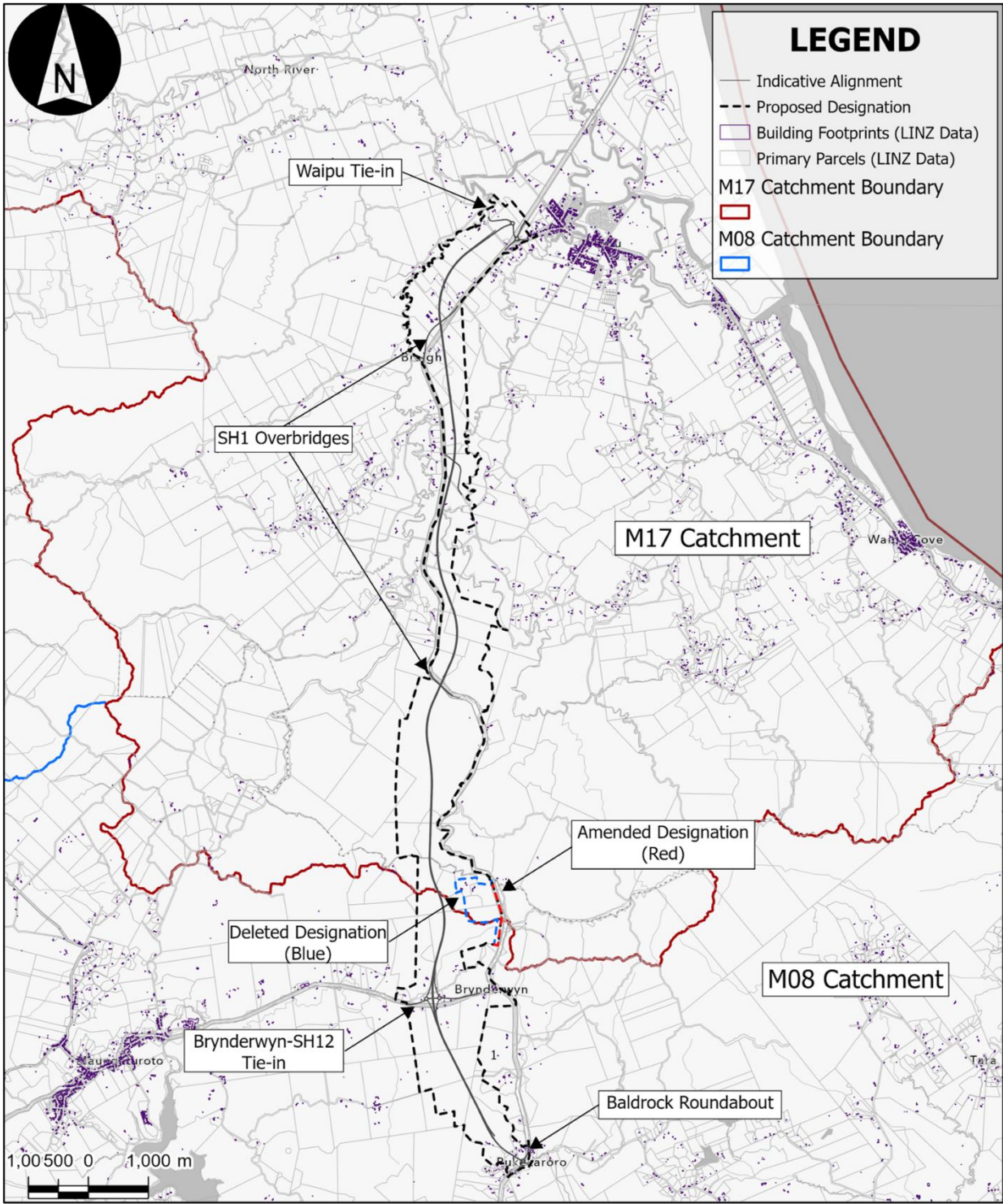


Figure 1 THTW Flood Models Extents Map for the Brynderwyn Hills

### 2.4.2. Flood Assessment Overview

The flood impact assessment in this report was undertaken by analysing the difference between the maximum flood level for the Design Scenario and the Existing Scenario.

We consider the following flood impacts are minor effects with no additional mitigation proposed:

- A flood level increase less than 100 mm outside the Proposed Designation, for the 1% AEP flood event with CC (RCP6.0 2110)<sup>6</sup>.
- No flood level increase above floor level of existing habitable buildings outside the Proposed Designation for the 1% AEP flood event with CC (RCP6.0 2110).<sup>7</sup> Buildings referenced throughout this assessment are based on the building footprints layer sourced from Land Information New Zealand (LINZ), downloaded on 20/01/2025. The LINZ data does not distinguish between habitable and non-habitable buildings, so this assessment is conservative to that extent. Further, since building floor levels are not available at this stage of the Project, in this report the impact assessment is based on the maximum flood level increase at the building footprint location.

Modelled flood level differences less than 10 mm were deemed below the model's margin of error and therefore negligible for the following reasons:

- **Topography:** Ground level data derived from Light Detection and Ranging (LiDAR) typically has a vertical accuracy in the order of  $\pm 20$ –50 mm. Changes in predicted flood levels smaller than this range are therefore within the uncertainty of the underlying terrain data.
- **Grid size:** The hydraulic model uses a digital terrain surface comprising a mesh or grid of horizontal and vertical coordinates. Due to the large size of the Project, to keep computing run times manageable the grid size for THTW flood models were set to 4 m minimum (within the Proposed Designation), and 16 m and 32 m outside, with 1 m Sub Grid Sampling (SGS) for calculation. Consequently, there may be minor uncertainty in the accuracy of the predicted flood levels.
- **Scenario representation:** Implementation of the Design Scenario geometry within the model can result in minor variations in grid configuration compared with the Existing Scenario. These variations can introduce small numerical differences in predicted flood levels between scenarios. Model setup aims to minimise such inconsistencies; however, they cannot be entirely eliminated.

## 2.5. Relevant Standards and Guidelines

The following documents contain the stormwater related guidelines that were used for the indicative stormwater design and in this assessment (with specific aspects of these referenced throughout):

- NZTA Standardised design solutions for use on State Highway Roads of National Significance (version 3.0, May 2025).
- P46 Stormwater management and minor stream diversion design specification (2025). NZTA
- NZTA Stormwater Treatment Standard for State Highway Infrastructure (May 2010).
- Chapter 4: Stormwater and drainage. Whangārei District Council Engineering Standards (2022)
- Auckland Council: Stormwater Management Devices in the Auckland Region (GD2017/01, version 1, 2017)
- Austroads Guide to Road Design Parts 5, 5A and 5B (January 2023).
- FHWA HEC-14, Hydraulic Design of Energy Dissipaters for Culverts and Channels (Third edition, July 2006).
- National Policy Statement for Freshwater Management 2020.

---

<sup>6</sup> This is consistent with what was consented for the Warkworth to Te Hana section.

<sup>7</sup> This is also consistent with the Warkworth to Te Hana consent.

- Resource Management (National Environmental Standards for Freshwater Management) Regulations 2020.
- Resource Management (National Environmental Standard for Sources of Human Drinking Water) Regulations 2007.
- National Institute of Water and Atmospheric Research (NIWA) New Zealand Fish Passage Guidelines (v2, June 2024).
- NIWA. Design rainfall, High Intensity Rainfall Design System (HIRDS) v4, <https://hirds.niwa.co.nz/>
- NZTA Technical Memorandum 2502 – Proposed Designation for calculating road surface run-off in New Zealand (August 2021).
- USBR Rock Ramp Design Guidelines (September 2007).
- NZTA: Various F-series specifications
- Commonwealth of Australia (Geoscience Australia): The Australian Rainfall and Runoff: A guide to flood estimation (ARR), Chapter 6, Book 6 (2019)
- HEC-14, Hydraulic Design of Energy Dissipaters for Culverts and Channels (USDOT, 2006).
- Melbourne Water Constructed Waterways Design Manual (2019)
- Climate Change Projections for New Zealand (2018) Ministry for the Environment (MfE).

Based on the documents outlined above, we have developed a range of stormwater assessment criteria to inform the design philosophy for the indicative stormwater design and this assessment of effects (as noted in Sections 2.2.2 and 2.2.3).

## 2.6. Alignment changes within the Proposed Designation

The Indicative Alignment within the Proposed Designation represents a possible alignment that has been developed for assessment purposes and to illustrate what the Project's final design might look like, and the effects generated by its construction and operation. The alignment that is ultimately built - including the design and placement of bridges, culverts, stormwater systems, spoil disposal areas and landscaping - will be refined and confirmed during the detailed design stage. This Indicative Alignment and indicative stormwater design have been assessed in this report to assist with the drafting of conditions that establish outcome-based criteria to ensure any adverse environmental effects of the detailed design are appropriately avoided, remedied or mitigated.

As such, should the final alignment within the Proposed Designation change, provided the proposed consent conditions are complied with, the effects associated with the revised alignment are expected to be broadly similar to those assessed in this Report.

## 3 Existing Environment

### 3.1. Description of Existing Infrastructure

The Proposed Designation intersects a range of existing infrastructure elements that influence stormwater design and management. The most significant single infrastructural constraint is the Transpower high voltage transmission line. This has significantly influenced the Indicative Alignment but has mainly influenced stormwater design by constraining the configuration of the Waihoihoi River diversion.

Multiple power and telecommunications assets, both local and trunk, lie within or near the Proposed Designation, mostly but not exclusively along existing roads. A gas main paralleling the southern portion of the Proposed Designation is also present and will need to be partially relocated. This relocation can be carried out to accommodate the final stormwater design. At the proposed Waipū Interim Tie-in near Waipū township, an underground trunk watermain is known to traverse the Proposed Designation, principally affecting the Millbrook Road link road, and will need consideration during design and construction to avoid service disruption and ensure compliance with utility protection standards.

As the Proposed Designation passes through rural farmland, informal drainage systems such as farm access culverts and open drains are commonly observed. These features support agricultural operations and may require diversion, upgrading, or integration into the proposed stormwater network. In some cases, they will also serve as potential outfall locations for new stormwater infrastructure.

Wetlands and farm ponds are also present within the Proposed Designation. However, these are not proposed to be used or integrated into the stormwater design due to hydraulic, ecological, or constructability constraints. Additionally, the Proposed Designation intersects existing state highways (SH1 and SH12) and local roads, where legacy stormwater infrastructure such as culverts and road drains are present. These systems will not be reused where new road intersections are proposed, and new drainage will render the existing assets redundant and may be removed.

Existing overland flow paths are evident throughout the Proposed Designation and play a vital role in conveying surface runoff. These natural flow paths are being considered as potential outfall locations for the proposed stormwater network. However, some will be affected by the new road corridor and may require diversion or modification to maintain hydraulic function and prevent localised flooding. The location and extent of these infrastructure elements were identified using council Geographic Information System (GIS) datasets and aerial imagery.

### 3.2. Stormwater Catchment Description

From its intersection with Baldrock Road, the existing SH1 traverses northward across rolling country before climbing the steep Brynderwyn Hills and descending more gradually onto the Waipū alluvial plains. There is currently no formalised stormwater treatment on the existing SH1, although the water table drains and grassed shoulders may provide some informal contaminant capture. The Indicative Alignment parallels the existing highway, crossing it twice, in addition to where the new road ties into the old.

The area the Proposed Designation traverses is influenced by three major watercourses: the Ahuroa River, the Waihoihoi River, and the Piroa Stream. These rivers and streams play a significant role in shaping the stormwater design for the Indicative Alignment (Figure 2).



Figure 3 shows a 1% AEP flood map for the Existing Scenario. Note that the Indicative Alignment is shown merely for orientation and is not part of the modelled scenario. More detailed maps for maximum flood plain extent are located in **Appendix B** for reference.

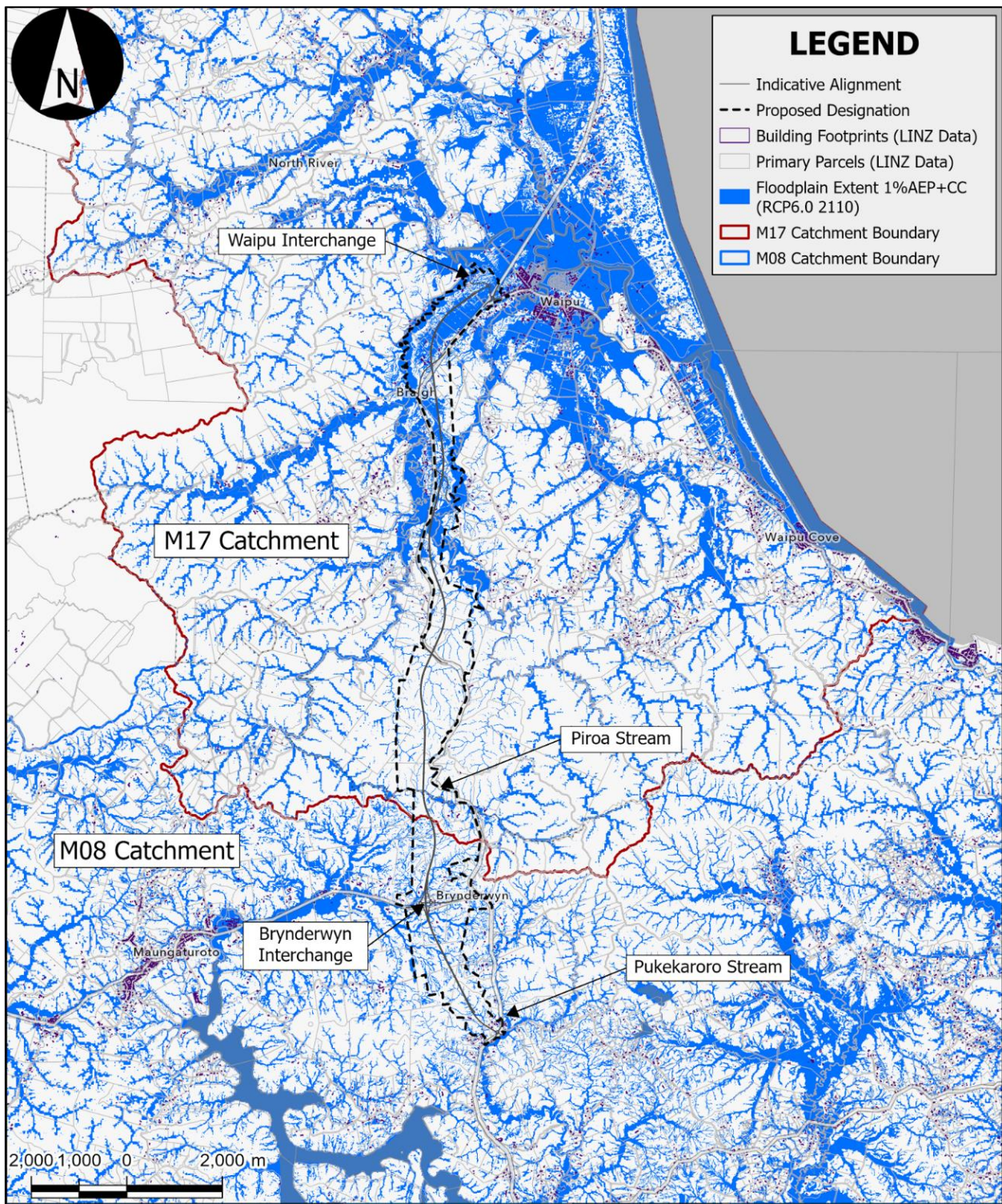


Figure 3: Existing flooding across the Project (1% AEP with CC (RCP6.0, 2110))

Figure 4 below shows THTW flood models' result south of the Brynderwyn Hills for the Existing Scenario during the 1% AEP with CC (RCP6.0 2110) event. This area starts from the southern end of the Indicative Alignment at Baldrock Road and extends to the northern part of the proposed SH12 interchange, near the Brynderwyn Hills. A summary of the flood model result for the Existing Scenario is outlined below:

The existing SH1 is susceptible to flooding south of Baldrock Road (outside the Project).

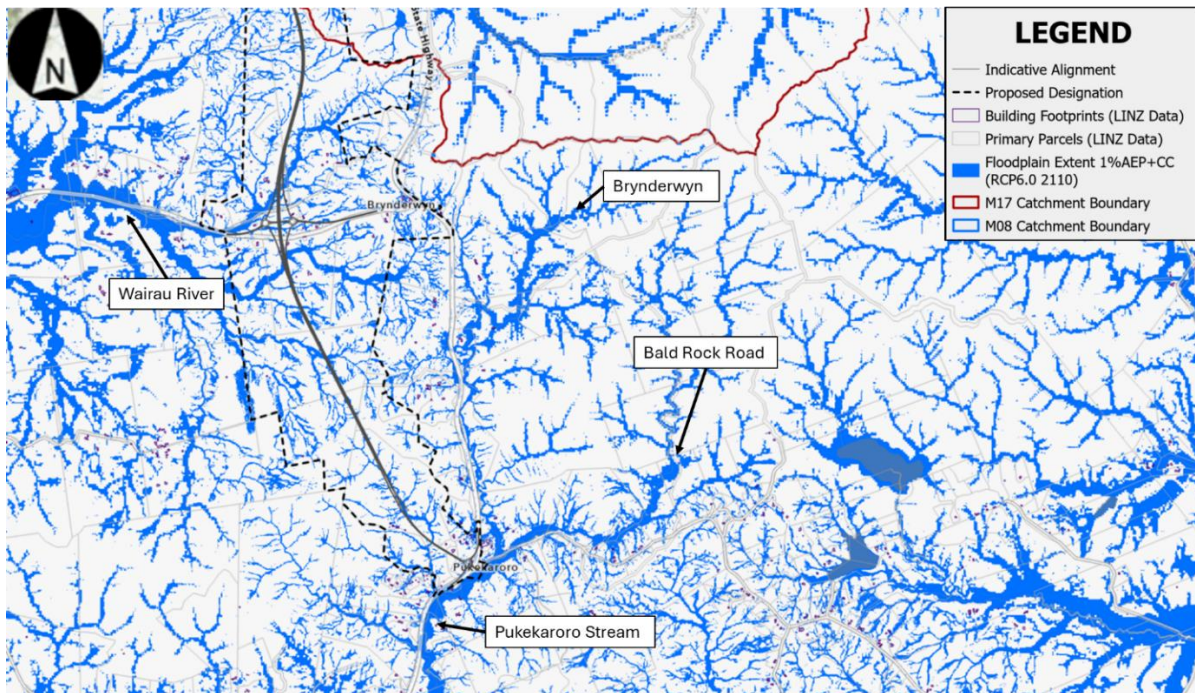


Figure 4: Maximum Flood Depth south of the Brynderwyn Hills for Existing Scenario during 1% AEP with CC (RCP6.0 2110)

Figure 5 below shows THTW flood models' result at the Brynderwyn Hills (SH12 interchange to the SH1 crossing south of Waipū Gorge Rd) for the Existing Scenario during a 1% AEP with CC (RCP6.0 2110) event. A summary of the flood model result for the Existing Scenario is outlined below:

- Across the Brynderwyn Hills section, the floodplain is mostly confined to gully flow, particularly in the incised gullies of the Brynderwyn Hills.
- The Piroa Stream originates from Piroa Hill and Cattlemount Hill and flows westward. The stream crosses SH1 at the eastern side of the Proposed Designation, flowing west to cross the Indicative Alignment. The stream eventually discharges into the Ahuroa River. The flood model shows that there is a floodplain associated with Piroa Stream flow, east of the Indicative Alignment.

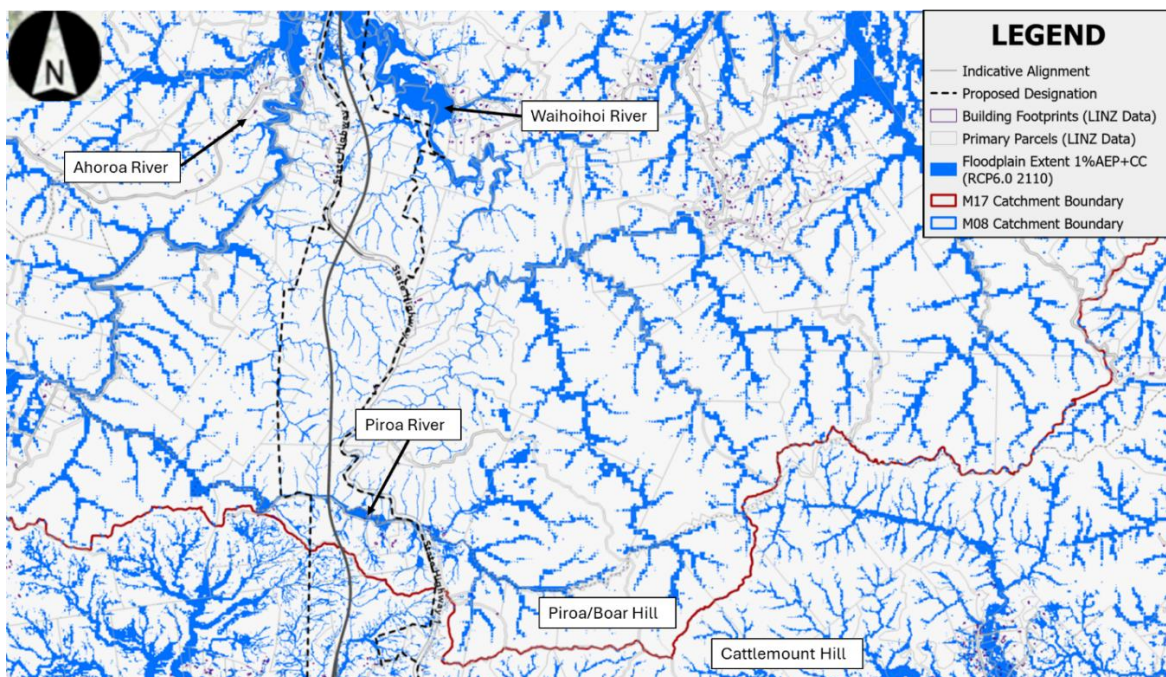


Figure 5: Maximum Flood Depth at Brynderwyn Hills for Existing Scenario during 1% AEP with CC (RCP6.0 2110)

Figure 6 below shows THTW flood models' result north of the Brynderwyn Hills for the Existing Scenario during a 1% AEP with CC (RCP6.0, 2110) event. This area starts from the intersection of SH1 and Waipū Gorge Road toward the north, traversing the alluvial plains between the Ahuroa and Waihoihoi Rivers and extends up to the northern limit of the Project at the Waipū interim tie-in. A summary of the existing flood condition is outlined below:

- As expected from its alluvial origins, large parts of the plains between the Brynderwyn Hills and Waipū are predicted to lie within 1%AEP floodplain.
- The existing SH1 and the Project both traverse a narrow corridor between the Ahuroa River and the Waihoihoi River. While these roads mostly avoid areas of river flooding, they do traverse poorly drained farmland impacted by river flooding, particularly north of Finlayson Brook Road.
- There is a large floodplain area, where the Ahuroa River and Millbrook Stream merge. The floodplain of the river turns toward the east and eventually discharges into the Waipū River.
- There are numerous farm drains within the floodplain area north of Brynderwyn Hills, which are mainly within the Proposed Designation.

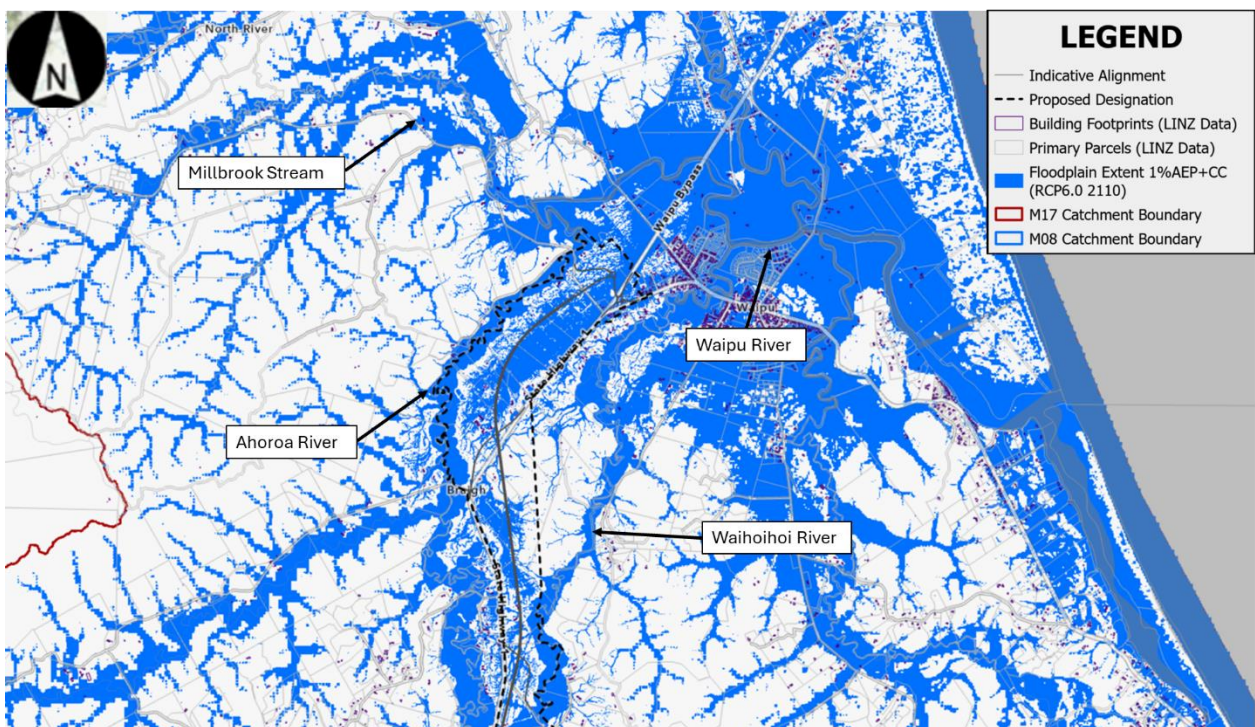


Figure 6: Maximum Flood Depth north of the Brynderwyn Hills for Existing Scenario during 1% AEP with CC (RCP6.0 2110)

## 4 Assessment of Operational Stormwater Effects

This section evaluates the potential environmental effects of the stormwater systems associated with the Indicative Alignment and is structured around five key topics: water quantity, water quality, ecological effects, effects on water users, and residual effects.

### 4.1. Water Quantity

The Project introduces new impervious surfaces that will increase stormwater runoff volumes and peak flows. Without appropriate mitigation, increases in stormwater runoff volumes and peak flows could result in increased flood levels within downstream watercourses and increased risk of erosion within these watercourses and flood plains. To mitigate these effects, the stormwater design for the Indicative Alignment incorporates the following measures to manage stormwater flow and erosion:

- Highway runoff conveyance systems sized for the 1% AEP rainfall event<sup>9</sup>. In steep terrain such as the Brynderwyn Hills, piped conveyance may be used to replace open channels to manage concentrated flows safely.
- Wetlands and wetland swales configured to provide extended detention<sup>10</sup>.
- Drainage diversions and culverts designed to maintain existing catchment hydrology, keep flows in-catchment, and avoid exacerbating downstream flooding (tested within modelled flood effects in Section 5).
- Rainfall depths and peak flows incorporate climate change projections RCP6.0 2110, consistent with NZTA P46 and MfE guidance<sup>11</sup>. Incorporating these projections will ensure long-term resilience for stormwater infrastructure under future rainfall intensities.
- Wherever practicable, carriageway runoff is retained within existing catchments.
- Flood hazard to adjacent properties has been assessed using the flood model and measures taken to eliminate or minimise flood level increases (refer Section 5 for further details).

With the implementation of these measures, we consider the flow and scour-related effects will be negligible.

### 4.2. Water Quality

Stormwater runoff from the road corridor contains contaminants such as sediment, heavy metals (zinc, copper), and hydrocarbons. Without appropriate mitigation, stormwater runoff from trafficked areas could result in effects detrimental to the health of ecology, agriculture and watercourses by smothering, increased turbidity and introducing elements toxic to life. To mitigate these effects, the stormwater design for the Indicative Alignment incorporates the following measures for managing stormwater-borne contaminants:

- Constructed wetlands and wetland swales designed in accordance with NZTA's P46 and Stormwater Treatment Standard for State Highway Infrastructure (SWTS) standards. Wetlands are located offline from natural watercourses and sized to provide both treatment and extended detention.
- Treatment swales for ramps and high-volume local roads.
- Clean runoff from non-contaminating surfaces (fill batters and some cuts) is diverted away from treatment devices to reduce unnecessary loading of the devices and preserve treatment capacity.

---

<sup>9</sup> Note that these systems may incorporate high flow bypass or overland flow path components

<sup>10</sup> While not specifically configured for flood mitigation, they may have an incidental flow reduction benefit

<sup>11</sup> MfE, Climate Change Projections for New Zealand, 2018

The Project will involve the large-scale transfer of traffic from an untreated highway to a treated highway, generating a net benefit for water quality at a Project scale<sup>12</sup>. With the implementation of these measures, we consider that undesirable water quality effects on the environment will be negligible.

### 4.3. Ecological Effects

The Project intersects multiple streams and watercourses, requiring culverts and drainage diversions. Without appropriate mitigation, intersecting these streams and watercourses could result in changes to the hydrology of streams, either reducing recharge potential or increasing flood and erosion risk, or creating physical or hydraulic barriers to fish. To mitigate these effects, the stormwater design for the Indicative Alignment incorporates the following measures:

- Provision of fish passage in culverts where determined necessary, and practicable<sup>13</sup>, following NIWA Fish Passage Guidelines (2024).
- Avoidance of Natural Wetlands for stormwater treatment by using only constructed devices, thus preserving sensitive ecological areas.
- Where drainage diversions are required, habitat continuity and hydraulic function are replaced where appropriate<sup>14</sup> through meandering alignments, substrate placement, habitat features and appropriate channel sizing.

A full assessment of ecological effects is contained in the Assessment of Terrestrial and Freshwater Ecology Effects reports in Volume B, Appendices D6 and D7 respectively of the Substantive Application. However, the authors of those reports have reviewed the indicative operational stormwater system and have made recommendation where required to manage any stormwater-generated ecological effects on the environment.

### 4.4. Stormwater Related Effects on Water Users

Beyond the Proposed Designation, farm water supply quantity and water quality could, in the absence of mitigation, be impacted by the Project, principally through diminished base-flows, increased peak flows, erosion, or discharge of contaminants. To mitigate these effects, the stormwater design for the Indicative Alignment incorporates the following measures:

- Retention of runoff within existing catchments where practicable.
- Treatment of road runoff.
- Extended detention of road runoff to minimise erosive flows and prolong discharge after rain has ceased.

Through implementation of these measures, we consider the Project will not adversely affect existing water users.

Effects on groundwater and potable water quantity have not been considered here. These issues are discussed further in the Assessment of Effects on Groundwater<sup>15</sup> in Volume B, Appendix D12 of the Substantive Application.

### 4.5. Residual Effects

Residual effects are those that remain after best practice mitigation measures are implemented. For this Project, residual effects are expected to be negligible and may include:

---

<sup>12</sup> Acknowledging that some discrete sub-catchments may suffer a disbenefit if they do not currently receive highway runoff.

<sup>13</sup> "Necessary" was determined based on assessment of the streams by a qualified ecologist. "Practicable" was determined by the stormwater design team based on matters such as gradient (feasibility of maintaining substrate), inlet conditions (presence of spoil disposal sites, flumed or drop inlets), etc.

<sup>14</sup> While these features are appropriate for diversion of a natural stream they may not be for a farm drain diversion.

<sup>15</sup> Volume B, Appendix D12 of the Substantive Application, Project report 10722-PTA-2B0-PE-RPT-0019

- Discharge of a small fraction of residual contaminants not removed by treatment devices.
- Increased flood levels, frequency or duration in a few locations where this is not fully mitigated by the Project works (refer Section 5).
- Some minor flow transfer between tributaries or catchments may occur, meaning that some watercourses will receive less flow and some more flow (which could lead to increased erosion)
- Some sediment will bypass treatment devices during extreme rainfall events. This is normal practice, as standards require the device to be designed for long-term average contaminant removal rather than peak flows.
- Some sub-catchments that do not currently receive highway runoff will in future receive discharges of treated stormwater runoff. While this may represent a disbenefit at a sub-catchment scale, there will be a net benefit at a Project scale due to the transfer of traffic to a fully treated highway.

Should the Project's final design differ from the Indicative Alignment, further stormwater analysis will be carried out to ensure the new design meets the requirements of the resource consent conditions, thereby ensuring any residual effects remain similarly negligible.

## 5 Assessment of Flooding Effects

### 5.1. Overview

We have assessed the potential flood effects of the Project on areas upstream and downstream of the Indicative Alignment. This assessment is based on the 1% and 10% AEP with CC (RCP6.0, 2110) storm events. We tested further sensitivity trials to gauge the likely range of flood effects due to differing assumptions or scenarios, and to provide greater confidence in our assessment (refer **Appendix D**).

As outlined in section 2.4.2, the assessment focuses on:

- Flood level increases predicted to occur outside the Proposed Designation.
- Flood level increases to buildings outside the Proposed Designation. For this assessment, we have assumed that +/-10mm change in flood levels is negligible and may be ignored.
- Changes in flood risk inside the Proposed Designation were excluded from the flood assessment. It is expected these effects are either internal to the Project and acceptable, or engineering solutions will be designed to mitigate them during the detailed design stage.
- Building flood risk inside the Proposed Designation was not considered in this assessment as all habitable buildings within the Proposed Designation are assumed to be removed and/or acquired by the Crown.

### 5.2. Overview of Flood Effects with 1% AEP with Climate Change (RCP6, 2110)

Figure 7 below shows the difference in maximum flood levels between the Design Scenario and the Existing Scenario during a 1% AEP with CC (RCP6.0, 2110) rainfall event across the Indicative Alignment (with more detailed images provided later in this section). Additionally, it identifies locations where the maximum flood level is predicted to be increased.

Table 1 provides a summary of the flood assessment for locations within the Proposed Designation based on the Indicative Alignment with more detailed summaries outlined in Section 5.3.

Table 2 provides a summary of the increase in maximum flood level at buildings in locations where flood levels are predicted to increase. As floor levels for the existing buildings are not available, the table summarises the predicted change in flood levels at these buildings during the 1% AEP with CC (RCP6, 2110) rainfall event, noting that further work is recommended to understand flood risk to these buildings, i.e. confirm whether these are habitable, and survey floor level.

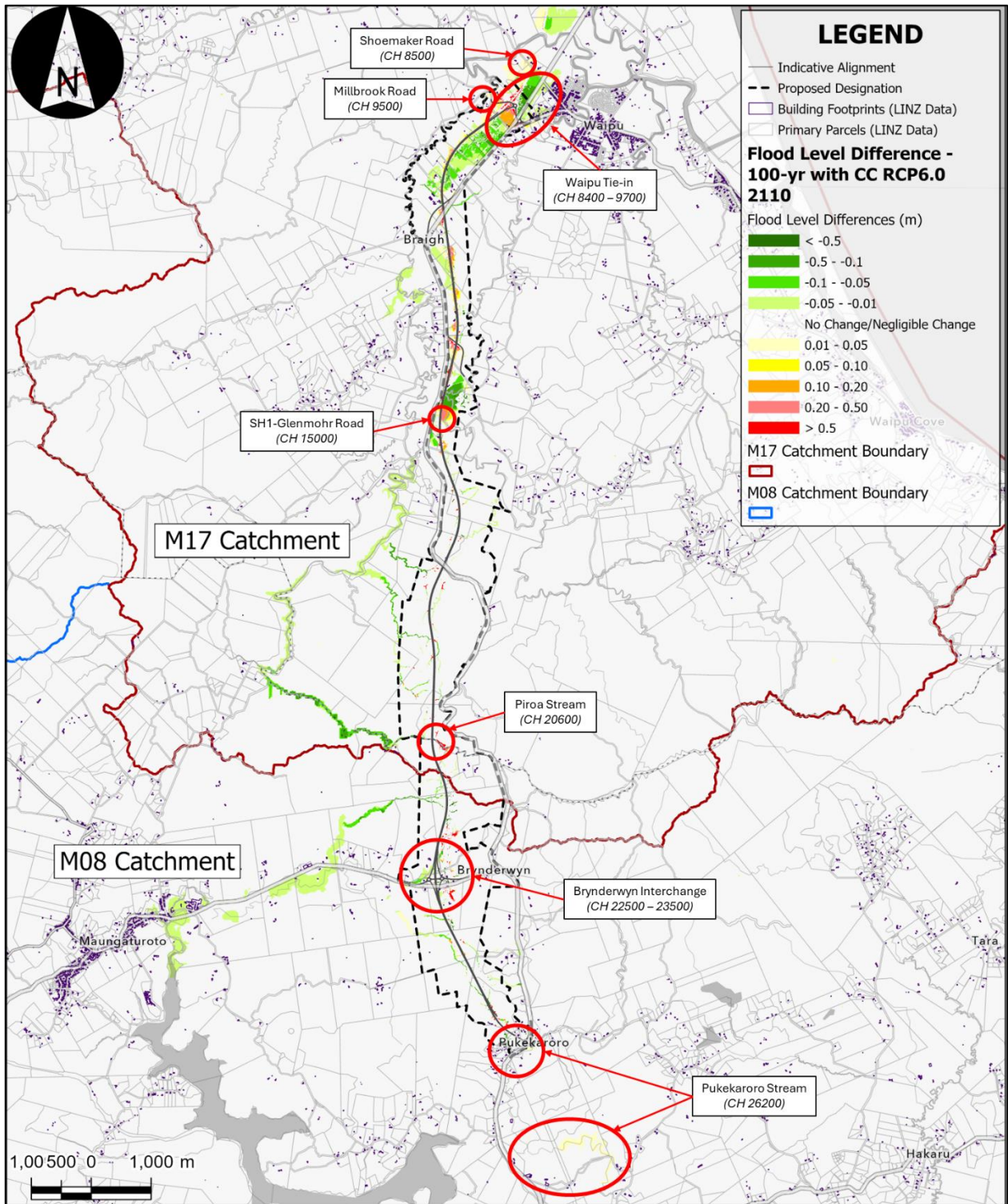


Figure 7: Flood level difference map for the Project (1% AEP with CC (RCP6.0, 2110))

Table 1: Flood Assessment Table for 1% AEP with CC (RCP6, 2110)

Assessment Criteria	Waipū Interim Tie-in	SH1 – South of Glenmohr Road intersection	Brynderwyn Interchange	Pukekaroro Stream
Flood level increase outside Proposed Designation boundary (>100 mm)	No	No	No	Yes <sup>3</sup> Extending up to 3m outside designation
Flood level increase to existing buildings outside Proposed Designation boundary	Yes <sup>1</sup>	No	No	No
Flood level increase to the existing roads and assets outside Proposed Designation Boundary	Yes <sup>1</sup> SH1 affected	Yes <sup>2</sup> SH1 affected; no carriageway impact.	No	Yes <sup>3</sup> Part of SH1 affected.

**Notes:**

- 1) Refer to Section 5.3.1 for further details.
- 2) Refer to Section 5.3.2 for further details.
- 3) Refer to Section 5.3.4 for further details.

Table 2: Number of buildings with predicted increase in the maximum flood level at the building location during 1% AEP with CC (RCP6.0, 2110)

Predicted increase in flood level	Outside the Proposed Designation			
	Waipū Interim Tie-in	SH1 – South of Glenmohr Rd intersection	Brynderwyn Interchange	Pukekaroro Stream
up to 50 mm	1	0	0	0
51 mm to 100 mm	0	0	0	0
Greater than 100 mm	0	0	0	0

**Notes:**

- 1) Further work is recommended to confirm flood risk to these buildings, specifically to confirm if they are habitable, and to obtain surveyed floor level data.

## 5.3. Flood Effects outside the Proposed Designation

The following sub-sections provide further details on the flood assessment findings.

### 5.3.1. Waipū Interim Tie-in (CH 8400 – 9700)

The flood level difference maps shown in Figure 8 and Figure 9 were processed based on THTW flood models result using a November 2025 version of the road alignment. In the final Indicative Alignment, the Waipū Interchange has been replaced by an interim tie-in to SH1 and the main alignment north of the tie-in and the Shoemaker Rd connection were excluded. As a result, the obstruction of the Ahuroa River floodplain apparent in the November 2025 iteration of the road alignment will not occur and flood behaviour is more likely to reflect the Existing Scenario conditions. We therefore anticipate that the flood level differences identified from CH 9100 (i.e. the northern-most extent of the Proposed Designation) towards the north will be diminished compared to what has been modelled. As a result, this subsection *excludes* consideration of flood impacts shown in the figures to the north of CH 9100.

The proposed Waipū Interim Tie-in is intended to connect the Indicative Alignment to SH1 and local roads (The Braigh).

The current design assumes that the proposed road ties into Millbrook and Shoemaker Roads before each bridge crossing. As a result, the existing bridge structures have been left as-is for this assessment.

Figure 8 and Figure 9 show the maximum flood level difference map between the Design Scenario and the existing scenario for the following storm events:

- 1% AEP with CC (RCP6.0, 2110); and
- 10% AEP with CC (RCP6.0, 2110), respectively.

An increase in the flood level was identified outside the Proposed Designation at the following locations:

- Location 1A: Within the floodplain extent north of Millbrook Road;
- Location 1B: South of The Braigh; and
- Location 1C: Along the Ahuroa River floodplain extent to the west of Millbrook Road.

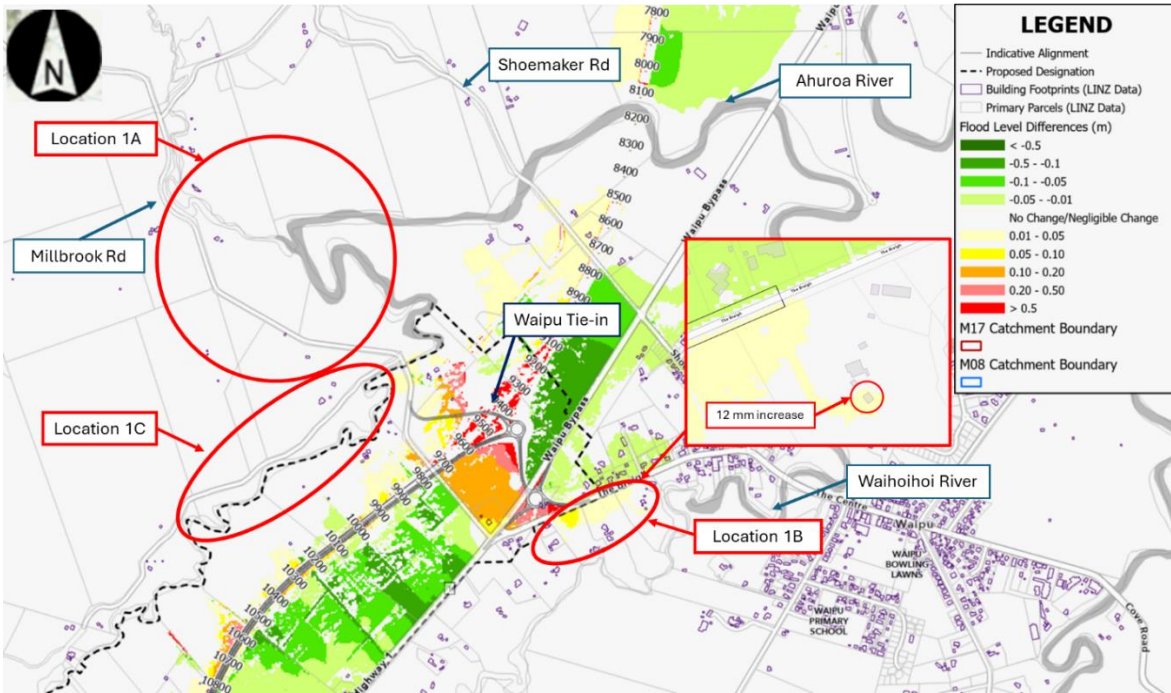


Figure 8: Flood level difference map for the proposed Waipū Interim Tie-in (1% AEP with CC (RCP6.0, 2110))

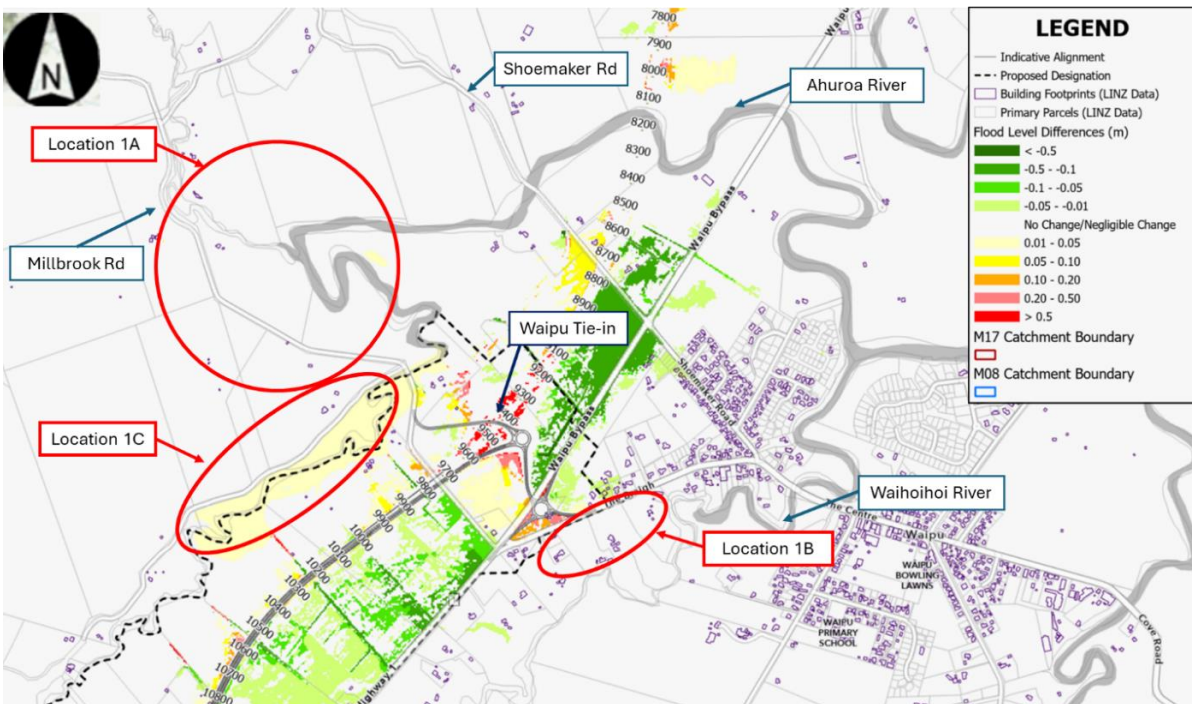


Figure 9: Flood level difference map for the proposed Waipū Interim Tie-in (10% AEP WITH CC RCP6.0 (2110))

Table 3 shows the predicted increase in the maximum flood level in the identified locations for rainfall events. Table 4 and Table 5 show the number of buildings with the predicted increase in the maximum flood level within these locations during different storm events.

Table 3: Predicted increase in maximum flood level outside the Proposed Designation for locations at Waipū Interim Tie-in

Location No.	Flood Level Increase	
	10% AEP WITH CC (RCP6.0 2110) Sensitivity Analysis	1% AEP WITH CC (RCP6.0 2110) Design Storm Event
Location 1A	10 mm	none
Location 1B	none	up to 61 mm
Location 1C	25 mm	10 mm

Table 4: Number of buildings with predicted increase in maximum flood level outside the Proposed Designation during 1% AEP with CC (RCP6.0 2110)

Location No.	Flood Level Increase		
	up to 50 mm	51 mm-100 mm	Greater than 100 mm
Location 1A	0	0	0
Location 1B	1	0	0
Location 1C	0	0	0

Table 5: Number of buildings with predicted increase of flood level outside Proposed Designation during 10% AEP with CC (RCP6.0 2110)

Location No.	Flood Level Increase		
	Up to 50 mm	51 mm-100 mm	Greater than 100 mm
Location 1A	0	0	0
Location 1B	0	0	0
Location 1C	0	0	0

A summary of the flood assessment findings is as follows:

#### Location 1A

- Maximum flood depths across most of the floodplain extent is greater than 1 m for the Existing Scenario during 1% AEP with CC (RCP6.0, 2110) storm event (Figure 8).
- The maximum flood level increase within the floodplain extent and outside the Proposed Designation is predicted to be less than 10 mm and considered as negligible during 1% and 10% AEP with CC (RCP6.0 2110) storm events (Figure 8 and Figure 9).
- The flood level increase affecting the existing buildings is predicted to be less than 10 mm and considered as negligible for 1% and 10% AEP with CC (RCP6.0 2110) storm events.
- By comparing the predicted increase in flood level with the maximum flood depth at this location, we anticipate the flood impact of the Project to the properties and buildings will be less than minor.

#### Location 1B

- Maximum flood depths across most of the floodplain extent is up to 240 mm for the Existing Scenario during a 1% AEP with CC (RCP6.0, 2110) storm event (Figure 8). The maximum flood depth at Robert Bruce Place is up to 940 mm for the Existing Scenario during a 1% AEP with CC (RCP6.0, 2110) storm event.

- The result shows a localised flood level increase south of The Braigh (up to 61 mm) within the floodplain area during a 1% AEP with CC (RCP6.0, 2110) storm event. The result does not show increase in maximum flood level during a 10% AEP with CC (RCP6.0, 2110) storm event.
- Considering the flow direction and predicted flood level changes at this location, the flood level increase is anticipated to be due to the following:
  - The proposed Waipū interim tie-in connections to The Braigh and SH1 act as a flow barrier for flood plain flow toward the northeast. This situation results in flow ponding up and overtopping SH1 eastward.<sup>16</sup>
  - At the tie-in point with SH1, the proposed road surface is lower than the current road level. This configuration allows an overtopping flow from the west side of the road toward the east and an increase in flood level. It is anticipated that the design road surface level can be adjusted in future to reduce the overtopping and minimise the impact at this location.
  - Due to the predominantly flat terrain, the increase in flood level results in an increase in floodplain extent by approximately 10 m toward the south. This increase of floodplain extent is not predicted to intersect any existing buildings.
- Flood model results initially showed that the increased maximum flood level impacts one habitable building footprint in Robert Bruce Place for the 1% AEP with CC (RCP6.0, 2110) storm event by approximately 13 mm. Updated aerial photos (as at August 2024) show this building has been removed to make way for the formation of a new street. It is assumed the future buildings in the subdivision will be constructed with sufficient freeboard. As a result, we expect the impact of the increased flood level to be minor at this location.

### Location 1C

- Upstream of Millbrook Road the flood plain is bounded by steep terrain and Ahuroa Road along the northwestern side. The maximum flood depth exceeds 7.0 m across the Ahuroa River for the Existing Scenario during the 1% AEP with CC (RCP6.0, 2110) storm event.
- The flood model shows that the maximum flood level increase outside the Proposed Designation is less than 10 mm during a 1% AEP with CC (RCP6.0, 2110) storm event and is considered negligible. The model shows an increase in maximum flood level up to 25 mm during a 10% AEP with CC (RCP6.0, 2110) storm event. While the *change* in flood level for the 10% AEP event is greater than for the 1% AEP event, the actual level remains lower than maximum flood level for 1%AEP.
- The increased flood level is not predicted to increase maximum flood level within buildings outside the Proposed Designation.
- The flood result shows the floodplain extent remains as per the Existing Scenario along Ahuroa Road boundary. The flood level increase along the carriageway is predicted to be less than 10 mm and considered negligible during 1% AEP with CC (RCP6.0, 2110) storm event. The floodplain extent is not predicted to encroach into the carriageway during a 10% AEP with CC (RCP6.0, 2110) storm event.
- We anticipate the impact of the flood level increase to the properties and buildings outside the designation boundary will be less than minor.

A peak flow analysis was undertaken along Ahuroa River to determine the peak flow changes due to the Indicative Alignment for different rainfall durations during the 1% AEP with CC (RCP6.0 2110) event. The flood model result shows that the peak flow increase in the critical duration (6-hour rainfall duration) is up to 0.20m<sup>3</sup>/s (~0.03% increase in peak flow), downstream of Shoemaker Road. The maximum peak flow increase is approximately 3.0 m<sup>3</sup>/s (0.53% increase in peak flow) in 12-hour rainfall duration. It is postulated that in the model the indicative road alignment influences the flow regime of farm drains discharging into the Ahuroa River at this location, resulting in the minor peak flow change. The peak flow

---

<sup>16</sup> While the modelled configuration differs from the consent design, the two are similar in this location.

increase is predicted to diminish compared with the existing condition downstream of the Ahuroa River bridge at SH01. Overall, we consider the impact of the peak flow change in the Ahuroa River system will be less than minor. **Figure 10** shows the peak flows for different rainfall durations within the area during the 1% AEP with CC (RCP6.0 2110) event.

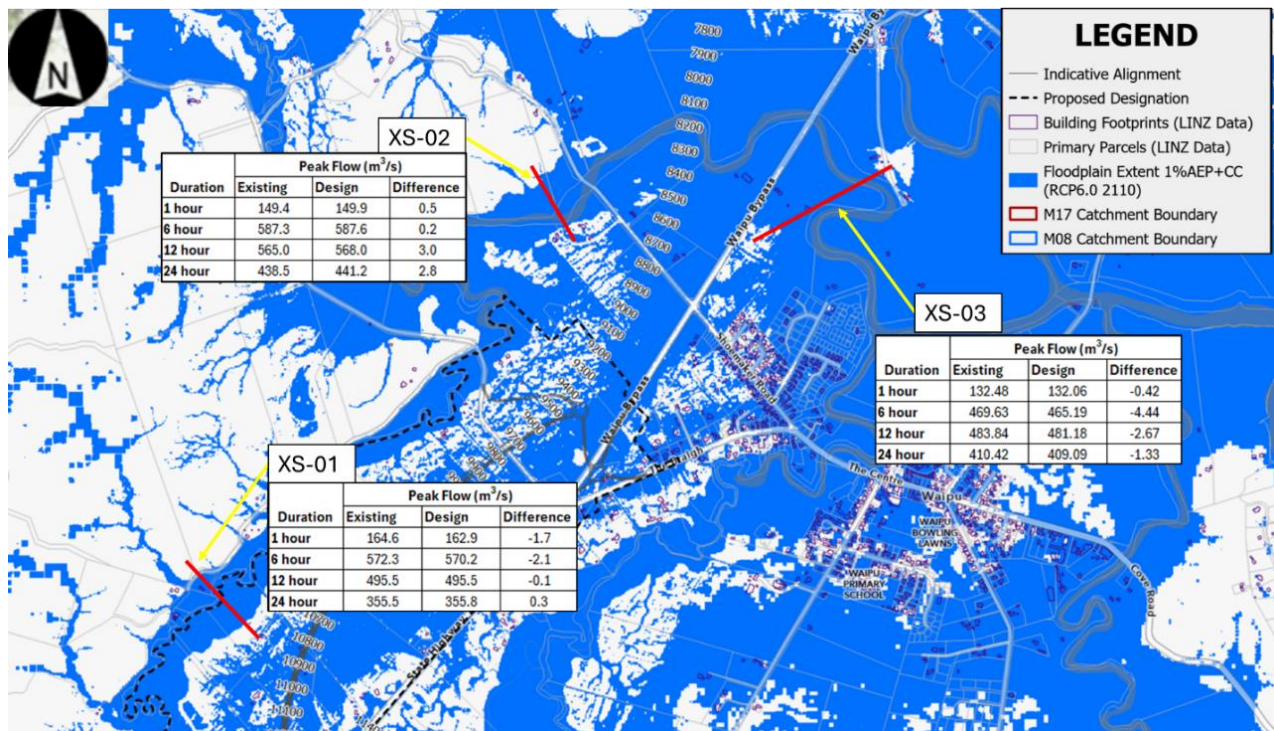


Figure 10: Peak flow analysis for different location at Waipū Interim tie in during 1%AEP with CC

### 5.3.2. SH1 South of Glenmohr Road Intersection (CH 14800 to 15200)

The Indicative Alignment between CH 14800 and 15200 has a potential impact on maximum flood level due to the following reasons:

- The proposed earthworks associated with the Indicative Alignment within an existing floodplain; and
- Potential headwater ponding upstream of the proposed culverts along the western side of the proposed highway due to elevated tailwater condition.

Figure 11 and Figure 12 below show the maximum flood level difference map between the Design Scenario and the Existing Scenario for the 1% AEP with CC (RCP6.0, 2110), and 10% AEP with CC (RCP6.0, 2110) events respectively.

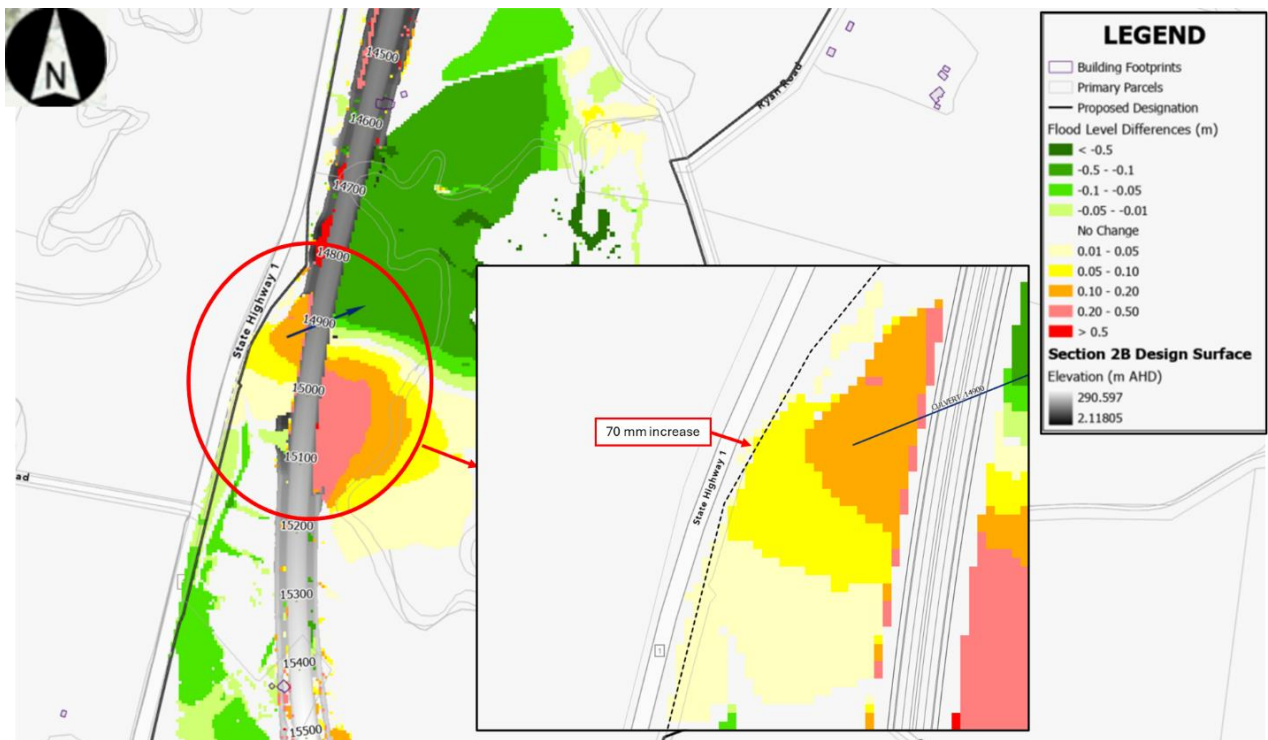


Figure 11: Flood level difference map near SH1-Glenmohr Road intersection (1% AEP WITH CC RCP6.0 (2110))

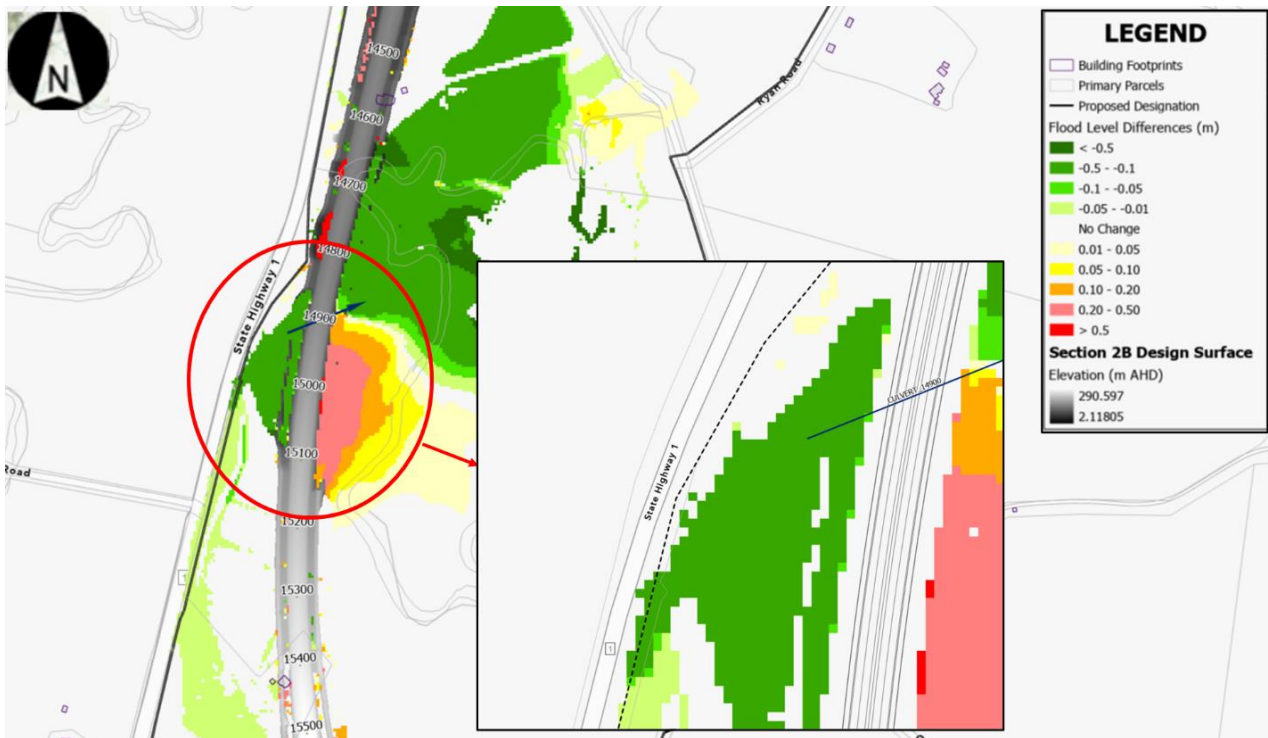


Figure 12: Flood level difference map near SH1-Glenmohr Road intersection (10% AEP WITH CC RCP6.0 (2110))

A summary of the flood assessment findings is as follows:

- A predicted increase in flood level occurs alongside the Indicative Alignment between CH14800 and CH15100. The maximum increase is predicted to be up to 70 mm just beyond the western edge of the Proposed Designation during the 1% AEP event including climate change (RCP6.0, 2110). This results in a minor increase in floodplain extent toward the existing SH1. However, the increased extent is not predicted to encroach on the carriageway and is therefore not considered to be an

adverse effect on the carriageway. The model results show a decrease in flood level at this location during the 10% AEP with CC (RCP6.0, 2110) event.

- We anticipate that the predicted increase in maximum flood level outside the Proposed Designation is due to downstream tailwater influencing the performance of a proposed culvert beneath the Indicative Alignment. This effect could be minimised through refinement of the proposed culvert design during detailed design (CH 14660).
- The proposed diversion of the Waihoihoi River has been designed to provide suitable conveyance for river flows while minimising potential flood effects.
- There are no existing buildings located within the flood-affected area beyond the Proposed Designation boundary.
- The predicted increase in maximum flood level dissipates by approximately CH14500 along the Indicative Alignment during both the 10% and 1% AEP with CC (RCP6.0, 2110).
- Overall, we predict the impact of the Project on properties and buildings upstream and downstream of the Proposed Designation boundary will be less than minor.

### 5.3.3. SH12 Interchange (CH 21700 to 24100)

The flood level differences maps shown in Figure 13 and Figure 14 below were processed based on THTW flood models' result using a November 2025 iteration of the road alignment. In the Indicative Alignment, the SH12 interchange has been moved horizontally toward the south-west.

The Indicative Alignment at the SH12 interchange and the Indicative Alignment between CH 21700 and 24100 cross multiple overland flow paths.

Figure 13 and Figure 14 below show the maximum flood level difference map between the Design Scenario and the Existing Scenario for a 1% AEP with CC (RCP6.0, 2110) and a 10% AEP with CC (RCP6.0, 2110) event respectively.

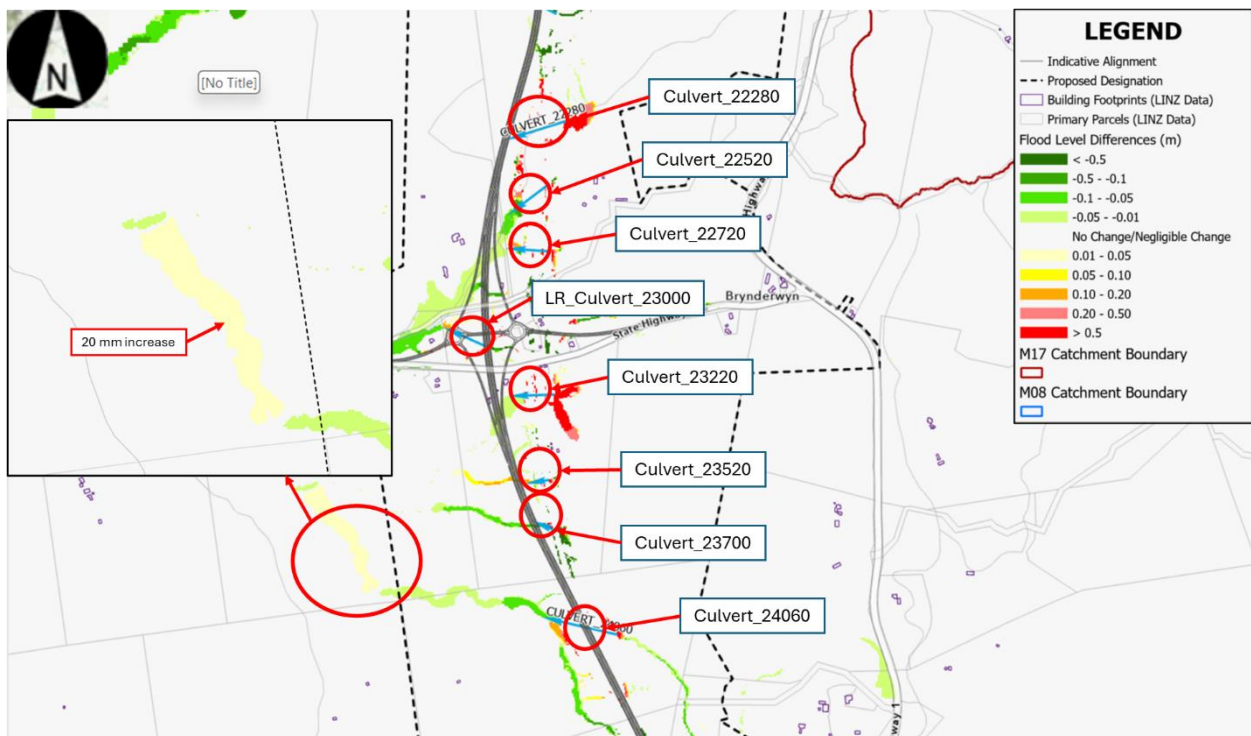


Figure 13: Flood level difference map within the SH12 Interchange (1% AEP WITH CC RCP6.0 (2110))

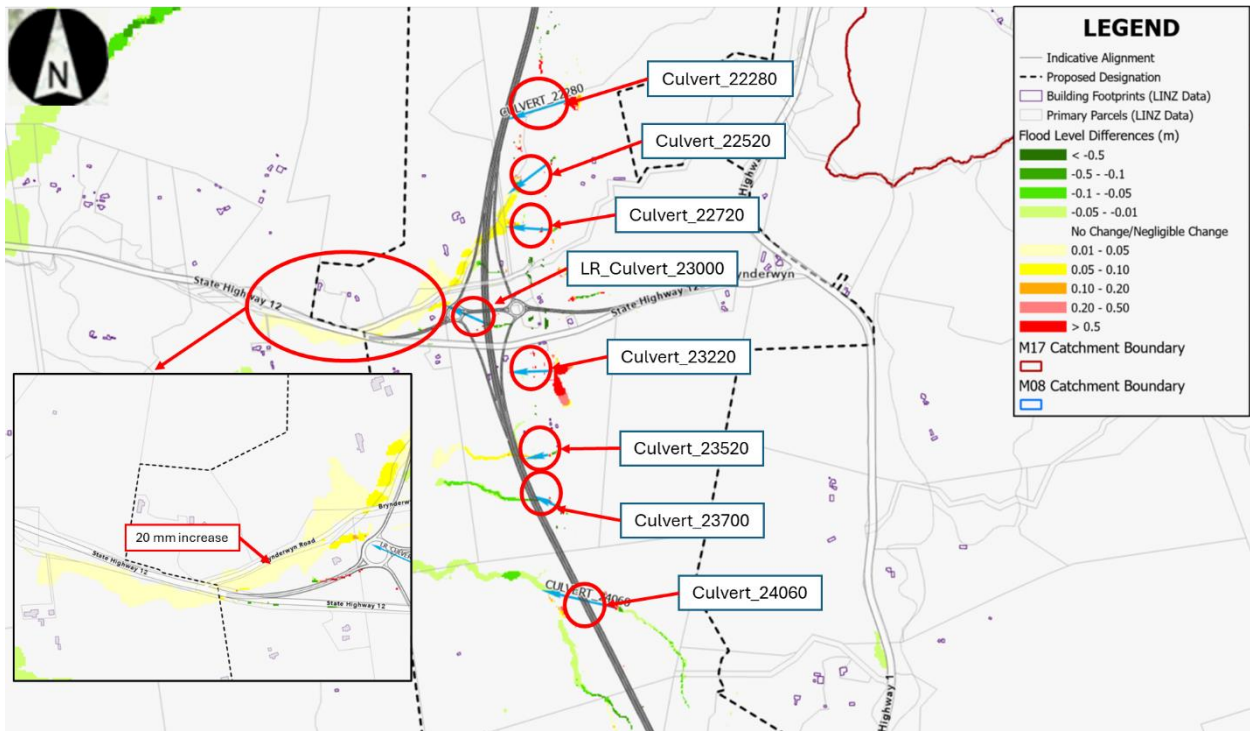


Figure 14: Flood level difference map within the SH12 Interchange (10% AEP WITH CC RCP6.0 (2110))

A summary of the flood assessment findings is as follows:

- Headwater ponding at the indicative culverts results in an increase in flood levels upstream of the Indicative Alignment. However, the result shows that this flood level increase remains inside the Proposed Designation. The increase of flood level does not adversely impact existing buildings east of the Indicative Alignment.
- More broadly, there are no predicted increases in maximum flood level at existing buildings upstream and downstream of the Project, outside the Proposed Designation.
- The results show an approximately 20 mm increase in predicted maximum flood levels for the 1% AEP and 10% AEP with CC (RCP6.0, 2110) storm event, downstream of the proposed culverts outside the Proposed Designation (shown in Figure 13 and Figure 14). We anticipate this increased flood level is due to minor flow regime change brought about by the design.
- We undertook an analysis to assess the peak flow changes downstream of the Indicative Alignment due to the Project's impact on local streams and the Wairau River. Figure 15 shows the peak flows for different rainfall duration for various sections during the 1% AEP with CC (RCP6.0, 2110) storm event. The result shows that the peak flow at the Wairau River eventually decreases compared to the existing scenario. We anticipate that the proposed culvert attenuates the peak flow discharging toward the west.
- In conclusion, we predict the impact of the Indicative Alignment on properties and buildings upstream and downstream of the Proposed Designation will be less than minor at this location.

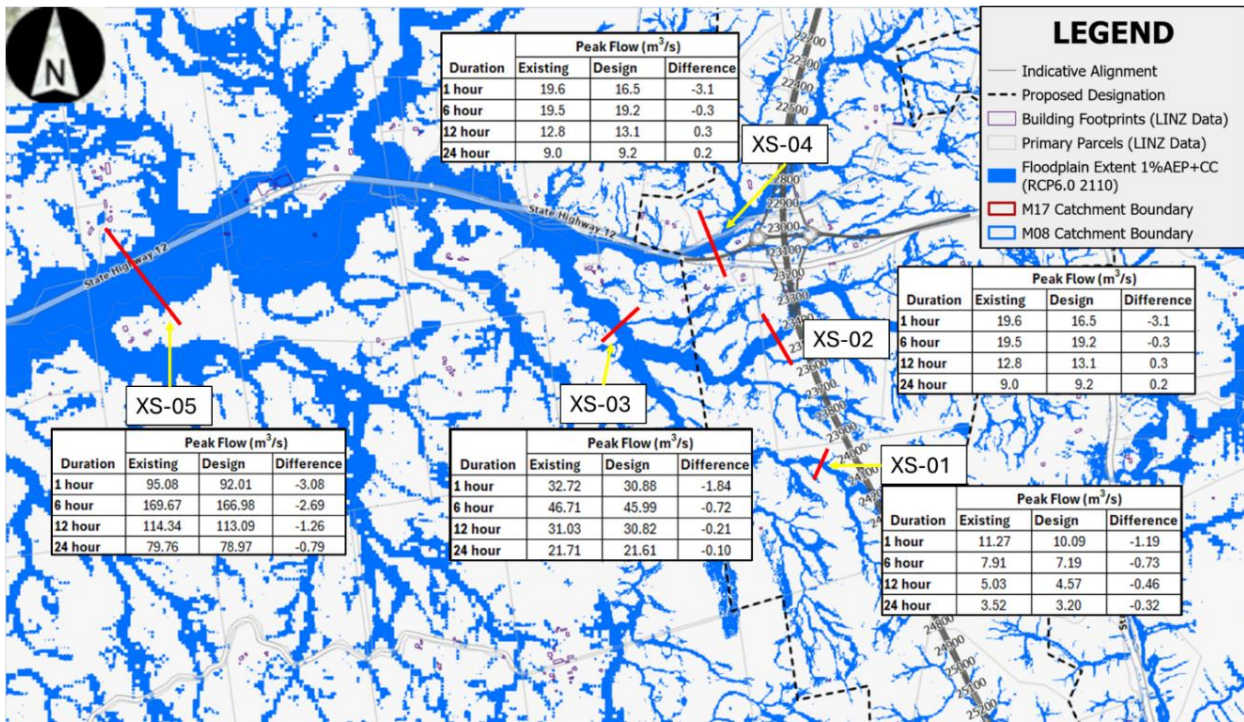


Figure 15: Peak flow analysis for different locations downstream of the SH12 Interchange during a 1%AEP with CC event

### 5.3.4. Pukekaroro Stream (CH 26200)

The southern end of the Project terminates at the existing SH1 near Baldrock Road. An interim at-grade tie-in is proposed to connect the southern end of the Indicative Alignment with local roads and the existing SH1. The flood model does not represent any earthworks for the highway continuation south-east of the interim tie-in. It is expected that the continuation of the highway will be part of the next stage of the Northland Corridor Project under a separate application, and subject to its own future flood assessment.

Figure 16 and Figure 17 below show the maximum flood level difference map between the Design Scenario and the Existing Scenario for the 1% AEP +CC (RCP6.0 2110) and 10% AEP +CC (RCP6.0 2110) events respectively.

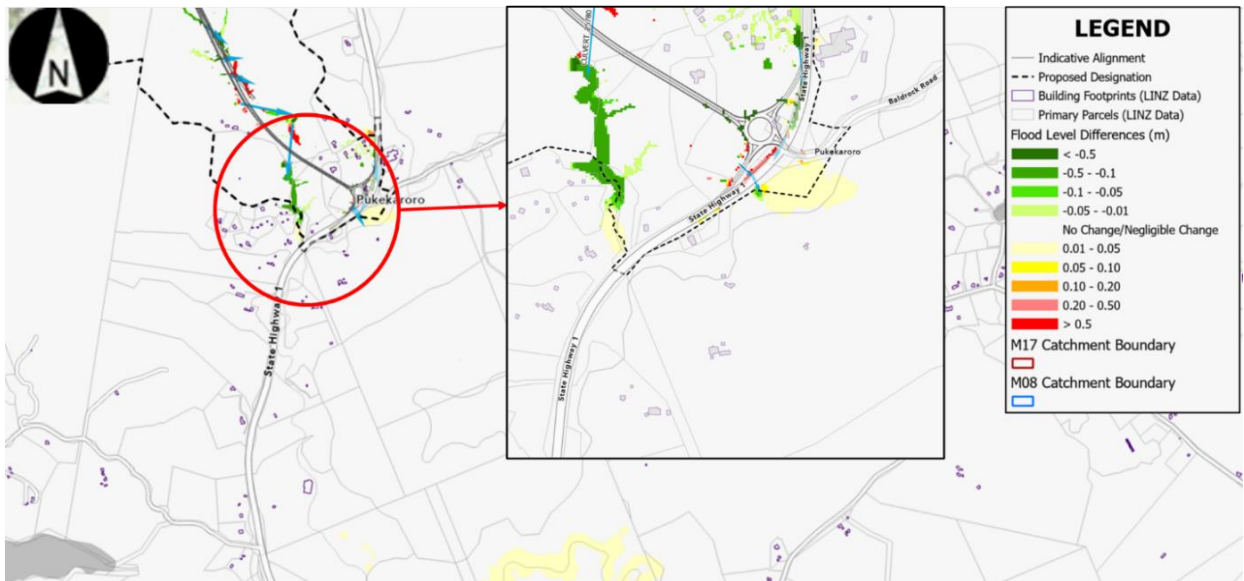


Figure 16: Flood Level Difference Map at Pukekaroro Stream (1% AEP with CC (RCP6.0, 2110))

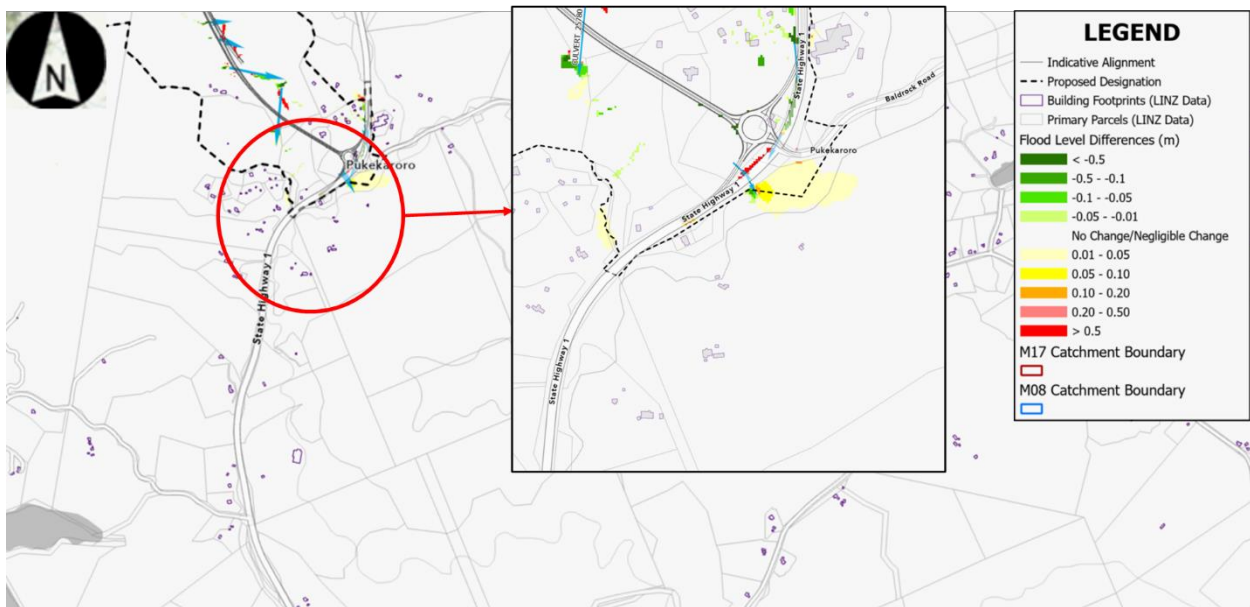


Figure 17: Flood Level Difference Map at Pukekaroro Stream (10% AEP with CC (RCP6.0, 2110))

A summary of the flood assessment findings is as follows:

- There is a localised increase in predicted maximum flood levels of up to 125 mm and 135 mm for the 1% AEP + CC (RCP6.0 2110) and 10% AEP + CC (RCP6.0 2110) storm events respectively at the southern end of the Project within Pukekaroro Stream. The increase in predicted flood levels occurs at the outlet of a new culvert discharging flow from the northern side of the existing SH1 to the stream and dissipates within a short distance. The level increase could be mitigated by relocating the outlet of proposed culvert in the future detail design stage, although the designation provides very limited connectivity to the stream at this location.
- The THTW flood models' result shows an increase in predicted maximum flood level up to 15 mm within the floodplain extent of the stream outside of the Proposed Designation. The increase of the flood level was identified in approximately 2.5 km downstream of the Proposed Designation and dissipated after approximately 2.3 km along the stream.
- Figure 18 below shows selected peak flows downstream of the Proposed Designation for different rainfall durations during the 1% AEP with CC (RCP6.0 2110) event. The result shows that peak flows increase for the critical duration within Pukekaroro Stream. The increased peak flow is approximately 0.85 m<sup>3</sup>/s (0.53% increase in peak flow). The flood model does not show any increase of floodplain extent within Pukekaroro Stream due to the peak flow increase. Considering the small percentage flow increase and the lack of flood plain area change, we conclude that the effect of peak flow increase downstream of the Proposed Designation boundary is negligible.

We anticipate the increase in the maximum flood level and peak flow increase downstream of the Proposed Designation is due to the following:

- Flow regimes change due to design culverts and drainage diversions, resulting in changed flow hydrographs and times to peak for the small tributaries. Skewing and flattening the hydrographs can cause the tributaries' peak flows to coincide with that of the mainstream, potentially increasing the overall peak flow.
- Increased peak flow due to the increased imperviousness of the Project.

The impact of the increased flood level to buildings outside the Proposed Designation is predicted to be negligible (refer to Table 2).

In conclusion, we predict the impact of the Project to properties and buildings upstream and downstream of the Proposed Designation will be less than minor at this location.

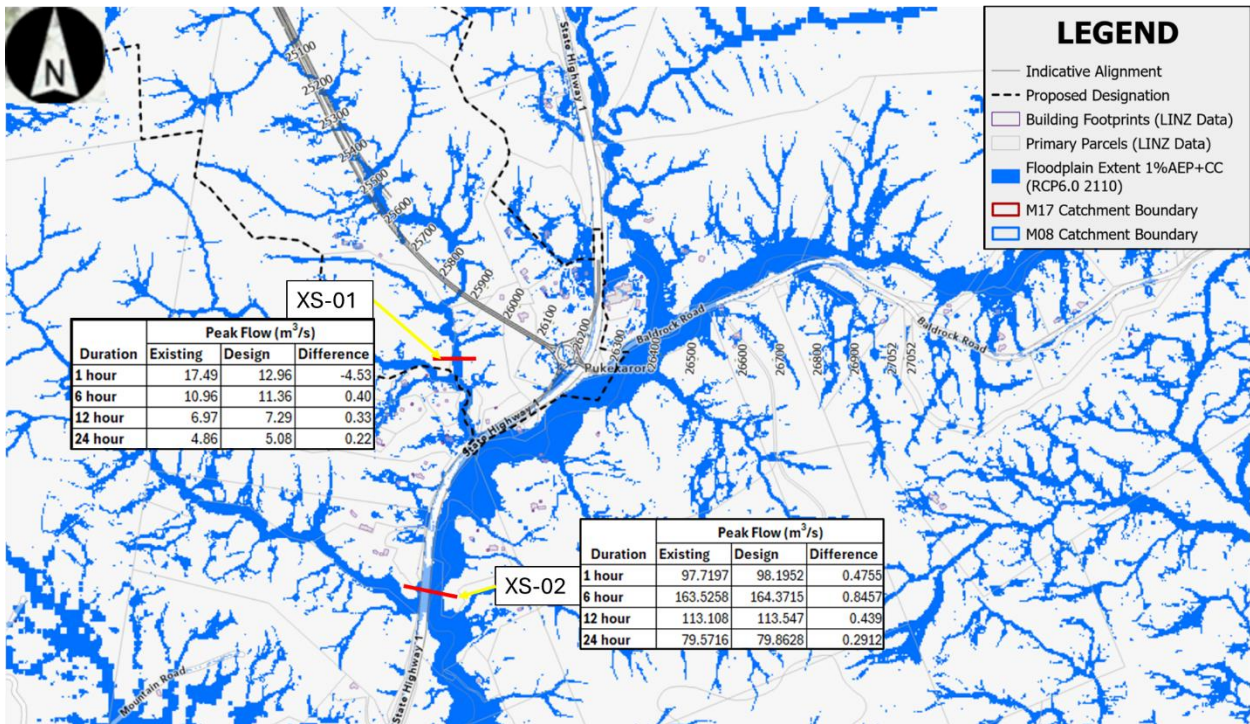


Figure 18: Peak flow analysis for different locations at the southern end of the Project during 1%AEP with CC

## 5.4. Design Changes and Predicted Flood Effects

Some refinement to the Indicative Alignment design occurred after flood modelling was carried out. The changes were mainly limited to the reduction in northern extent of the Project, including removal of the Waipū Interchange and further south, a shift west of the SH12 interchange. While these changes have not been formally modelled, we can draw some insights from available modelling about the potential effects of these changes. Commentary in this section is based on the authors' experience, engineering judgement, and THTW flood models' results for the Existing and Design Scenarios.

### 5.4.1. Waipū Interchange Area

Figure 19 shows the modelled alignment and the Indicative Alignment at the northern end of the Project.

The Indicative Alignment removes the northern roundabout and several associated connections, including the Shoemaker Road connection. As a result, in the Indicative Alignment, the obstruction of the Ahuroa River floodplain apparent in the November 2025 iteration of the road alignment will not occur and flood behaviour is more likely to reflect the Existing Scenario conditions for the Ahuroa River floodplain.

The connection between the new highway and the existing SH1 at The Braigh remains unchanged and the Design Scenario flood result will be more reflective of this area.

Overall, the Indicative Alignment is expected to result in equal or reduced interaction with the floodplain compared with the modelled alignment design. Accordingly, flood effects associated with the Indicative Alignment are anticipated to be no greater (and probably less) than those identified in the flood model results.

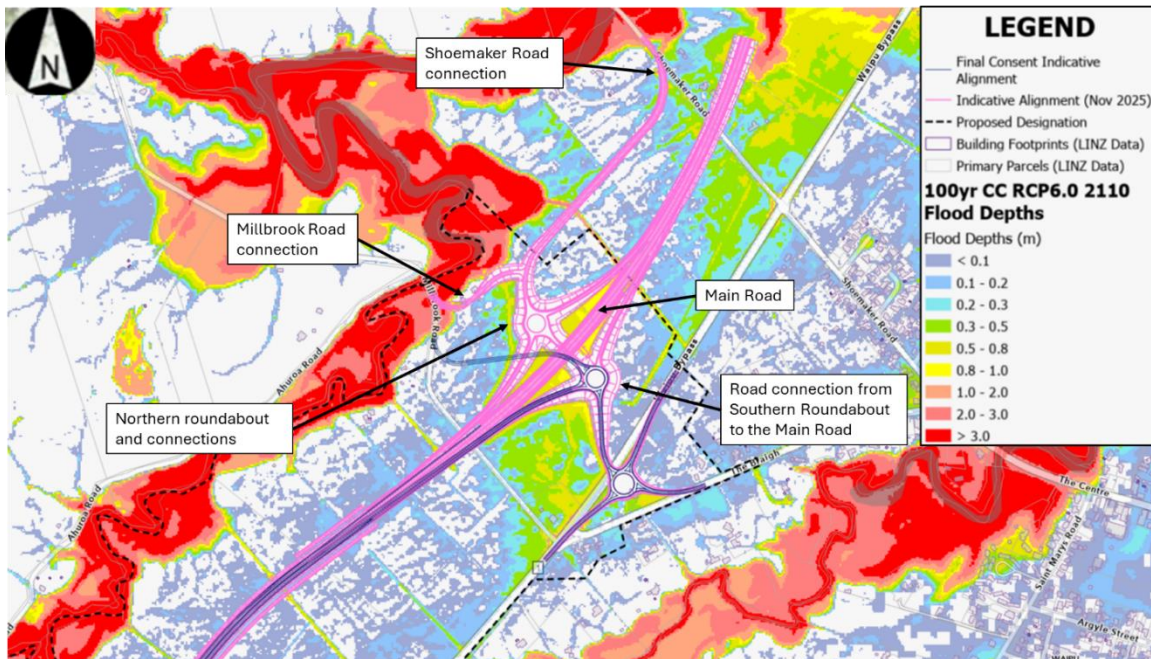


Figure 19: Waipū interchange as modelled (pink) and Indicative Alignment (violet), Nov 2025 Design scenario, showing the Indicative Alignment tie-in does not greatly influence, and is not greatly influenced by, flooding of the major watercourses

#### 5.4.2. SH12 Interchange

Figure 20 below shows the modelled alignment and the Indicative Alignment at the SH12 interchange.

The Indicative Alignment shifts west between approximately CH20500 and CH24100 and relocates the SH12 interchange slightly west and south.

- Flood flows in this area are largely confined to defined gullies that cross the alignment. Based on the flood modelling results and terrain characteristics, these flow paths can be accommodated through appropriate stormwater conveyance structures consistent with those assumed in the flood model.
- The relocated western roundabout earthworks encroach further into the course of an existing stream, requiring a diversion channel in addition to the highway culvert. The floodplain extent remains within the Proposed Designation.

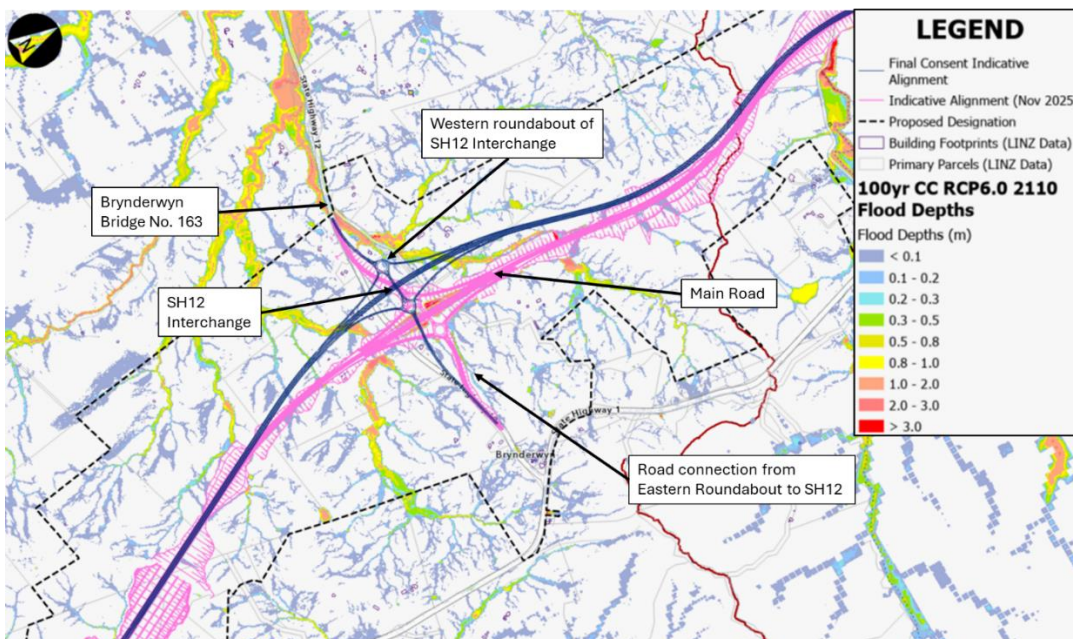


Figure 20: SH12 Interchange as modelled (pink) and Indicative Alignment (violet) Nov 2025 Design scenario

## 6 Recommendations

We have assessed any operational stormwater effects as a result of the Project as negligible, providing best practice stormwater design is implemented and maintained.

We have assessed any flooding effects as very minor, with a small number of locations exceeding the thresholds applied in this assessment by a small amount in each case. It is possible that these very minor effects may be able to be mitigated even further during detailed design.

The following recommendations are intended to record the design philosophy recommended for future stages of the Project, and to inform potential resource consent conditions.

### 6.1. Operational Stormwater

To ensure the effects of the Project remain as assessed in this report, while allowing for flexibility in design, we recommend the following matters are incorporated into the final operational stormwater system:

- An operational stormwater system in accordance with NZTA, regional and national best practice guidelines and requirements, as listed in Section 2.5.
- The stormwater design should include measures where necessary and appropriate to prevent increased stream erosion, to facilitate fish passage and to provide new habitat in lieu of habitat unavoidably lost.
- The stormwater design should represent optimal whole-of-life value.

### 6.2. Flooding

Further design development should be tested with a suitable hydrologic/hydraulic model to confirm the following:

- That design of the Project does not result in increased flooding for events up to and including the 100-year ARI event in either of the following situations:
- An increase in flood levels greater than 100 mm vertically outside the designation (unless that increase is wholly contained within the banks of an existing watercourse, wetland or river flood plain);  
or
- An increase in flooding above floor level to any habitable building outside the Designation.
- That the headwater ponding upstream of any Project culvert in the 100-year ARI event is contained within either the Designation or an existing stream channel, wetland or floodplain.

Where the design does not achieve the above standards, it should be amended (for example, larger culverts, additional diversion drains) or non-structural alternatives (for example, property buy-out, compensation) implemented.

## 7 Conclusion

The indicative stormwater design demonstrates that a suitable system can be implemented to mitigate stormwater effects arising from the operational highway. Provided best practice stormwater management is applied as outlined in Section 6.1, we expect the residual stormwater effects of the Project to be less than minor.

We carried out a flood assessment (outlined in Section 5) to predict potential flood effects of the Project. The outcome of this flood assessment, based on the 1% AEP with CC (RCP6.0, 2110) storm event, is summarised as follows:

- We predict that there are some localised increases in maximum flood level outside the Proposed Designation exceeding the numerical thresholds recommended in Section 6.2, but these are contained in an existing watercourse where effects will be negligible.
- We anticipate that flood effect outside the Proposed Designation can be further mitigated with design modifications such as extra culvert capacity, additional cut-off drains or relatively minor earthworks modifications during detailed design.

Overall, we consider the Project can be constructed to avoid significant adverse flood effects outside of the Proposed Designation, provided the recommendations outlined in Section 6 are implemented. The final design should be remodelled prior to construction to confirm it has no adverse flooding effects.

# APPENDICES



# Appendix A

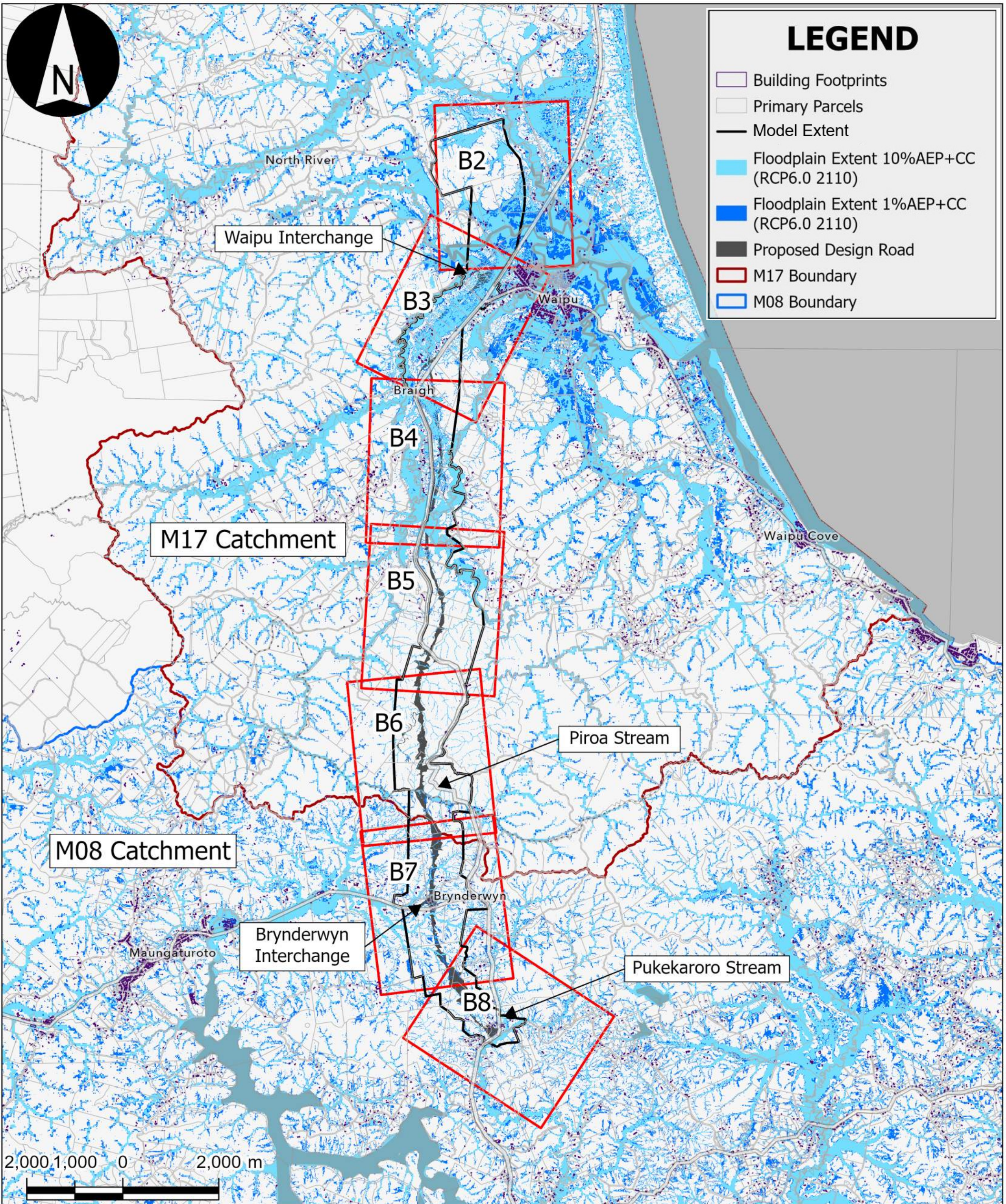
## Stormwater Plans

# Appendix B

## Flood Model Result Figures

Note that flood modelling is based on an earlier version of the highway alignment and neither the alignment nor the proposed Designation Boundary represent the final FTAA application. Useful insights can still be drawn from the results providing this limitation is borne in mind.

Figure Number	Description
Figures B1-B8	Section 2B Maximum Flood Extents Map – 10% AEP and 1% AEP with CC RCP 6.0 2110 (Existing Scenario)
Figures B9-B16	Section 2B Maximum Flood Extents Map – 10% AEP and 1% AEP with CC RCP 6.0 2110 (Design Scenario)
Figures B17-B24	Section 2B Maximum Flood Difference Map – 1% AEP with CC RCP6.0 2110 (Design versus Existing Scenario)
Figures B25-B32	Section 2B Maximum Flood Difference Map – 10% AEP with CC RCP6.0 2110 (Design versus Existing Scenario)



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

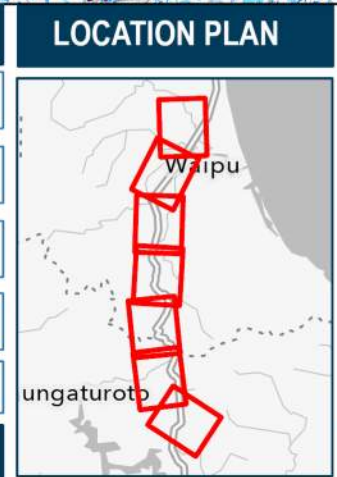
**NZ TRANSPORT AGENCY**  
WAKA KOTAHĪ

**Northland Corridor**

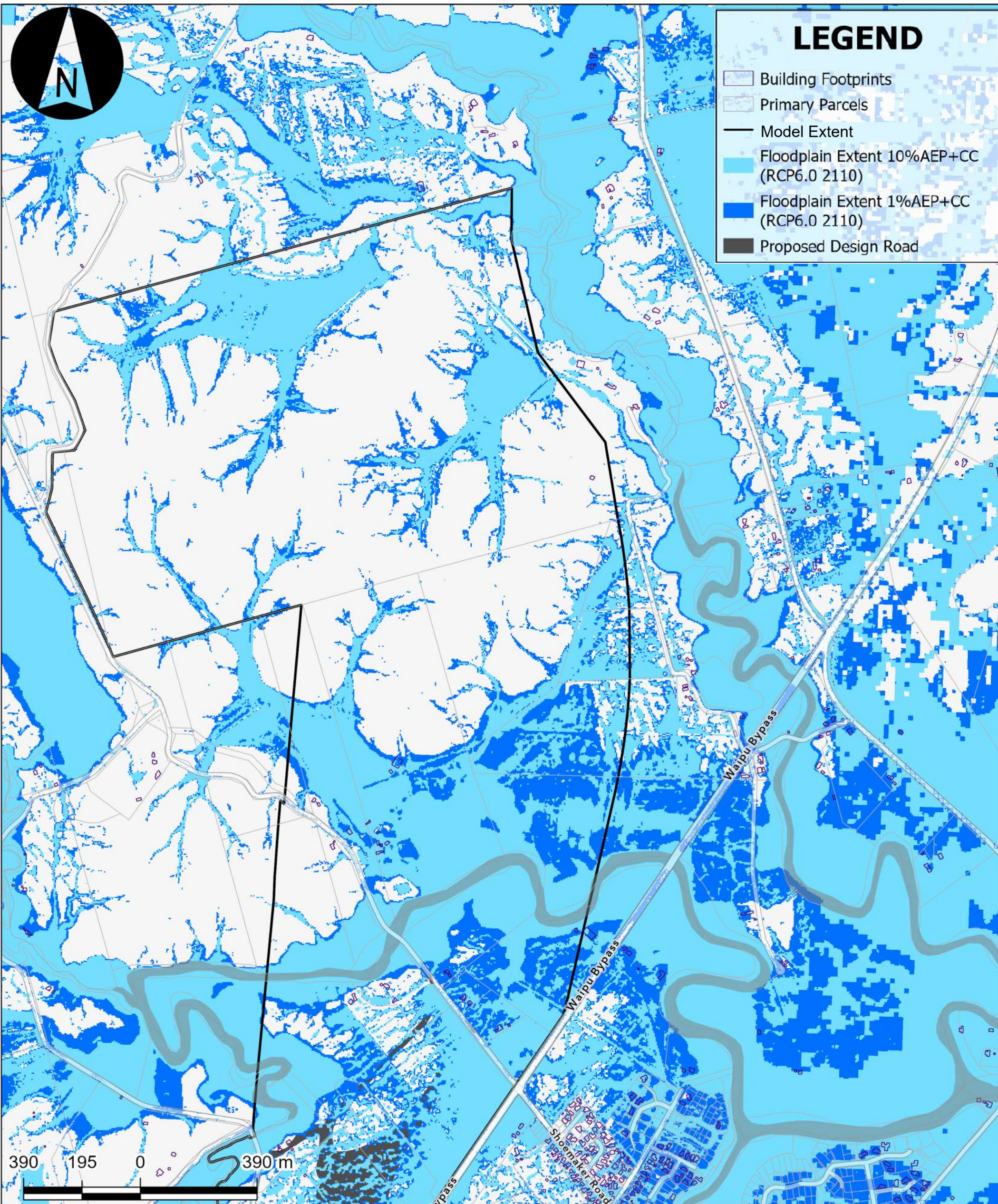
Roads of National Significance

A3 SCALE: 1:75,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025
<b>APPROVED</b>		<b>DATE</b>



PROJECT INFORMATION	
<b>TITLE:</b> SECTION 2B MAXIMUM FLOOD EXTENTS MAP 10% AEP AND 1% AEP WITH CC RCP6.0 2110 EXISTING SCENARIO	
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION	
	B1



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Floodplain Extent 10%AEP+CC (RCP6.0 2110)
- Floodplain Extent 1%AEP+CC (RCP6.0 2110)
- Proposed Design Road

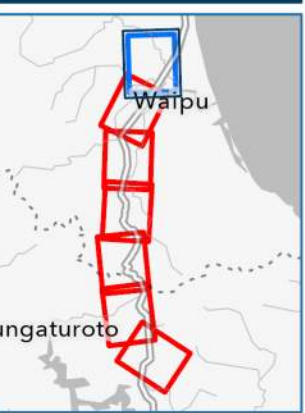
## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

## LOCATION PLAN

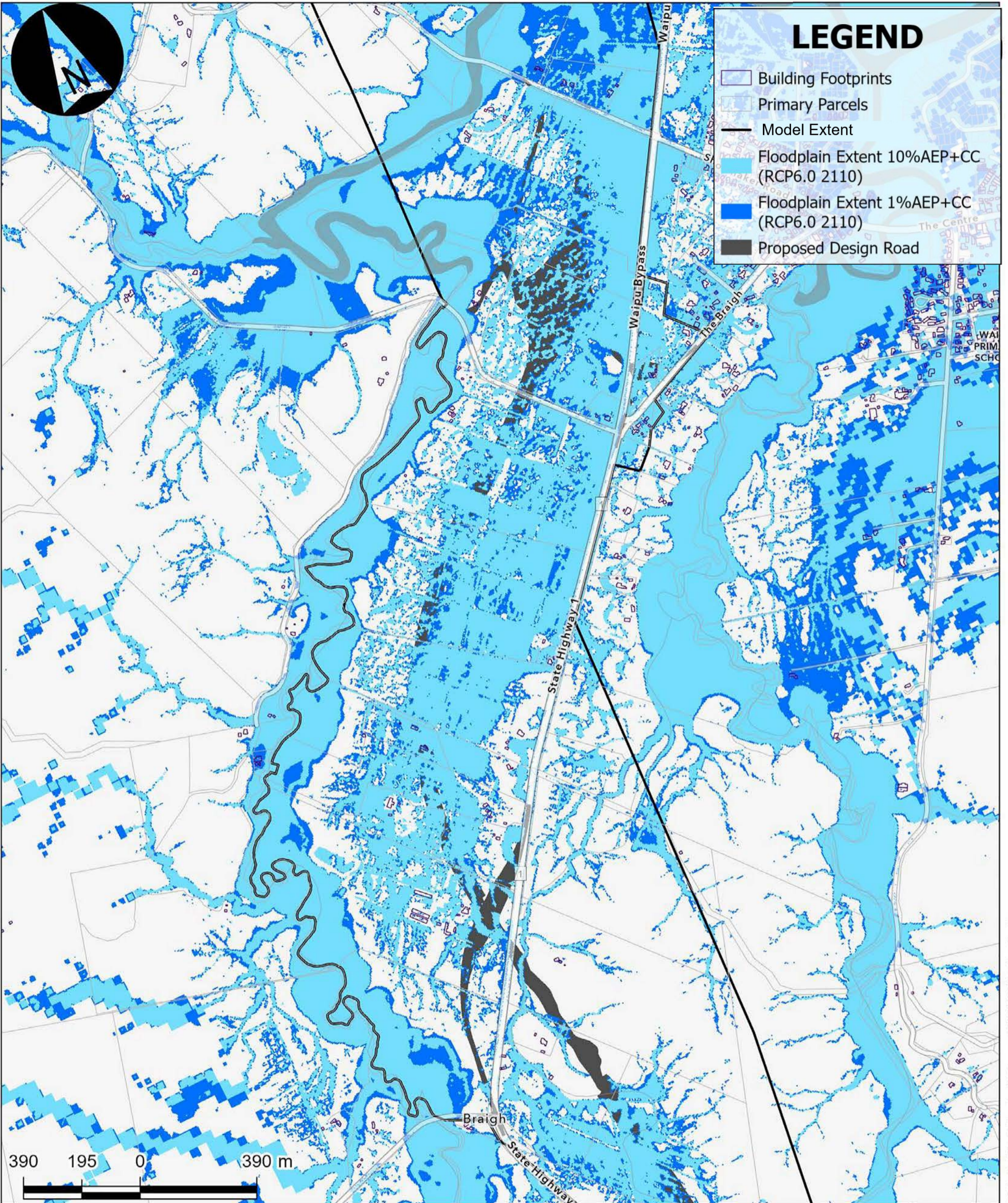


## PROJECT INFORMATION

**TITLE:**  
SECTION 2B MAXIMUM FLOOD EXTENTS MAP  
10% AEP AND 1% AEP WITH CC RCP6.0 2110  
EXISTING SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B2



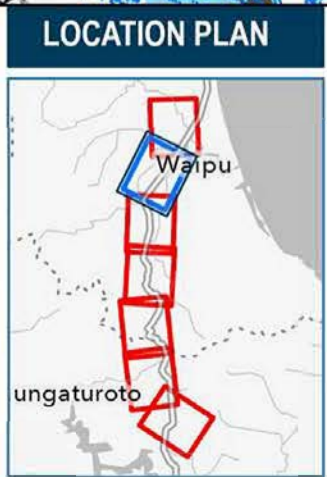
# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Floodplain Extent 10%AEP+CC (RCP6.0 2110)
- Floodplain Extent 1%AEP+CC (RCP6.0 2110)
- Proposed Design Road

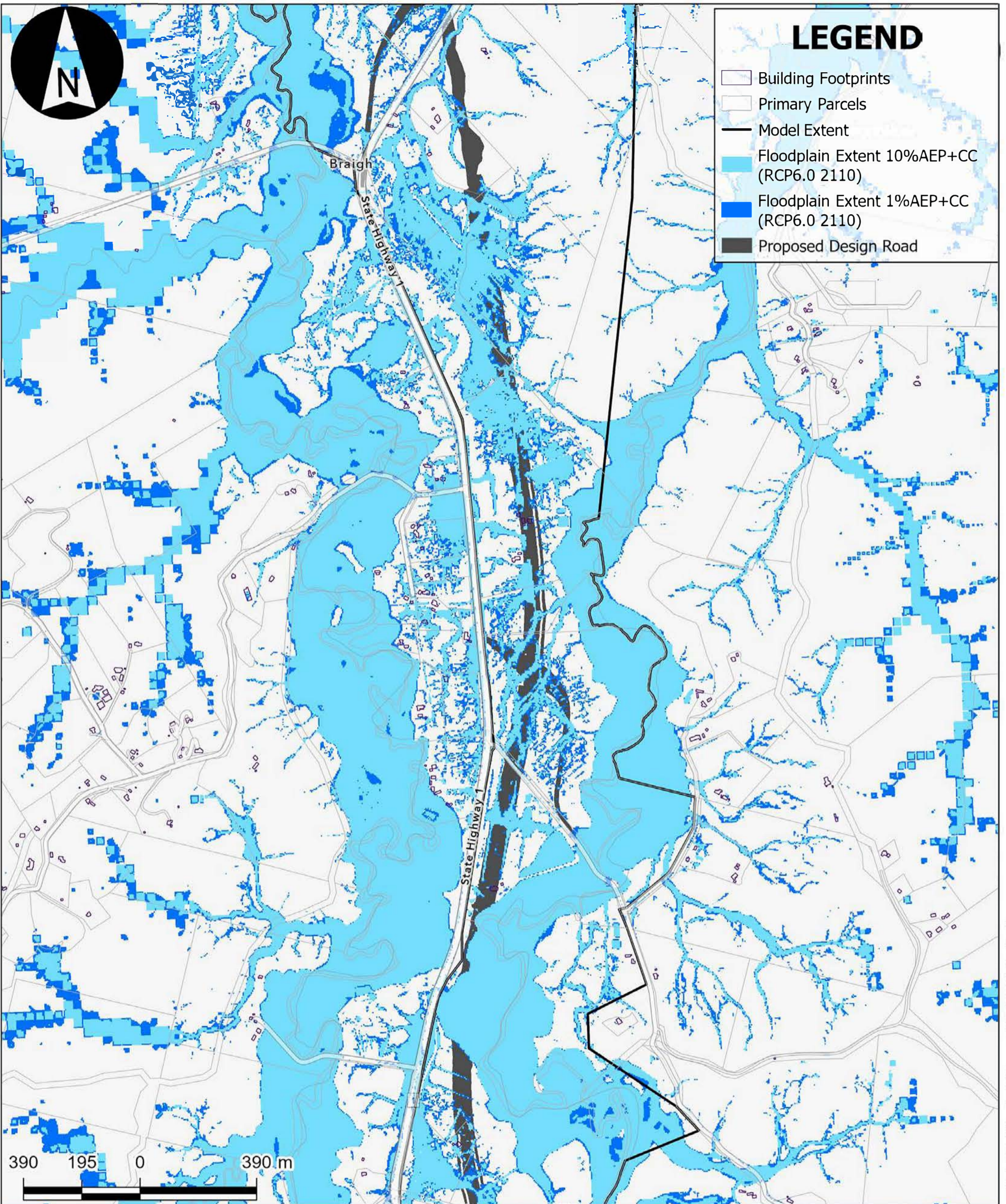
**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025



PROJECT INFORMATION	
<b>TITLE:</b>	SECTION 2B MAXIMUM FLOOD EXTENTS MAP 10% AEP AND 1% AEP WITH CC RCP6.0 2110 EXISTING SCENARIO
<b>SECTION:</b>	NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
	B3



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

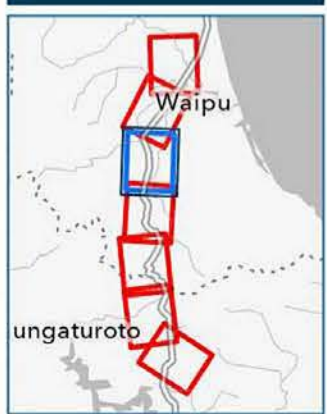
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**QA**

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

**APPROVED** **DATE**

**LOCATION PLAN**

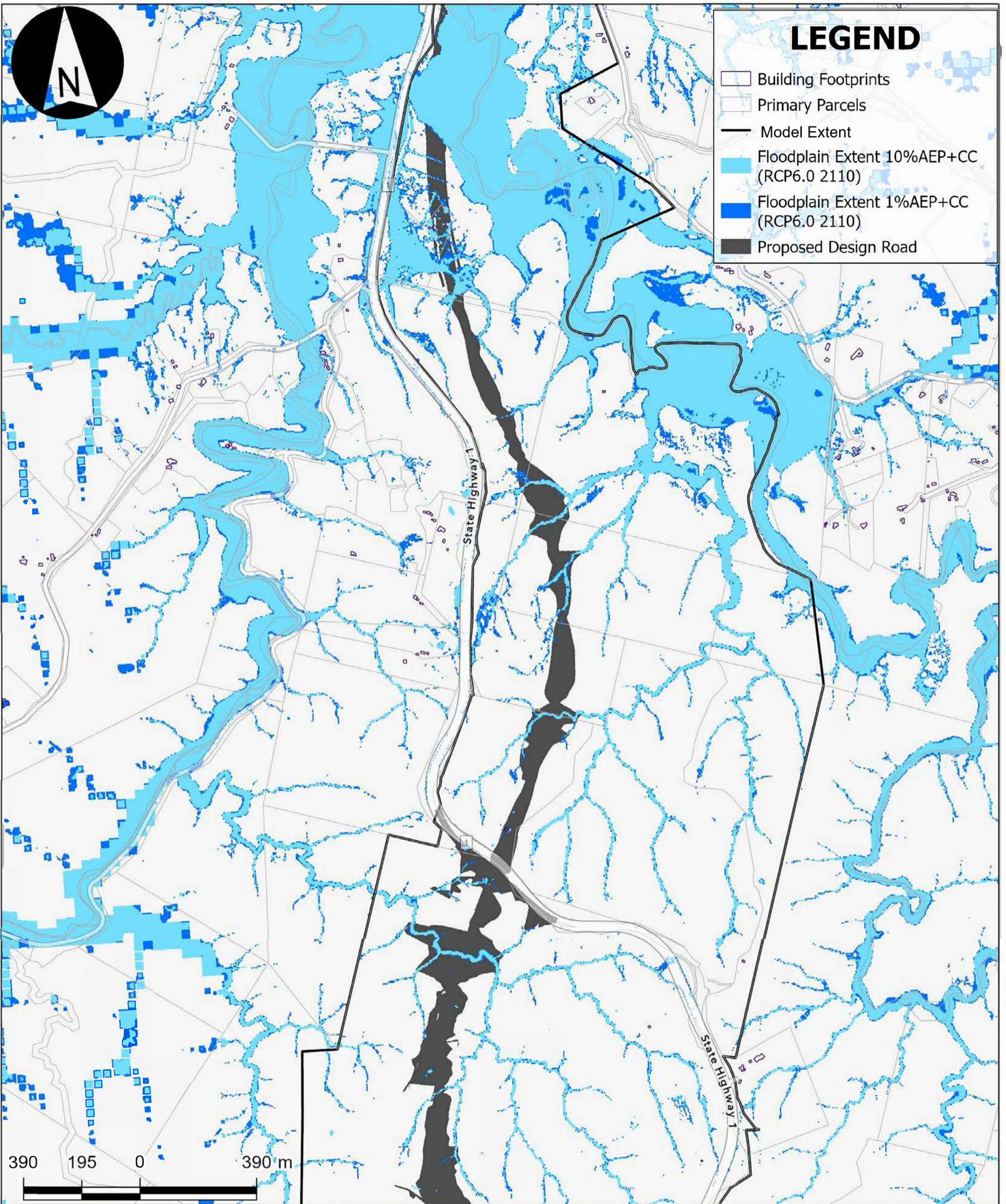


**PROJECT INFORMATION**

**TITLE:**  
SECTION 2B MAXIMUM FLOOD EXTENTS MAP  
10% AEP AND 1% AEP WITH CC RCP6.0 2110  
EXISTING SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

**B4**



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



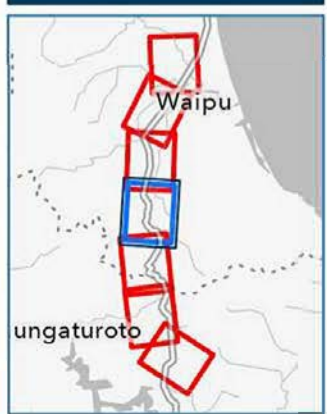
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**QA**

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

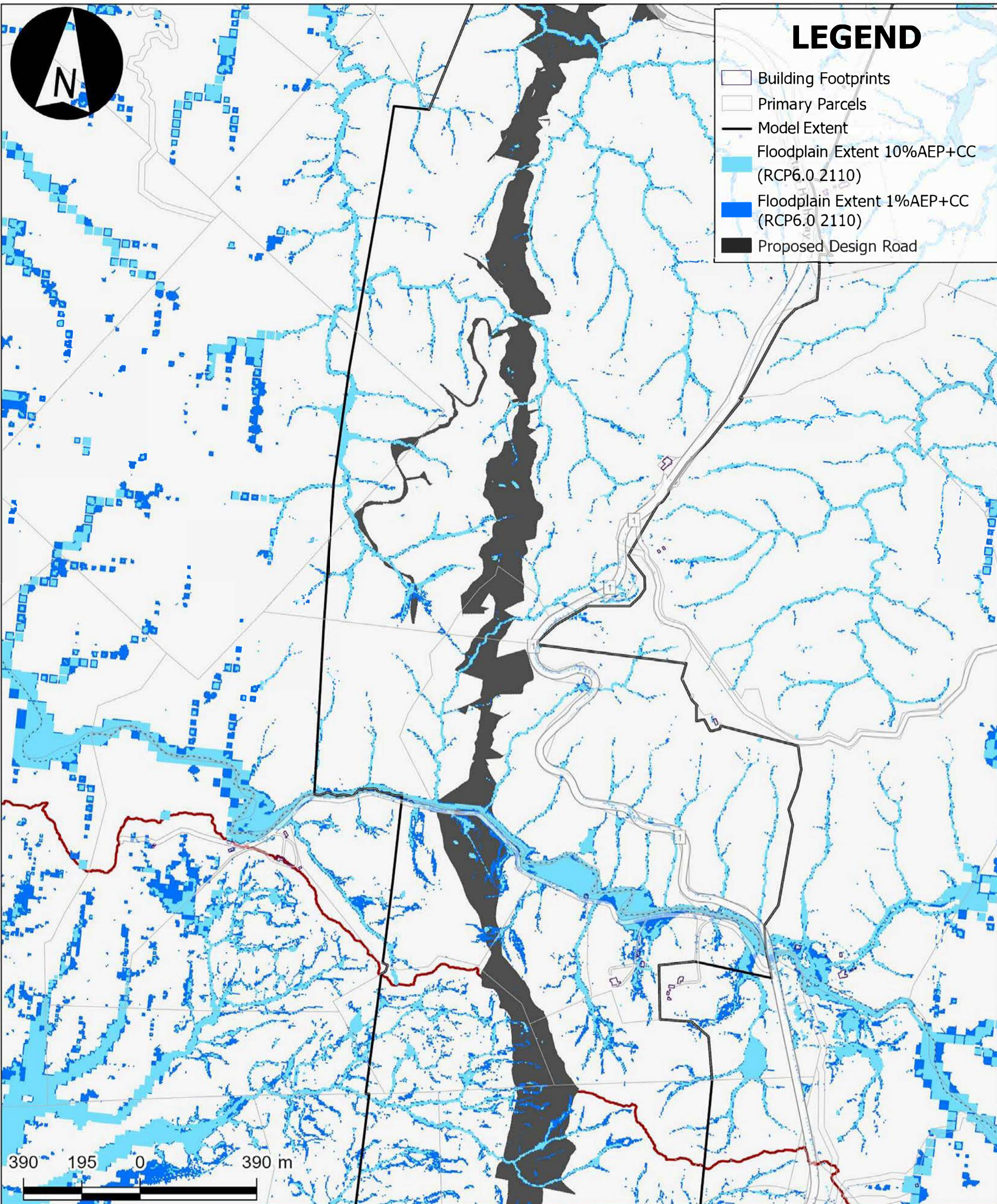
**APPROVED** **DATE**

**LOCATION PLAN**



**PROJECT INFORMATION**

<b>TITLE:</b> SECTION 2B MAXIMUM FLOOD EXTENTS MAP 10% AEP AND 1% AEP WITH CC RCP6.0 2110 EXISTING SCENARIO
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
<b>B5</b>



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Floodplain Extent 10%AEP+CC (RCP6.0 2110)
- Floodplain Extent 1%AEP+CC (RCP6.0 2110)
- Proposed Design Road

## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



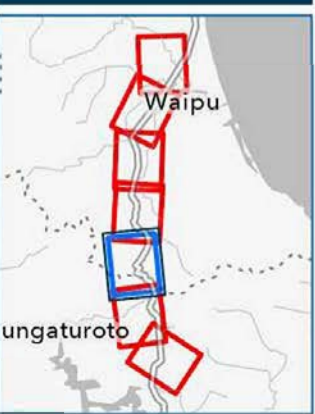
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

APPROVED DATE

## LOCATION PLAN

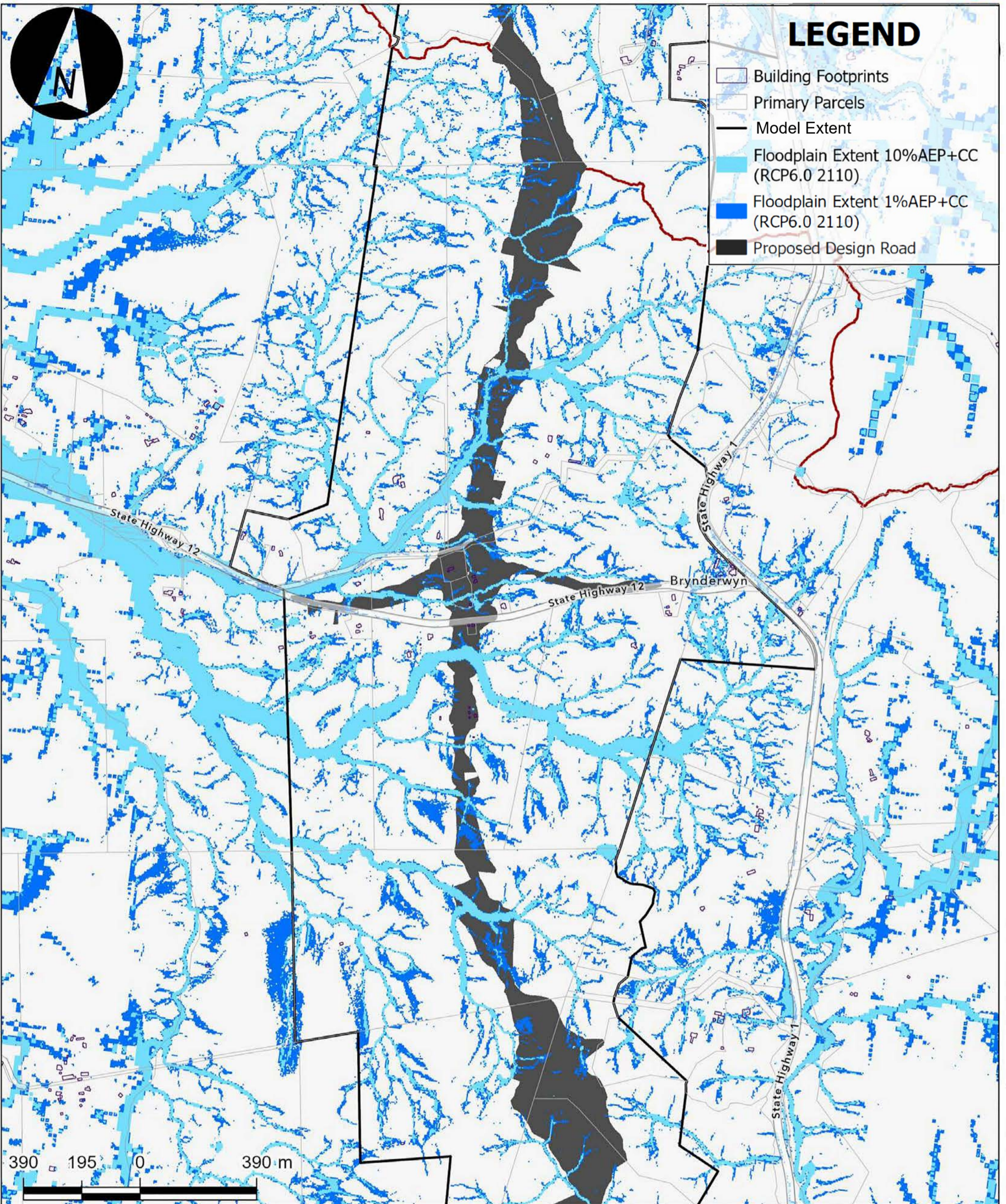


## PROJECT INFORMATION

**TITLE:**  
SECTION 2B MAXIMUM FLOOD EXTENTS MAP  
10% AEP AND 1% AEP WITH CC RCP6.0 2110  
EXISTING SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B6



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Floodplain Extent 10%AEP+CC (RCP6.0 2110)
- Floodplain Extent 1%AEP+CC (RCP6.0 2110)
- Proposed Design Road

## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

## LOCATION PLAN



## PROJECT INFORMATION

**TITLE:**  
SECTION 2B MAXIMUM FLOOD EXTENTS MAP  
10% AEP AND 1% AEP WITH CC RCP6.0 2110  
EXISTING SCENARIO

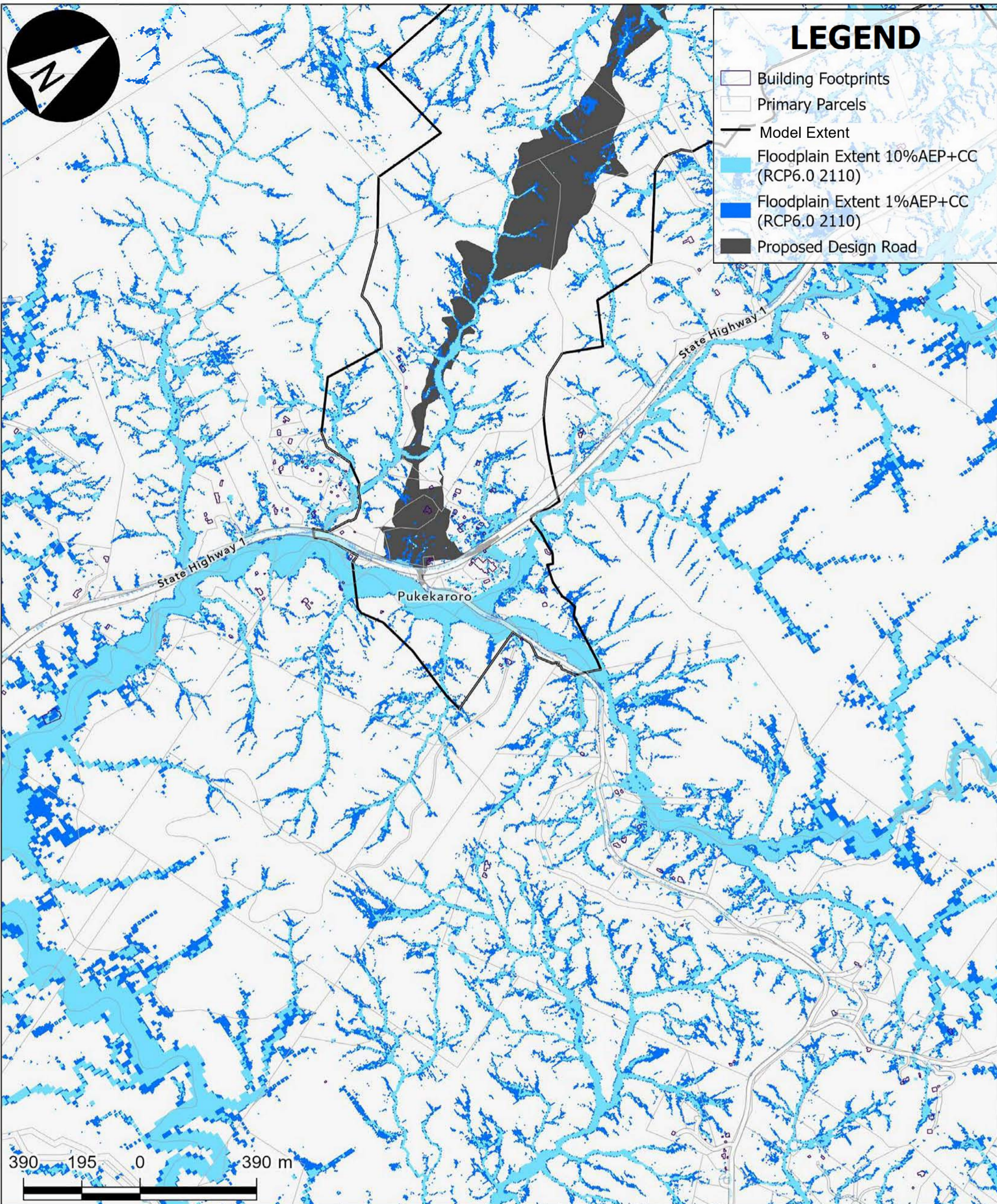
**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B7



A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

APPROVED DATE



**NOTES**

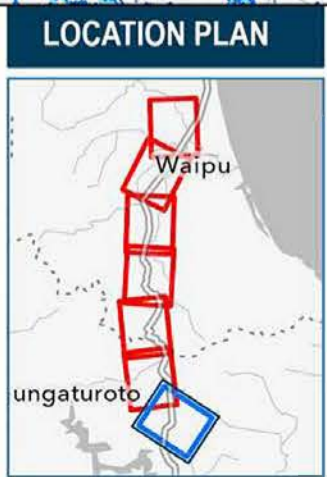
Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



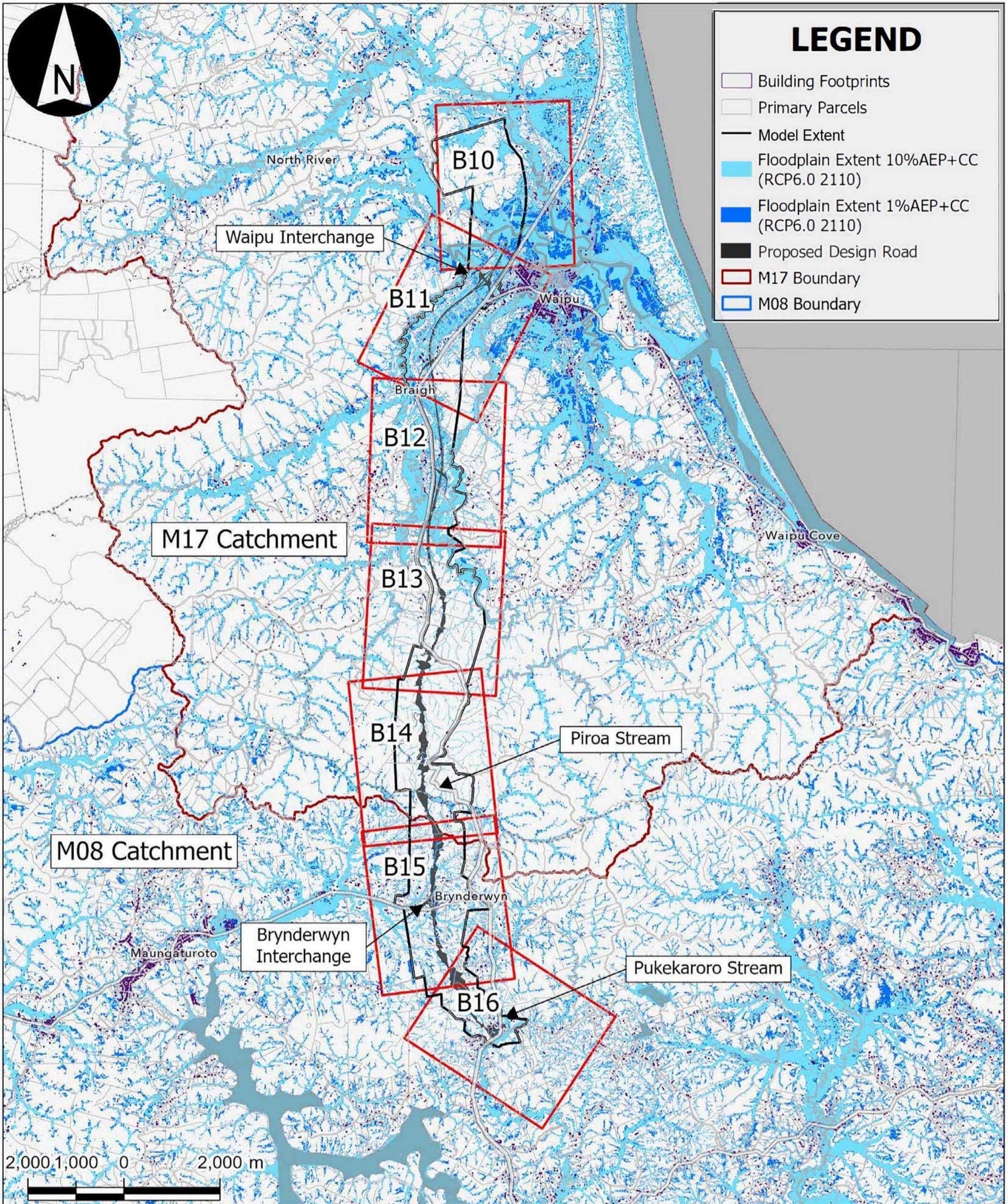
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

**APPROVED** **DATE**



PROJECT INFORMATION	
<b>TITLE:</b>	SECTION 2B MAXIMUM FLOOD EXTENTS MAP 10% AEP AND 1% AEP WITH CC RCP6.0 2110 EXISTING SCENARIO
<b>SECTION:</b>	NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
	B8



**NOTES**

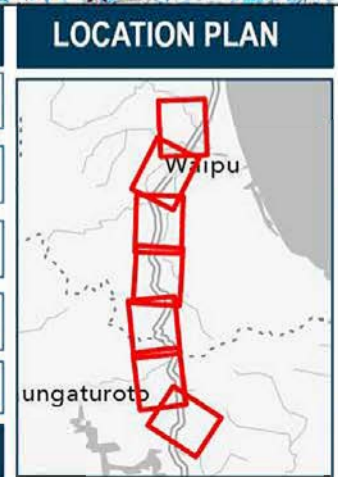
Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

**NZ TRANSPORT AGENCY**  
WAKA KOTAHU

**Northland Corridor**  
Roads of National Significance

A3 SCALE: 1:75,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025
<b>APPROVED</b>		<b>DATE</b>

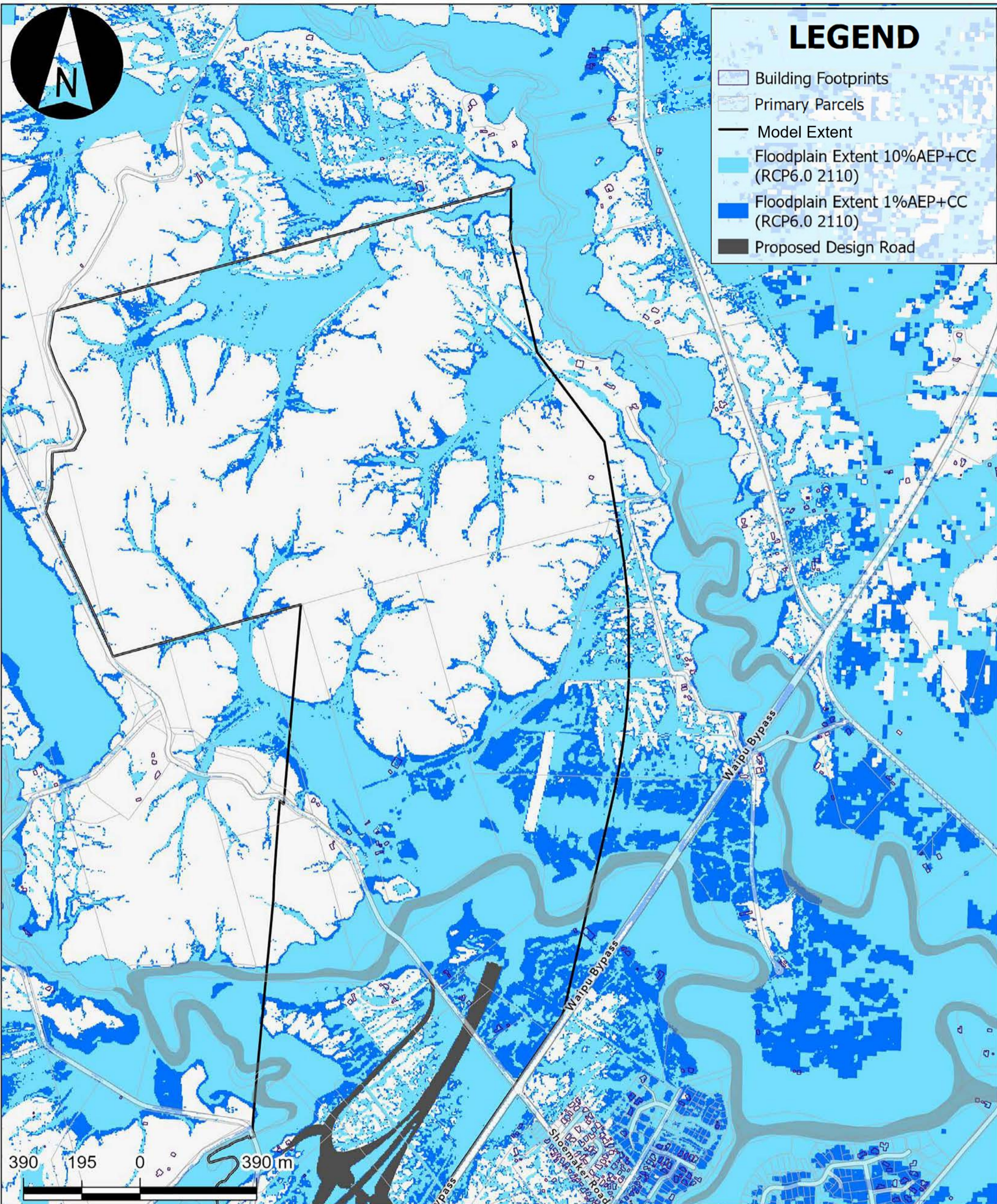


**PROJECT INFORMATION**

**TITLE:**  
SECTION 2B MAXIMUM FLOOD EXTENTS MAP  
10% AEP AND 1% AEP WITH CC RCP6.0 2110  
DESIGN SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B9



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

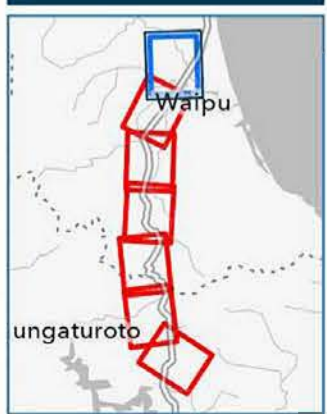
**NZ TRANSPORT AGENCY**  
WAKA KOTAHU

**Northland Corridor**  
Roads of National Significance

**QA**

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

**LOCATION PLAN**

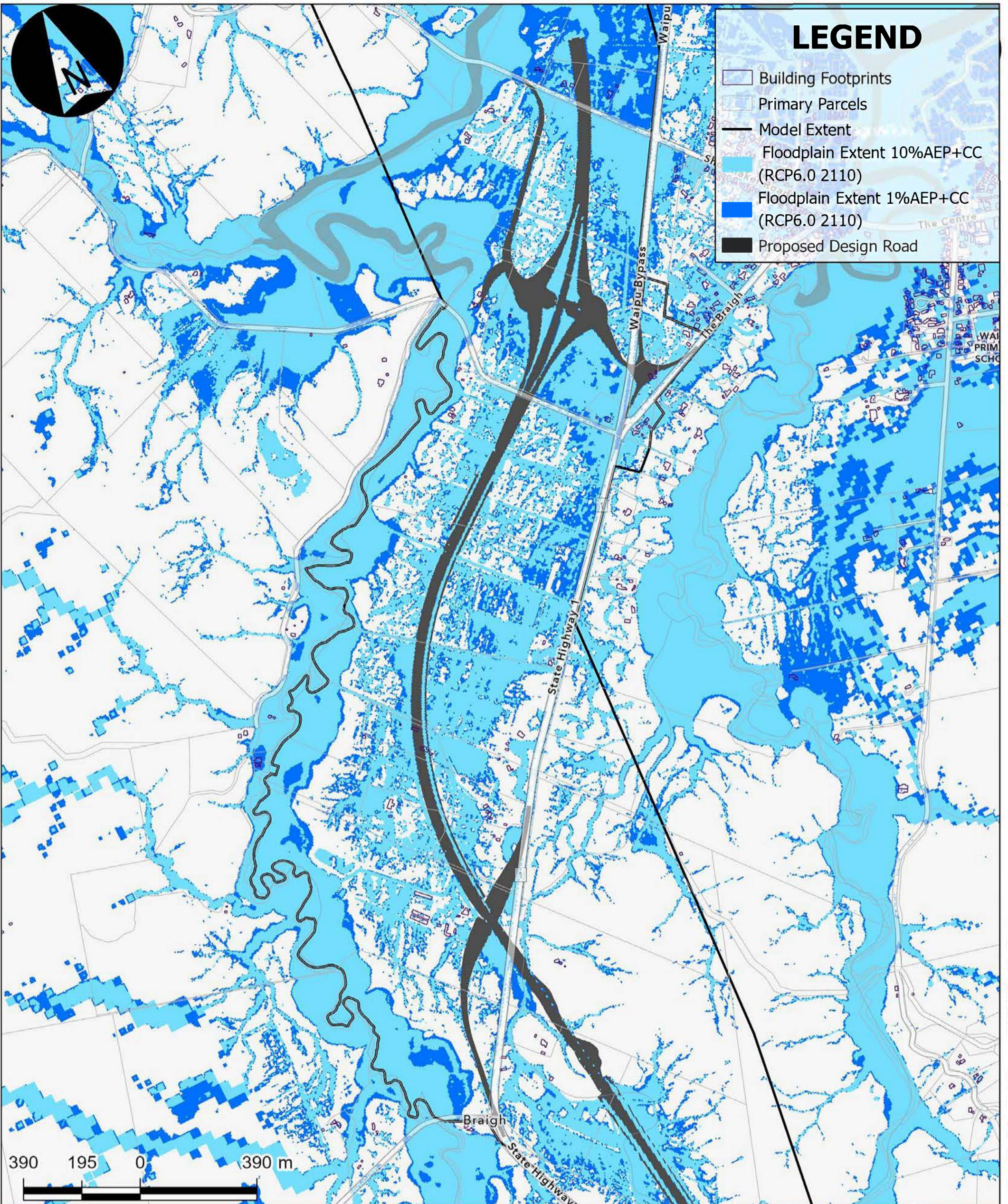


**PROJECT INFORMATION**

**TITLE:**  
SECTION 2B MAXIMUM FLOOD EXTENTS MAP  
10% AEP AND 1% AEP WITH CC RCP6.0 2110  
DESIGN SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

**B10**



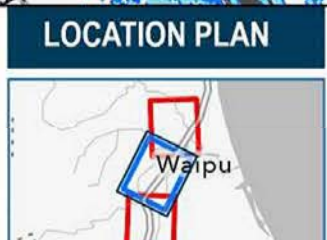
# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Floodplain Extent 10%AEP+CC (RCP6.0 2110)
- Floodplain Extent 1%AEP+CC (RCP6.0 2110)
- Proposed Design Road

**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025



**PROJECT INFORMATION**

**TITLE:**  
SECTION 2B MAXIMUM FLOOD EXTENTS MAP  
10% AEP AND 1% AEP WITH CC RCP6.0 2110  
DESIGN SCENARIO

**NZ TRANSPORT AGENCY**  
WAKA KOTAHU

**Northland Corridor**

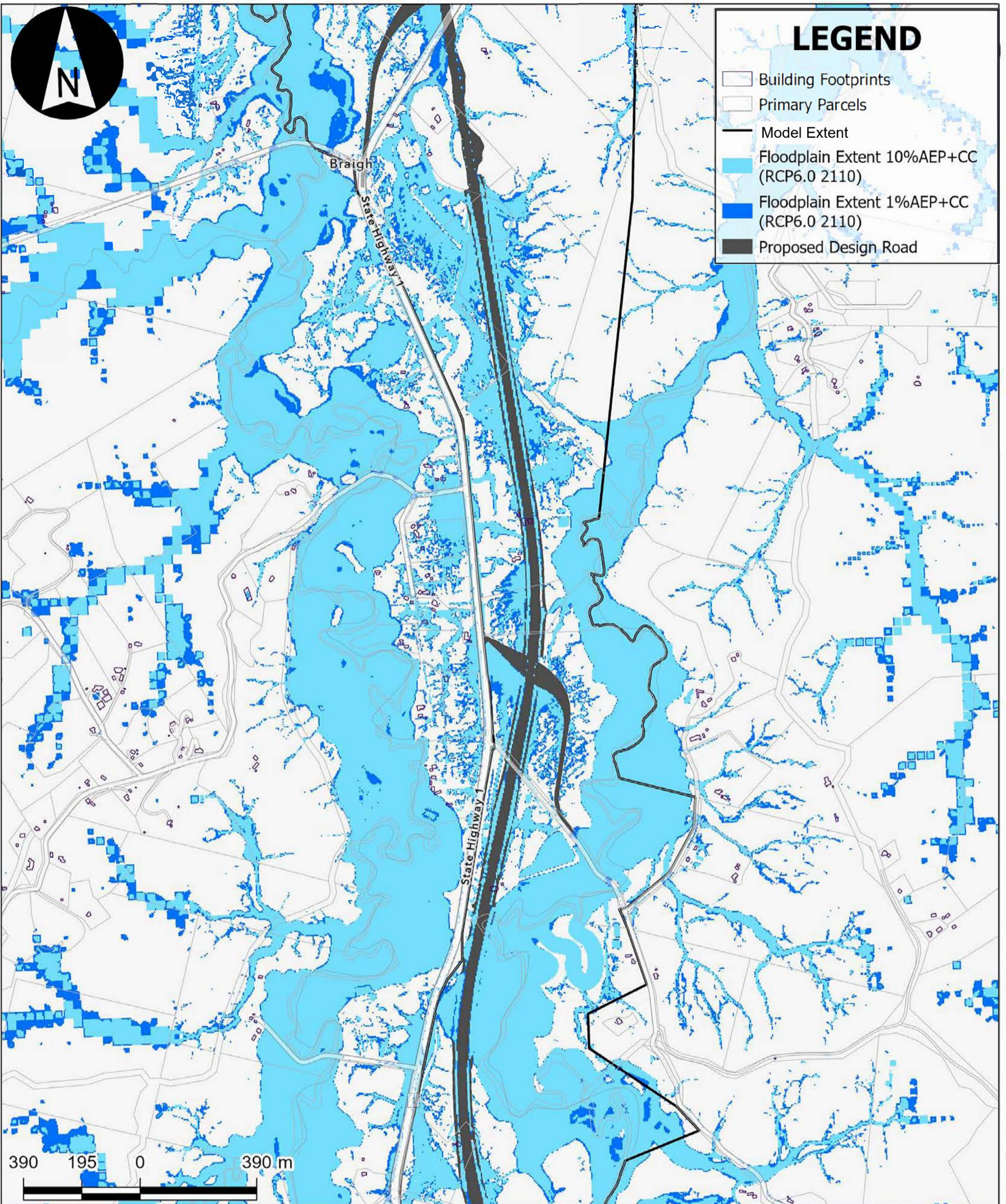
Roads of National Significance

APPROVED	DATE



**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

**B11**



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



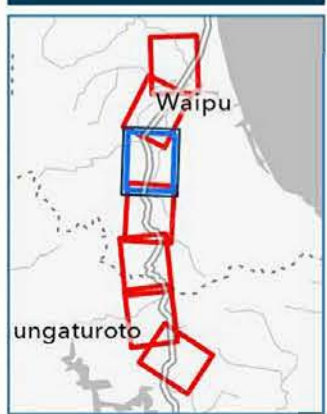
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**QA**

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

**APPROVED** **DATE**

**LOCATION PLAN**

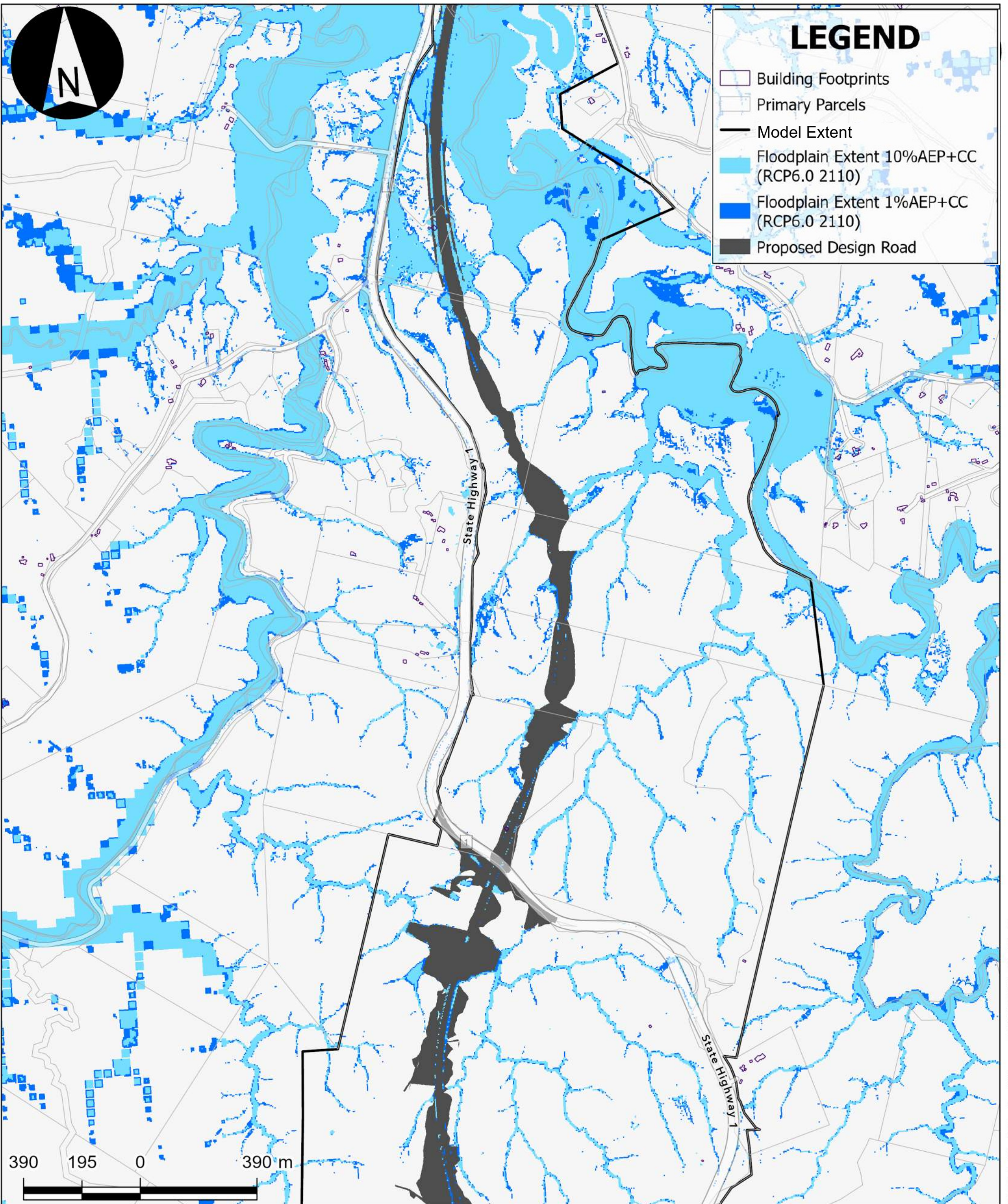


**PROJECT INFORMATION**

**TITLE:**  
SECTION 2B MAXIMUM FLOOD EXTENTS MAP  
10% AEP AND 1% AEP WITH CC RCP6.0 2110  
DESIGN SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B12



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Floodplain Extent 10%AEP+CC (RCP6.0 2110)
- Floodplain Extent 1%AEP+CC (RCP6.0 2110)
- Proposed Design Road

## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



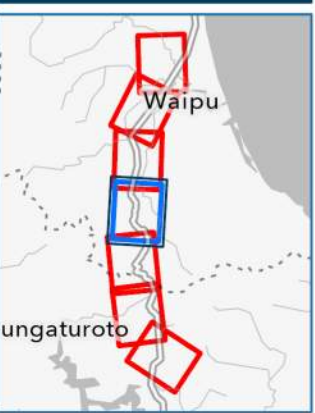
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

APPROVED DATE

## LOCATION PLAN

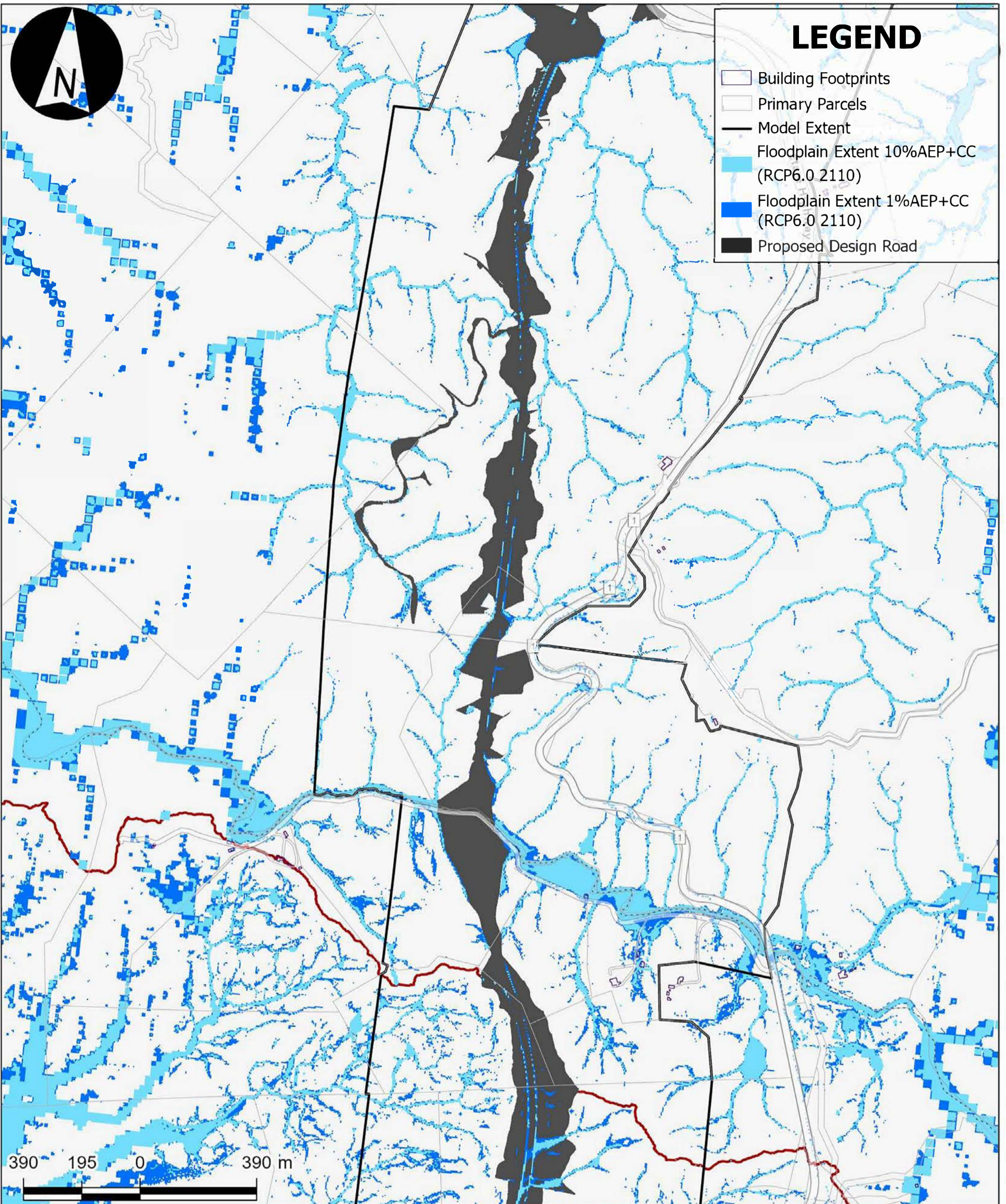


## PROJECT INFORMATION

**TITLE:**  
SECTION 2B MAXIMUM FLOOD EXTENTS MAP  
10% AEP AND 1% AEP WITH CC RCP6.0 2110  
DESIGN SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B13



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



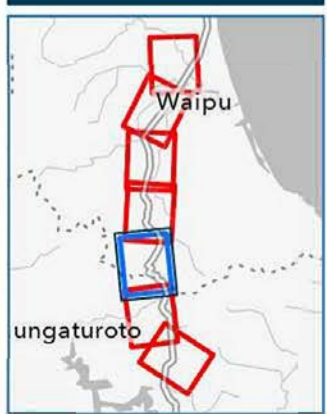
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**QA**

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

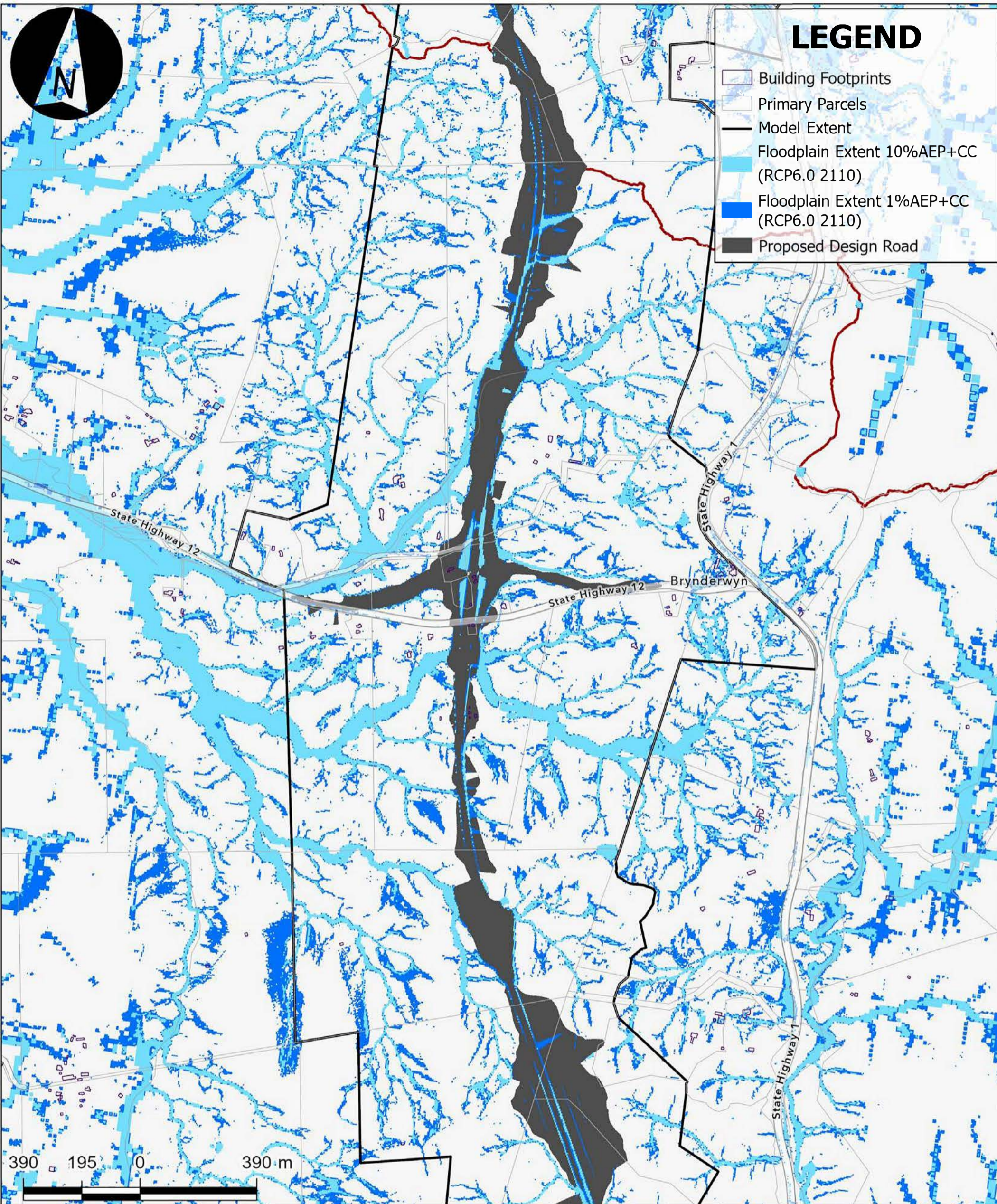
**APPROVED** **DATE**

**LOCATION PLAN**



**PROJECT INFORMATION**

<b>TITLE:</b> SECTION 2B MAXIMUM FLOOD EXTENTS MAP 10% AEP AND 1% AEP WITH CC RCP6.0 2110 DESIGN SCENARIO
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
<b>B14</b>



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Floodplain Extent 10%AEP+CC (RCP6.0 2110)
- Floodplain Extent 1%AEP+CC (RCP6.0 2110)
- Proposed Design Road

## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

APPROVED DATE

## LOCATION PLAN

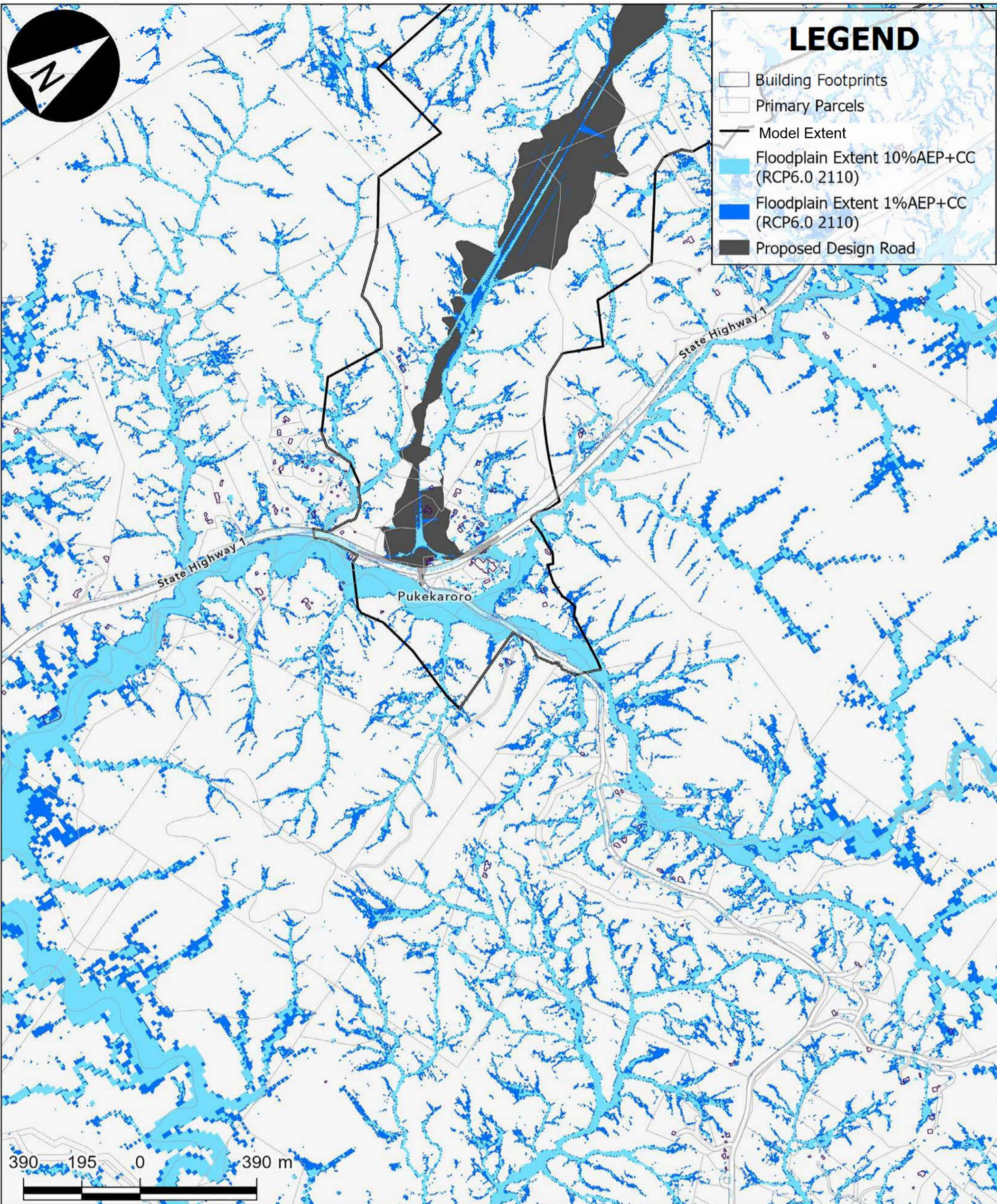


## PROJECT INFORMATION

**TITLE:**  
SECTION 2B MAXIMUM FLOOD EXTENTS MAP  
10% AEP AND 1% AEP WITH CC RCP6.0 2110  
DESIGN SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B15



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



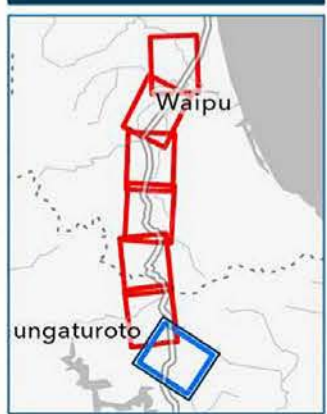
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**QA**

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

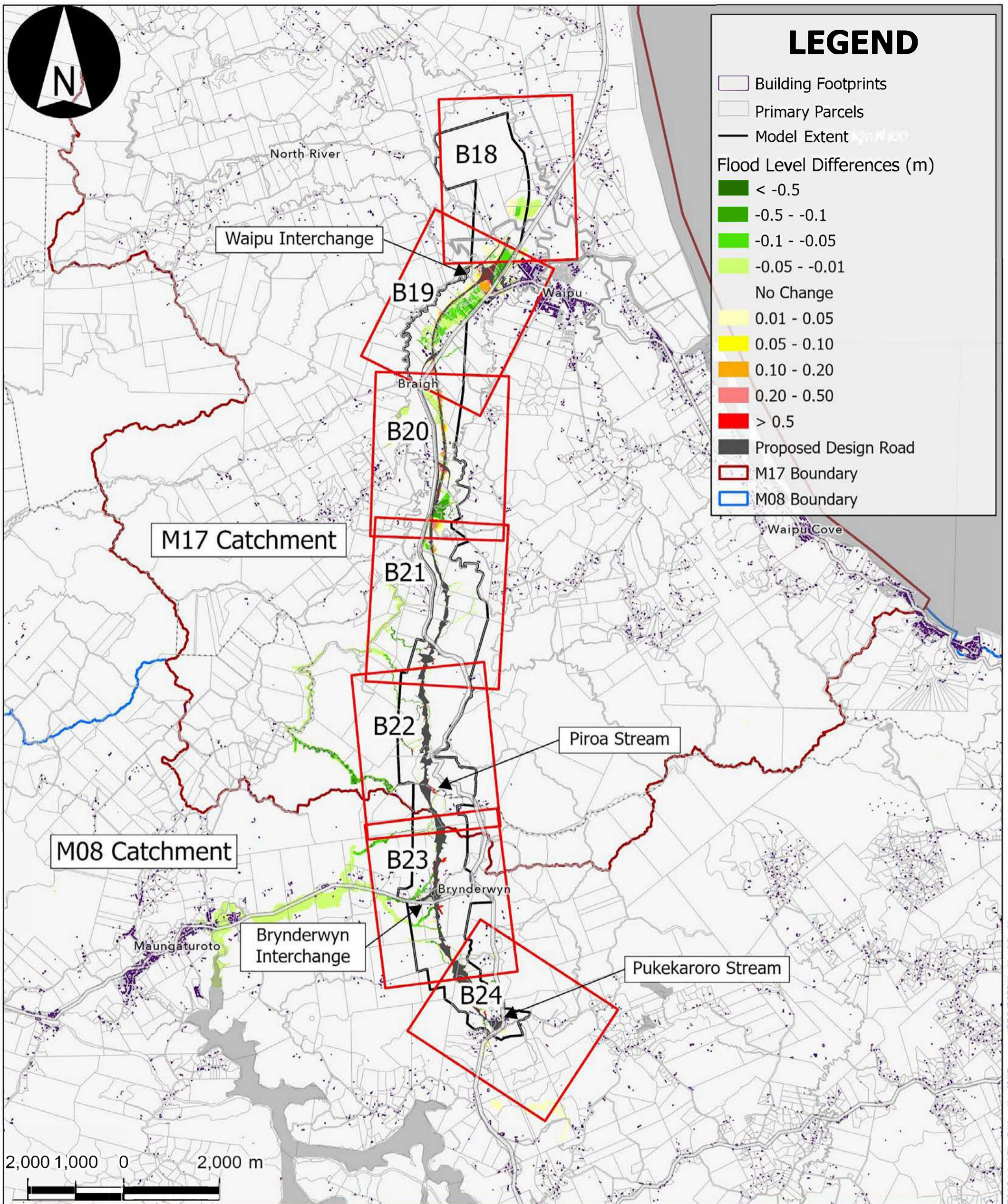
**APPROVED** **DATE**

**LOCATION PLAN**



**PROJECT INFORMATION**

<b>TITLE:</b> SECTION 2B MAXIMUM FLOOD EXTENTS MAP 10% AEP AND 1% AEP WITH CC RCP6.0 2110 DESIGN SCENARIO
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
<b>B16</b>



NOTES	
Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS	

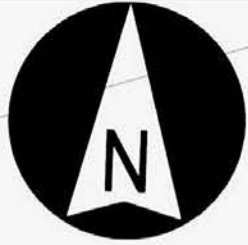
QA	
DRAWN	LLOYD SANTELICES 12/12/2025
CHECKED	NARIMAN VALIZADEH 12/12/2025
DESIGNED	N/A
VERIFIED	SINDIYA VAAKESAN 12/12/2025
	RAELIZE DU PLOOY 12/12/2025

APPROVED	
	DATE

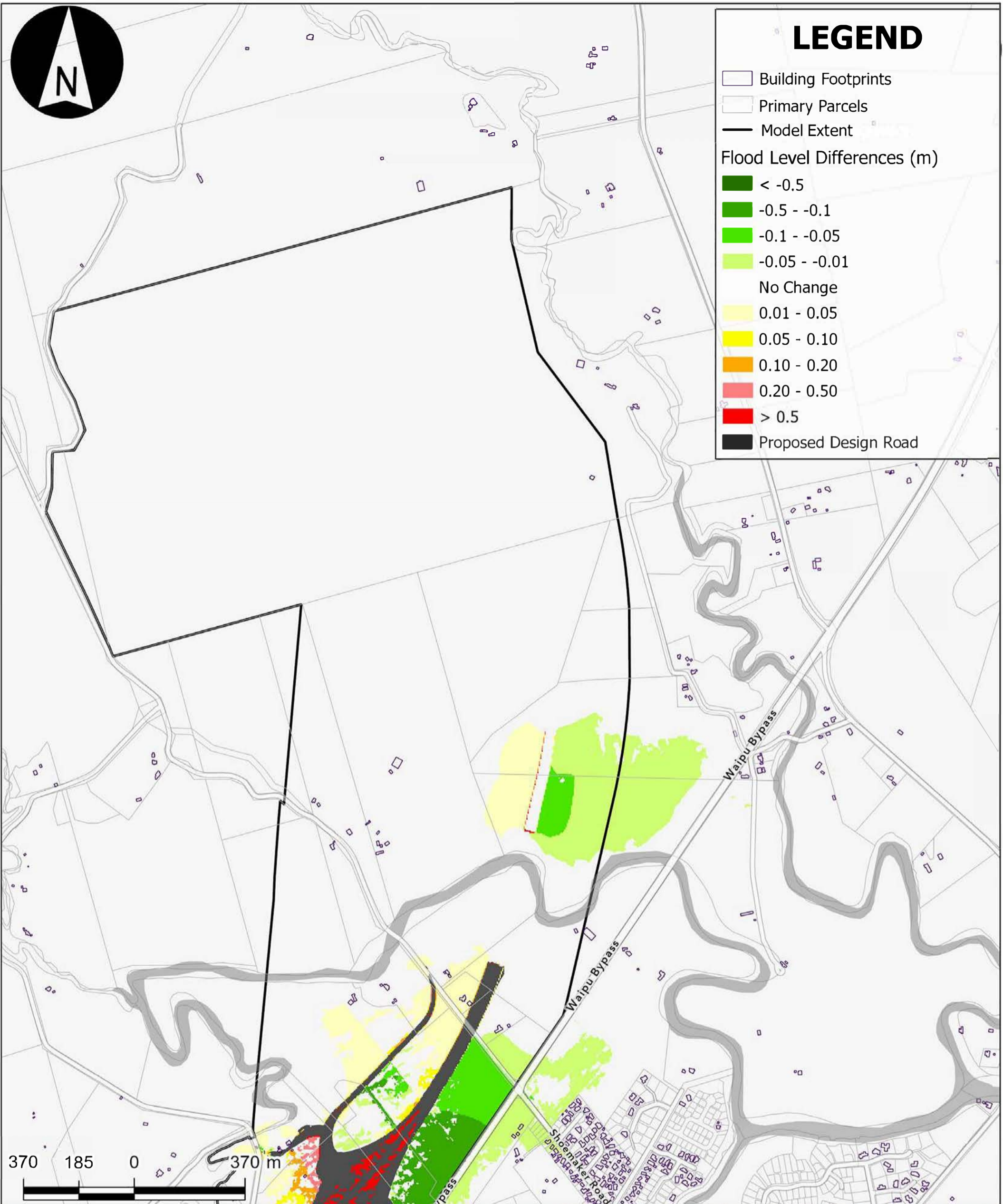
LOCATION PLAN	

PROJECT INFORMATION	
<b>TITLE:</b> SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO	
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION	
	B17



# LEGEND

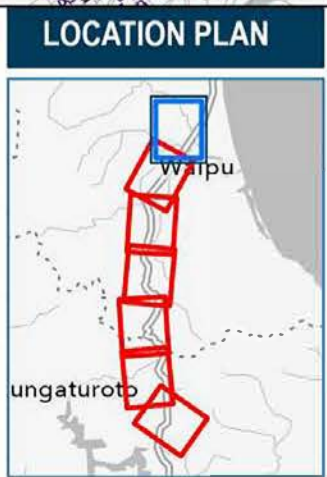
- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025



**PROJECT INFORMATION**

**TITLE:**  
SECTION 2B MAX FLOOD DIFFERENCE MAP  
1% AEP WITH CC RCP6.0 2110  
DESIGN VERSUS EXISTING SCENARIO

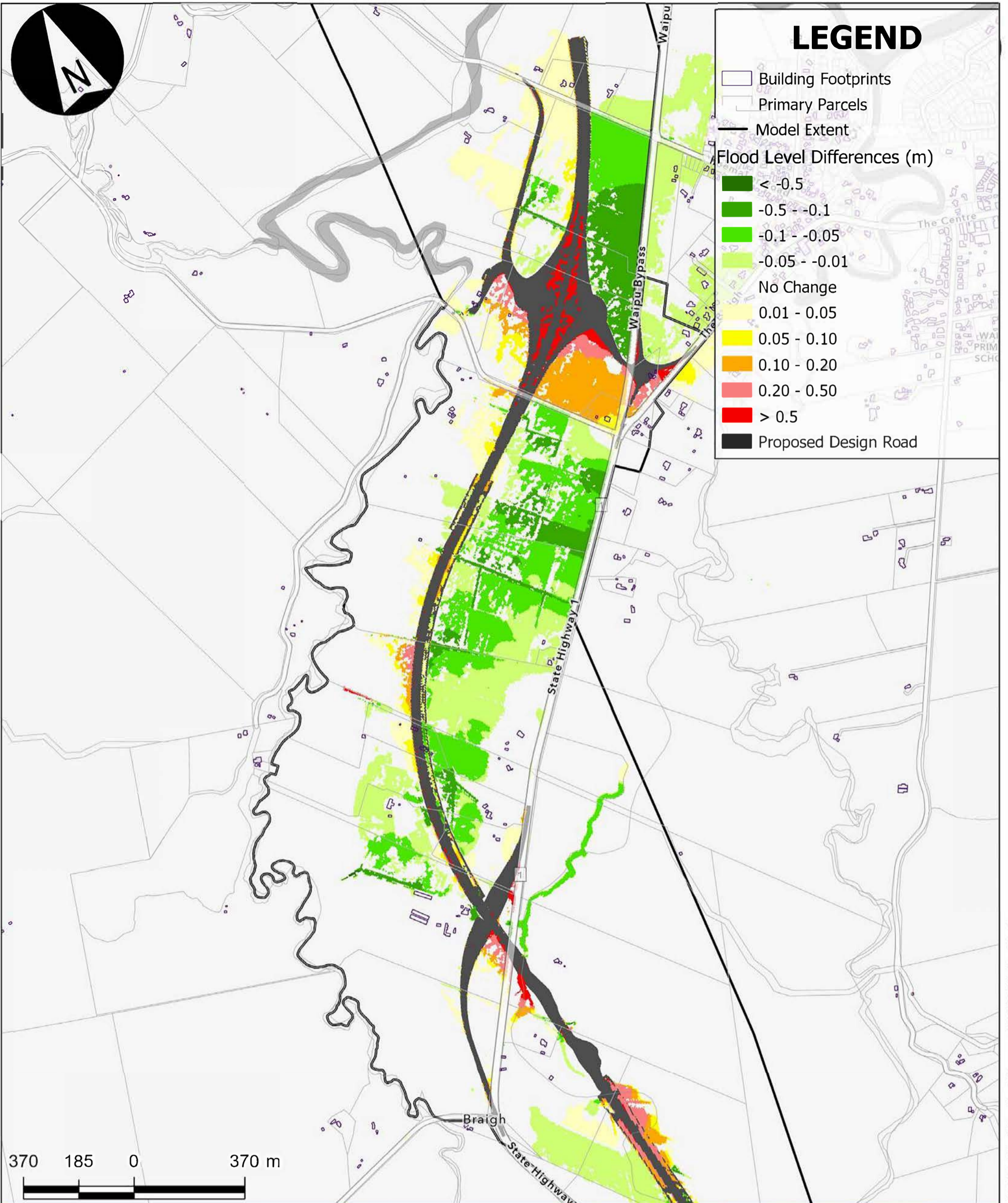
**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B18



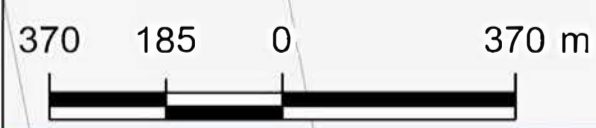
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**APPROVED** **DATE**

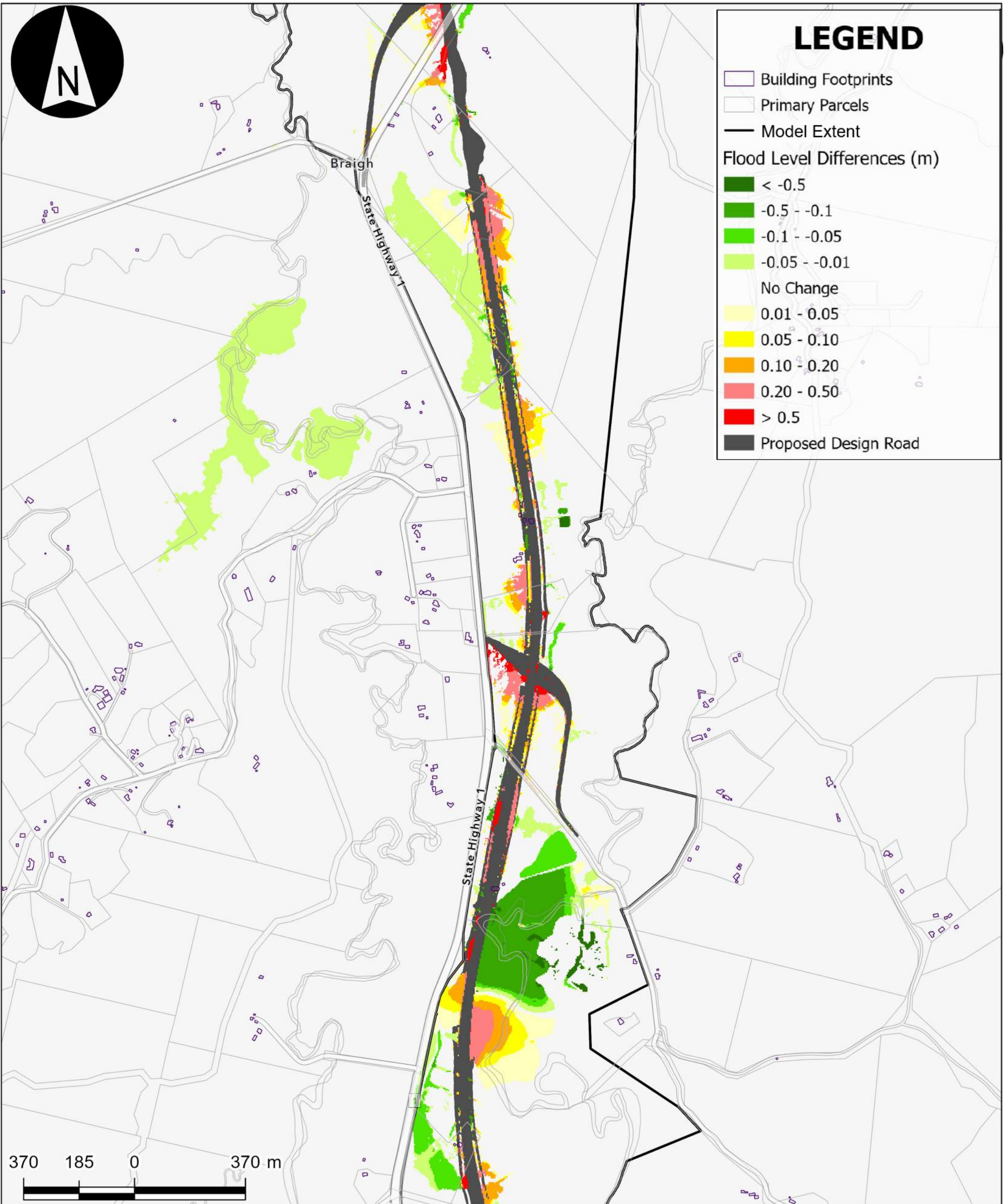


# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road

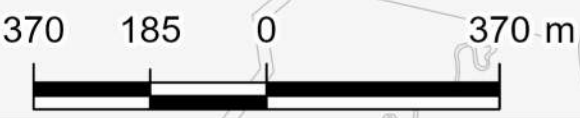


NOTES	QA	LOCATION PLAN	PROJECT INFORMATION															
Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="background-color: #003366; color: white; font-size: x-small;">DRAWN</td> <td style="font-size: x-small;">LLOYD SANTELICES</td> <td style="font-size: x-small;">12/12/2025</td> </tr> <tr> <td style="background-color: #003366; color: white; font-size: x-small;">CHECKED</td> <td style="font-size: x-small;">NARIMAN VALIZADEH</td> <td style="font-size: x-small;">12/12/2025</td> </tr> <tr> <td style="background-color: #003366; color: white; font-size: x-small;">DESIGNED</td> <td colspan="2" style="text-align: center; font-size: x-small;">N/A</td> </tr> <tr> <td style="background-color: #003366; color: white; font-size: x-small;">VERIFIED</td> <td style="font-size: x-small;">SINDIYA VAAKESAN</td> <td style="font-size: x-small;">12/12/2025</td> </tr> <tr> <td style="background-color: #003366; color: white; font-size: x-small;"> </td> <td style="font-size: x-small;">RAELIZE DU PLOOY</td> <td style="font-size: x-small;">12/12/2025</td> </tr> </table>	DRAWN	LLOYD SANTELICES	12/12/2025	CHECKED	NARIMAN VALIZADEH	12/12/2025	DESIGNED	N/A		VERIFIED	SINDIYA VAAKESAN	12/12/2025		RAELIZE DU PLOOY	12/12/2025		<p><b>TITLE:</b> SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO</p> <p><b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION</p>
DRAWN	LLOYD SANTELICES	12/12/2025																
CHECKED	NARIMAN VALIZADEH	12/12/2025																
DESIGNED	N/A																	
VERIFIED	SINDIYA VAAKESAN	12/12/2025																
	RAELIZE DU PLOOY	12/12/2025																
APPROVED	DATE	B19																



## LEGEND

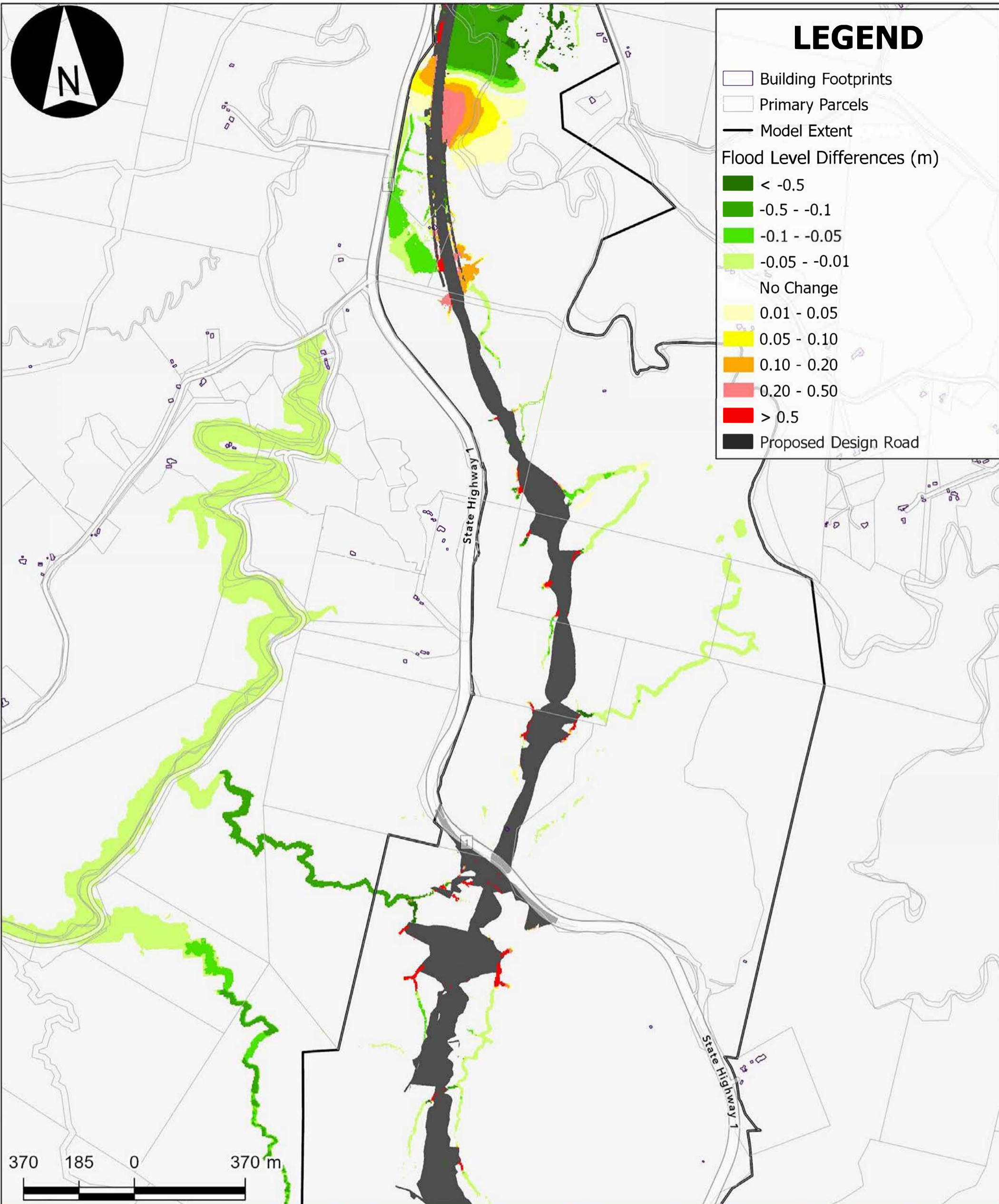
- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



NOTES	QA	LOCATION PLAN	PROJECT INFORMATION															
<p>Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;"><b>DRAWN</b></td> <td style="width: 35%;">LLOYD SANTELICES</td> <td style="width: 50%;">12/12/2025</td> </tr> <tr> <td><b>CHECKED</b></td> <td>NARIMAN VALIZADEH</td> <td>12/12/2025</td> </tr> <tr> <td><b>DESIGNED</b></td> <td colspan="2" style="text-align: center;">N/A</td> </tr> <tr> <td><b>VERIFIED</b></td> <td>SINDIYA VAAKESAN</td> <td>12/12/2025</td> </tr> <tr> <td></td> <td>RAELIZE DU PLOOY</td> <td>12/12/2025</td> </tr> </table>	<b>DRAWN</b>	LLOYD SANTELICES	12/12/2025	<b>CHECKED</b>	NARIMAN VALIZADEH	12/12/2025	<b>DESIGNED</b>	N/A		<b>VERIFIED</b>	SINDIYA VAAKESAN	12/12/2025		RAELIZE DU PLOOY	12/12/2025		<p><b>TITLE:</b> SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO</p> <p><b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION</p>
<b>DRAWN</b>	LLOYD SANTELICES	12/12/2025																
<b>CHECKED</b>	NARIMAN VALIZADEH	12/12/2025																
<b>DESIGNED</b>	N/A																	
<b>VERIFIED</b>	SINDIYA VAAKESAN	12/12/2025																
	RAELIZE DU PLOOY	12/12/2025																
<p><b>APPROVED</b></p>	<p><b>DATE</b></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;"></td> <td style="width: 20%; text-align: center;">B20</td> </tr> </table>			B20													
	B20																	



A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



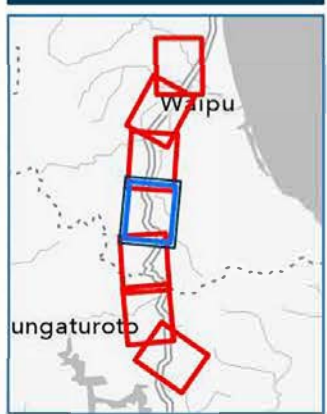
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**QA**

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

**APPROVED** **DATE**

**LOCATION PLAN**



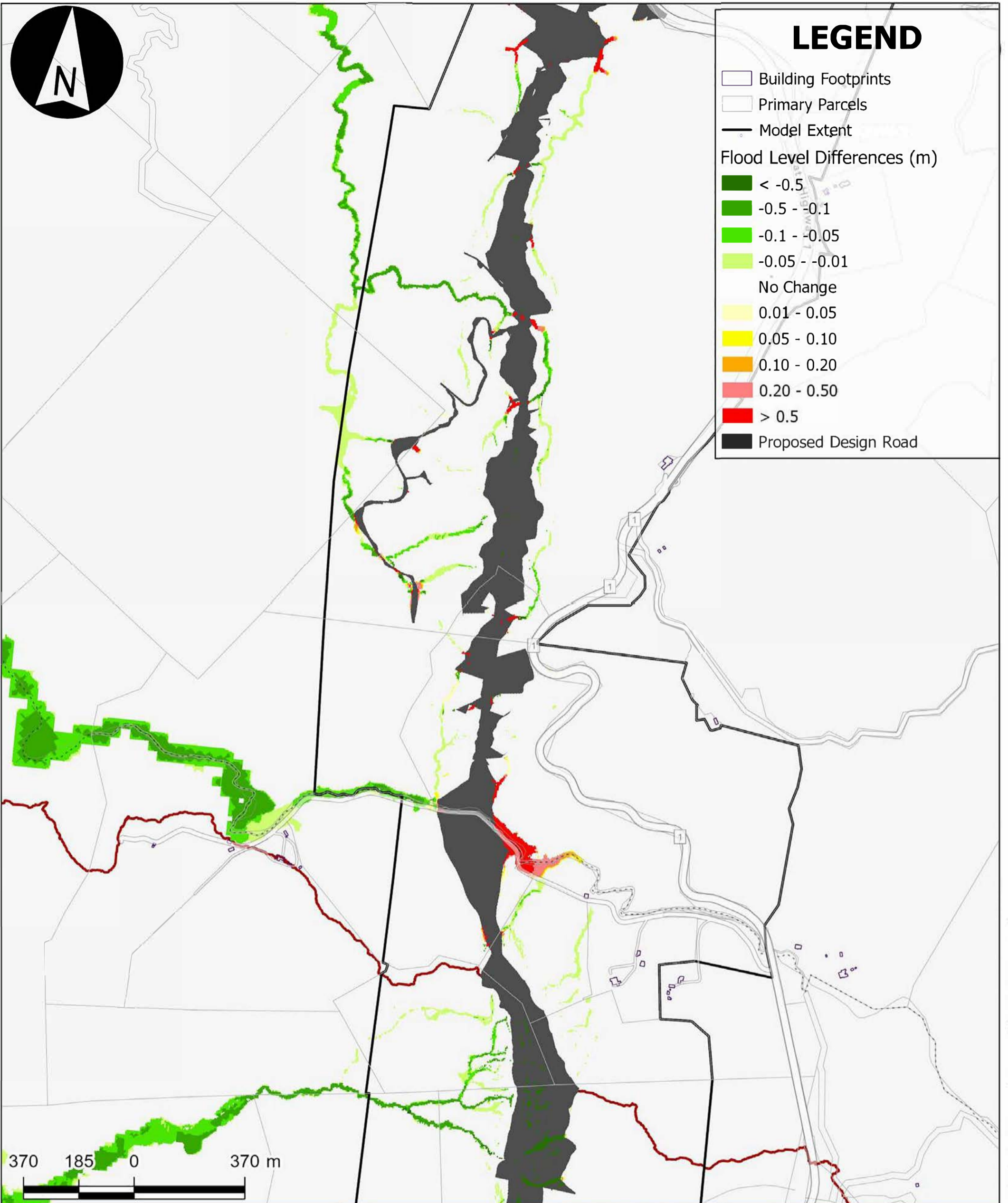
**PROJECT INFORMATION**

<b>TITLE:</b> SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
B21



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



## NOTES

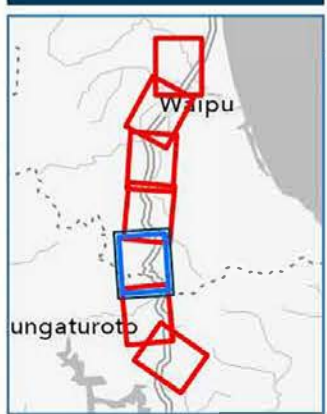
Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

## LOCATION PLAN

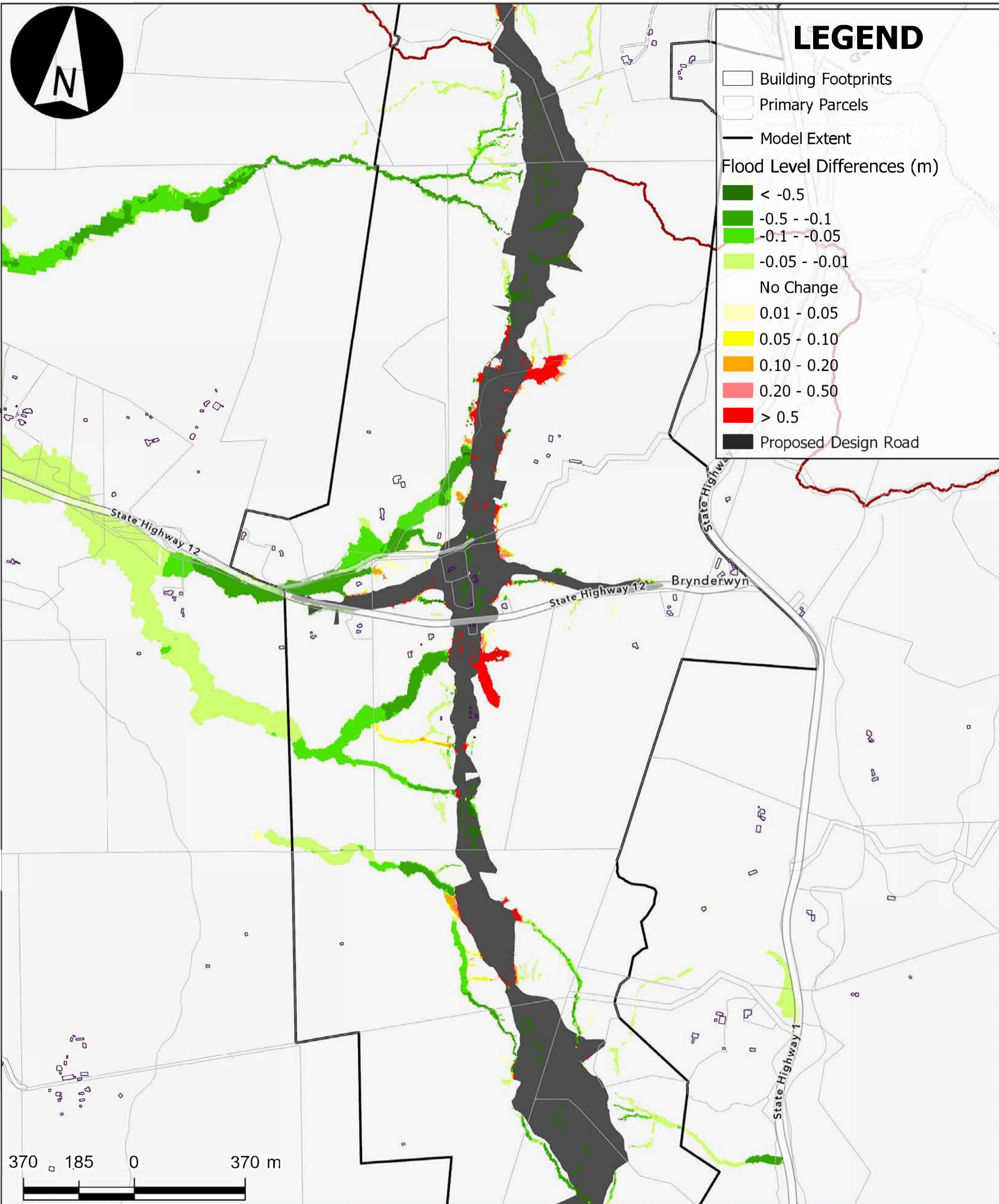


## PROJECT INFORMATION

<b>TITLE:</b> SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
B22

A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**APPROVED** **DATE**



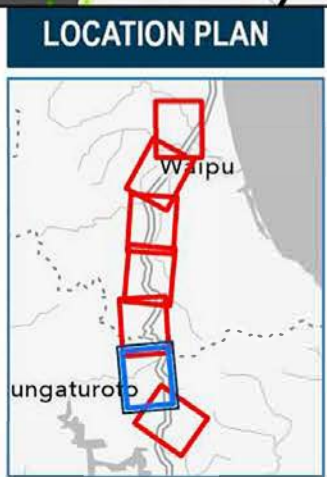
# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road

**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025



PROJECT INFORMATION	
<b>TITLE:</b>	SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO
<b>SECTION:</b>	NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
	B23



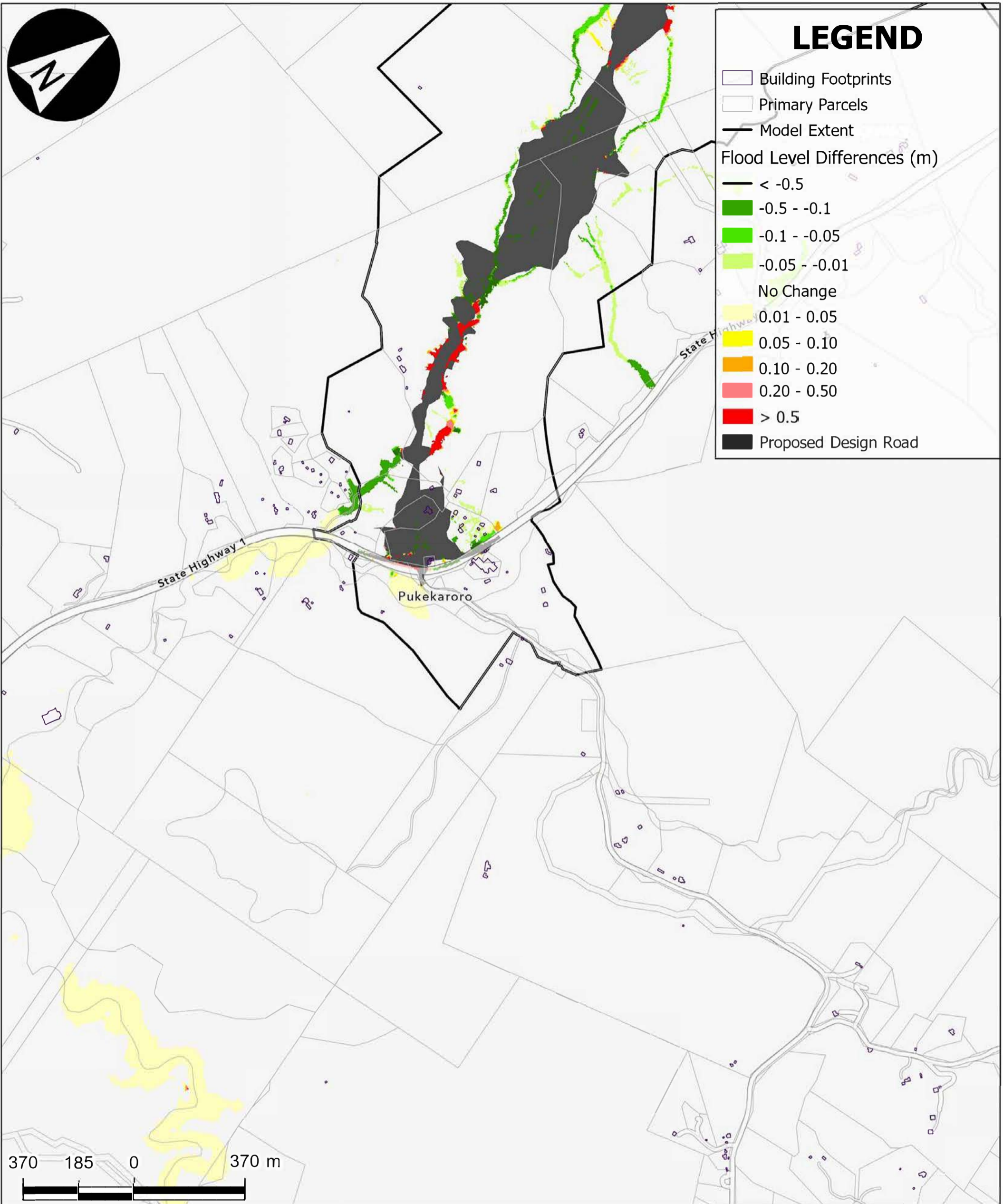
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**APPROVED** **DATE**



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



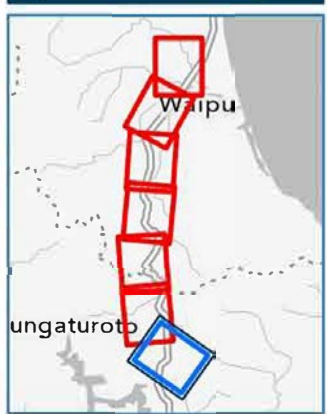
## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

## LOCATION PLAN



## PROJECT INFORMATION

**TITLE:**  
SECTION 2B MAX FLOOD DIFFERENCE MAP  
1% AEP WITH CC RCP6.0 2110  
DESIGN VERSUS EXISTING SCENARIO

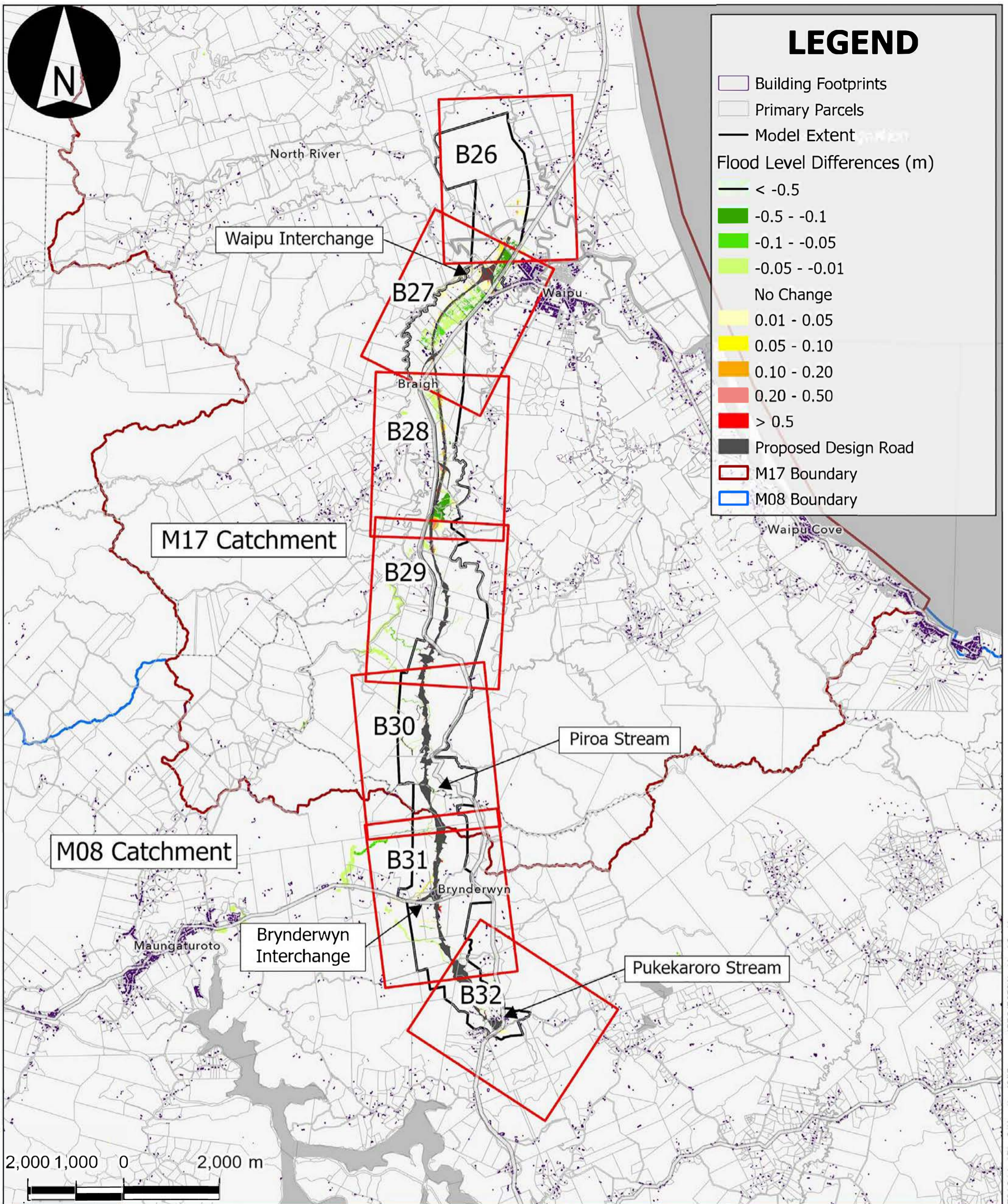
**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B24



A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**APPROVED**      **DATE**



**NOTES**

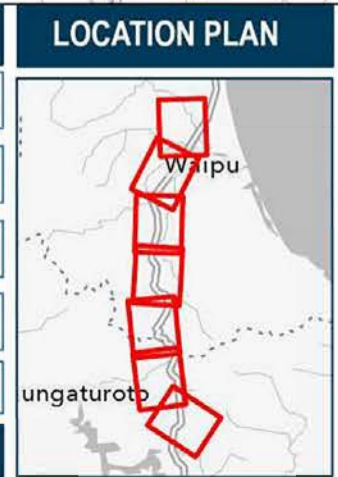
Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

**NZ TRANSPORT AGENCY**  
WAKA KOTAHU

**Northland Corridor**  
Roads of National Significance

A3 SCALE: 1:75,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025
<b>APPROVED</b>		<b>DATE</b>

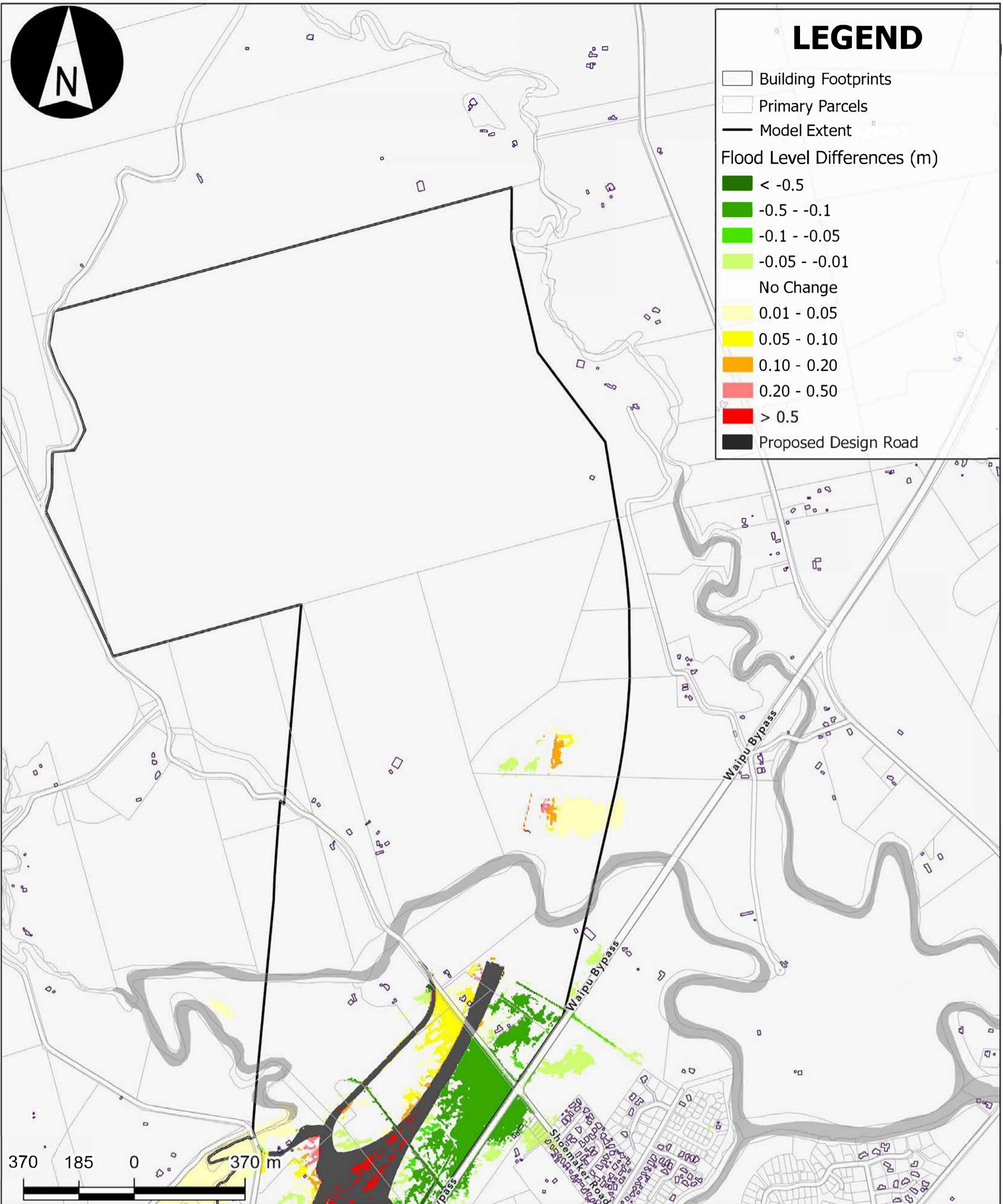


PROJECT INFORMATION	
<b>TITLE:</b> SECTION 2B MAX FLOOD DIFFERENCE MAP 10% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO	
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION	
	B25



# LEGEND

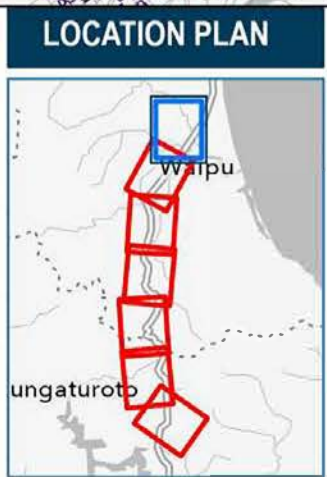
- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



**NOTES**

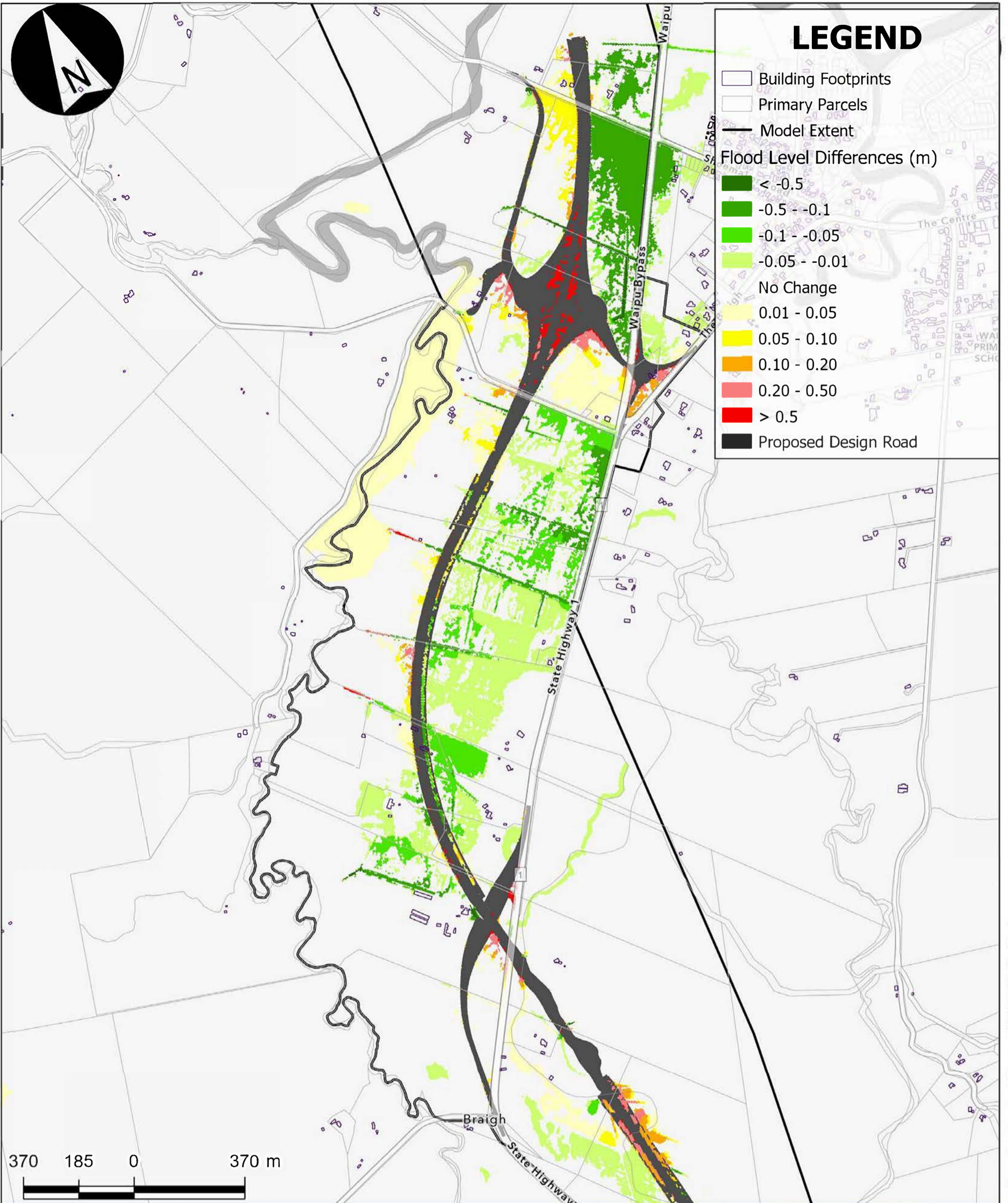
Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025



PROJECT INFORMATION	
<b>TITLE:</b>	SECTION 2B MAX FLOOD DIFFERENCE MAP 10% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO
<b>SECTION:</b>	NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
	B26





**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

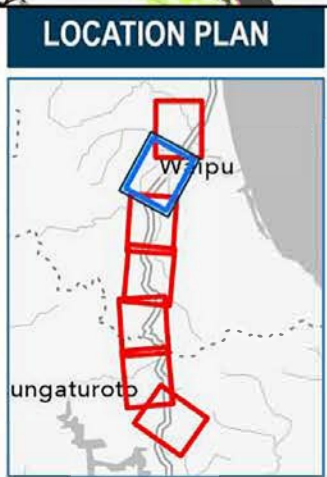
**NZ TRANSPORT AGENCY** WAKA KOTAHĪ

**Northland Corridor**

Roads of National Significance

A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025
<b>APPROVED</b>		<b>DATE</b>

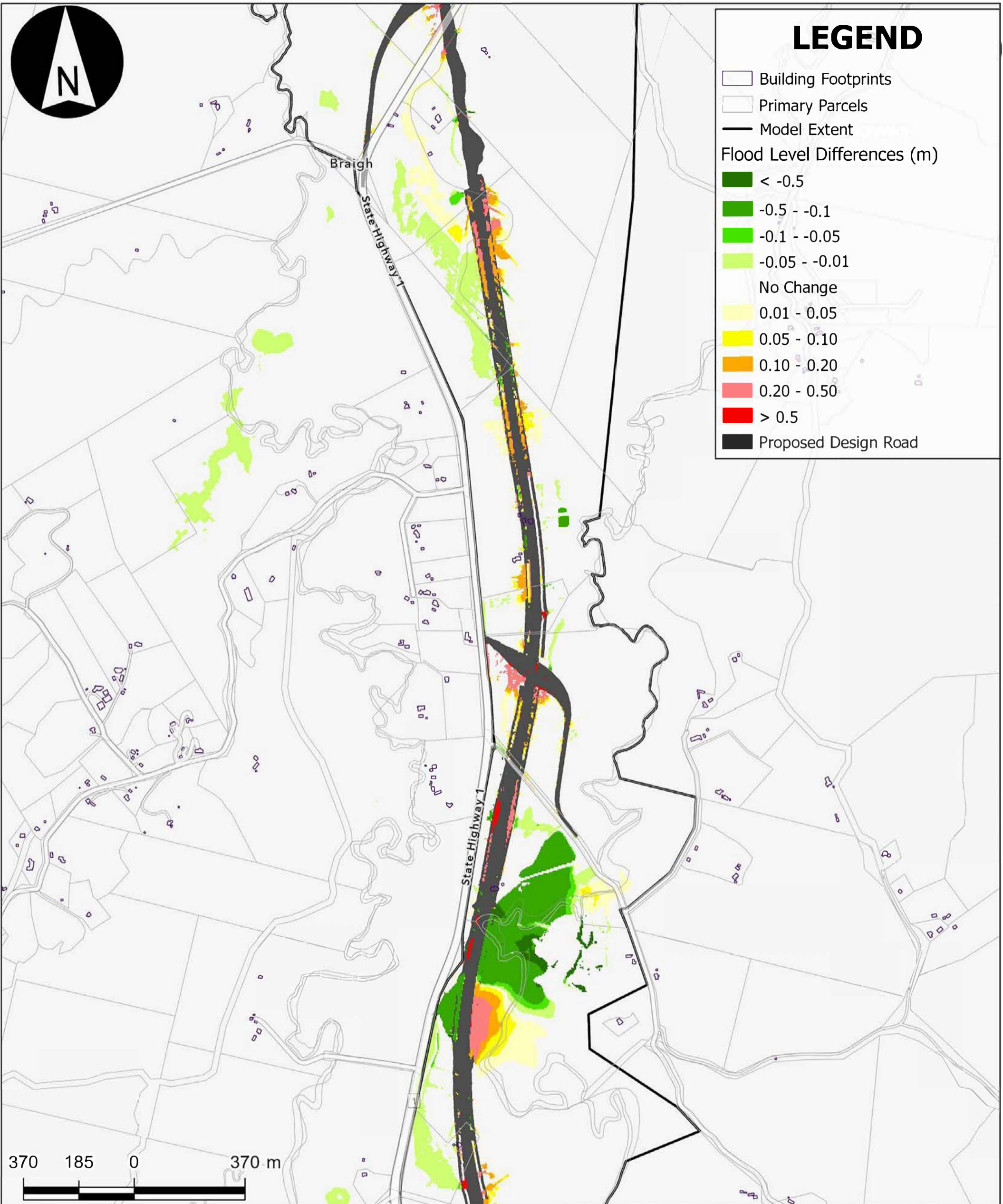


PROJECT INFORMATION	
<b>TITLE:</b>	SECTION 2B MAX FLOOD DIFFERENCE MAP 10% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO
<b>SECTION:</b>	NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
	B27



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

APPROVED DATE

## LOCATION PLAN

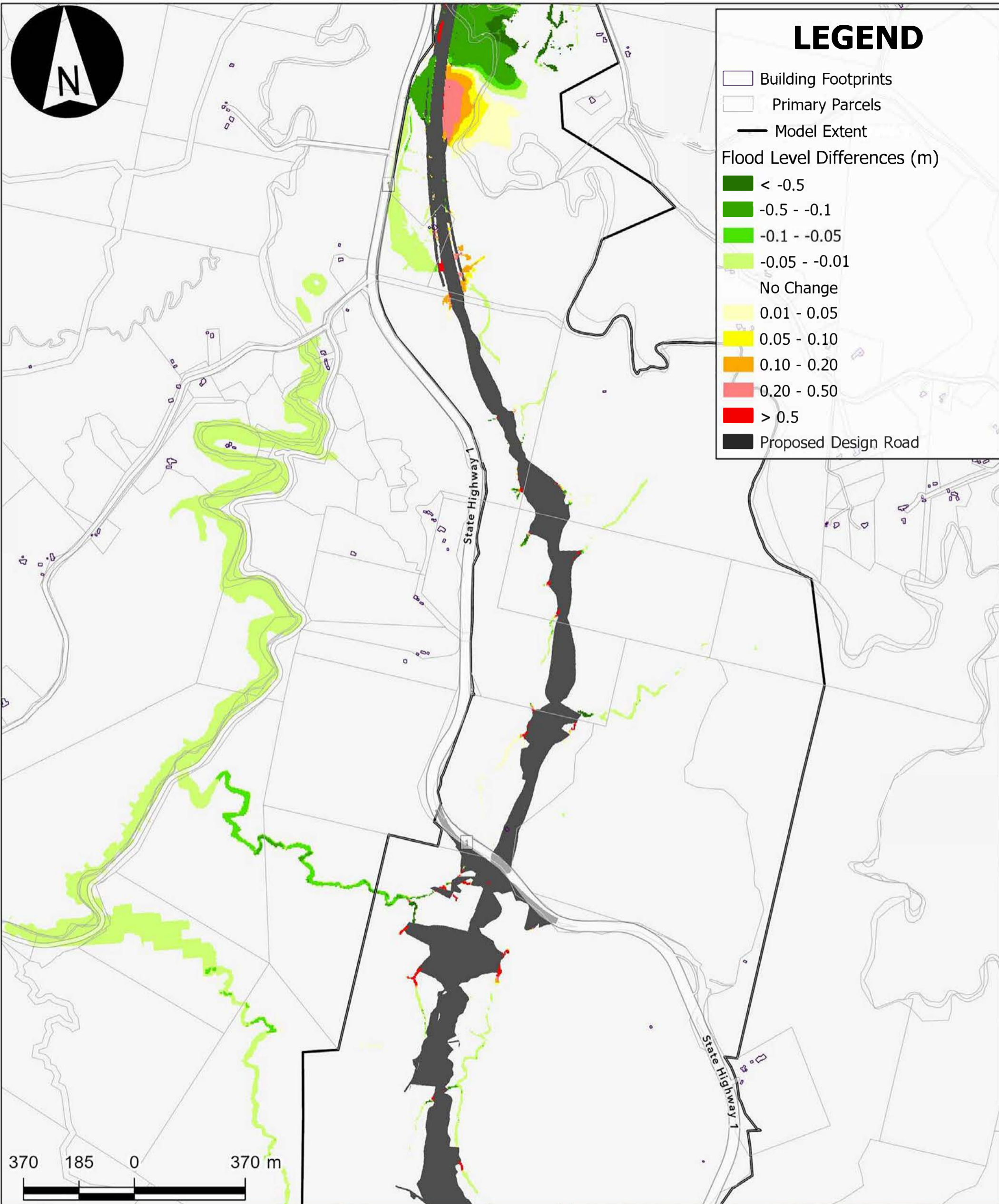


## PROJECT INFORMATION

**TITLE:**  
SECTION 2B MAX FLOOD DIFFERENCE MAP  
10% AEP WITH CC RCP6.0 2110  
DESIGN VERSUS EXISTING SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B28



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



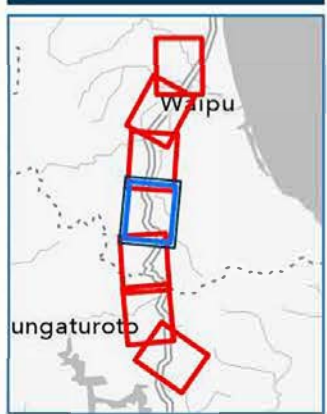
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**QA**

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

**APPROVED** **DATE**

**LOCATION PLAN**



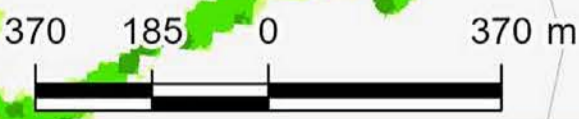
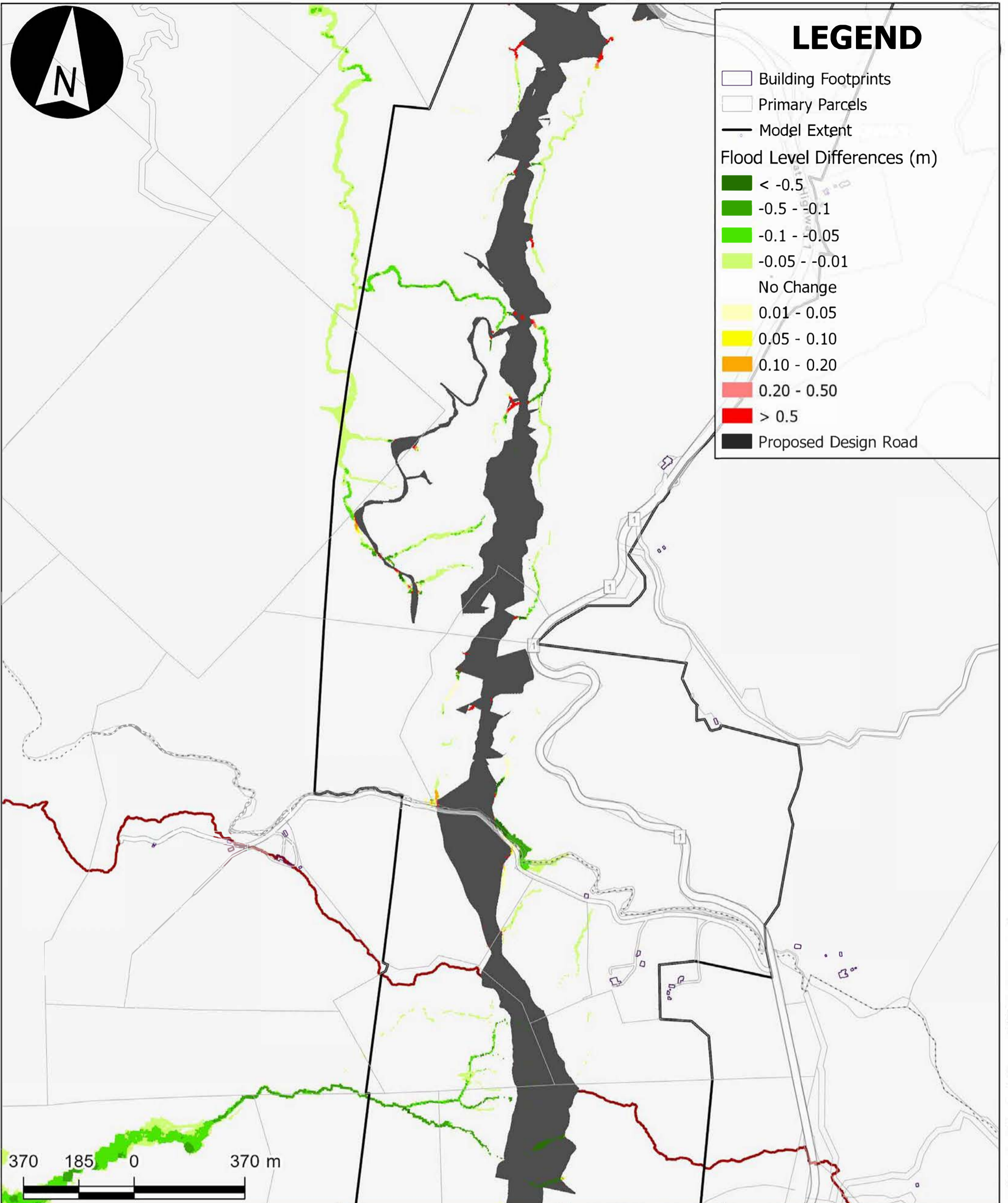
**PROJECT INFORMATION**

<b>TITLE:</b> SECTION 2B MAX FLOOD DIFFERENCE MAP 10% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
B29



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



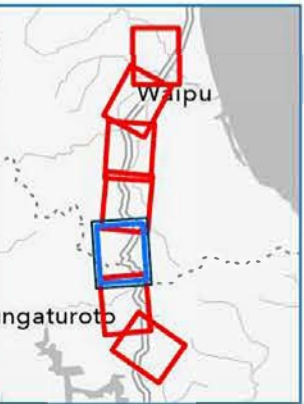
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

APPROVED DATE

## LOCATION PLAN

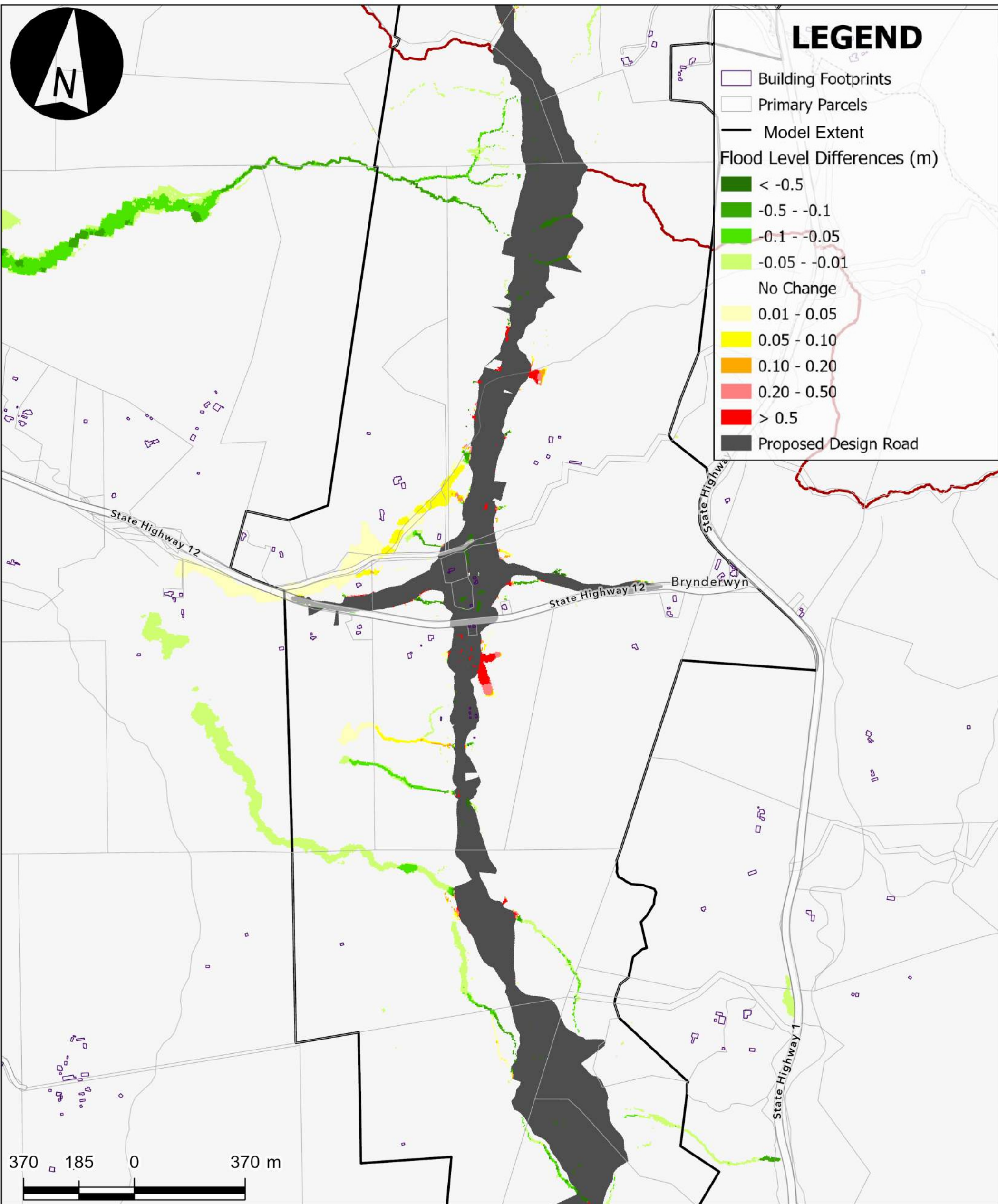


## PROJECT INFORMATION

**TITLE:**  
SECTION 2B MAX FLOOD DIFFERENCE MAP  
10% AEP WITH CC RCP6.0 2110  
DESIGN VERSUS EXISTING SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B30



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road

## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

APPROVED DATE

## LOCATION PLAN



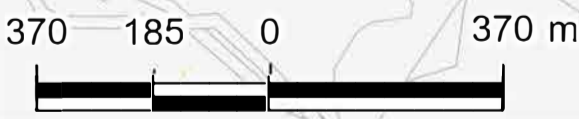
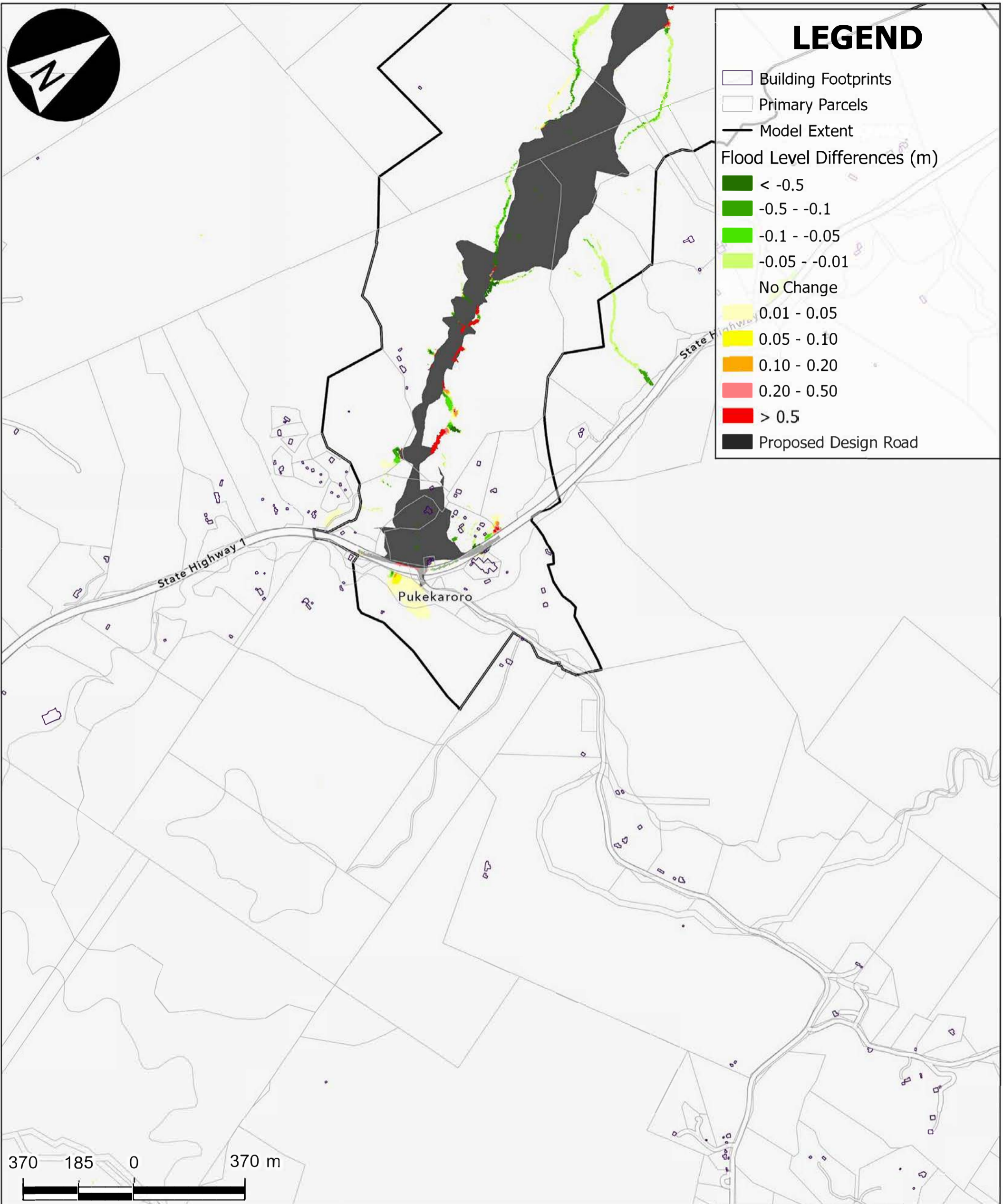
## PROJECT INFORMATION

<b>TITLE:</b> SECTION 2B MAX FLOOD DIFFERENCE MAP 10% AEP WITH CC RCP6.0 2110 DESIGN VERSUS EXISTING SCENARIO
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
B31



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

## LOCATION PLAN



## PROJECT INFORMATION

**TITLE:**  
SECTION 2B MAX FLOOD DIFFERENCE MAP  
10% AEP WITH CC RCP6.0 2110  
DESIGN VERSUS EXISTING SCENARIO

**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

B32



A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**APPROVED** **DATE**

# Appendix C

## Indicative Culvert, Treatment Device and Drainage Diversion Schedules

Note: Drainage diversions associated with spoil fill sites cannot be quantified at this stage due to lack of data.

Table 6: Culvert Schedule

Catchment	Culvert Reference	Cross sectional type	Diameter / Height (mm)	No. Barrels	Length (m)	Gradient (%)	Fish Passage (Y / N)	Debris Management (Y / N)	Energy Dissipation Structure	Drop Inlet (Y/N)
Ahuroa Zone 1A	CH 9700	Circular	1050	3	52	0.12%	N	N	RIPRAP APRON	N
	CH 10220	Circular	1200	4	61	0.01%	N	N	RIPRAP APRON	N
	CH 10520	Circular	750	8	56	0.52%	N	N	RIPRAP APRON	N
	CH 10800	Circular	750	8	66	0.30%	N	N	RIPRAP APRON	N
Waihoihoi Zone 1B	CH 11700	Circular	2550	1	90	0.03%	N	N	RIPRAP APRON	N
	CH 11940	Circular	825	3	40	1.92%	N	N	RIPRAP APRON	N
	CH 12240	Circular	1800	1	101	0.34%	N	N	RIPRAP APRON	N
	CH 12480	Circular	900	6	133	0.39%	N	N	RIPRAP APRON	N
	CH 13000	Circular	900	2	73	0.12%	N	N	RIPRAP APRON	N
	CH 13600	Circular	1050	1	94	2.65%	N	N	RIPRAP APRON	N
	CH 14900	Circular	1950	2	109	0.37%	Y	N	RIPRAP APRON	N
	CH 15640	Circular	825	1	121	0.77%	N	N	RIPRAP APRON	N
	CH 16100	Circular	450	1	62	10.11%	N	N	RIPRAP BASIN	N
	CH 16200	Circular	450	1	35	4.58%	N	N	RIPRAP APRON	Y
	CH 16360	Circular	1200	2	152	7.77%	N	N	RIPRAP BASIN	N
	CH 16480	Circular	1200	1	174	3.57%	N	N	RIPRAP BASIN	N
	CH 16640	Circular	1050	1	158	12.16%	N	N	RIPRAP BASIN	N
CH 17100	Circular	1350	1	175	6.57%	N	N	RIPRAP BASIN	N	
Piroa Zone 2	CH 17960	Circular	3050	1	372	12.24%	N	Y	RIPRAP BASIN	Y
	CH 18460	Circular	1050	1	75	13.04%	N	Y	RIPRAP BASIN	Y
	CH 18980	Circular	1950	1	86	10.31%	N	Y	RIPRAP BASIN	Y
	CH 19240	Circular	750	1	134	5.84%	N	Y	RIPRAP BASIN	N
	CH 20040	Circular	1650	1	273	22.12%	N	Y	RIPRAP BASIN	N
	CH 20540	Circular	1500	1	225	2.89%	Y	Y	RIPRAP APRON	N
	CH 20640	Circular	3050	4	230	0.98%	Y	Y	RIPRAP APRON	N
Wairau Zone 3	CH 21340	Circular	1050	2	87	2.44%	N	N	RIPRAP APRON	Y
	CH 21880	Circular	1500	1	377	3.53%	N	N	RIPRAP APRON	Y
	CH 22720	Circular	2550	2	147	0.34%	N	N	MANHOLE CHAMBER	Y
	CH 22880	Circular	1500	3	190	0.63%	N	N	MANHOLE CHAMBER	Y
	CH 23080	Circular	900	3	226	0.13%	N	N	MANHOLE CHAMBER	N

Catchment	Culvert Reference	Cross sectional type	Diameter / Height (mm)	No. Barrels	Length (m)	Gradient (%)	Fish Passage (Y / N)	Debris Management (Y / N)	Energy Dissipation Structure	Drop Inlet (Y/N)
Wairau Zone 4	CH 23220	Circular	3050	1	123	0.94%	N	N	RIPRAP APRON	Y
	CH 23520	Circular	525	6	47	4.39%	N	N	RIPRAP APRON	N
	CH 23700	Circular	1050	1	58	6.91%	N	N	RIPRAP BASIN	Y
	CH 24060	Circular	1800	1	231	2.32%	N	N	RIPRAP APRON	Y
Pukekaroro Zone 4	CH 25100	Circular	1800	1	109	0.16%	N	N	RIPRAP APRON	Y
	CH 25280	Circular	825	1	41	1.02%	N	N	RIPRAP BASIN	Y
	CH 25360	Circular	750	1	73	0.74%	N	N	RIPRAP APRON	Y
	CH 25500	Circular	1200	1	204	3.25%	N	N	RIPRAP APRON	Y
	CH 25780	Circular	2300	1	213	1.65%	N	Y	RIPRAP APRON	N
Ahuroa Zone 1A	LR-CH 9260	Circular	375	2	19	0.50%	N	N	RIPRAP APRON	N
	LR-CH 9400	Circular	450	1	15	-	N	N	RIPRAP APRON	N
	LR-CH 9340	Circular	1200	1	69	0.08%	N	N	RIPRAP APRON	N
	LR-CH 11640	Circular	750	1	88	1.25%	N	N	RIPRAP BASIN	N
Waihoihoi Zone 1B	LR-CH 13760	Circular	900	1	79	0.65%	N	N	RIPRAP APRON	N
	LR-CH 13870	Circular	900	1	82	1.49%	N	N	RIPRAP BASIN	N
Piroa Zone 3	CH 22720 - L1	Circular	2550	2	138	0.72%	N	N	MANHOLE CHAMBER	Y
	CH 22720 - L2	Circular	3050	2	376	1.38%	N	N	RIPRAP BASIN	Y
Wairau Zone 4	CH 23080 - L3	Circular	1050	2	234	0.29%	N	N	RIPRAP BASIN	Y
Pukekaroro Zone 4	LR-CH 26160	Circular	2550	1	42	1.54%	N	N	RIPRAP APRON	N
	LR-CH 26180	Circular	2550	1	66	0.76%	N	N	RIPRAP APRON	N
	LR-CH 26100	Circular	2550	1	26	0.00%	N	N	RIPRAP APRON	N
	LR-CH 26120	Circular	675	2	35	6.77%	N	N	RIPRAP BASIN	N

Culvert 17960: It is not practicable to provide fully compliant fish passage at this culvert; however the Project Ecologist has requested that basic fish passage measures (i.e. not necessarily fully-compliant) suitable for climbing species be implemented to the extent practicable.

Table 7: Constructed Wetland Schedule

Wetland ID	Catchment Area (m <sup>2</sup> )	Wetland Size							
		Bottom			Top			Depth (m)	Volume (m <sup>3</sup> )
		Width (m)	Length (m)	Area (m <sup>2</sup> )	Width (m)	Length (m)	Area (m <sup>2</sup> )		
NORTH OF BRYNDERWYNS (Zone 1A)									
CH 9580 WEST	37841	16	64	1024.00	36	84	3024.00	1.6	2290.7
NORTH OF BRYNDERWYNS (Zone 1B)									
CH 11690 EAST	15693	10	43	430.00	29	62	1798.00	1.5	1033.8
CH 12260 WEST	4845	10	25	250.00	28	43	1204.00	1.3	522.6
CH 15620 EAST	24407	13	51	663.00	33	71	2343.00	1.6	1590.2
CH 16300 EAST	12887	10	40	400.00	28	58	1624.00	1.4	879.2
CH 16800 EAST	25253	13	51	663.00	33	71	2343.00	1.6	1590.2
CH 17300 EAST	31565	15	60	900.00	35	80	2800.00	1.6	2053.9
BRYNDERWYNS (Zone 2)									
CH 18040 WEST	49131	18	77	1386.00	38	97	3686.00	1.7	3225.3
CH 18680 EAST	72931	26	78	2028.00	46.8	98.8	4623.84	1.8	4731.3
SOUTH OF BRYNDERWYNS (Zone 3)									
CH 21020 WEST	121031	33	98	3234.00	53.8	118.8	6391.44	1.8	7101.8
CH 22380 EAST	151046	35	105	3675.00	57	127	7239.00	2.0	9126.0
CH 22783 WEST	68042	20	99	1980.00	40	119	4760.00	1.7	4443.0
SOUTH OF BRYNDERWYNS (Zone 4)									
CH 23320 WEST	85086	26	78	2028.00	46.8	98.8	4623.84	1.8	4731.3
CH 24080 WEST	37667	16	64	1024.00	36	84	3024.00	1.6	2290.7
CH 25531 EAST	105098	29	88	2552.00	49.8	108.8	5418.24	1.8	5797.6
CH 26100 EAST	50486	18	77	1386.00	38	97	3686.00	1.7	3225.3
LOCAL ROADS									
CH 23020 EAST	18242	11	45	495.00	30	64	1920.00	1.5	1151.6

## Wetland Swale Schedule

Wetland Swale ID	Length (m)	Catchment Area (m <sup>2</sup> )	Channel		
			Bottom Width (m)	Depth (m) (with 300mm freeboard)	Side Slope (1:Z)
NORTH OF BRYNDERWYNS (Zone 1A)					
CH 9930 WEST	207	2594	2.0	0.75	4.0
CH 9930 EAST	278	4594	3.0	0.75	4.0
CH 10220 EAST	298	7750	5.0	0.75	4.0
CH 10530 EAST	261	7000	5.0	0.75	4.0
CH 10810 EAST	615	22000	7.0	0.80	4.0
NORTH OF BRYNDERWYNS (Zone 1B)					
CH 12230 WEST	195	2875	2.0	0.70	4.0
CH 12460 WEST	533	6750	4.0	0.70	4.0
CH 13000 WEST	578	7487	4.0	0.75	4.0
CH 13600 WEST	169	3489	2.0	0.75	4.0
CH 12270 EAST	232	3250	2.0	0.70	4.0
CH 12530 EAST	461	5875	3.0	0.70	4.0
CH 13000 EAST	605	7764	5.0	0.75	4.0
CH 13260 EAST	158	3386	4.0	0.75	4.0
CH 13880 WEST	438	5620	2.0	0.75	4.0
CH 14900 WEST	578	7381	5.0	0.75	4.0
CH 14920 WEST	714	8777	3.0	0.70	4.0
CH 13890 EAST	431	5505	2.0	0.75	4.0
CH 14870 EAST	536	6869	7.0	0.75	4.0
CH 14890 EAST	701	8844	3.0	0.70	4.0

## Drainage Diversion Schedule

Drainage Diversion Name	Base Width (m)	Depth (m)	RHS Side Slope	LHS Side Slope	Top Width (m)	Length (m)	Type of Stream Diversion
<b>NORTH OF BRYNDERYWNS (Zone 1A)</b>							
DD 9220 E	10	1	1 in 3	1 in 3	16.0	687	Type 2
DD 9280 W	12	1.3	1 in 3	1 in 3	19.8	268	Type 1
DD 9360 A E	6	0.8	1 in 3	1 in 3	10.8	125	Type 1
DD 9360 B E	5	0.7	1 in 3	1 in 3	9.2	71	Type 1
DD 9360 C E	5	0.8	1 in 3	1 in 3	9.8	29	Type 1
DD 9360 D E	13	1.3	1 in 3	1 in 3	20.8	183	Type 2
DD 9400 W	11	1.2	1 in 3	1 in 3	18.2	161	Type 1
DD 9680 A W	5	0.8	1 in 3	1 in 3	9.8	71	Type 1
DD 9680 B W	12	1.1	1 in 3	1 in 3	18.6	208	Type 2
DD 9680 C W	11	1.1	1 in 3	1 in 3	17.6	229	Type 2
DD 9900 E	4	0.7	1 in 3	1 in 3	8.2	89	Type 1
DD 10200 W	11	1.2	1 in 3	1 in 3	18.2	225	Type 2
DD 10200 A E	10	1	1 in 3	1 in 3	16.0	579	Type 2
DD 10200 B E	13	1.3	1 in 3	1 in 3	20.8	386	Type 2
DD 10520 W	12	1.3	1 in 3	1 in 3	19.8	135	Type 2
DD 10520 E	5	0.8	1 in 3	1 in 3	9.8	385	Type 2
DD 10780 W	20	1.5	1 in 3	1 in 3	29.0	455	Type 2
DD 11360 W	11	1.1	1 in 3	1 in 3	17.6	631	Type 2
<b>NORTH OF BRYNDERYWNS (Zone 1B)</b>							
DD 11670 W	12	1.2	1 in 3	1 in 3	19.2	316	Type 2
DD 12260 W	10	1.1	1 in 3	1 in 3	16.6	80	Type 1
DD 12260 A E	5	0.8	1 in 3	1 in 3	9.8	51	Type 2
DD 12260 B E	12	1.3	1 in 3	1 in 3	19.8	136	Type 2
DD 13850 W	7	0.9	1 in 3	1 in 3	12.4	254	Type 2
DD 14300 W	5	0.8	1 in 3	1 in 3	9.8	232	Type 1
DD 14840 E	20	1.5	1 in 3	1 in 3	29.0	158	Type 2
Waihoihoi High-Flow	60	0.3	1 in 3	1 in 3	61.8	244	Type 2
Waihoihoi Low-Flow	18	1.2	1 in 6	1 in 6	32.4	870	Type 2
DD 15600 E	9	0.9	1 in 3	1 in 3	14.4	37	Type 2
DD 16700 W	4	0.7	1 in 3	1 in 3	8.2	119	Type 3
DD 17100 W	8	0.9	1 in 3	1 in 3	13.4	102	Type 3
<b>BRYNDERWYNS (Zone 2)</b>							
DD 17900 W	5	0.8	1 in 3	1 in 3	9.8	453	Type 3
DD 17950 E	8	0.8	1 in 3	1 in 3	12.8	103	Type 2
DD 18400 E	4	0.7	1 in 3	1 in 3	8.2	104	Type 3
DD 19800 W	14	1.4	1 in 3	1 in 3	22.4	159	Type 3
DD 19900 W	3	0.6	1 in 3	1 in 3	6.6	6	Type 1
<b>SOUTH OF BRYNDERWYNS (Zone 3)</b>							
DD 22250 E	4	0.7	1 in 3	1 in 3	8.2	23	Type 2
DD 22500 E	41	1.5	1 in 3	1 in 3	50.0	522	Type 2
DD 22690 E	7	1	1 in 3	1 in 3	13.0	62	Type 2
DD 22850 E	6	0.8	1 in 3	1 in 3	10.8	101	Type 3
DD 22920 E	6	0.8	1 in 3	1 in 3	10.8	83	Type 3
<b>SOUTH OF BRYNDERWYNS (Zone 4)</b>							
DD 23120 W	7	0.8	1 in 3	1 in 3	11.8	76	Type 2
DD 23270 E	5	0.6	1 in 3	1 in 3	8.6	31	Type 2
DD 24100 W	10	1.1	1 in 3	1 in 3	16.6	83	Type 2
DD 24150 E	8	0.8	1 in 3	1 in 3	12.8	51	Type 2
DD 25400 E	10	1	1 in 3	1 in 3	16.0	256	Type 2
DD 25600 E	13	1.3	1 in 3	1 in 3	20.8	287	Type 2
DD 26100 E	19	1.5	1 in 3	1 in 3	28.0	111	Type 1
DD 26200 E	14	1.4	1 in 3	1 in 3	22.4	104	Type 1
DD 26200 W	14	1.4	1 in 3	1 in 3	22.4	64	Type 1

**Note: Drainage Diversions are subject to change as spoil sites have not been confirmed during design, and drainage diversions will need to reflect spoil sites along the alignment.**

**Note:** Drainage diversion types are defined on the typical details in Appendix A.

# Appendix D

## D1 Sensitivity Analysis

A sensitivity analysis was carried out to assess flood behaviour during a 1%AEP, RCP8.5 (2110) climate change scenario.

The findings of this assessment at the key locations shown in Figure 7 are as follows:

### Waipū Interim Tie-in (CH 8400 – 9700)

- The maximum flood level increase is predicted to exceed 100mm south of The Braigh. The increased flood level is due to road overflow at Waipū interim tie-in connections to The Braigh and SH1. The flood level increase is localised, and we anticipate it can be mitigated as explained in section 5.3.1.
- There is an increase in maximum flood level of up to 50 mm within the floodplain extent north of Millbrook Road. There are existing buildings located within the area affected by the flood level increase. It is noted that the flood model was developed based on the November 2025 Indicative Alignment; in the final Indicative Alignment the obstruction of the Ahuroa River floodplain apparent in the November 2025 iteration of the road alignment will not occur and flood behaviour is more likely to reflect the Existing Scenario conditions for the floodplain extent related to Ahuroa River. As a result, we anticipate that the flood level increase in this area is diminished in the final Indicative Alignment compared to the model.
- In conclusion, we anticipate that the effect of the flood level increase to the properties and receiving environment can be mitigated by updating the Indicative Alignment and stormwater assets.

### SH1 South of Glenmohr Road Intersection (CH 14800 to 15200)

- A predicted increase in flood level occurs alongside the Indicative Alignment between CH14800 and CH15100. The maximum increase is predicted to exceed 100mm just beyond the western edge of the Proposed Designation. This results in a minor increase in floodplain extent toward the existing SH1. However, the increased extent is not predicted to encroach on the carriageway and is therefore not considered to be an adverse effect on the carriageway. As a result, we anticipate that the effect of flood level increase due to severe climate change outside the Proposed Designation is minor.
- The increased flood level is not predicted to increase maximum flood level within buildings outside the Proposed Designation

### SH12 Interchange (CH 21700 to 24100)

- The maximum flood level increase is predicted to be less than 100mm outside the Proposed Designation.
- The increased flood level is not predicted to increase maximum flood level within buildings outside the Proposed Designation

### 5.3.4. Pukekaroro Stream (CH 26200)

- There is a localised increase in predicted maximum flood levels greater than 100mm at the southern end of the Project within Pukekaroro Stream. It is consistent with the base model THTW flood model results for 1%AEP with CC (RCP6.0 (2110)).
- The increased flood level is not predicted to increase maximum flood level within buildings outside the Proposed Designation

In summary, the outcome of the assessment is as follows:

- The flood level increase outside the Proposed Designation in the high-range climate change sensitivity scenario remains mostly less than 100 mm. In the few locations the flood level increase

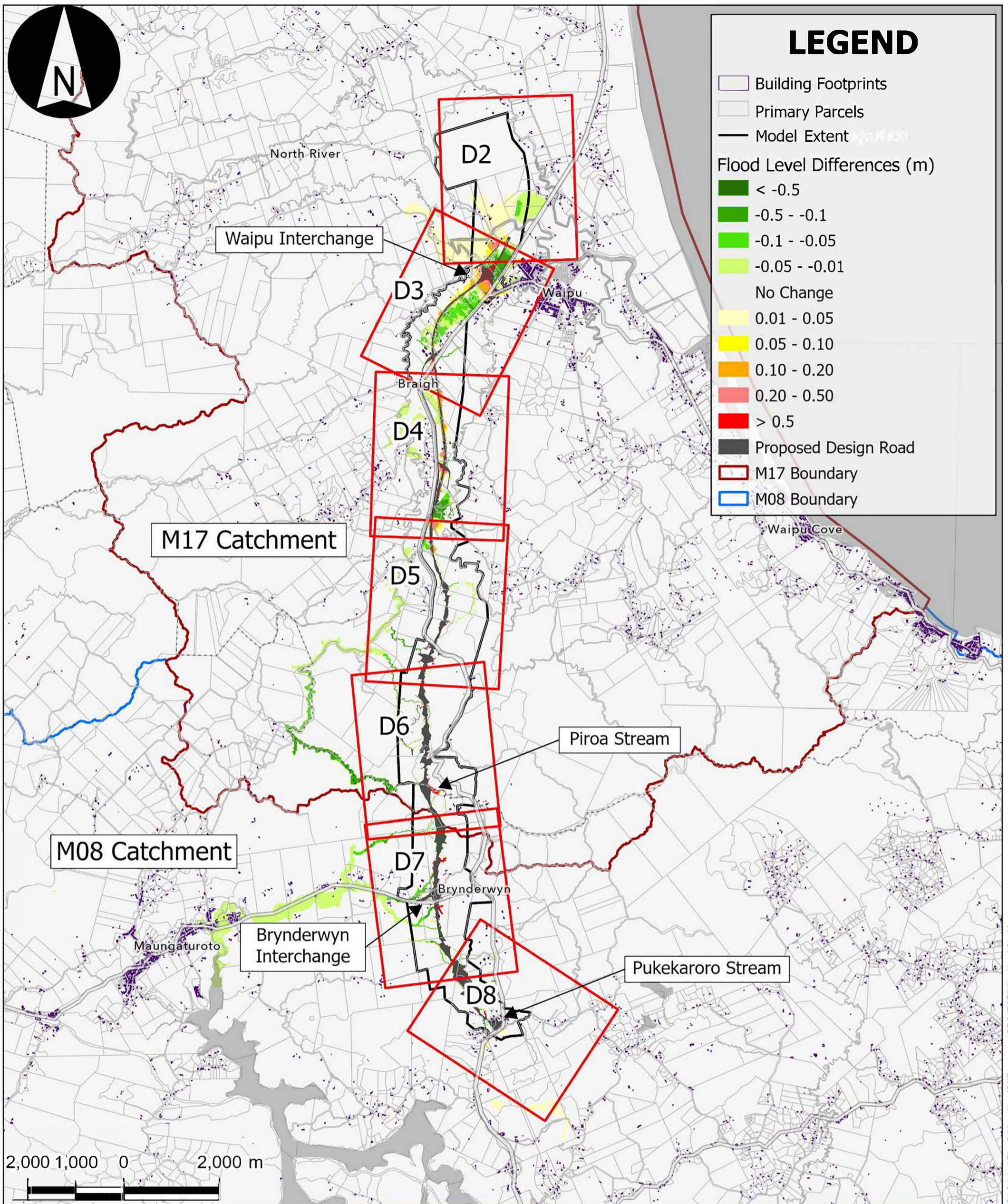
exceeded 100mm marginally outside the designation boundary we anticipate that this flood level increase can be resolved during future detail design.

- Under the high-range climate change scenario (1%AEP with Climate change (RCP8.5 (2110)), flood levels and extents increase marginally compared to the base case (1%AEP with Climate change (RCP6.0(2110))), however the changes are not sufficient to trigger any change in flood hazard category. In general, effects outside the Proposed Designation occur in the same locations, to a similar extent, and do not justify a changed design approach.

## D2 Sensitivity Analysis Figures

Note that flood modelling is based on an earlier version of the highway alignment and neither the alignment nor the proposed Designation Boundary represent the final FTAA application. Useful insights can still be drawn from the results providing this limitation is borne in mind.

Figure Number	Description
Figures D1-D8	Sensitivity Analysis: Section 2B Max Flood Difference Map – 1% AEP with CC (RCP8.5, 2110) - Design versus Existing Scenario



**NOTES**

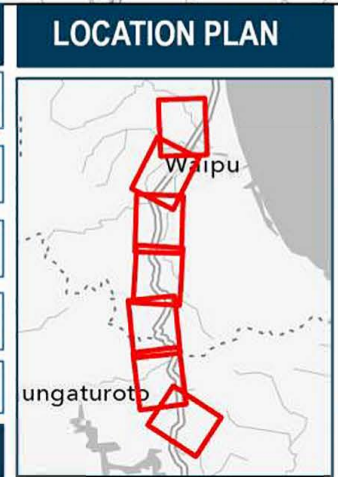
Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

**NZ TRANSPORT AGENCY**  
WAKA KOTAHĪ

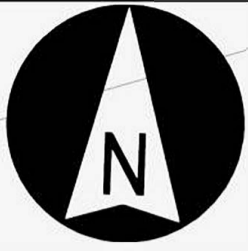
**Northland Corridor**  
Roads of National Significance

A3 SCALE: 1:75,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025
<b>APPROVED</b>		<b>DATE</b>

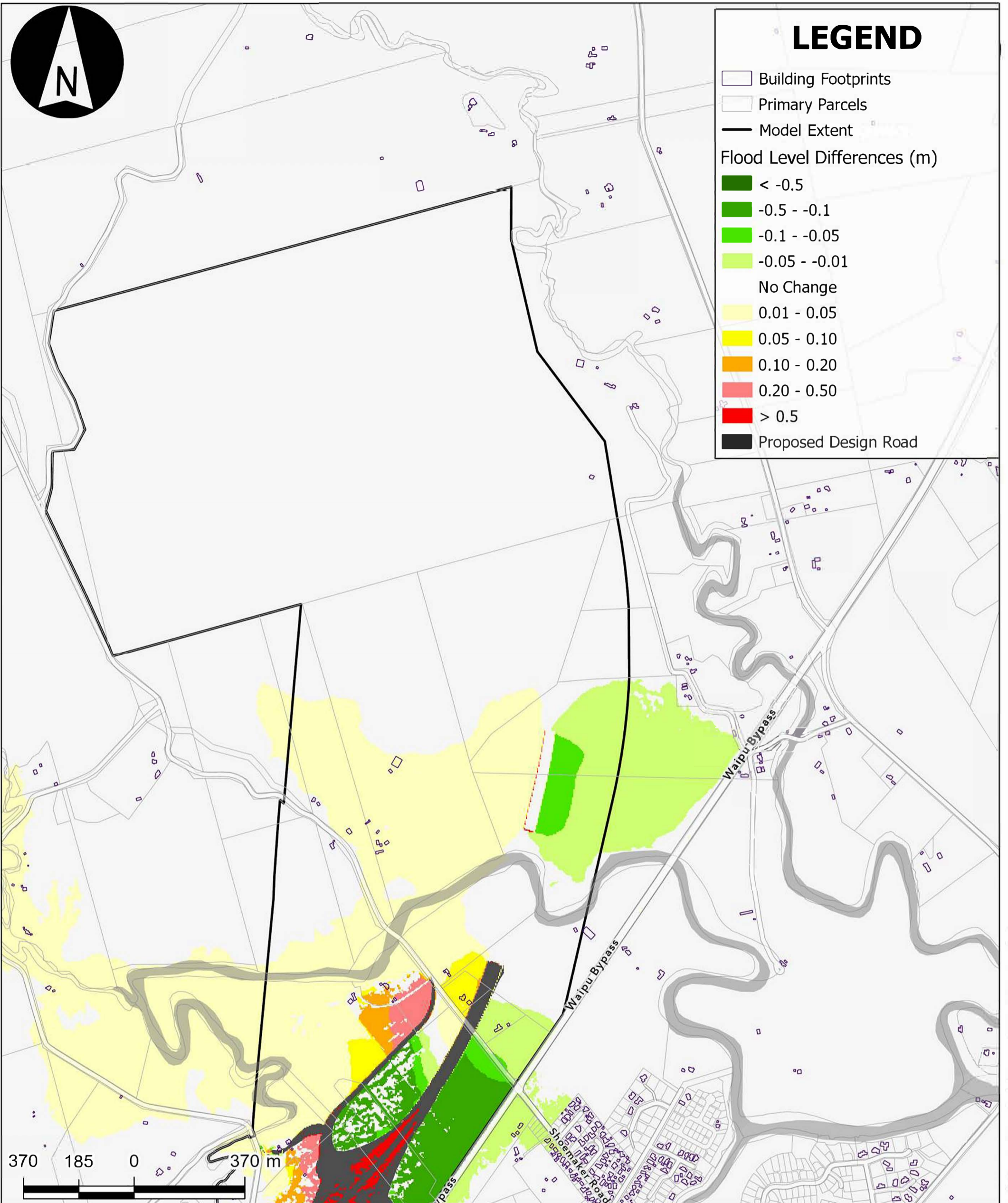


PROJECT INFORMATION	
<b>TITLE:</b> SENSITIVITY ANALYSIS: SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP8.5 2110 DESIGN VERSUS EXISTING SCENARIO	
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION	
	D1



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



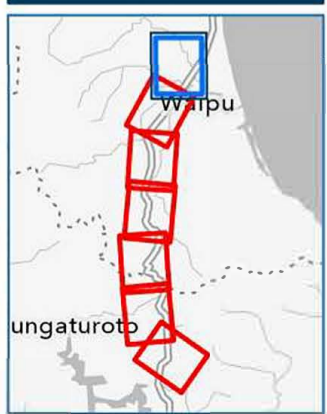
## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

## LOCATION PLAN



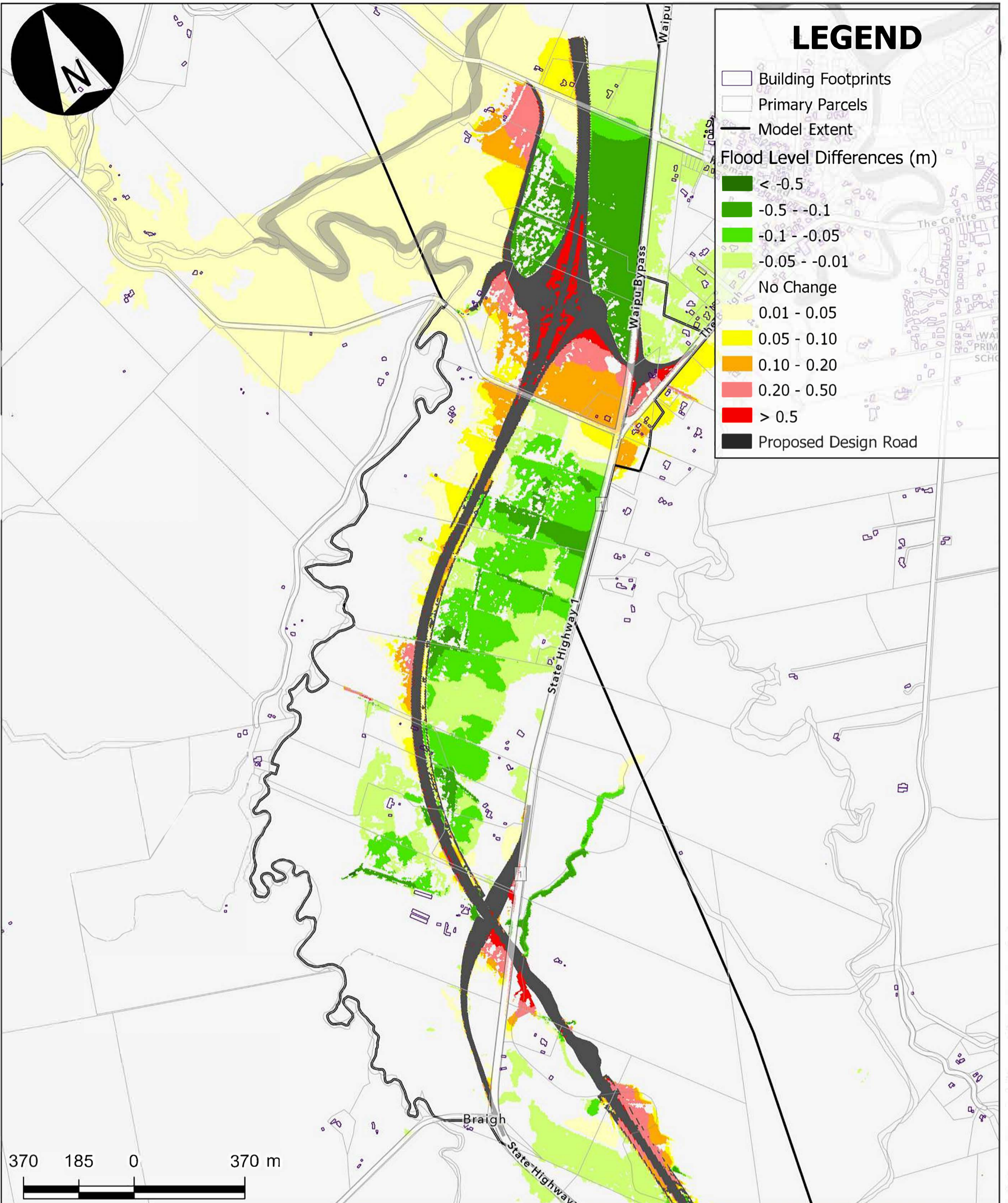
## PROJECT INFORMATION

<b>TITLE:</b> SENSITIVITY ANALYSIS: SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP8.5 2110 DESIGN VERSUS EXISTING SCENARIO
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
D2



A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

**APPROVED** **DATE**



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

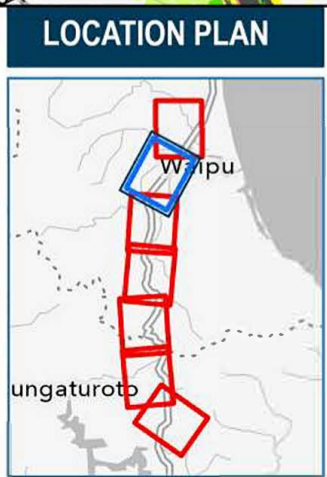
**NZ TRANSPORT AGENCY** WAKA KOTAHU

**Northland Corridor**

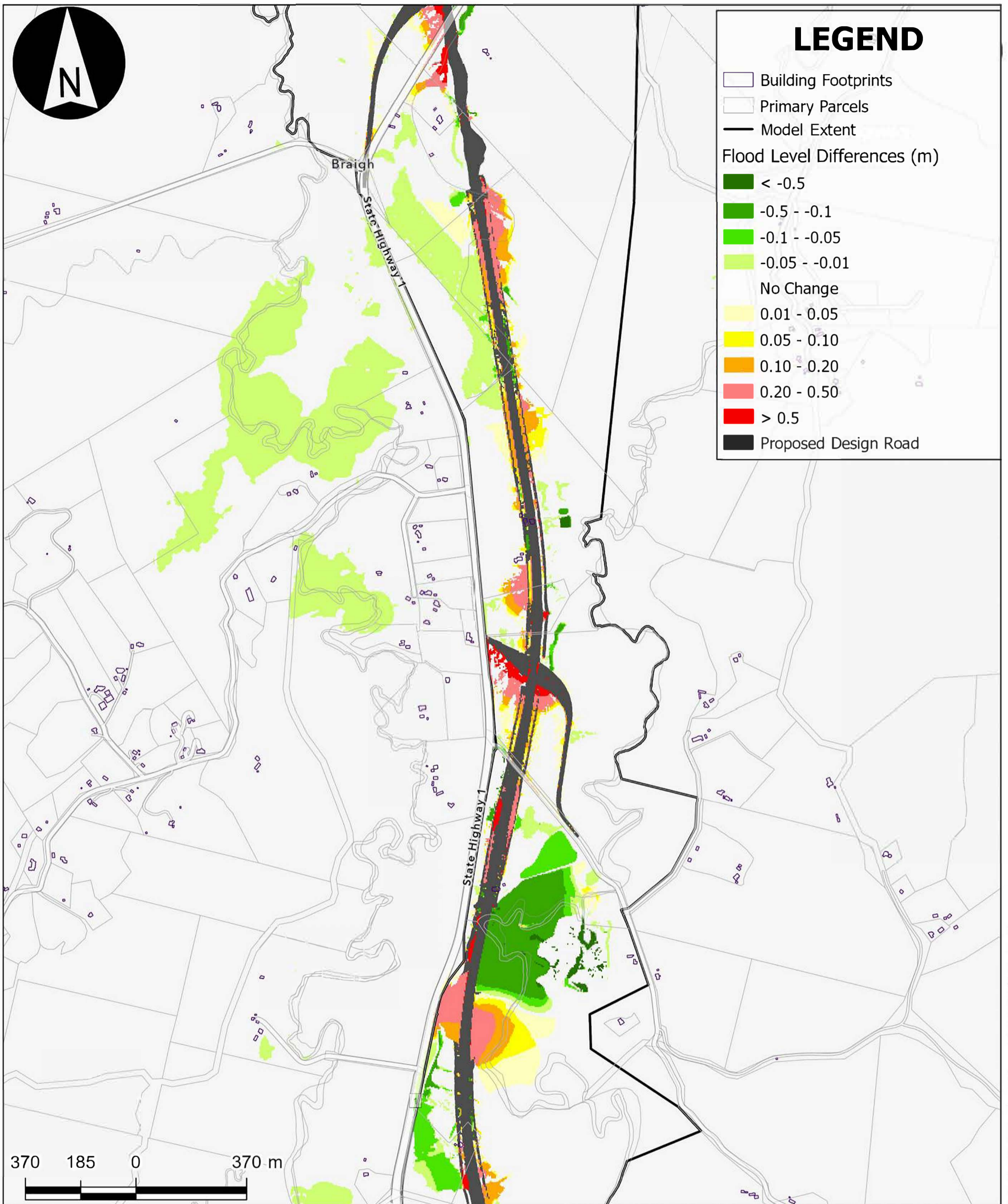
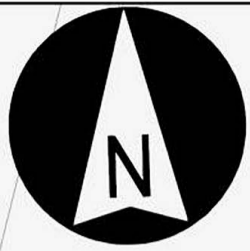
Roads of National Significance

A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025
<b>APPROVED</b>		<b>DATE</b>

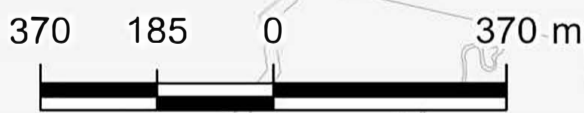


PROJECT INFORMATION	
<b>TITLE:</b> SENSITIVITY ANALYSIS: SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP8.5 2110 DESIGN VERSUS EXISTING SCENARIO	
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION	
	D3



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



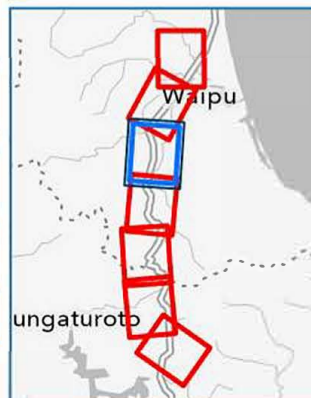
## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

## QA

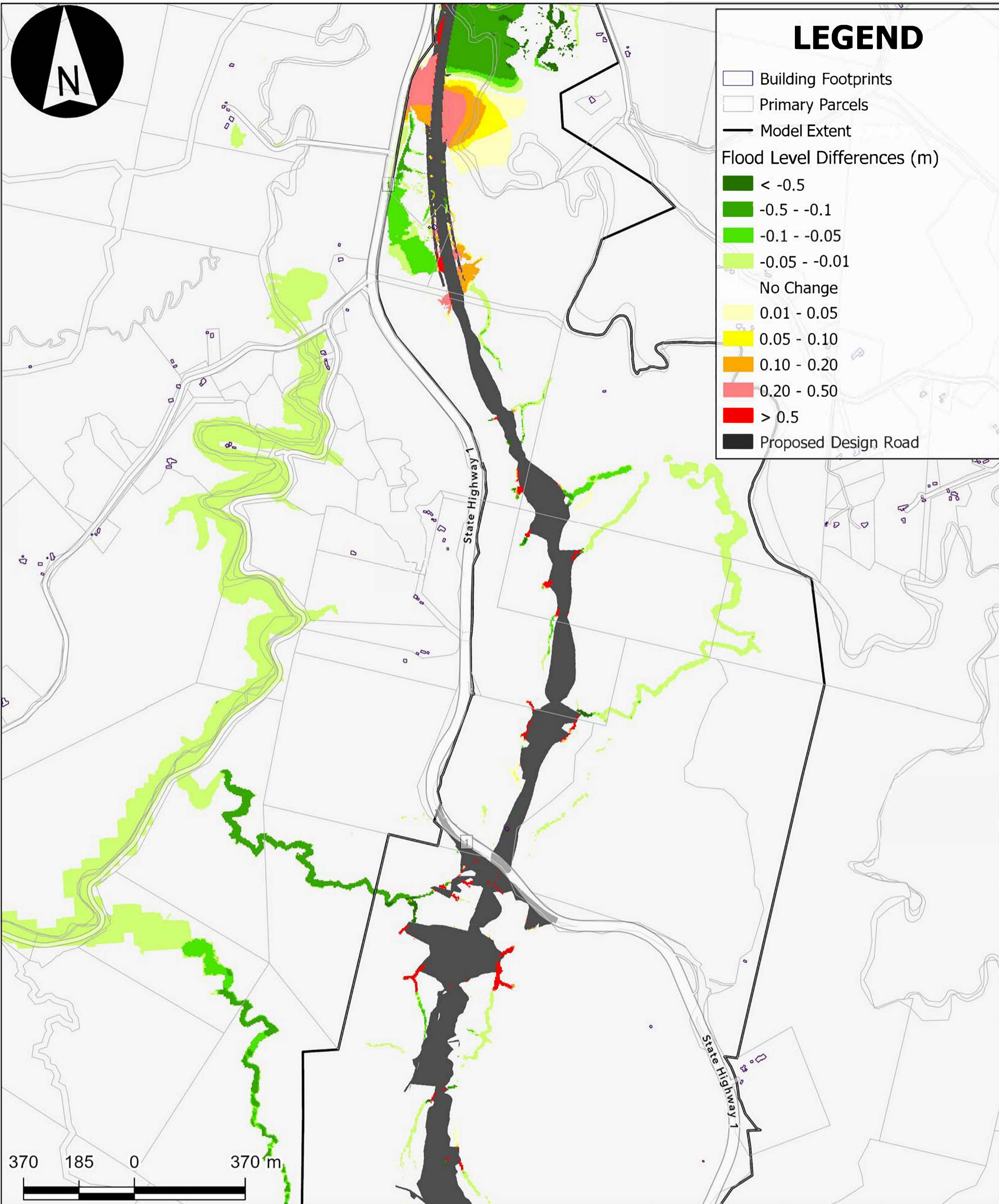
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

## LOCATION PLAN



## PROJECT INFORMATION

<b>TITLE:</b> SENSITIVITY ANALYSIS: SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP8.5 2110 DESIGN VERSUS EXISTING SCENARIO
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
D4



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road

## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



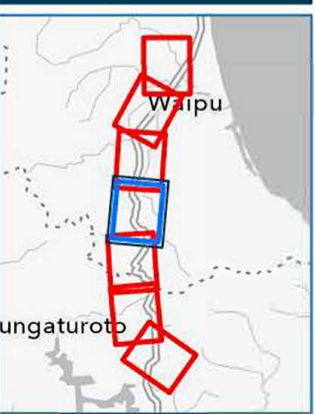
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

**APPROVED** **DATE**

## LOCATION PLAN



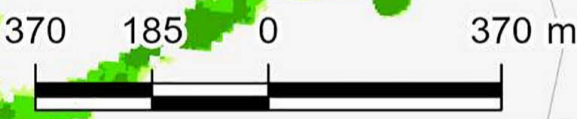
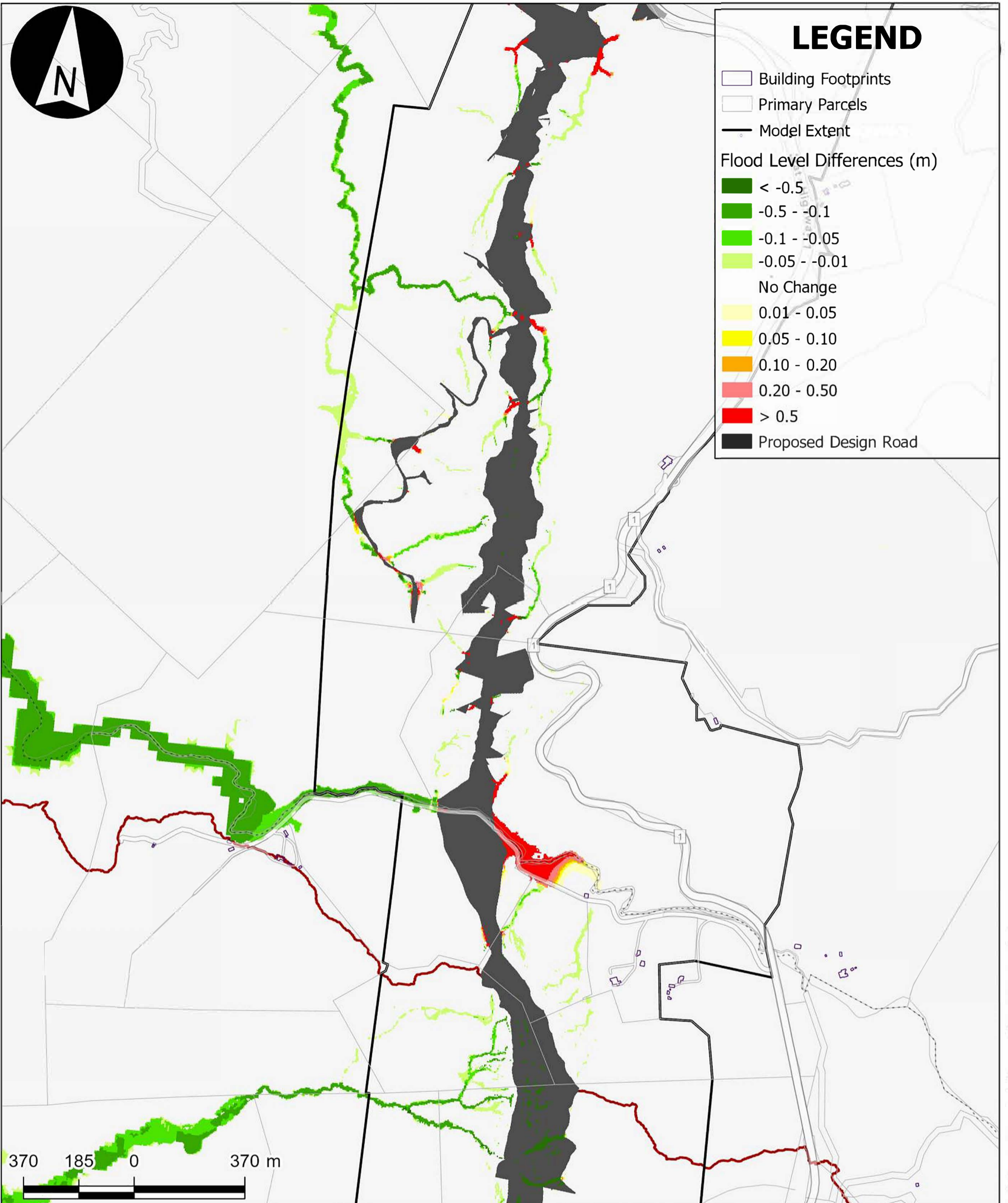
## PROJECT INFORMATION

<b>TITLE:</b> SENSITIVITY ANALYSIS: SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP8.5 2110 DESIGN VERSUS EXISTING SCENARIO
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION
D5



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



## NOTES

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS



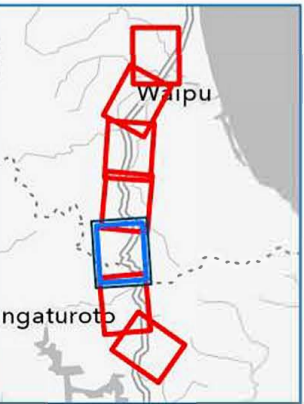
A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

## QA

DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025

APPROVED DATE

## LOCATION PLAN



## PROJECT INFORMATION

**TITLE:**  
SENSITIVITY ANALYSIS: SECTION 2B MAX FLOOD DIFFERENCE MAP  
1% AEP WITH CC RCP8.5 2110  
DESIGN VERSUS EXISTING SCENARIO

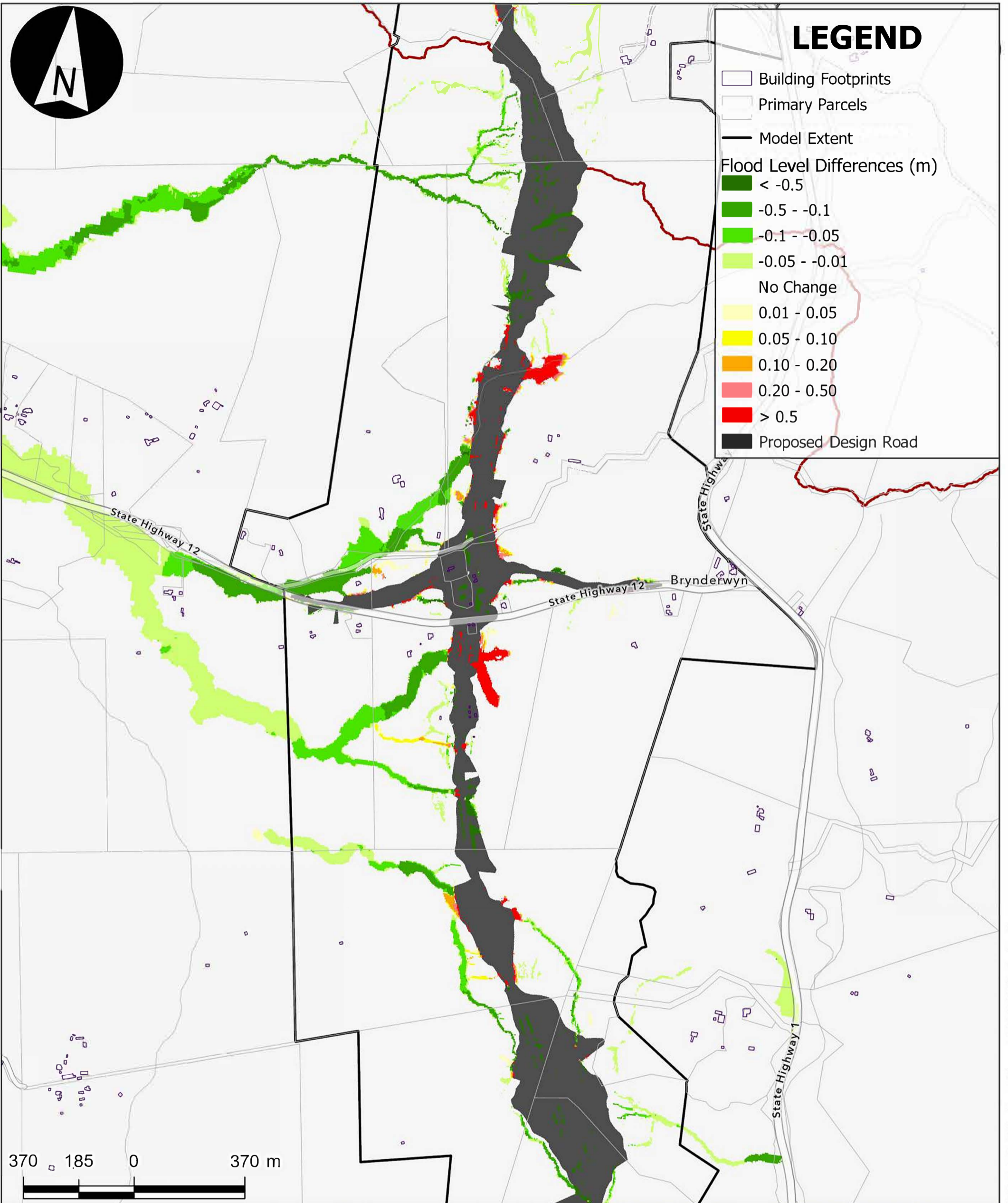
**SECTION:**  
NORTHLAND CORRIDOR  
ALTERNATIVE TO BRYNDERWYN HILLS SECTION

D6



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



**NOTES**

Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

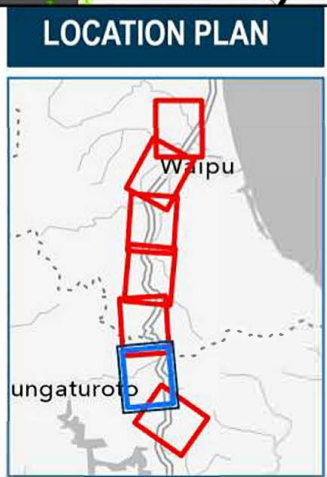
**NZ TRANSPORT AGENCY**  
WAKA KOTAHĪ

**Northland Corridor**

Roads of National Significance

A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025
<b>APPROVED</b>		<b>DATE</b>

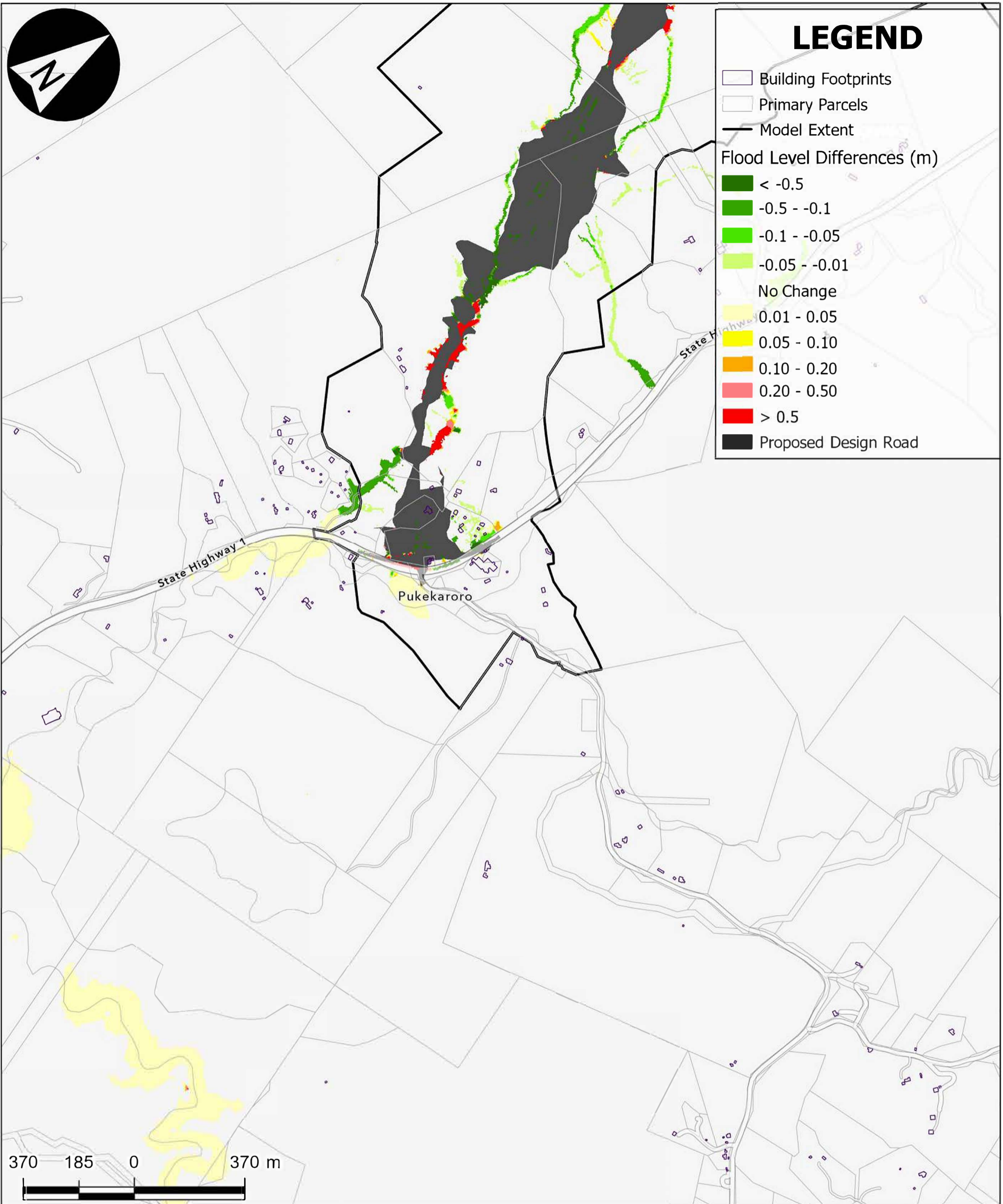


PROJECT INFORMATION	
<b>TITLE:</b> SENSITIVITY ANALYSIS: SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP8.5 2110 DESIGN VERSUS EXISTING SCENARIO	
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION	
	D7



# LEGEND

- Building Footprints
- Primary Parcels
- Model Extent
- Flood Level Differences (m)**
- < -0.5
- 0.5 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Change
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.5
- Proposed Design Road



**NOTES**

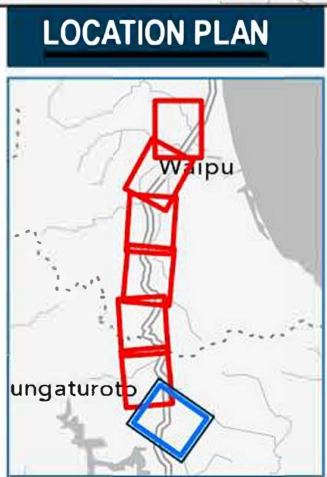
Stats NZ, Esri, TomTom, Garmin, FAO, METI/NASA, USGS, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS

**NZ TRANSPORT AGENCY**  
WAKA KOTAHU

**Northland Corridor**  
Roads of National Significance

A3 SCALE: 1:12,000 | COORDINATE SYSTEM: NZGD 2000 New Zealand Transverse Mercator

QA		
DRAWN	LLOYD SANTELICES	12/12/2025
CHECKED	NARIMAN VALIZADEH	12/12/2025
DESIGNED	N/A	
VERIFIED	SINDIYA VAAKESAN	12/12/2025
	RAELIZE DU PLOOY	12/12/2025
<b>APPROVED</b>		<b>DATE</b>



PROJECT INFORMATION	
<b>TITLE:</b> SENSITIVITY ANALYSIS: SECTION 2B MAX FLOOD DIFFERENCE MAP 1% AEP WITH CC RCP8.5 2110 DESIGN VERSUS EXISTING SCENARIO	
<b>SECTION:</b> NORTHLAND CORRIDOR ALTERNATIVE TO BRYNDERWYN HILLS SECTION	
	D8