Candor³
ENGINEERING FOR LIFE

Kāinga Ora Oranga Redevelopment

STORMWATER MANAGEMENT PLAN

20 APRIL 2020

1 DOCUMENT CONTROL RECORD

Client	Kāinga Ora
Project	Kāinga Ora Oranga Redevelopment
Document	1317_ KāingaOra_Oranga_StormwaterManagementPlan

2 ISSUE INFORMATION

Date of Issue	20 April 2020
Revision:	D
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4 GENERAL INFORMATION

4.1 Site Information

APPLICANT (DEVELOPER):	*Kāinga Ora*
APPLICANT'S AGENT:	*Candor³*
SITE AREA (HA):	*46.6 Ha*
NATURE OF DEVELOPMENT:	*Infill Development*
AUP ZONE:	*Residential – Mixed Housing Suburban* *Residential – Mixed Housing Urban*
SMAF AREA:	*Not Applicable*
NETWORK DISCHARGE CONSENT:	*Not Applicable*

4.2 Hydrology

OVERARCHING CATCHMENT NAME AND CATCHMENT AREA:	*One Tree Hill, 1501 Ha* *Onehunga, 1058 Ha*
TYPE OF RECEIVING ENVIRONMENT:	*Onehunga Volcanic Aquifer* *Manukau Harbour*

4.3 Council Representatives

DEVELOPMENT ENGINEER (NATURAL RESOURCES AND SPECIALIST INPUT):	*Omar Al Shebaini*
CATCHMENT PLANNING SPECIALIST (HEALTHY WATERS):	*Camilla Needham*

4.4 Stakeholders

PARKS REPRESENTATIVES:	*Wendy Zapart*
AUCKLAND TRANSPORT REPRESENTATIVE:	*Chris Beasley, Rebecca Phillips*
HEALTHY WATERS REPRESENTATIVES:	*Camilla Needham, Gemma Chuah, Jack Turner*
IWI:	*Te Akitai Waiohoua* *Ngati Whatua* *Marutuahu* *Te Kawerau a Maki*

4.5 Record of Pre-Application & Site Meeting/s

PRE-APPLICATION MEETING DATE:	*24th October 2018*
PRESENT:	*Shaun Jones* *Jack Turner* *Mel Chow* *Dali Suljic*
MEETING MINUTES:	• *Network discharge strategy – two alternatives – one overall strategy or a couple of small ones – i.e. one per neighbourhood area (something similar to the Mangere approach)* • *Candor3 received HW's modelling info, and it's all good with T&T's work. However, there are a lot more flooding.* • *Shaun advised that the applicant should focus on chapter 36 of the AUP-OP, in relation to the hazard assessment, and it is preferred that the applicant work on the 'risk base*

	approach.' The SMP also need to focus on the code of practice for overland flow management and flooding.
	• *Once Candor 3 has completed the modelling data, HW's modelling team will carry out a peer review.*
	• *Candor 3 agreed to submit the model + SMP to HW's review*
	• *Shaun asked if the SMP will cover all the 3rd party land, as this is a preferred approach for the precinct area.*
	• *Dali will confirm the area (boundary) for the SMP, and it was agreed in principle that the 3rd party land be included.*
	• *The SMP approach should focus on:*
	  ○ *Network Discharge Consent (deals with diversion but not 'filling' in flood plains and this is covered by earthworks consent)*
	  ○ *Chapter E36 – land use*
	  ○ *Stage comes in then site specific memos (i.e. RC1 links with discharge consent 1, RC2 links with discharge consent 2 etc)*
	• *For references, Auckland wide (regional) NDC only covers public soakage, and not private soakage. If private drainage, discharge consent is required*
	• *Soakage manual is being rewritten, Shaun will double check the status. Shaun suggested rather than focus on the guideline – the best practice option should be adopted.*
	• *In relation to specific roofing material – pre-treatment to remove litter, avoid sediments being blocked, paved area = rain garden*
	• *Candor 3 will investigate engaging PDP and T & T to carry in relation to hydrology/Geotech work*

OUTCOMES	*Candor 3 to prepare:* • *Purpose of SMP (supporting NDC, cumulative effects); and* • *Table of contents (i.e. next steps around overland flow management and water quality infiltration, bore hole and soakage system)* • *Check if shallow infiltration rate has been done*

PRE-APPLICATION MEETING DATE:	*22nd May 2019*
PRESENT:	*Camilla Needham* *Jack Turner* *Gemma Chuah* *Alina Wimmer* *Mel Chow* *Brendon Hosken* *Carl Whitten* *Dali Suljic*
MEETING MINUTES:	• *Strategically, HLC (Kāinga Ora) are carrying out two pieces of work within the Oranga which are relevant to the Healthy Waters unit – the draft SMP, and the berm design workstream.* • *Dali gave an overview of the SMP – a holistic approach has been taken, and a SMP has been prepared for all sites. The principal objective is to enhance the aquifer and reduce the discharge going in the aquifer. Soakage will be designed in accordance within the manual. Jack clarified that the manual is more for functional purposes rather than the quality for the environment.* • *The watermain is about 80 years and some pipes were built in 1915.* • *How to qualify treatment – offsetting on public road ahead of time, and keep a council/HLC (Kāinga Ora) spreadsheet to see track the discharges.* • *An example can be Edmonton Ave – the berms are less than 4m, but small devices can be installed on the berm.*

	• *PDP has completed their report and Candor3 has sent their draft SMP report to PDP so the GAS model has been updated. There are some groundwater out-break (soakage basin) – shallow ground water zone covers the south eastern area. The modelling will be completed next week, and the estimated timeframe for the SMP to be completed is mid June.* • *The EPA has been approved to take out the 225m SW pipe – this is for Edmonton Avenue – ED18* • *Private discharge consents are required for Oranga (NDC not applicable). It was discussed whether a holistic/global private discharge consent was appropriate to be lodged by HLC (Kāinga Ora). The private discharge consent is valid for 35 years under s14 and s15 of the Resource Management Act, and the consent holder is responsible for the administration of this private consent. The risk is that HLC (Kāinga Ora) will be the consent holder and looking after private developments' discharges. This option is to be considered by HLC (Kāinga Ora), and the alternative is for individual build partners to lodge their own discharge consent.* • *Jack highlighted that iwi values are to be considered. It would be good to include a section where their values are considered and this should be included within the SMP.* • *In terms of rain garden to be located at the berm area – test the threshold of GD01 (rather than the old stormwater guide of TP10). Healthy water has stated that they don't prefer road reserve devices*
OUTCOMES	• *HLC (Kāinga Ora) to review traffic on Mount Smart Road* • *Candor 3 to send PDP report to Healthy Waters team, and cc DPO in* • *Candor 3 need to update the aquifer section within the SMP* • *Candor 3 still need to complete the implementation section, risk assessment and complete the summary of the PDP section (flood model being updated because extra sites were added)* • *Camilla to get in touch with AT (Rebecca Phillips) regarding SW runoff/discharges* • *Candor 3 to liaise with Scott Wilkson (Opus) regarding the model (Oranga area) and cc Camilla in the correspondence* • *Mel to find out if Northcote had similar consent conditions regarding tracking discharges* • *Dali to liaise with Rachelle Hui (Planning Focus) and see if a template can be drafted for a private discharge consent that can be attached to sites over 1000sqm. Once this has been completed, send this to HW team for review* • *Brendon to follow up with liaison with iwi – the objectives of the SMP will need to be communicated to iwi, and a section would be included within the SMP* • *Healthy Waters to provide preliminary feedback on the draft SMP within 4 weeks time* • *Carl to send the Auckland Transport soak hole design to Brendon*

4.6 Record of Healthy Waters SMP Consultation Meeting

MEETING DATE:	*26th March 2020*
PRESENT:	*Sarah Karlsen* *Camilla Needham* *Dali Suljic* *Matt Wilkins* *Scott Wilkinson*
MEETING OUTCOMES:	• *Candor³ to clarify the assessment requirements for overland flow paths for all redevelopment areas.* • *Candor³ to show overland flow paths of concern and explain why they are a concern.*

	• *Candor³ to provide more detail regarding interference effects of soakholes – including when PDP design advice should be used.* • *Candor³ to provide more detail on the management of overland flow paths, what is proposed, who is responsible, how will they be managed.* • *Candor³ to clarify the scope of the SMP and requirements for detailed assessment at individual development approval stage.* • *Candor³ to provide a summary of the modelling assumptions, limitations and requirements.* • *Candor³ to include implementation and staging requirements for mitigation storage areas.* • *Candor³ to provide MPD flood maps.* • *Candor³ to provide a user manual (developers toolbox) that will provide more detailed information for the implementation of stormwater management for the area. The user manual shall be used in conjunction with the SMP and will not replicate information or be used in isolation. User manual is subject to Healthy Waters approval.* • *Candor³ to provide a summary of the runoff treatment device assessment process.* • *Candor³ to provide more detail as to how storage areas are defined (dead vs live storage).* • *Candor³ to carry out a sensitivity analysis to assess the impact of max flow rate on the mitigation of additional stormwater runoff.*

5 EXECUTIVE SUMMARY

This document outlines the guidelines and objectives for the management of stormwater within the Kāinga Ora Oranga redevelopment. The proposed Stormwater Management Plan (SMP) has been prepared in accordance with the Auckland Unitary Plan and a Water Sensitive Design approach. This SMP supports the private Discharge Consent (DC) for the subject area.

The purpose of this SMP is to provide stormwater management guidelines for development within the Kāinga Ora Oranga redevelopment. The objectives set by the proposed SMP are:

- Enhance the water quality of stormwater discharge using water sensitive design and at source stormwater management approaches.
- Target water quality treatment for high contaminant generating activities such as high use roads and exposed carparks.
- Provide water sensitive management guidelines for developers.
- Provide criteria to ensure safe conveyance of stormwater runoff through the primary and secondary networks.
- Manage flood risk and ensure the proposed development does not create adverse flooding effects on the upstream and downstream properties.

A summary of the design criteria for the Kāinga Ora Oranga redevelopment, set to achieve the objectives of this SMP, is shown in Table 5.1.

All developments within the Kāinga Ora Oranga redevelopment area are responsible for ensuring that they achieve the stormwater management objectives set out in this SMP by adhering to the relevant design criteria.

Table 5.1 - Design Criteria Summary

ITEM	CRITERIA		RESPONSIBILITIES
Rainfall Depths (Climate Change)	*2 Year ARI*	*82mm (Includes 9% Increase on TP108 rainfall depth of 75mm)*	*Kāinga Ora and other private developers[1] to use the rainfall data as required for the purpose of stormwater design.*
	10 Year ARI	*136mm (Includes 13.2% Increase on TP108 rainfall depth of 120mm)*	
	100 Year ARI	*199mm (Includes 16.8% Increase on TP108 rainfall depth of 170mm)*	
Water Quality	*Private Impervious Areas*	*Avoid use of exposed high contaminant yielding building materials such as copper and galvanised metals.*	*Kāinga Ora and other private developers[1] to avoid use of high contaminant yielding building materials on all development within the SMA.*
		Provide gross pollutant traps (GPTs) for new impervious areas such as leaf guards on downpipes and spouting, catchpits or similar silt trap devices.	*Kāinga Ora and other private developers[1] to provide GPTs for new private impervious areas.*
		Provide offset water quality treatment mitigation for new hardstand areas on existing untreated public road catchments in accordance with Section 11.1.	*Kāinga Ora to implement the water quality requirements via offset mitigation for private impervious areas.*
		Provide at-source stormwater quality treatment for high contaminant generating exposed carparks servicing over 30 vehicles.	*Kāinga Ora and other private developers[1] to provide water quality treatment for high contaminant generating exposed carparks.*

	Public Impervious Areas	*Provide at source stormwater quality treatment for impervious areas within newly created public road reserves. See Appendix C1 for indicative locations.*	*Kāinga Ora to implement at source water quality requirements at the redevelopment stage.*
Hydrology Mitigation	*Impervious Areas*	*Not Required.*	*Not Applicable*
Conveyance	*Primary Network*	*Provide soakage for 10 year ARI rainfall event via new or existing soakhole.*	*Kāinga Ora and other private developers[1] to provide soakage for private impervious areas.* *Kāinga Ora to provide soakage for offset mitigation treatment devices.*
	Secondary Network	*Size secondary network within private property to allow for conveyance of MPD 100 year ARI event including upstream catchment.*	*Kāinga Ora and other private developers[1] to carry out a detailed site-specific assessment of overland flow paths within or adjacent to their site. This includes the OLFPs shown on the overland flow and flooding plans provided in Appendix C3, and any other local OLFPs not identified in this SMP. Information on OLFPs identified in this SMP will be provided by Candor³ to support the assessment.*
Flood Management	*Freeboard for habitable floor levels*	*Minimum 150mm freeboard to Maximum Probable Development (MPD) 100 year ARI event water level for all minor overland flow paths with flow of less than 2m³/s and depth of less than 100mm (where adjacent to trafficable areas).*	*Kāinga Ora and other private developers[1] will carry out a detailed site-specific assessment of local flooding areas within or adjacent to their site. This includes the flooding areas shown on the overland flow and flooding plans provided in Appendix C3, and any other local flooding areas not identified in this SMP. Information on flooding areas identified in this SMP will be provided by Candor³ to support the assessment.* *Kāinga Ora and other private developers[1] will ensure freeboard is provided to new habitable floor levels at individual development stage.*
		Minimum 500mm freeboard to MPD 100 year ARI event water level for all major overland flow paths with flow of more than 2m³/s or depth of more than 100mm (where adjacent to trafficable areas) for vulnerable activities and minimum 300mm for less vulnerable activities as defined in the AUP.	
	Downstream and upstream environment	*Ensure redevelopment does not cause or increase flooding of other properties, due to increased impervious areas and filling in ponding areas, during rainfall events up to 10 year ARI.*	*Kāinga Ora and other private developers[1] will carry out a detailed site-specific assessment of local OLFPs and flooding areas within or adjacent to their site. This includes the OLFPs and flooding areas shown on the overland flow and flooding plans provided in Appendix C3, and any other local OLFPs and flooding areas not identified in this SMP. Information on OLFPs and flooding areas identified in this SMP will be provided by Candor³ to support the assessment.*
		Ensure redevelopment does not cause or increase inundation of buildings or other properties, due to increased impervious areas and filling in ponding areas, in rainfall events up to 100 year ARI.	
	Hazard risk assessment	*Provide hazard risk assessment in accordance with AUP Chapter E36.*	

1. Private developers within the Kāinga Ora Oranga redevelopment extent covered by this SMP.

6 INTRODUCTION

Kāinga Ora are master planning and carrying out infrastructure upgrades within Oranga to facilitate the redevelopment of Housing New Zealand (HNZ) land. Candor³ has been engaged by Kāinga Ora to prepare a Stormwater Management Plan (SMP) for the Kāinga Ora Oranga redevelopment.

The redevelopment is located in the suburb of Oranga (between Ellerslie and Onehunga) in central Auckland, as shown in Figure 6.1. The redevelopment is bordered by Oranga Avenue to the north, Rockfield Road to the east, Mount Smart Road to the south, and Namata Road to the west. In the north – western corner of the proposed redevelopment area lies the Fergusson Park.

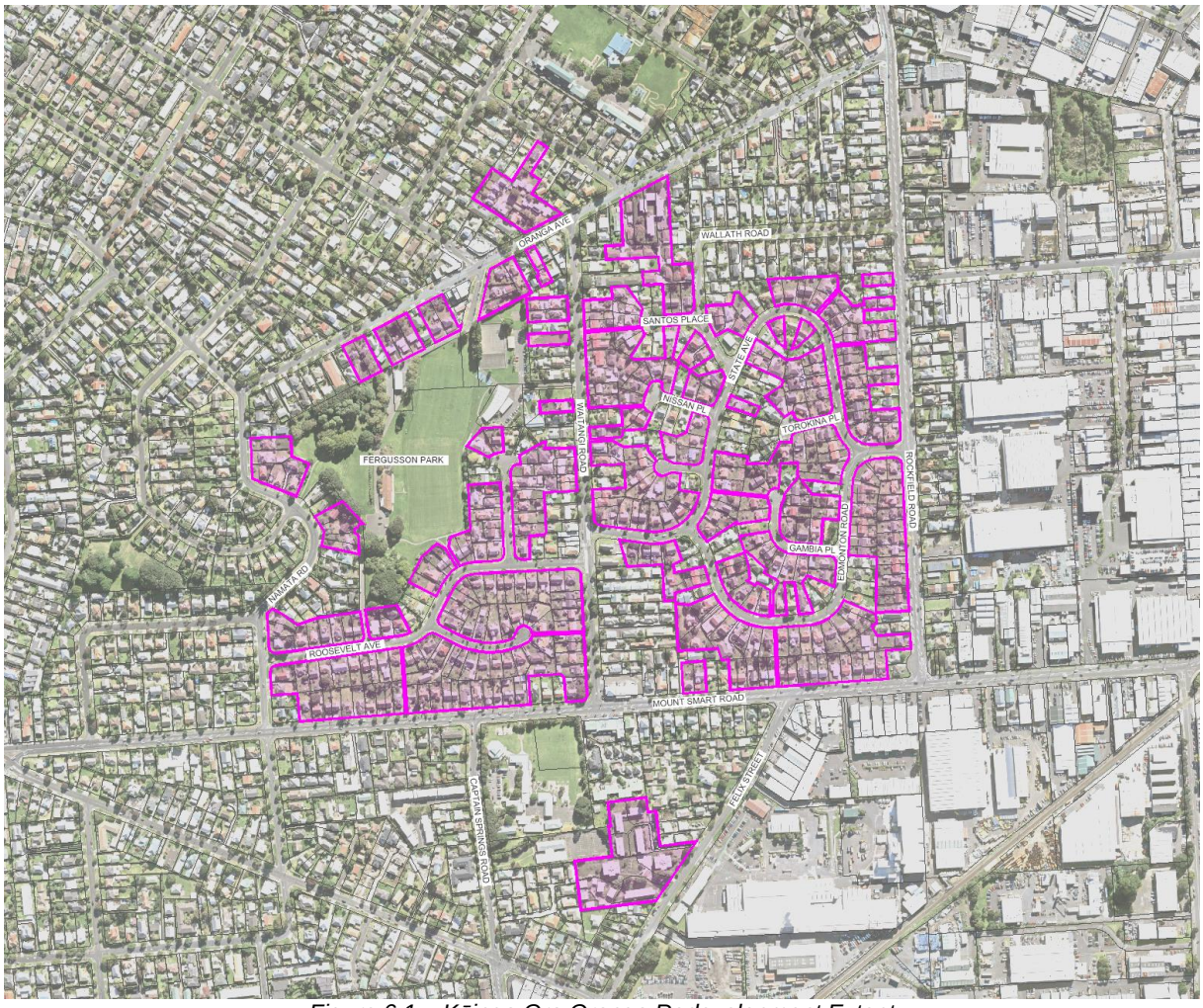

Figure 6.1 – Kāinga Ora Oranga Redevelopment Extent

This SMP is only directly applicable to lots being redeveloped by Kāinga Ora, as listed in Section 4 and shown in Figure 6.1. However, it can be used for context in respect of non-Kāinga Ora landholdings within the Oranga catchment, supplemented by a site-specific analysis. If Kāinga Ora acquire further properties, not shown in figure 6.1 or Section 4, they will need to undergo further analysis to ensure redevelopment does not cause adverse flooding effects.

7 PURPOSE AND OBJECTIVES

The purpose of this SMP is to provide an overview of how stormwater will be managed within the Kāinga Ora Oranga redevelopment area. The objectives proposed in this SMP are in accordance with the requirements of the Auckland Unitary Plan (AUP) and will contribute towards achieving the vision of the Auckland Plan 2050 for Auckland to meet the opportunities and challenges of the future. This SMP supports the following values:

- Improve Auckland water systems and promote a healthy natural environment.
- Protect the health and wellbeing of communities.
- Incorporate Māori cultural values and restore the Mauri of water.
- Create communities resilient to natural hazards and effects of climate change.

The objectives set by the proposed SMP for Kāinga Ora Oranga redevelopment area, to support the vision of the Auckland Plan 2050 are:

- Enhance the water quality of stormwater discharge using water sensitive design and at source stormwater management approaches.
- Target water quality treatment for high contaminant generating activities such as high use roads and exposed carparks.
- Provide water sensitive management guidelines for developers.
- Ensure safe conveyance of stormwater runoff through the primary and secondary networks.
- Manage flood risk and ensure the proposed development does not create adverse flooding effects on the upstream and downstream properties.

8 EXISTING CATCHMENT

8.1 Catchment

The Kāinga Ora Oranga redevelopment sits within the One Tree Hill and Onehunga catchments. This SMP covers lots being redeveloped by Kāinga Ora, which have a land area of approximately 23.4 hectares. Figure 8.2 shows where the Kāinga Ora Oranga redevelopment is located within the One Tree Hill and Onehunga catchments.

Figure 8.2 – Kāinga Ora Oranga Redevelopment Location within the Onehunga and One Tree Hill Catchment

8.2 Current Land use and Landcover

The proposed redevelopment area is currently low density residential properties and is located within the Residential – Mixed Housing Urban, and Residential – Mixed Housing Suburban Zones of the Auckland Unitary Plan.

The lots covered under this SMP have a current imperviousness of 37%. 22% percent of this comes from roof area, whilst the remaining 15% is other impervious surfaces (driveways, hardstand etc).

Access to the proposed redevelopment area is provided via Mount Smart Road (arterial road) and a number of local roads, including Rockfield Road, Oranga Avenue, Waitangi Road, Namata Road, Roosevelt Avenue, Edmonton Avenue, Wallath Road, State Avenue, and Felix Street.

8.3 Natural and Physical Characteristics

8.3.1 Topography

The overall area slopes in the southeast direction from approximately RL55m at Namata Road to RL15m at Mt Smart Road over a distance of approximately 850m. The topography is varying in slope, with large flat areas and portions of steep terrain. Figure 8.3 below shows the existing 1m contours.

Figure 8.3 – Existing Topography

8.4 Geology and Contaminated Land

8.4.1 Geology

The published geological records indicate that the site is underlain by Auckland Basalts from the One Tree Hill volcano and tuff of the Auckland Volcanic Field. This geology is made up of lithic tuff, comprising comminuted pre-volcanic materials with basaltic fragments and unconsolidated ash and lapilli deposits of well sorted basalt and basinite fragments, alongside basalt lava flows.

A geotechnical report was carried out on properties within a portion of the redevelopment area, which included drilling percussion boreholes to investigate the basalt deposits and subsurface profile. Groundwater was not encountered in any hand augers, and only pockets of perched groundwater were found during drilling at depths of 2.9m and 8.2m.

Soakage testing was carried out in conjunction with the percussion drilling at locations across both stages. Tests were carried out with hydrant flows, and subsequently combined with water trucks to increase flow rates for testing. Results show soakage rates of at least

39.3 l/s per bore hole. Soakage rate testing results were limited by the available water supply.

8.4.2 **Contaminated Land**

A Detailed Site Investigation (DSI) and subsequent Remedial Action Plan (RAP) was undertaken for a portion of the proposed redevelopment. Hazardous Activities Industries List (HAIL) have been, or more likely than not, have been undertaken within the catchment.

Concentrations of arsenic, lead, and asbestos were detected in the site soils at levels above the limits specified by the Soil Contaminant Standards for health for residential land use as outlined by the National Environmental Standards (NES). In addition to this, concentrations of arsenic, copper, lead, and zinc were detected at levels above the discharge criteria of the AUP.

Contaminated soils within the proposed redevelopment area will require remediation in accordance with the RAP.

8.5 Receiving Environments

8.5.1 **Aquifers**

The proposed catchment is underlain by the Onehunga Volcanic Aquifer, which is within the High-Use Aquifer Management Area, and the Quality-Sensitive Aquifer Management Area as defined by the AUP.

Onehunga Volcanic Aquifer is highly allocated and can supply up to 21 million litres of water per day to the Onehunga community and the metropolitan water supply network. The aquifer is relatively shallow and unconfined, and is susceptible to pollution from surface sources.

As noted in Section 8.1, the proposed development covers an area of approximately 23.4 hectares. This is approximately 0.9% of the total Onehunga Volcanic Aquifer area, which spans over approximately 2699.1 hectares.

Groundwater Aquifer Study (GAS) model carried out by PDP has identified a shallow groundwater area located within the development extents. This area is limited to where groundwater is likely to be less than 2m below surface level. The extent of the shallow groundwater is shown in Figure 8.4.

The Onehunga Water Pump Station is located to the south of the proposed redevelopment and is being used to pump and treat the water from the Onehunga aquifer and feed into the metropolitan water supply network. The pump station can supply 12 million litres of potable water a day.

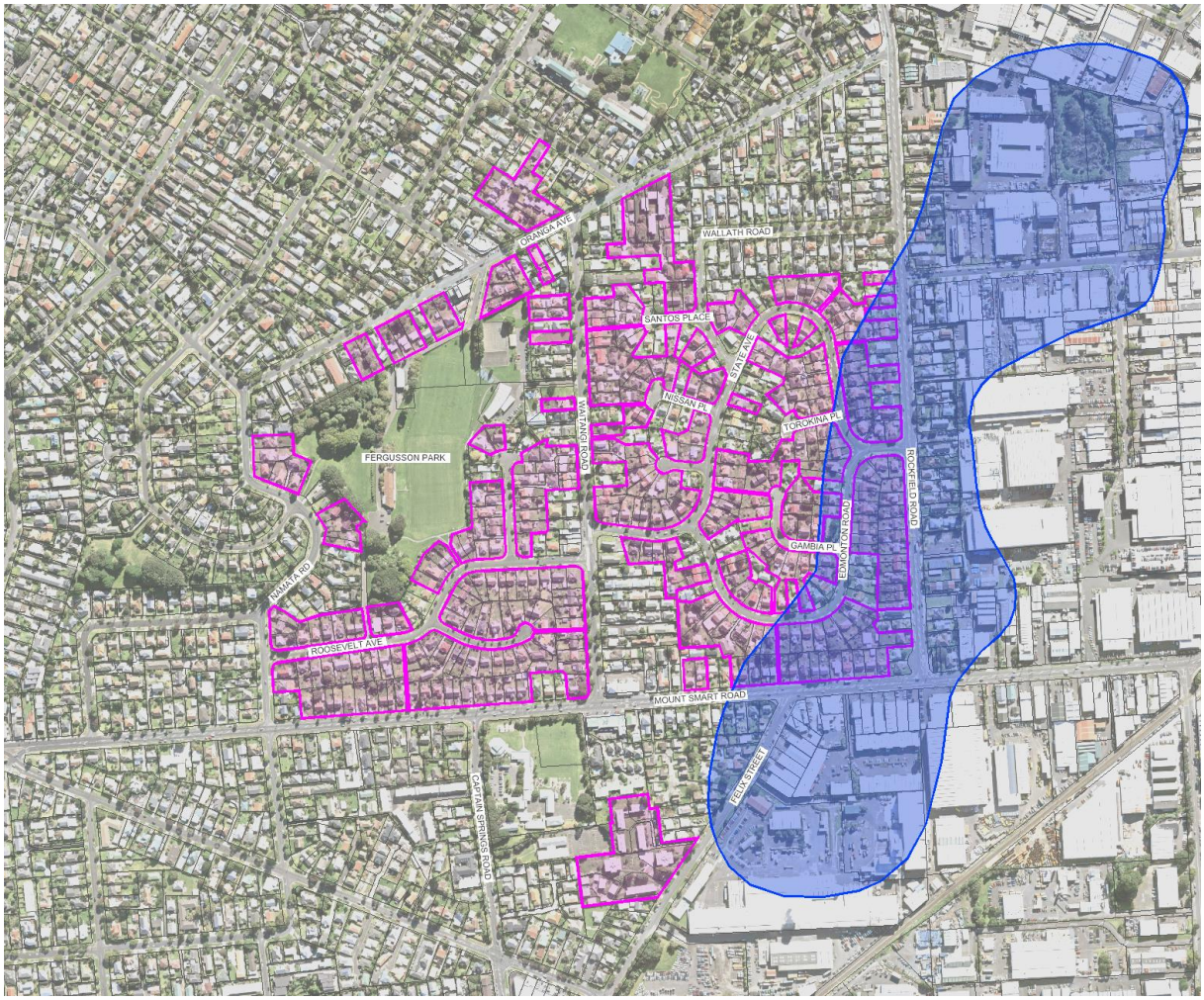

Figure 8.4 – Shallow Groundwater Extent

8.6 Stormwater Network

8.6.1 Primary Network

Currently, stormwater runoff from the catchment discharges via soakholes, to the fractured basalt beneath the ground. The majority of the properties within the Kāinga Ora Oranga redevelopment discharge via private soakholes. The soakage network ranges from approximately 70 years old public and private systems through to 15-year-old private systems. On-site inspection suggests most of these have been poorly maintained, and are in need of remediation works or replacement.

The stormwater runoff in the area is at present discharged directly to soakholes without any water quality treatment. This includes private lots and public roads. Locations of existing public network assets are shown in Figure 8.5.

Figure 8.5 – Location of Existing Public Primary Network

8.6.2 **Secondary Network**

The secondary network within the Kāinga Ora Oranga redevelopment area consists of existing overland flow paths (OLFPs). A hydraulic model completed by Tonkin + Taylor shows OLFPs generally following the road corridor however several traverse across private property. Furthermore, some of the OLFPs along the road are not constrained to the legal boundary, and spill into private lots. These OLFP of concern are shown in Figure 8.6 below.

Figure 8.6 shows the existing 100 year Annual Recurrence Interval (ARI) flood extents and the overland flow paths of within the Kāinga Ora Oranga redevelopment area. The existing overland flow paths shown to be traversing across private properties are expected to flood the existing buildings during the 100 year ARI rainfall event and consequently cause risk to people and property.

Beyond the development, the overland flows eventually discharge into the Manukau Harbour.

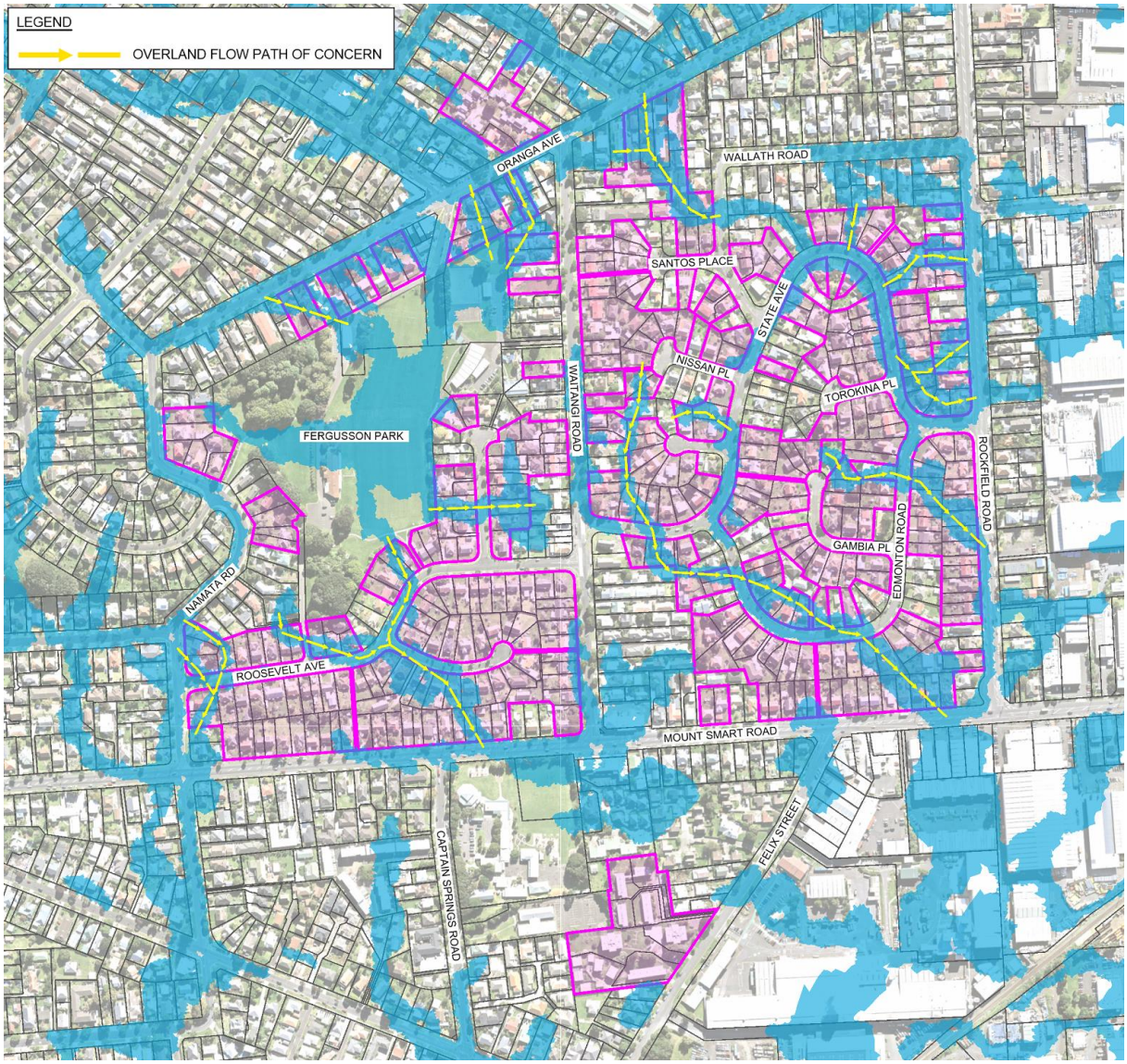

Figure 8.6 – 100 Year Existing Flooding Extent

8.7 Wastewater Network

At present, Oranga is being serviced by approximately 80-year-old wastewater reticulation, which has reached the end of its useable life. An investigation using CCTV was completed on the reticulation and identified several pipes which are in poor condition and are leaking.

8.8 Flood Hazards

The proposed redevelopment has several flood prone areas as identified by Auckland Council GIS. This model was completed by Connell Wagner in 2005. It identifies flooding in Fergusson Park and the industrial areas along Rockfield Road during the 100 year ARI rainfall event.

A subsequent model was completed by Tonkin + Taylor in 2018. This model shows far more extensive flooding than the 2005 model. For the purpose of this SMP, the Tonkin + Taylor model will be used to assess the effects of the proposed development on existing flooding during the 10 and 100 year ARI and ensure the flood risks within the catchment are not exacerbated. Note that the updated flooding information from the T+T model is yet to be published to Auckland Council Geomaps.

9 PROPOSED DEVELOPMENT

The proposed Kāinga Ora Oranga redevelopment is located within the AUP Residential – Mixed Housing Urban, and Residential – Mixed Housing Suburban Zones. The redevelopment covers approximately 23.4 hectares of existing residential land. Refer to Figure 9.1 for a spatial representation of the Kāinga Ora Oranga redevelopment within the AUP zones.

9.1 Landuse changes

The proposed redevelopment currently proposes to create over 1000 new dwellings. The maximum impervious area of the redeveloped residential lots will not exceed 60% as per the AUP rule H5.6.9, unless further mitigation outside of the scope of this SMP is put in place.

The increase in the number of dwellings is expected to increase traffic in the Oranga area. This will increase the contaminant yield generated from vehicles in the area, potentially effecting the quality of the stormwater runoff.

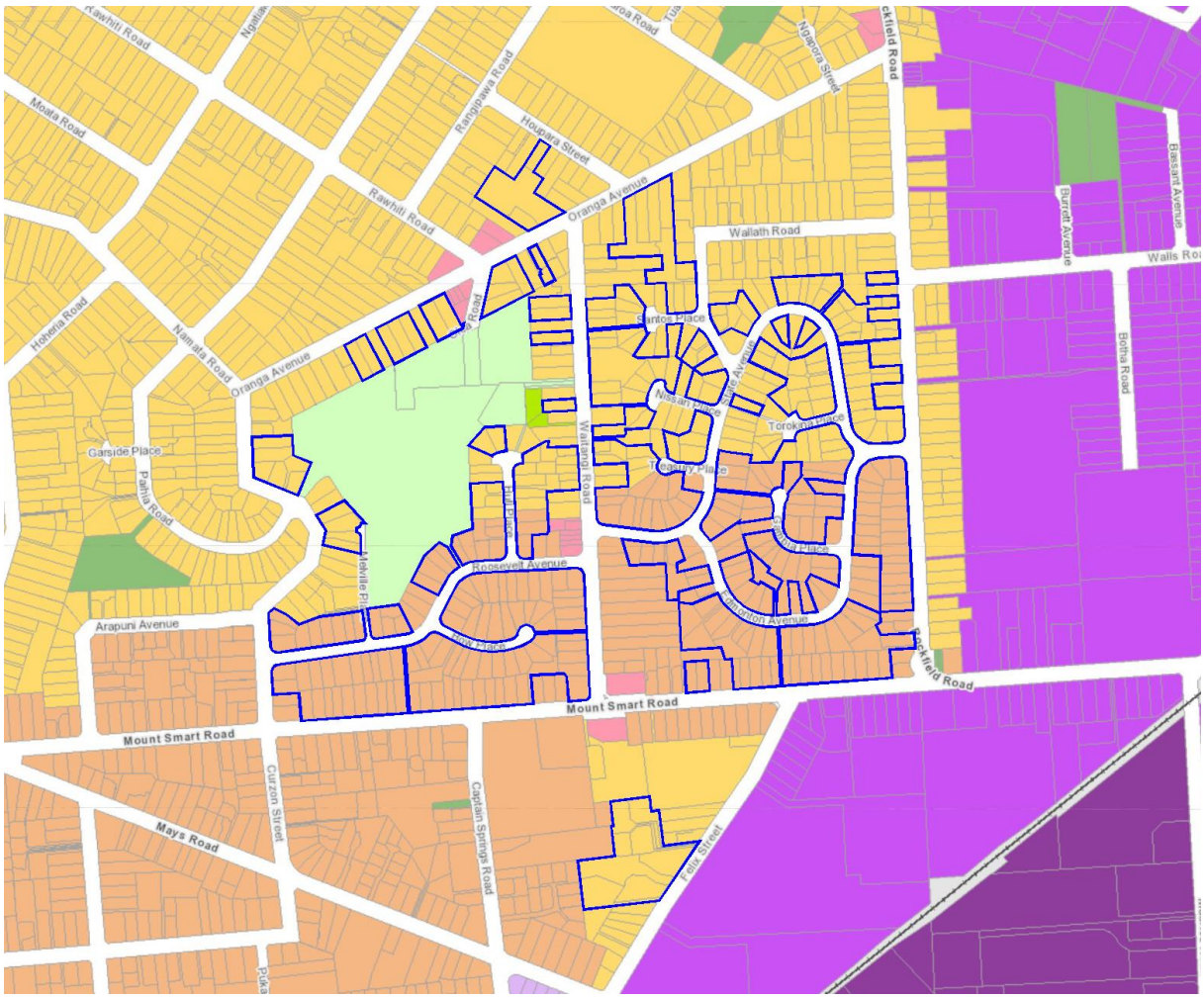

Figure 9.1 – Auckland Unitary Plan Zones

10 STORMWATER & FLOOD MANAGEMENT REQUIREMENTS

The following section summarises the relevant documents used to set out the requirements for stormwater and flood risk management within the Kāinga Ora Oranga redevelopment area.

10.1 Auckland Unitary Plan

The Auckland Unitary Plan (AUP) sets out objectives, policies and rules for development within the Auckland region.

10.1.1 **Auckland Wide Provisions**

The AUP policies covering the stormwater and flood management are generally set out in Chapter E – Auckland Wide. Some of the key sections are listed below:

- Section E1 – Water quality and integrated management.
- Section E8 – Discharge of stormwater runoff from impervious areas.
- Section E9 – Stormwater quality – High contaminant generating car parks and high use roads.
- Section E36 - Natural hazards and flooding.

Section E1 sets out the objectives and requirements for the management of freshwater and sediment quality to minimise adverse effects of contaminants on the receiving environment.

Policy E1.3.9 specifically sets out the requirements for management of stormwater runoff from the redevelopment of existing urban areas. The following applies:

Minimise or mitigate new adverse effects of stormwater runoff, and where practicable progressively reduce existing adverse effects of stormwater runoff, on freshwater systems, freshwater and coastal waters during intensification and redevelopment of existing urban areas by all of the following:

- Requiring measures to reduce contaminants, particularly from high contaminant-generating car parks and high-use roads;
- Requiring measures to reduce the discharge of gross stormwater pollutants;
- Requiring measures to be adopted to reduce the peak flow rate and volume of stormwater flows:
    - Where development exceeds the maximum impervious area for the relevant zone; or
    - From areas of impervious surface where discharges may give rise to flooding or adversely affect rivers and streams.
- Taking an integrated stormwater management approach for large-scale and comprehensive redevelopment and intensification (refer to Policy E1.3.10 below) and encourage the restoration of freshwater systems where practicable; and
- Ensuring intensification is supported by appropriate stormwater infrastructure, including natural assets that are utilised for stormwater conveyance and overland flow paths.

Other key policies relevant to the proposed SMP under Section E1 are summarised below:

- When considering any application for a discharge the Council must have regard to the following matters:

- The extent to which the discharge would avoid contamination that will have (a) an adverse effect on the health of people and communities as affected by their secondary contact with fresh water; and (Policy E1.3.5a).

- In taking an integrated stormwater management approach have regard to all of the following (Policy E1.3.10):
    - The nature and scale of the development and practical and cost considerations, recognising:
        - Greenfield and comprehensive brownfield development generally offer greater opportunity than intensification and small-scale redevelopment of existing areas;
        - Intensive land uses such as high-intensity residential, business, industrial and roads generally have greater constraints; and
        - Site operational and use requirements may preclude the use of an integrated stormwater management approach.
    - The location, design, capacity, intensity and integration of sites/development and infrastructure, including roads and reserves, to protect significant site features and hydrology and minimise adverse effects on receiving environments;
    - The nature and sensitivity of receiving environments to the adverse effects of development, including fragmentation and loss of connectivity of rivers and streams, hydrological effects and contaminant discharges and how these can be minimised and mitigated, including opportunities to enhance degraded environments;
    - Reducing stormwater flows and contaminants at source prior to the consideration of mitigation measures and the optimisation of on-site and larger communal devices where these are required; and
    - The use and enhancement of natural hydrological features and green infrastructure for stormwater management where practicable.

- Avoid as far as practicable, or otherwise minimise or mitigate adverse effects of stormwater diversions and discharges, having particular regard to (Policy E1.3.11):
    - The nature, quality, volume and peak flow of the stormwater runoff;
    - The sensitivity of freshwater systems and coastal waters,
    - The potential for the diversion and discharge to create or exacerbate flood risks;
    - Options to manage stormwater on-site or the use of communal stormwater management measures;
    - Practical limitations in respect of the measures that can be applied; and
    - The current state of receiving environments.

- Manage contaminants in stormwater runoff from high contaminant generating car parks and high use roads to minimise new adverse effects and progressively reduce existing adverse effects on water and sediment quality in freshwater systems, freshwater and coastal waters (Policy E1.3.12).

- Require stormwater quality or flow management to be achieved on-site unless there is a downstream communal device or facility designed to cater for the site's stormwater runoff (Policy E1.3.13).

- Adopt the best practicable option to minimise the adverse effects of stormwater discharges from stormwater network and infrastructure including road, and rail having regard to all of the following (Policy E1.3.14):

    - The best practicable option criteria as set out in section 2 of the Resource Management Act 1991;

    - The reasonable timeframes over which adverse effects can be avoided as far as practicable, or otherwise minimised or mitigated;

    - The scale and significance of the adverse effects;

    - Infrastructure investment priorities and the consequences of delaying infrastructural improvements in other areas;

    - The ability to prevent or minimise existing adverse effects having regard to the effectiveness and timeframes of other feasible methods, including land use controls;

    - Opportunities to integrate with other major infrastructure projects or works;

    - The need to maintain and optimise existing stormwater networks and provide for planned land use and development; and

    - Operational requirements and space limitations.

- Utilise stormwater discharge to ground soakage in areas underlain by shallow or highly permeable aquifers provided that (Policy E1.3.15):

    - Ground soakage is available;

    - Any risk to people and property from land instability or flooding is avoided;

    - Stormwater quality treatment is implemented to minimise effects on the capacity and water quality of the underlying aquifer system; and

    - Discharge to ground soakage is the most effective and sustainable option.

Section E8 regulates the discharge of stormwater runoff from impervious areas into land, water, or the coastal marine environment pursuant to Sections 14 and 15 of the Resource Management Act 1991. Objectives and policies are as specified in section E1. Section E8 also sets out general standards in E8.6.1. Relevant standards include:

- The diversion and discharge must not cause or increase scouring or erosion at the point of discharge or downstream (Standard E8.6.1.2).

- The diversion and discharge must not result in or increase the following (Standard E8.6.1.3):

    - Flooding of other properties in rainfall events up to the 10 percent annual exceedance probability (AEP); or

    - Inundation of buildings on other properties in events up to the 1 percent annual exceedance probability AEP.

- The diversion and discharge must not cause or increase nuisance or damage to other properties (Standard E8.6.1.4).

- Where the diversion and discharge is to ground soakage, groundwater recharge or peat soil areas any existing requirements for ground soakage, including devices to manage discharges or soakage, must be complied with (Standard E8.6.1.6).

Section E9 sets out the objectives and policies for managing stormwater runoff quality from impervious areas pursuant to section 9(2) of the Resource Management Act 1991. This includes high contaminant generating car parks and high use roads. Objectives and policies are as specified in section E1, additional rules applicable to high contaminant generating activities can be found in section E8. High contaminant generating car parks are classified as exposed car parks servicing more than 30 vehicles.

Section E36 sets out the objectives and policies for the management of natural hazards and flooding. Some of the key relevant policies are listed below:

- In existing urban areas require new buildings designed to accommodate more vulnerable activities to be located (Policy E36.3.13):

    - Outside of the 1 per cent annual exceedance probability (AEP) floodplain; or

    - Within or above the 1 per cent annual exceedance probability (AEP) floodplain where safe evacuation routes or refuges are provided.

- Require redevelopment of sites where existing more vulnerable activities are located within the 1 per cent annual exceedance probability (AEP) floodplain to address all of the following (Policy E36.3.14):

    - Minimise risks from flood hazards within the site;

    - Minimise the risks from flood hazards to people and property upstream and downstream of the site;

    - Remedy or mitigate where practicable or contribute to remedying or mitigating flood hazards in the 1 per cent annual exceedance probability floodplain;

    - Location of habitable rooms above flood levels; and

    - Provide safe evacuation routes or refuges from buildings and sites.

- Ensure all development in the 1 per cent annual exceedance probability (AEP) floodplain does not increase adverse effects from flood hazards or increased flood depths and velocities, to other properties upstream or downstream of the site (Policy E36.3.21).

- Maintain the function of overland flow paths to convey stormwater runoff safely from a site to the receiving environment (Policy E36.3.29).

- Require changes to overland flow paths to retain their capacity to pass stormwater flows safely without causing damage to property or the environment (Policy E36.3.30).

- Surface parking areas and above ground parking areas (excluding parking on roads) within the 1 per cent annual exceedance probability (AEP) floodplain must be located where depth of flood waters in a 1 per cent annual exceedance probability (AEP) event does not exceed 500mm above ground level (Standard E36.6.2.1).

10.1.2 **Overlay Provisions**

The Kāinga Ora Oranga redevelopment proposes to discharge stormwater to the Onehunga Volcanic Aquifer, which is within the High-Use Aquifer Management Area, and the Quality-Sensitive Aquifer Management Area as defined by the AUP. This aquifer is subject to policies set out within Chapter D – Overlays of the AUP, specifically D1 – High-use Aquifer Management Areas Overlay, and D2 – Quality-sensitive Aquifer Management Areas Overlay.

Section D1 sets out to ensure that high-use aquifers can continue to provide water for domestic, industrial, and rural use and maintain sources of spring and stream flow. Aquifers in this zone are currently over pumped or are likely to become over-allocated through future development. Objectives and policies manage proposals to take and use water from high-use aquifers, and recharge of these should be encouraged where possible.

The objective of Section D2 is to protect the quality and quantity of water in quality-sensitive aquifer management areas from contamination. This is given effect through policies that:

- Recognise the sensitivity of the following aquifers to groundwater contamination and minimise the discharge of contaminants in quality-sensitive aquifer management areas (Policy 2.3.1):

    - Urban aquifers - Auckland isthmus volcanics (including the Ōnehunga, Western Springs Volcanic, Mt Richmond Volcanic, Wiri Volcanic and Mt Wellington aquifers).

- Discourage the discharge of contaminants where they are likely to have significant adverse effects on groundwater quality within quality-sensitive aquifer management areas (Policy 2.3.2).

- Maintain the quality of the Onehunga aquifer as a source of municipal water supply for Auckland and minimise the risk of chemical spills into ground or into stormwater drains in the catchment (Policy 2.3.3).

10.2 Auckland Council Guidance Document 2015/004 (GD04)

GD04 is a guidance document published by Auckland Council, introducing the principles and objectives for Water Sensitive Design (WSD). The principles of WSD include inter-

disciplinary design approach, using at-source stormwater management practices to mimic natural systems and protect the functions of natural ecosystems. The objectives of WSD as presented in GD04 are:

- Manage Stormwater Quality to avoid adverse environmental effects. The approaches include maximising landscape elements, reducing extent of impervious surfaces, integrating "green" stormwater runoff contaminant treatment devices and minimising the use of materials that leach contaminants such as copper, galvanised metal and treated timber.
- Minimise Soil Disturbance to minimise sediment in stormwater runoff, especially during construction. This includes identifying soil properties, considering alternative approaches for site levelling, limiting the development footprint, minimising soil degradation, remediating soils where practical, and considering development overland flow paths, riparian margins, aquifer recharge and spring seepages.
- Promote Ecosystem Health through management of stormwater on a site scale. Applying WSD methods will promote the maintenance and enhancement of receiving environments.
- Deliver Best Practice as part of the stormwater management design including incorporation Iwi perspectives, enhancing landscape and natural character values and providing positive and safe urban and community outcomes.
- Maximise Return on Investment by achieving a broad range of benefits and maximum value from stormwater management through consideration of design, construction, operation and maintenance costs.

10.3 Technical Guidance

The stormwater management plan for Kāinga Ora Oranga redevelopment has been developed with an integrated approach and in accordance with Policy E1.3.10 of the Auckland Unitary Plan.

10.3.1 Guidance Documents

A summary of the relevant technical guidance documents for this Stormwater Management Plan is presented in Table 10.1 – Guidance Document Summary:

Table 10.1 - Guidance Document Summary

GUIDANCE DOCUMENT	CONTENT SUMMARY
AUP Operative in Part. April 2019. Auckland Council.	*Policies and objectives for the management of stormwater*
Stormwater Management Devices in Auckland Council Guideline Document 2017/001 (GD01) December 2017. Auckland Council.	*Technical guidance and design criteria for stormwater management devices*
Guidelines for Stormwater Runoff Modelling in the Auckland Region- Technical Publication 108 (TP108. April 1999. Auckland Regional Council.	*Modelling of stormwater runoff for Auckland Region*
Auckland Code of Practice: For Land Development and Subdivision (Chapter 4 - Stormwater) - November 2015. Auckland Council.	*Standards and guidelines for the design and construction of stormwater systems*
Auckland Council Stormwater Flood Modelling Specifications. November 2011. Auckland Council.	*Technical specification document for hydraulic stormwater modelling*
Water Sensitive Design for Stormwater – Guidance Document 2015/004 (GD04). March 2015. Auckland Council.	*Guidance document for the application of Water Sensitive Design (WSD)*

NZS4404 – Land development and Subdivision infrastructure. October 2010. Standards New Zealand.	*Nationwide standards for stormwater management including WSD, flood risk management, freeboard etc.*
Stormwater Disposal via Soakage in the Auckland Region (Technical report 2013/040)	*Technical guidance for the disposal of stormwater via soakage in the Auckland region.*

11 STORMWATER MANAGEMENT APPROACH

The proposed SMP approach has been developed to achieve the objectives and policies set out in Section 10 of this document. The approach focuses on water sensitive design, the enhancement of stormwater runoff quality and management of flood risk. The proposed stormwater management approach will contribute towards restoring the Mauri of the Onehunga aquifer.

The quality of stormwater discharge will be managed by restricting the use of high contaminant generating building materials, and providing offset mitigation within existing legal road reserves. The proposed offset mitigation does not cater for high contaminant generating car parks. These will be treated via at-source treatment using a Best Practicable Option (BPO) approach.

Flooding risk during the 100 year ARI rainfall event will be managed by maintaining building floor levels above adjacent flood levels, including freeboard, and ensuring there are no adverse effects on existing flooding upstream and downstream of the proposed redevelopment.

11.1 Stormwater Quality Requirements

As stated in Section 8.5.1, the Onehunga Volcanic Aquifer is relatively shallow and unconfined, and is susceptible to pollution from surface sources. At present the stormwater runoff from the area, including public roads and private lots, is generally being discharged directly to the underlying fractured basalt without any water quality treatment. The water from the aquifer is being pumped at the Onehunga Water Pump Station to supply the metropolitan potable water network. The SMP proposes a WSD approach to improve the water quality discharging to the underlying aquifer in accordance with the AUP Chapter D2 requirements. The proposed WSD approach will contribute towards restoring the Mauri of the Onehunga aquifer.

All roof runoff will be discharged directly to the fractured basalt via private soakholes. Water quality for new buildings will be managed by restricting the use of high contaminant yielding building materials such as copper and galvanised metals. This includes roofing, cladding, spouting and other architectural features. All new buildings will also require gross pollutant traps (GPT) to remove sediment and debris prior to stormwater entering the soakholes. These include devices such as leaf guards installed on spouting and downpipes, or similar devices which will act as silt traps.

Public roads are believed to be some of the highest contributors of heavy metals and sediment in the Oranga catchment. In order to ensure best practicable solution to enhance the quality of stormwater discharge in the area is achieved; Candor[3] has completed an analysis of the existing and proposed hardstand contaminant generating areas within Kāinga Ora Oranga redevelopment area. The analysis included assessing projected occupancy times for vehicles over 1m² of impervious surface. The analysis has shown that due to high number of traffic volumes, the projected vehicle occupancy time per m² of impervious area within public roads can be approximately 3 to 58 times greater than for private hardstand areas. The factor of 3 corresponds to State Avenue, which is a low traffic local road in the area and the factor of 58 corresponds to Mount Smart Road, which is a high traffic arterial

road in the area. The high occupancy times have a higher potential to generate contaminants and are proposed to be targeted for water quality treatment. The analysis has shown that providing water quality treatment on the existing public roads will deliver best practicable solution to enhance the quality of stormwater discharge in the area. We note that due to the nature of the proposed redevelopment and the receiving environment, the analysis carried out by Candor[3] is only applicable for the purpose of developing a water quality management approach under this SMP and should not be relied upon for application within other areas around Auckland without a detailed site specific assessment. The results of the analysis are presented in Appendix D of this SMP.

Based on the results of the analysis presented in the paragraph above, offset mitigation is proposed for private hardstand areas, including driveways. The offset mitigation will be carried out within the existing legal roads in the area. The public roads, including the existing and predicted 5-day average daily traffic volumes from FlowNZ, that will be targeted for offset mitigation are displayed in Table 11.1. High contaminant generating roads, which includes roads with more than 5,000 vehicles per day, will be targeted as a priority. Other roads within the Kāinga Ora Oranga redevelopment area, which are subject to traffic volumes of less than 5,000 vehicles per day will be targeted secondarily. Although less traffic is observed on these roads, it is expected that based on the analysis completed, the provision of water quality treatment will still provide for greater benefit than the treatment of private hardstand areas.

Table 11.1 - Existing legal roads proposed to be treated as part of offset mitigation

EXISTING LEGAL ROAD	EXISTING 5-DAY AVERAGE DAILY TRAFFIC	PREDICTED 5-DAY AVERAGE DAILY TRAFFIC
Mount Smart Road	*17,520*	*18,220*
Rockfield Road	*10,810*	*11,910*
Oranga Avenue	*5,150*	*5,750*
Waitangi Road	*2,680*	*3,880*
Namata Road	*2,000*	*2,400*
Roosevelt Avenue	*1,200*	*1,800*
Edmonton Avenue	*1,200*	*1,800*
Wallath Road	*550*	*950*
State Avenue	*1,200*	*1,800*

1. ADTV is based on a two way, five-day average daily traffic count.
2. ADTV varies with location and an average ADTV value within the Oranga area for a specific road was taken for the purpose of this table.

The water quality devices proposed to be implemented for offset mitigation within public roads have been selected based on an assessment of available devices against the benefits each provides, including receiving environment, location of existing infrastructure, construction, and maintenance.

Candor[3] undertook a treatment device assessment with consultation from Healthy Waters and Auckland Transport. This assessment took into consideration the space limitations, the benefit of targeted contaminant treatment for the Onehunga Aquifer, construction costs, and long-term maintenance costs. The long term maintenance cost assessment is included in Appendix D. Ultimately, due to the brownfield's nature of this redevelopment, the key driver for the selection of the treatment devices was the space limitation. This included limited berm space as a result of the berm width itself, and the location of the existing services and other assets. Stormwater 360 Stormfilter proprietary device was selected as the best option for this SMA, mainly due to its small footprint. However, the Stormfilter can also specifically target contaminants such as heavy metals, hydrocarbons and pathogens, and has shown to have comparable maintenance costs. The detailed construction and maintenance cost assessment for the Stormfilter is included in Appendix D of this report.

Candor³ has completed an extensive desktop study to identify areas within public roads, which can be treated using the Stormfilters. This included assessing all the public roads shown in Table 12.1 against the layout of existing services and available berm space. Through consultation with Auckland Transport and Healthy Waters, high contaminant generating catchments such as Mount Smart Road, and Rockfield Road and other catchments with significant traffic flows have been prioritised. The catchments proposed for treatment are shown in Figure 11.1 and in Appendix E. This may change through ongoing consultation with Auckland Transport and Healthy Water as a part of the Engineering Approval process.

Figure 11.1 – Offset Mitigation

Construction of Stormfilters in public roads will be carried out by Kāinga Ora. Upon completion of works, these devices will be vested to Auckland Transport, who will take over the ongoing operation and maintenance.

Due to the proposed offset mitigation approach, private hardstand areas within Kāinga Ora Oranga redevelopment areas do not need to provide for water quality treatment. However, the stormwater runoff will need to be discharged to a catchpit or a similar silt trap device prior to entering a soakhole. This is to ensure long term performance of the soakhole is achieved as per the Stormwater Disposal via Soakage in the Auckland Region Technical Report 2013/40 (TR40).

The proposed offset mitigation does not apply to private high contaminant generating car parks, which are classified as exposed car parks servicing more than 30 vehicles under AUP Chapter E9. At-source treatment will still need to be provided for these areas by installing site specific water quality treatment devices using a BPO approach and will be subject to further consent requirements.

As noted in Section 8.4.2, a Detailed Site Investigation (DSI) completed for a portion of the proposed redevelopment has identified the presence of concentrations of arsenic, lead, and asbestos above the limits specified by the Soil Contaminant Standards for health for residential land use as outlined by the National Environmental Standards (NES). As part of the proposed redevelopment, remedial works will need to be carried out in order to mitigate

adverse effects on human health and the receiving environment. This is expected to improve the quality of stormwater discharge in the area.

As per Section 8.7, the existing wastewater reticulation in the area is comprised of old pipes in poor condition, a lot of which are leaking. As part of the proposed redevelopment, the wastewater reticulation will be upgraded, which will reduce the leakage of wastewater in the area. This is expected to further improve the quality of water discharging to the aquifer.

11.2 Hydrology Mitigation Requirements

The proposed development area is not located within the Auckland Unitary Plan Stormwater Management Area Flow (SMAF) zone and is proposed to discharge the stormwater to ground. As such the hydrology mitigation is not required under the AUP, however the implementation of retention and detention has been assessed against the benefits to the receiving environment.

Retention manages the total stormwater surface runoff volumes through ground recharge and reuse. As the proposed redevelopment will discharge stormwater directly to ground, the total surface runoff volumes will be reduced without the implementation of retention. Pattle Delamore Partners Limited (PDP) completed a Groundwater Aquifer Study (GAS), which showed that the aquifers in the Auckland area have capacity to accept more than double the current recharge. It is expected that providing retention through reuse, for the purpose of minimising total recharge volumes to the aquifer, will not have significant benefits. Furthermore, the retention volumes are small and are not expected to have significant effects on minimising the peak discharges to the aquifer.

Retention provides recharge to groundwater in order to maintain base flows in streams and aquifers. The proposed redevelopment discharges directly to the fractured basalt underlying the site, and ultimately to the aquifer below. This means that the proposed redevelopment will accommodate for the aquifer recharge without the provision of retention.

Retention reduces the temperature of water prior to discharge to the receiving environment. As the proposed redevelopment will discharge stormwater directly to ground, the utilisation of retention to reduce stormwater runoff temperature will not have significant benefits.

As stated in the paragraphs above, retention in this case could only potentially contribute towards the treatment of first flush contaminants. The proposed stormwater management devices, implemented and designed in accordance with the water quality treatment approach as specified in Section 12.1 of this SMP, will ensure that that the treatment of first flush contaminants - consistent with the objectives of GD01, can be achieved without the implementation of retention.

Detention manages peak stormwater flows to minimise stream erosion. As the proposed redevelopment will discharge directly to ground, the utilisation of detention will not provide significant benefits.

Developments within Kāinga Ora Oranga redevelopment area do not need to provide retention and detention, as their implementation will not provide significant benefits to the receiving environment and the enhancement of the Mauri of the Onehunga aquifer.

11.3 Stormwater Network

11.3.1 Primary Network

Runoff in the Kāinga Ora Oranga redevelopment is at present discharged to the fractured basalt via soakage using private and public soakholes. As mentioned in Section 8.6.1, the

existing infrastructure is generally in need of remediation or replacement. The majority of all redeveloped lots are expected to discharge via a new soakhole. If the existing soakhole is in a suitable location and is assessed to have sufficient capacity, then it can be retained and reused. Maintaining the existing method of stormwater discharge will ensure that mixing of water from different sources is avoided and the Mauri of the Onehunga aquifer maintained respectively.

New or upgraded soakholes within the proposed Kāinga Ora Oranga redevelopment should have the capacity to discharge peak flows during the 10 year ARI rainfall event, including climate change. Soakholes will be designed in conjunction with Auckland Council Disposal via Soakage in the Auckland Region Technical Report 2013/040 (TR40).

It is envisaged that the redeveloped lot will generally utilise one privately owned and maintained soakhole. However, there may be scenarios where multiple soakholes will be used.

As discussed in Section 11.1, discharge to soakholes from private roof and hardstand areas will require gross pollutant traps (GPT) to remove debris and sediment. This is to ensure long term performance of soakholes is achieved. High contaminant generating carparks serving over 30 vehicles will require water quality treatment using devices such as raingardens, tree pits, and proprietary devices prior to discharge to a soakhole.

An Operation and Maintenance manual will be required for all new soakholes constructed within the Kāinga Ora Oranga redevelopment area.

11.3.2 **Aquifer Capacity Assessment**

Pattle Delamore Partners Limited (PDP) were engaged to undertake an assessment of stormwater disposal for the proposed development to the Onehunga Volcanic Aquifer. PDP assessed the effects of the proposed development using the existing Groundwater Aquifer Study (GAS) model.

The PDP report recommends that there is sufficient capacity in the Onehunga Volcanic Aquifer to accept the additional stormwater runoff from the proposed development at MPD levels during the 10-year ARI rainfall event, including climate change. The increase in the development soakage volume disposal will have minimal effects on the existing groundwater breakout areas, with the effects being similar or less than those originally predicted by the GAS study. There are no groundwater breakout areas within the proposed development area.

The area shown in Figure 11.2 shall be designated as an exclusion zone, as it is subject to shallow groundwater. The proposed exclusion zone is roughly 66,000m², and will restrict the disposal of stormwater to soakage to the runoff generated within this area only. Stormwater runoff from areas outside of the exclusion zone cannot be conveyed into the exclusion zone for disposal, however it is acknowledged that runoff in larger rainfall events may pass through it via overland flow paths.

In addition to the aquifer capacity assessment, PDP assessed the interference effects of multiple soakage devices on soakage rates. Soakage rate reduction factors for the tested soakage rate of a single isolated device, as noted in the PDP report, are shown in Table 11.2. Developers should use this table when designing soakage infrastructure in lots outside of the exclusion zone, to ensure that adequate soakage is provided considering interference from other devices. The catchment currently has an average of four soakholes within a 30m radius. Limitations to the use of this table are set out in the PDP report in Appendix B. Specialist input is required where the design of the soakage device is outside of the scope

of Table 11.2 (including limitations), and for the design of all soakage devices within the designated exclusion zone.

Table 11.2 – Soakage Device Soakage Rate Reduction Due to Interference

NUMBER OF DEVICES	DEVICE SPACING (m)					
	0	5	10	20	30	50
1	0%	-	-	-	-	-
2	-	37%	32%	27%	23%	20%
3	-	54%	49%	42%	37%	30%
4	-	62%	57%	49%	44%	35%

For limitations to the use of this table refer to PDP report in Appendix B of this SMP.

As stated in Section 8.5.1, the Onehunga Volcanic Aquifer is supplying water to the Onehunga community and the wider metropolitan water supply network. The existing water supply users and uses are not expected to be adversely affected as a result of the proposed development, due to the increase in potential recharge.

The full PDP assessment of stormwater disposal report is included in Appendix B of this SMP.

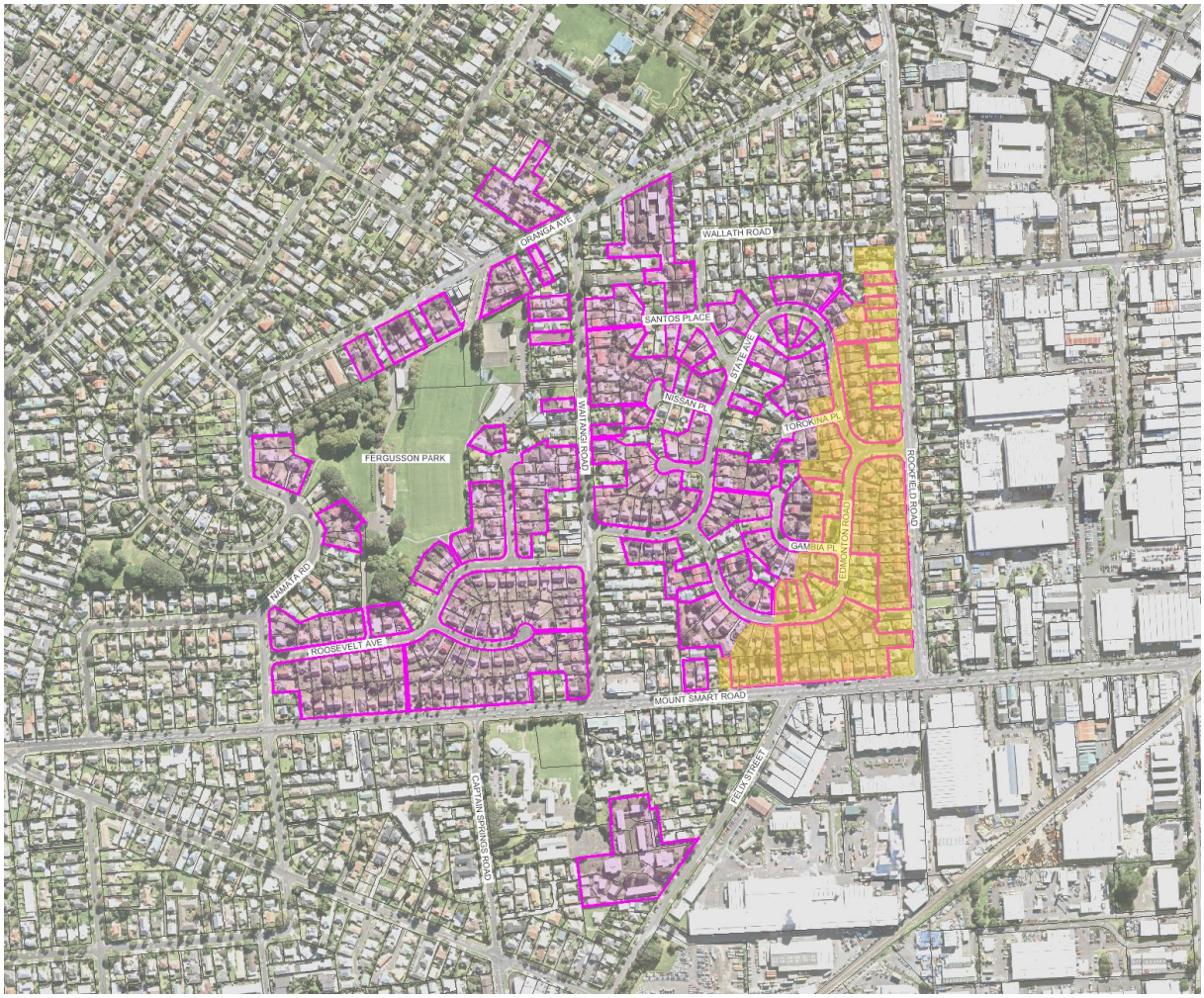

Figure 11.2 – Soakage Exclusion Zone (in Yellow)

11.3.3 **Secondary Network (Overland Flow Paths)**

The secondary network provides for the conveyance of stormwater runoff during rainfall events in excess of the primary network capacity. The Auckland Council hydraulic model shows several existing OLFPs traversing private properties. These OLFPs are expected to cause flooding risk to people and property. The existing overland flow paths (OLFPs) and their location is addressed in Section 8.6.2.

The proposed management of existing OLFPs is to contain them within the legal road reserve, or where this is not practicable, route them through private lots in accordance with the design criteria specified in this SMP. The proposed management of overland flows will improve the risk from flooding in the area. All OLFPs within redevelopment lots will be protected with an instrument to ensure the conveyance performance is maintained on an ongoing basis.

As outlined in Section 9, the Kāinga Ora Oranga redevelopment will increase the imperviousness and the generated stormwater runoff. A portion of this will be taken up in the primary network however, during more extreme events, additional stormwater will flow via the secondary network. In accordance with Chapter E8 Stormwater – Discharge and Diversion Section 8.6.1.3 of the AUP the proposed SMP will manage secondary network flows such as that:

- Flooding of other properties is not caused or increased in rainfall events up to the 10 year ARI rainfall event,

- Inundation of buildings on other properties is not caused or increased in events up to the 100 year ARI rainfall event.

A flood modelling analysis completed by Candor[3], discussed in detail in Section 11.4 below, has demonstrated the overland flows within the proposed Kāinga Ora Oranga redevelopment will be in accordance with AUP Section 8.6.1.3. Plan 4-901 in Appendix C3 shows the proposed overland flow paths within the SMA and highlights which are associated with storage mitigation areas.

The flood modelling analysis completed by Candor[3] is a high-level assessment and addresses the management of effects of overland flows at a global scale. A detailed site-specific OLFP assessment and design subject to Auckland Council approval will be provided by Kāinga Ora and other private developers as a part of a resource consent application and Engineering Plan Approval (EPA) for individual super lots. The following design criteria must be adhered to:

- OLFPs will be sized to accommodate the MPD 100 year ARI storm event including climate change. OLFP sizing will exclude flows discharged by the primary network – this will be assessed against risk of blockage.

- Overland flows to be contained within public land. Where this is not possible, flows will be directed through private accessways, car parks, or other designated overland flow paths and protected with an instrument.

- Flow depth and velocity product not to exceed 0.4m²/s (pedestrian hazard) as per the Auckland Council Code of Practice for Land Development and Subdivision Chapter 4 – Stormwater, where overland flows traverse pedestrian or vehicular accessways and public carriageways.

Freeboard from OLFPs to habitable floor levels for all lots within the Kāinga Ora Oranga redevelopment will be designed in conjunction with the Auckland Council Code of Practice for Land Development and Subdivision Chapter 4 – Stormwater.

11.4 Flood Risk Management

11.4.1 Flood Modelling Analysis

Kāinga Ora Oranga redevelopment will increase the stormwater runoff generated in the area and may include filling within the existing floodplains to elevate residential dwellings above the existing flood levels.

A stormwater modelling analysis was carried out for the proposed redevelopment to ensure the adverse effects of the increased imperviousness and filling within the existing floodplain are mitigated. As stated in Section 8.8 of this SMP, the modelling was carried out on an existing Auckland Council model created by Tonkin + Taylor. This analysis is only applicable to the development of properties identified in Section 4 and Figure 6.1. Any development outside of the scope of this SMP, including future acquisitions by Kāinga Ora, will require a separate flood analysis to be undertaken.

The hydraulic model completed by Tonkin + Taylor was built using relatively large sub-catchments. These can be up to 21 hectares in size, with an average of 1.8 hectares across the entire model. As a result, there may be internal overland flow paths and localised flooding areas present within these sub-catchments, which are not represented in the hydraulic model. All developers within the Kāinga Ora Oranga redevelopment area will carry out an additional assessment of effects of their development on any localised flooding areas and overland flowpaths within, or adjacent to their site, which are not shown on Plan 4-901 and covered by the Candor³ analysis.

The flood modelling analysis completed by Candor³ is a high-level assessment and addresses the management of effects of flooding at a global scale. A detailed site-specific flood assessment and design subject to Auckland Council approval will be provided by Kāinga Ora and other private developers as a part of a resource consent application and Engineering Plan Approval (EPA) for individual super lots.

The proposed Kāinga Ora Oranga redevelopment works were modelled in the existing development scenario and analysed for both the 10 and 100 year ARI storm events. The post development (PD) and existing development (ED) scenarios assume current rainfall depth (no climate change) and were run for the entire One Tree Hill catchment. Climate change was not considered in this analysis in order to assess any adverse effects of the proposed redevelopment at present. We note that the design of overland flow paths and soakage devices will include climate change considerations as required by the SMP criteria. All Kāinga Ora Oranga redevelopment lots were modelled according to the masterplan included in Appendix C1. This included imperviousness, ground cover/roughness, and landform i.e. where proposed parking/overland flow areas would be located. The bathymetry of the model was altered so that all Kāinga Ora Oranga redevelopment lots were raised 500mm above the MPD flood levels where appropriate.

The initial analysis of the PD scenarios has shown that the Kāinga Ora Oranga redevelopment will increase the existing flood levels during the 10 and 100 year ARI rainfall events. In order to mitigate the adverse effects of the proposed redevelopment on existing flooding, localised surface ponding areas and key overland flow conveyance areas have been proposed within the Kāinga Ora Oranga redevelopment area. The localised surface ponding areas, providing flood storage, and key overland flow conveyance areas have demonstrated that the flooding during the 10 and 100 year ARI rainfall event, as a result of the proposed redevelopment, has no adverse effects on other properties within the catchment.

The proposed Kāinga Ora Oranga redevelopment was also modelled in the Maximum Probable Development (MPD) scenario and analysed for both the 10 and 100 year ARI rainfall events. The model assumes rainfall depth including climate change and maximum probable imperviousness for the entire One Tree Hill catchment.

The analysis of MPD scenarios was carried out to ensure the future flood risks during the 10 and 100 year ARI rainfall events will not be increased as a result of the Kāinga Ora Oranga redevelopment

A flood risk assessment was carried out in accordance with Chapter E36 Natural Hazards and Flooding of the AUP. A summary of this is included in Section 11.4.3 of this document.

11.4.2 **Management of Allocated Flood Mitigation and Overland Flow Areas**

As discussed in Section 11.4.1, flood mitigation within the Kāinga Ora Oranga redevelopment will be carried out via localised surface ponding areas and key overland flow conveyance areas. This was determined via a BPO approach outlined in Appendix C of this SMP. Locations of surface ponding areas and key OLFP are shown in Figure 11.3 below.

Locations of the storage areas and key overland flow paths were based on the Isthmus Master Plan, contained in Appendix C1, and the existing 100 year ARI flood maps. As the Isthmus Master Plan is not finalised, the storage requirements are implemented on a high-level storage area basis. A detailed site-specific OLFP design of the storage areas subject to Auckland Council approval will be provided by Kāinga Ora and other private developers as a part of a resource consent application and Engineering Plan Approval (EPA) for individual super lots.

The proposed mitigation is considered adequate as long as these storage volumes and key overland flow paths are maintained, in the areas shown, throughout the proposed development area. Appendix C3 shows the location of proposed storage areas and associated key overland flow paths within the Kāinga Ora Oranga redevelopment. Where a storage area is associated with a key overland flow path, as shown in Appendix C3, it must remain so regardless of any masterplan changes. Table 11.3 below outlines the required storage volumes for each storage area. Storage areas that are associated with a key OLFP are noted with an asterisk. The volumes outlined in Table 11.3 are the minimum requirements.

Kāinga Ora will be responsible to ensure that the flood mitigation measures proposed in this SMP, including the storage areas, are implemented throughout the redevelopment.

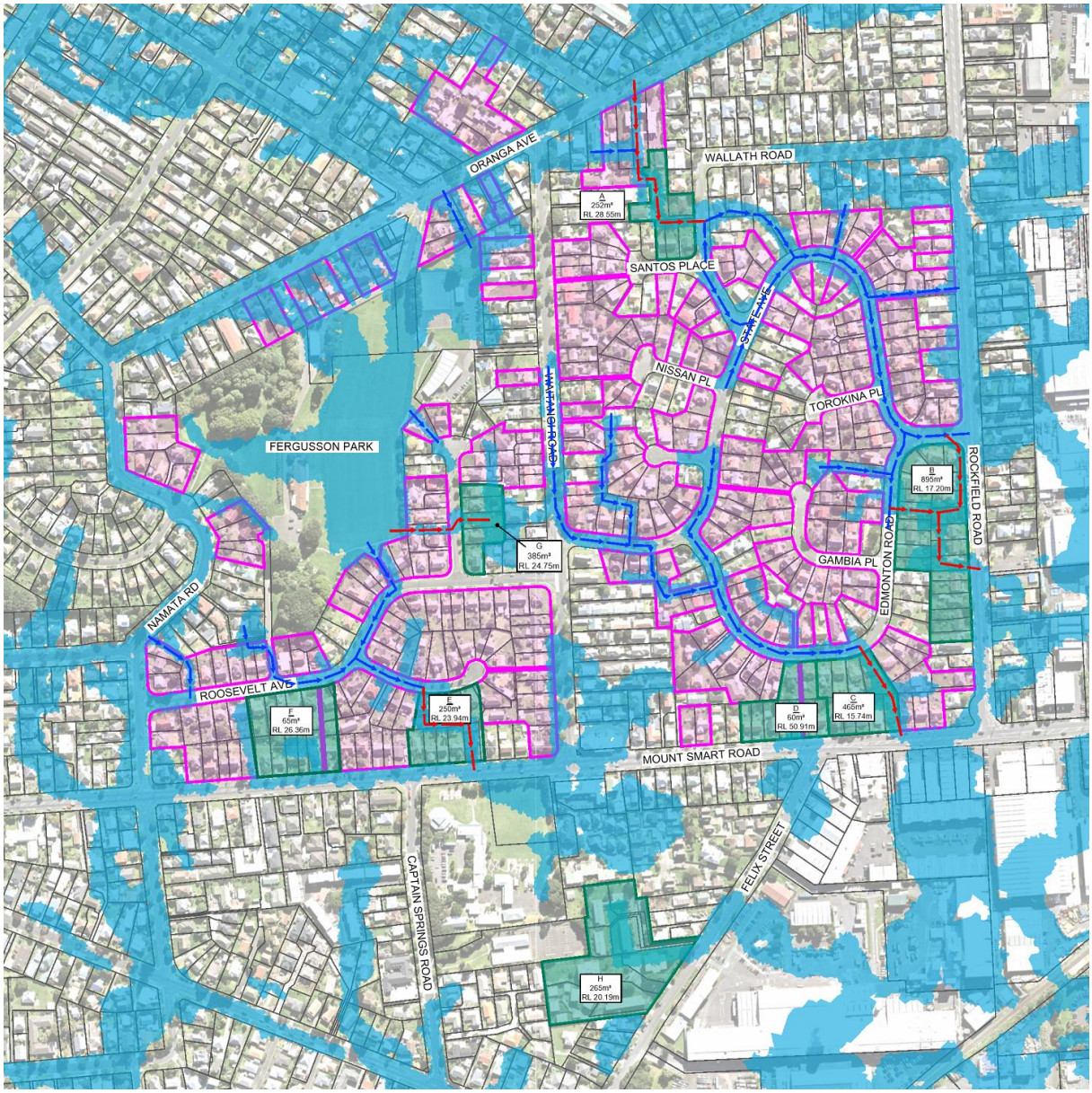

Figure 11.3 – MPD100 mitigation storage areas and OLFP

There is no development staging plan set for the Kāinga Ora Oranga redevelopment area at this point. Kāinga Ora will ensure that the timing of the redevelopment of the lots containing the proposed storage areas is as such that the existing flooding is not exacerbated in the redevelopment area. The staging of the redevelopment area will be overseen by Kāinga Ora and the development of the super lots with the proposed storage areas will be required as followed:

- In case the overall existing imperviousness for the Kāinga Ora Oranga redevelopment area is increased within the catchment for which the proposed storage area is providing mitigation; and
- In case filling within existing floodplain for the Kāinga Ora Oranga redevelopment area is carried out within the catchment for which the proposed storage area is providing mitigation.

Maintaining imperviousness within a catchment for a proposed storage area can be achieved by balancing the development of one super lot with the clearing and demolition of another. Figure 11.5 shows the individual mitigation catchments for each of the proposed storage areas.

Table 11.3 – Storage Area Minimum Storage Requirements

Storage Area	Flood RL	Minimum Storage Required Below Flood RL
A*	28.55 m	260 m³
B*	17.20 m	900 m³
C*	15.74 m	470 m³
D	15.91 m	60 m³
E*	23.94 m	250 m³
F	26.36 m	70 m³
G*	24.75 m	390 m³
H	20.19 m	270 m³

* Indicates that a storage area is associated with a global overland flow path.

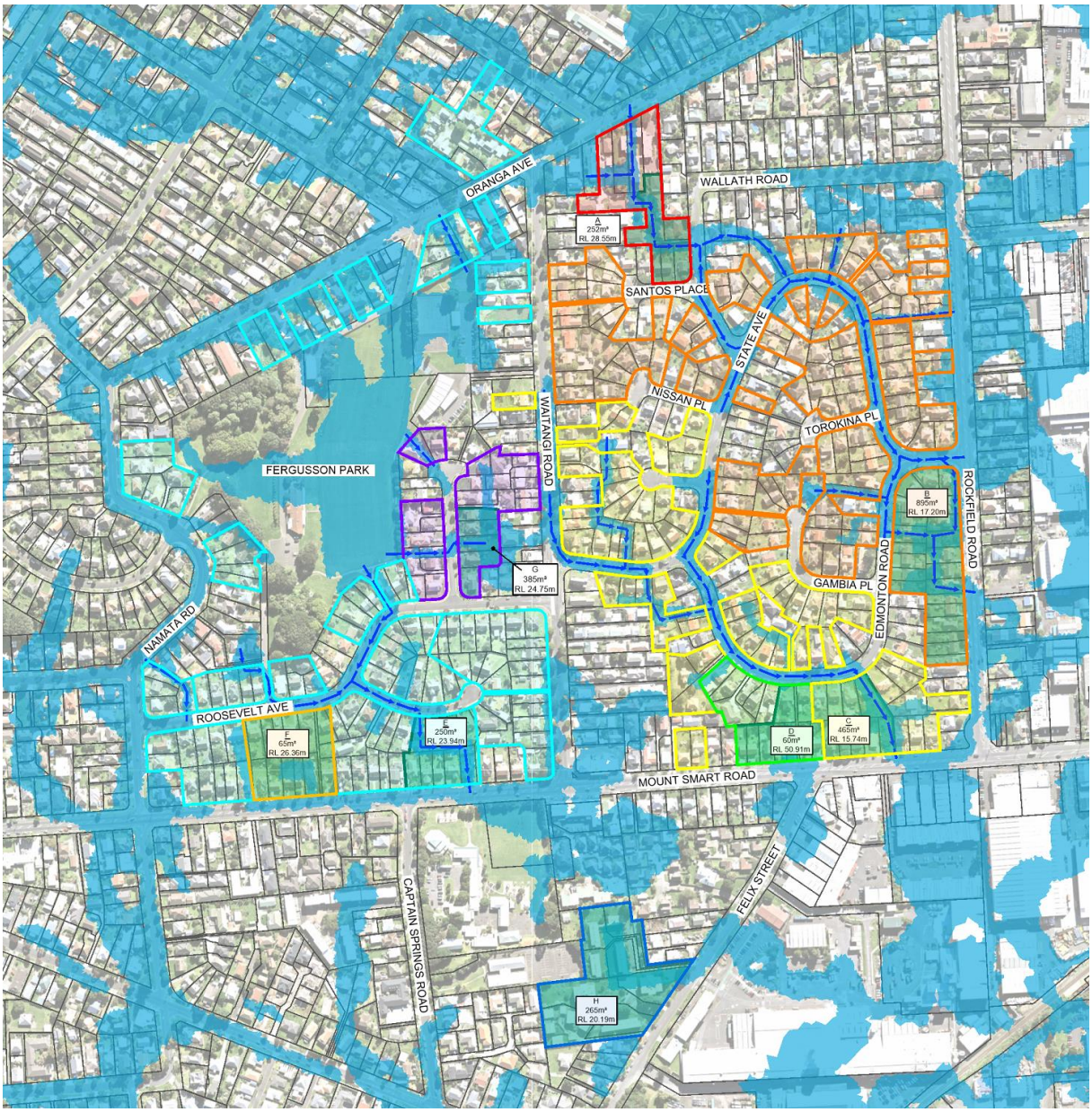

Figure 11.4 – MPD100 mitigation development catchments

11.4.3 **Flood Risk Assessment**

The Kāinga Ora Oranga redevelopment will intensify housing density in the catchment. This will expose more people and property to the potential risk of flooding. To ensure the proposed redevelopment does not cause an increase in overall risk of adverse effects, a hazard risk assessment was carried out in accordance with Auckland Unitary Plan E36 Natural Hazards and Flooding. The objectives and policies of E36 are summarised in

Section 10.1.1. The assessment was carried out with reference to the MPD scenario taking into account climate change.

All new habitable floor levels will be elevated 500mm above the 100 year ARI flood levels, including climate change, and MPD catchment imperviousness. This will mitigate the risk of flooding for buildings and property within the redevelopment. Economic risk for repair, cleaning, and replacement will be minimised as a result.

Flood analysis within the redevelopment has shown that the product of flood depth and velocity within public roads, proposed private accessways, and parking areas does not exceed the pedestrian safety limit of 0.4m²/s. Refer to Plan 4-821 in Appendix C2 for a copy of the flood hazard map.

The hydraulic model shows flood depths within storage area B reach 655mm, and 880mm within storage area G during the peak 100 year ARI event under MPD conditions. However, as required by this SMP, these areas are subject to detailed design to ensure compliance with E36.6.2.1 of the AUP and that risk to pedestrians and vehicles is mitigated.

The Kāinga Ora Oranga redevelopment will reduce the overall extent of the floodplain and reduce the areas of flooding within private property. This minimises the flood risk to property, people, and buildings in the area.

Based on this risk analysis, it has been concluded that the Kāinga Ora Oranga redevelopment will not exacerbate the existing flood risk. The mitigation measures proposed ensure that adverse effects from flood hazards to people, buildings, and the environment will be avoided. Refer to the Stormwater Modelling Report in Appendix C for the detailed flood risk assessment.

11.5 Design Criteria

A summary of the relevant stormwater management design criteria for this Stormwater Management Plan is presented in Table 11.4- Design Criteria Summary.

Table 11.4 - Design Criteria Summary

ITEM	CRITERIA		RESPONSIBILITIES
Rainfall Depths (Climate Change)	*2 Year ARI*	*82mm (Includes 9% Increase on TP108 rainfall depth of 75mm)*	*Kāinga Ora and other private developers[1] to use the rainfall data as required for the purpose of stormwater design.*
	10 Year ARI	*136mm (Includes 13.2% Increase on TP108 rainfall depth of 120mm)*	
	100 Year ARI	*199mm (Includes 16.8% Increase on TP108 rainfall depth of 170mm)*	
Water Quality	*Private Impervious Areas*	*Avoid use of exposed high contaminant yielding building materials such as copper and galvanised metals.*	*Kāinga Ora and other private developers[1] to avoid use of high contaminant yielding building materials on all development within the SMA.*
		Provide gross pollutant traps (GPTs) for new impervious areas such as leaf guards on downpipes and spouting, catchpits or similar silt trap devices.	*Kāinga Ora and other private developers[1] to provide GPTs for new private impervious areas.*
		Provide offset water quality treatment mitigation for new hardstand areas on existing untreated public road catchments in accordance with Section 11.1.	*Kāinga Ora to implement the water quality requirements via offset mitigation for private impervious areas.*
		Provide at-source stormwater quality treatment for high contaminant generating exposed carparks servicing over 30 vehicles.	*Kāinga Ora and other private developers[1] to provide water quality treatment for high contaminant generating exposed carparks.*
	Public Impervious Areas	*Provide at source stormwater quality treatment for impervious areas within newly created public road reserves. See Appendix C1 for indicative locations.*	*Kāinga Ora to implement at source water quality requirements at the redevelopment stage.*
Hydrology Mitigation	*Impervious Areas*	*Not Required.*	*Not Applicable*
Conveyance	*Primary Network*	*Provide soakage for 10 year ARI rainfall event via new or existing soakhole.*	*Kāinga Ora and other private developers[1] to provide soakage for private impervious areas.* *Kāinga Ora to provide soakage for offset mitigation treatment devices.*
	Secondary Network	*Size secondary network within private property to allow for conveyance of MPD 100 year ARI event including upstream catchment.*	*Kāinga Ora and other private developers[1] to carry out a detailed site-specific assessment of overland flow paths within or adjacent to their site. This includes the OLFPs shown on the overland flow and flooding plans provided in Appendix C3, and any other local OLFPs not identified in this SMP. Information on OLFPs identified in this SMP will be provided by Candor[3] to support the assessment.*

Flood Management	*Freeboard for habitable floor levels*	*Minimum 150mm freeboard to Maximum Probable Development (MPD) 100 year ARI event water level for all minor overland flow paths with flow of less than 2m³/s and depth of less than 100mm (where adjacent to trafficable areas).*	*Kāinga Ora and other private developers[1] will carry out a detailed site-specific assessment of local flooding areas within or adjacent to their site. This includes the flooding areas shown on the overland flow and flooding plans provided in Appendix C3, and any other local flooding areas not identified in this SMP. Information on flooding areas identified in this SMP will be provided by Candor[3] to support the assessment.* *Kāinga Ora and other private developers[1] will ensure freeboard is provided to new habitable floor levels at individual development stage.*
		Minimum 500mm freeboard to MPD 100 year ARI event water level for all major overland flow paths with flow of more than 2m³/s or depth of more than 100mm (where adjacent to trafficable areas) for vulnerable activities and minimum 300mm for less vulnerable activities as defined in the AUP.	
	Downstream and upstream environment	*Ensure redevelopment does not cause or increase flooding of other properties, due to increased impervious areas and filling in ponding areas, during rainfall events up to 10 year ARI.*	*Kāinga Ora and other private developers[1] will carry out a detailed site-specific assessment of local OLFPs and flooding areas within or adjacent to their site. This includes the OLFPs and flooding areas shown on the overland flow and flooding plans provided in Appendix C3, and any other local OLFPs and flooding areas not identified in this SMP. Information on OLFPs and flooding areas identified in this SMP will be provided by Candor[3] to support the assessment.*
		Ensure redevelopment does not cause or increase inundation of buildings or other properties, due to increased impervious areas and filling in ponding areas, in rainfall events up to 100 year ARI.	
	Hazard risk assessment	*Provide hazard risk assessment in accordance with AUP Chapter E36.*	

1. Private developers within the Kāinga Ora Oranga redevelopment extent covered by this SMP.

11.6 Best Practicable Options (Stormwater Management Toolbox)

Following the WSD principle and using a Best Practicable Option (BPO) approach, a stormwater management device toolbox has been prepared that outlines the available stormwater management devices and their implementation in the Kāinga Ora Oranga redevelopment. The summary of devices is displayed in Table 11.5. To meet the required objectives, the devices selected for the toolbox have been assessed against the following criteria:

- Characteristics of the downstream receiving environment
- Topography
- Existing infrastructure
- Soil parameters
- Construction and maintenance.

All devices shall be designed in accordance with the water quality objectives of GD01 and the design criteria set out by this SMP.

Table 11.5 - Stormwater Device Toolbox

STORMWATER DEVICES	TYPICAL APPLICATIONS		TREATMENT	FLOOD MANAGEMENT	IMPLEMENTATION
	PRIVATE	PUBLIC			
Gross pollutant and silt traps	*Yes*	*No*	*Yes*	*No*	*To be implemented for roof areas on spouting and downpipes and includes devices such as leaf guards, debris diverters, or similar silt trap devices.* *To be implemented for private hardstand areas and includes devices such as catchpits or similar silt trap devices.*
Proprietary Devices	*Yes (Hardstand area)*	*Yes*	*Yes*	*No*	*To be implemented for water quality treatment offset mitigation within public roads. Stormwater 360 Stormfilter or similar will be used.* *Can be implemented to provide stormwater quality treatment for private high contaminant generating exposed carparks servicing over 30 vehicles. Stormwater 360 Stormfilter or similar will be used.*
Raingardens and tree pits	*Yes (Hardstand area)*	*No*	*Yes*	*No*	*Can be implemented to provide stormwater quality treatment for private high contaminant generating exposed carparks servicing over 30 vehicles.*
Localised ponding areas	*Yes*	*No*	*No*	*Yes*	*To be implemented as flood management devices within the catchment.*

12 STORMWATER MANAGEMENT USER MANUAL

A stormwater management user manual will be provided to all developers and future landowners in the Kāinga Ora Oranga redevelopment area. This document will serve as a toolbox to assist private developers with detailed design. The manual will be used in conjunction with this SMP.

The manual will be prepared at a later date and will be included as an addendum to this SMP in Appendix G, following a review from Auckland Council.

13 CONSULTATION

13.1 Mana Whenua

Kāinga Ora has carried out regular consultation meetings with the Mana Whenua in regards to the proposed redevelopment in Oranga area. This includes Te Akitai Waiohoua, Ngati Whatua, Marutuahu, Ngati Tamaoho, and Te Kawerau a Maki. In addition to this, Te Akitai Waiohua and Ngati Tamaoho were involved in the blessings of the first sites and the info centre opened 4 December 2019.

Candor[3] has attended meetings with Te Akitai Waiohua and Marutuahu on 9 August 2019 and 29 August 2019. The objectives of this SMP including the proposed stormwater management approach were presented and discussed. The proposed SMP was acknowledged as to have positive effects on the quality of existing stormwater discharges to the Onehunga aquifer and the safety from flooding the community.

Marutuahu have highlighted that the benefits generated throughout the redevelopment area, as a result of the implementation of this SMP, should be presented and be visible to the community. Kāinga Ora has proposed to engage with the Oranga community through newsletters and community meetings, in order to tell the story of the proposed redevelopment and the positive effects on the water quality and natural hazard safety in the area it will deliver. The first of the Mana Whenua Collective workshops was carried out on the 19th November 2019 and will be ongoing. Mana Whenua acknowledged they had all received draft copies of the SMP.

13.2 Other Stakeholders

Kāinga Ora and Candor[3] has held regular clinics, starting in October 2018, with Healthy Waters, Watercare and Auckland Transport in regards to the management of stormwater for the Kāinga Ora Oranga redevelopment area. Additional meetings were held with Healthy Waters to discuss the specifics of the proposed stormwater management approach.

Health Waters and Watercare agree with the objectives of the proposed SMP to improve the quality of water discharging to ground in the area.

Auckland Transport have been consulted with regards to carrying out stormwater quality offset mitigation within public roads and have not opposed the proposal to date. The detailed design and location of the proposed offset mitigation devices will be coordinated with Auckland Transport at Rngineering Plan Approval stage.

14 CONCLUSION

The Stormwater Management Plan for Kāinga Ora Oranga redevelopment has been developed following the requirements of the Auckland Unitary Plan and using a WSD approach. The objectives set by the proposed SMP will support the vision of the Auckland Plan 2050.

The objectives set by the proposed SMP are:

- Enhance the water quality of stormwater discharge using water sensitive design and at source stormwater management approaches.
- Target water quality treatment for high contaminant generating activities such as high use roads and exposed carparks.
- Provide water sensitive management guidelines for developers.
- Provide criteria to ensure safe conveyance of stormwater runoff through the primary and secondary networks.
- Manage flood risk and ensure the proposed development does not create adverse flooding effects on the upstream and downstream properties.

The design criteria for the proposed SMP are:

- Water quality treatment for the Kāinga Ora Oranga redevelopment will be carried out via the restriction of high contaminant generating building materials, providing gross pollutant and silt traps, and implementing proprietary devices, raingardens or tree pits. Offset mitigation for new private hardstand areas will be implemented on public roads in the area, subject to the private hardstand area not being a high contaminant generating carpark.
- Hydrology mitigation in the form of retention and detention does not need to be provided within the redevelopment catchment.
- Primary Network will accommodate disposal of stormwater from new impervious areas via soakage during events up to 10 year ARI.
- Secondary Network within the Kāinga Ora Oranga redevelopment area will be sized to accommodate the MPD 100 year ARI storm event including climate change.
- Flood Risk Management will be implemented by providing freeboard to habitable floor levels and demonstrating adverse effects of the development on flooding are being mitigated.

The proposed Stormwater Management Plan for Kāinga Ora Oranga redevelopment demonstrates that the stormwater management objectives and requirements set out by the Auckland Unitary Plan have been satisfied. The proposed SMP will contribute towards achieving the values of the Auckland Plan 2050 including protecting the health and wellbeing of communities, improving the health of the natural environment and Mauri of water and creating communities resilient to natural hazards and effects of climate change.

Appendix A: Stormwater Management Context

DOES THIS SITE HAVE AN EXISTING SMP/CMP/ICMP?	*Yes ☐*	*No ☑*	*Not yet known ☐*
DOES THIS SITE HAVE AN EXISTING NDC OR CURRENTLY UNDER REVIEW NDC?	*Yes ☑*	*No ☐*	*Not yet known ☐*
IS THE SITE WITHIN AN IDENTIFIED PRECINCT (AUP) OR STRUCTURE PLAN?	*Yes ☐*	*No ☑*	*Not yet known ☐*
WHICH SMAF ZONE IS THE SITE IN?	*1 ☐*	*2 ☐*	*Not Applicable ☑*
ARE THERE ANY HIGH CONTAMINANT GENERATING ACTIVITIES PROPOSED IN YOUR SITE?	*Yes ☐*	*No ☐*	*Not yet known ☑*
DOES THE SITE CONTAIN OR SIT ADJACENT TO ANY STREAMS?	*Yes ☐*	*No ☑*	*Not yet known ☐*
DOES THE SITE CONTAIN ANY OVERLAND FLOW PATHS?	*Yes ☑*	*No ☐*	*Not yet known ☐*
IS THERE CAPACITY IN DOWNSTREAM STORMWATER PRIMARY NETWORK? (PIPE OR CHANNEL)	*Yes ☐*	*No ☐*	*Not yet known ☑*
DOWNSTREAM FLOOD RISK OR EVIDENCE OF PAST FLOODING?IS THERE ANY	*Yes ☑*	*No ☐*	*Not yet known ☐*
ANY SIGNIFICANT ECOLOGICAL AREAS WITHIN OR ADJACENT TO YOUR SITE?	*Yes ☐*	*No ☑*	*Not yet known ☐*
ANY SIGNIFICANT AREAS OF VEGETATION WITHIN OR ADJACENT TO YOUR SITE?	*Yes ☐*	*No ☑*	*Not yet known ☐*
ANY AREAS OF SOIL CONTAMINATION WITHIN OR ADJACENT TO YOUR SITE?	*Yes ☑*	*No ☐*	*Not yet known ☐*
IS YOUR SITE WITHIN AN AQUIFER PROTECTION AREA?	*Yes ☑*	*No ☐*	*Not yet known ☐*
WHAT IS YOUR TOTAL SITE AREA?	*Less than 1000m^2 ☐*	*Between 1000 and 5000m^2 ☐*	*More than 5000m^2 ☑*

Appendix B: Aquifer Assessment Report

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solutions for your environment

23 May 2019

Carl Whitten
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Dear Carl

ASSESSMENT OF STORMWATER DISPOSAL THROUGH SOAKAGE FOR PROPOSED ORANGA DEVELOPMENT

1.0 Introduction

Housing New Zealand (HNZ) is currently looking to redevelop their properties within the area in Onehunga known as Oranga. The redevelopment will be in accordance with the development plan as provided (dated 25 May 2018).

Pattle Delamore Partners Limited (PDP) have been requested by Candor 3 (C3) to review the proposed residential development to determine the potential implications of stormwater disposal to soakage utilising the work carried out as part of the Groundwater Aquifer Study (GAS) programme. The GAS was part of the Integrated Catchment Study (ICS) conducted by Auckland City Council (ACC) (now defunct).

2.0 Objectives

The overall objectives of this assessment are:

- To consider the applicability of the results of the modelling work carried out as part of the GAS programme to the proposed Oranga development in respect of stormwater disposal through soakage.
- To consider the effects of the stormwater disposal through soakage from the proposed development in relation to the Greater Onehunga Aquifer.
- To recommend design considerations for the detailed design of stormwater soakage systems within the proposed development.

3.0 Background

Disposal to soakage for stormwater has been the preferred solution for drainage on the Auckland Isthmus in all areas with volcanic soils. As such there are no major stormwater networks within these soakage areas. Ongoing development has resulted in a reduction of pervious area and a greater generation of stormwater runoff which needs to be accommodated by the soakage capacity of the basalt aquifers of the isthmus. These major basalt aquifers on the isthmus are shown in Figure 1.

To understand the potential effect of the proposed development in relation to stormwater disposal via soakage background information relating to the previous work carried out by PDP in understanding the efficiency and capacity of the basalt aquifers is given in Appendix A.

The main conclusions of the scenario analysis carried out as part of the GAS programme were summarised as follows:

- The aquifers have the capacity to accept recharge of more than 160,000 cubic metres per day which is more than double the current recharge of 73,000 cubic metres per day.
- Less than 1 to 15%, depending upon scenario, of the aquifer area is affected by groundwater breakout.
- Disposal of stormwater generated outside the aquifer boundary is possible in the upper extents of the main aquifers.
- Aquifer groundwater volumes increase in greater recharge scenarios and thus the existing water supply users will not be affected in particular:
  - Watercare Onehunga water supply
  - Existing wetlands
  - Western Springs Lake
  - Motions and Meola Streams
  - Other industrial groundwater users

The study also identified areas where groundwater breakout is an issue, and these could be dealt with by implementing engineering works to reduce the impact of elevated groundwater levels.

These breakout and elevated groundwater areas are of relevance to the Oranga development as one of these areas exists along the eastern boundary of the area under consideration. Therefore, a review of the GAS data and the current knowledge of the area is required to determine if the conclusions drawn from the GAS project are relevant to the Oranga development. This review is discussed in the following sections.

4.0 Review of Proposed Development

The proposed development will involve the construction of 2-3 storey terraced houses and associated driveways and carparking within the Oranga area. The specific objectives for stormwater discharge through soakage are:

- Provide soakage capacity for 10 year ARI rainfall event including climate change
- Consider soakage interference effects
- Achieve long-term performance for soakage systems through treatment of stormwater discharge
- Ensure underlying aquifer has capacity to accommodate the additional stormwater discharge volumes

The proposed development will also provide an opportunity to provide for soakage systems designed to be more efficient and potentially have a greater capacity than the current soakage systems at the existing properties. This will reduce surface runoff and potential flooding in the area for the design storm events.

5.0 Comparison with GAS Project Modelling

As part of the GAS programme, a range of scenarios were investigated to examine groundwater behaviour and potential effects on groundwater users and uses on the Auckland Isthmus. These scenarios considered existing and future conditions, including likely extremes of the most probable 2050 climate scenarios and maximum probable and maximum possible imperviousness. A breakdown of each scenario is given in Table 1.

Table 1: Summary Breakdown of Scenarios Analysed

Recharge Options		1	2	3	4	5	6	7	8
Land Use	Existing	✓	·	·	·	✓	·	·	✓
	Future	·	·	·	✓	·	✓	✓	·
	100% Recharge	·	✓	✓	·	·	·	·	·
Rainfall	Existing	✓	✓	·	✓	·	·	·	✓
	Wet	·	·	✓	·	✓	✓	·	·
	Dry	·	·	·	·	·	·	✓	·

Scenarios 4 and 6 (future land use (maximum probable development (MPD)) with both current and wettest future rainfall conditions) of the GAS modelling scenarios are the ones most likely to reflect the proposed development; as such the following information relates to these scenarios.

Both scenarios were analysed under future land use conditions, whereby the recharge fraction for residential areas within the aquifer boundary was increased to reflect the potential maximum level of imperviousness. For the Oranga development region, a minimum percentage recharge through soakage of 90% was used within the proposed development zone apart from the open space areas which have a percentage recharge (natural soakage related) of 43%.

From the scenario modelling, there is a groundwater level increase of between 0.1 – 0.3 m within the basalt aquifer in the area of interest (the Oranga development) for scenario 6 compared to scenario 4.

The wettest year from a synthetic data set of 50 years for a possible future climate (developed for the ICS project), was used for scenario 6. This can be considered a worst-case scenario for the proposed development.

From the GAS modelling of an area of shallow groundwater (<2m bgl) was located partially within the Oranga development region and is shown in Figure 1. No regions of breakout were identified within the proposed development area.

Similarly, from the scenarios modelled for the GAS project, it is seen that there is additional capacity within the aquifer to accept a greater recharge in the upper and mid aquifer zone areas with slight increases in the area of already existing groundwater breakout areas. The proposed Oranga development can be considered as being in the mid aquifer zone of the Onehunga Aquifer.

The findings from the GAS programme are summarised in Appendix A.

SITE LOCATION

KEY :

- HNZ PROPERTIES
- STORMWATER EXCLUSION ZONE
- SHALLOW GROUNDWATER ZONE
- SITE AREA

CONTOURS

- MAJOR
- MINOR

SOURCE:
1. AERIAL IMAGERY (FLOWN 2017), SERVICES AND CONTOUR DATA (VERTICAL DATUM AUCKLAND 1946) PROVIDED UNDER LICENCE FROM AUCKLAND COUNCIL WHO MAKES NO CLAIMS AS TO ITS RELIABILITY, ACCURACY OR ADEQUACY FOR ANY PARTICULAR PURPOSE.
2. CADASTRAL/TOPOGRAPHICAL INFORMATION AND INSET DERIVED FROM LINZ DATA.
3. PARCEL DATA SOURCED FROM HLC NEW ZEALAND

NO.	REVISION	DATE	APP.
A	ISSUE 1	MAY 19	

CLIENT : HLC

PROJECT : ASSESSMENT OF STORMWATER DISPOSAL THROUGH SOAKAGE FOR PROPOSED ORANGA DEVELOPMENT

TITLE : FIGURE 1: PROPOSED ORANGA DEVELOPMENT, EXCLUSION ZONE AND SHALLOW GROUNDWATER

pdp solutions for your environment
PATTLE DELAMORE PARTNERS LTD
Auckland Tauranga Wellington Christchurch

SCALE :1:5,000 (A3)

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METRES

PROJECT NO. :	FIGURE NO. :	REVISION :
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6.0 Discussion

6.1 Effects of Proposed Development

The results of the GAS modelling are considered to of a scale that is relevant the proposed Oranga development with the GAS modelling scenario 6 (wet) representing a worst-case situation i.e. the maximum disposal of stormwater to soakage across the catchment area. The affect on the groundwater levels predicted by the GAS modelling therefore represents the type of potential effect that the disposal of stormwater to soakage from the proposed development when considered on an area pro-rata basis. The proposed development covers approx. 483,000 m^2 against the overall Onehunga aquifer area of approx. 26,991,400 m^2 (approx. 1.8%).

From the GAS modelling for the Greater Onehunga Aquifer, the increase in groundwater breakout area from the current (2004) situation to the MPD scenario with almost 100% recharge was 38,000 m^2. On an area pro rata basis, the proposed development would then increase the breakout area by 680 m^2. Similarly, with the shallow groundwater areas, the modelled area with almost 100% recharge is 365,000 m^2 and the increase as a result of the proposed development would be 6,600 m^2.

The extent of the modelled area of groundwater breakout and shallow ground water are shown in Figure 1.

6.2 Stormwater Effects Management

In order to minimise the potential increase in the area of the shallow groundwater zone due to the proposed development, an exclusion zone has been defined in the east where the development overlies the existing shallow groundwater zone. This exclusion zone requires that only stormwater generated from the design storm events in this zone is to be disposed of through soakage to the underlying basalt aquifer. This applies up to the design event (10 year ARI event) recognising that stormwater from outside the zone may have to be disposed of in the zone during rainfall exceeding the design event due to the zone being downslope of other parts of the development. In addition, where possible stormwater collected within the exclusion zone should be disposed of outside the zone to minimise recharge within the zone.

All stormwater generated outside the exclusion zone will need to be disposed of outside the zone i.e. not conveyed into the exclusion zone. This will require the design of stormwater collection systems and soakage devices to collect all stormwater from the 10 year ARI event such that the soakage devices are located outside the exclusion zone. It is therefore important that soakage devices are located as close as possible to the source of generation. The potential for interference between soakage devices must however also be considered (refer next section).

6.3 Soakage Device Interference Considerations

Interference effects between soakage devices (boreholes) can result because as the distance between boreholes decreases the maximum soakage rates for a single borehole (or soakage device) are reduced for each borehole (or soakage device). The interference effect concept is illustrated on Figure 2.

The interference effect of one borehole on another means that, with both boreholes operational, the drawups/cones of impression at each are increased over what would be expected for a single borehole. This effectively reduces the available unsaturated thickness and therefore reduces the maximum inflow rate. The amount by which the inflow rate is reduced depends on the aquifer conditions and the distance between the boreholes.

Recent work for the Auckland basalt aquifers has indicated that for two boreholes within 50 metres of each other, the theoretical maximum inflow rate per borehole is typically reduced by around 10%; for two boreholes one metre apart it is reduced by approximately 40% per borehole; and for three bores 1 m apart

(i.e. the spacing of the bores within the soakage chamber) the reduction is approximately 55% per borehole. This means that by placing three boreholes 1 m apart, the total maximum inflow rate of the three would be approximately 165% (55% + 55% + 55%) that of a single borehole.

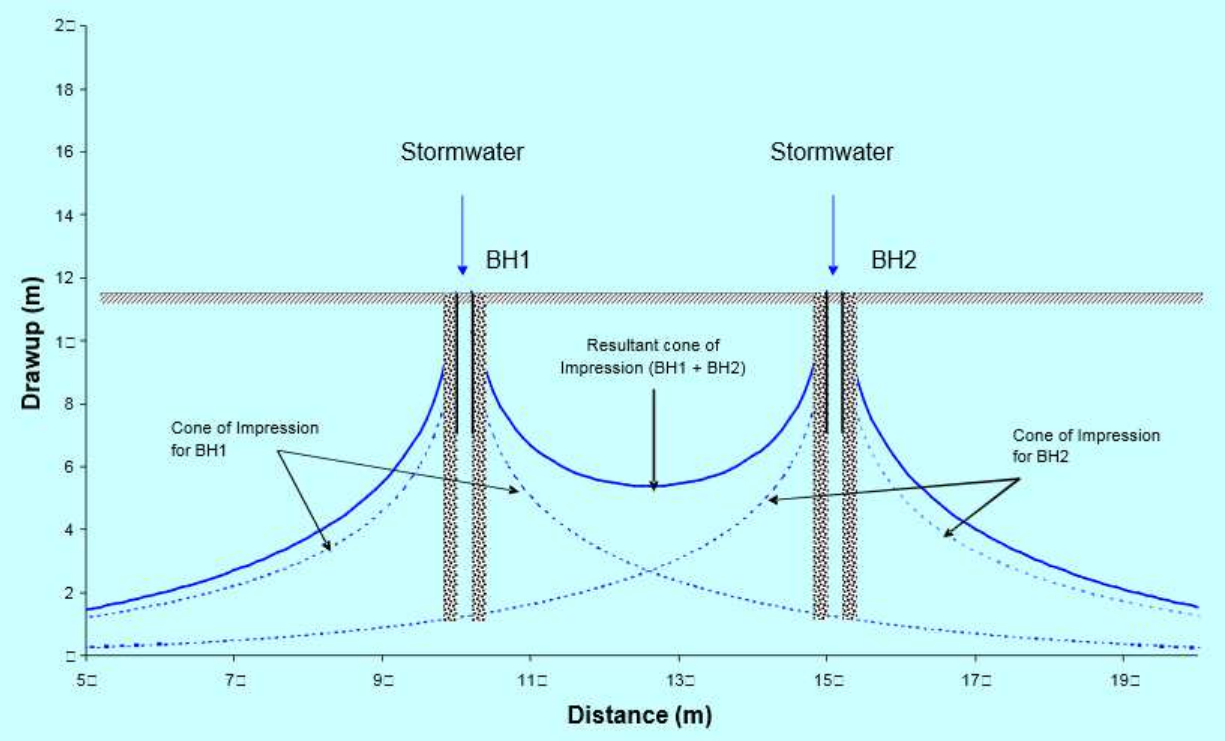

Figure 2: Soakage Device Performance and Interference

The design of the soakage systems and devices (location and operation) should take these interference effects into account. These effects are determined by the configuration of the soakage devices and the characteristics of the basalt aquifer in terms of available depth of unsaturated and saturated basalt, size of soakage boreholes and the local permeability of the fractured basalt aquifer.

The tables below provide a summary of our assessment of the effects of interference on the performance of soakage bores and devices for specific configurations that reflect the aquifer characteristics across the major portion of the development (i.e. the western area of the proposed development).

Two tables are presented:

- the first shows the reduction in performance per standard device, normalised to a single isolated standard device which would be considered to show no reduction;
- the second shows the reduction per borehole normalised to a single isolated bore which would also be considered to show no reduction.

The basis for the results calculated in the tables is summarised in Appendix B.

This allows calculation of the total reduction to be made where the performance of a single device is known (the first table) or where the performance of a single borehole is known (the second table). The following steps are suggested for use of the tables:

1. Determine whether soakage rate is that for a bore or a standard device.
2. If the soakage rate is for a standard device then, using Table 2, reduce the device capacity as indicated for the configuration in question. This will give the new rate per device. Multiply by the number of devices to obtain the total soakage capacity of the group.

3. If the soakage rate is for a single borehole (e.g. a test borehole) then, using Table 3, reduce the borehole capacity as indicated for the configuration in question. This will give the new rate per borehole. Multiply by the number of boreholes (e.g. 3 standard devices = 9 boreholes) to obtain the total soakage capacity of the group.

Table 2: Soakage Rate Reduction (Device Normalised)

	Device Spacing (m)					
Number of Devices	**0**	**5**	**10**	**20**	**30**	**50**
1	0%	-	-	-	-	-
2	-	37%	32%	27%	23%	20%
3	-	54%	49%	42%	37%	30%
4	-	62%	57%	49%	44%	35%

Notes:
1. *See comments and assumptions in Appendix B for limitations on use of this table.*

Table 3: Soakage Rate Reduction (Borehole Normalised)

	Device Spacing (m)					
Number of Devices	**0**	**5**	**10**	**20**	**30**	**50**
1	56%	-	-	-	-	-
2	-	72%	70%	68%	66%	65%
3	-	80%	77%	74%	72%	69%
4	-	83%	81%	78%	75%	72%

Notes:
1. *See comments and assumptions in Appendix B for limitations on use of this table.*

For the design the above two tables will need to be adjusted for areas where the average conditions are not applicable – e.g. within the exclusion zone.

7.0 Conclusions and Recommendation

Overall the conclusions of this assessment are:

- The Greater Onehunga Aquifer has the capacity to accept the additional stormwater from the proposed development with the groundwater breakout areas and areas of shallow groundwater being similar to or less than those modelled by the GAS modelling.
- Over the major portion of the area the characteristics of the basalt aquifer is suitable for the development of soakage devices.

The main conclusions of assessing the applicable GAS scenarios can be summarised as:

- For future development under wet conditions (scenario 6), 13% of the Oranga development region is affected by groundwater levels that are between 1.2 – 2m below ground level.

- For future development under current conditions (scenario 4), 12% of the region is affected by groundwater levels that are between 1.3 – 2m below ground level.
- Aquifer groundwater depths remain similar for both scenarios 4 and 6 and thus the existing water supply users and uses are not expected to be adversely affected.

It is recommended that:

- A stormwater exclusion zone of approx. 66,000 m^2 be established in the south-eastern region of the site as shown in Figure 1. This area is to have only stormwater generated within the zone disposed of within the zone. The design of soakage devices within this area are also to take the interference effects into account (e.g. spacing and location).
- The design of stormwater systems outside of the exclusion zone along the eastern boundary of the development will require that this stormwater is disposed of through soakage devices located outside the exclusion zone.
- The design and location of the soakage devices are required to take the potential interference effects into account as part of the detailed design of the stormwater systems.

In line with findings of the GAS study (Appendix A), there are no unexpected effects arising from increasing stormwater disposal through soakage for the proposed development and that the findings and recommendations are followed. The recommended management measures put forward are consistent with the GAS conclusions namely, the GAS study has also identified areas where groundwater breakout is an issue and these can be dealt with by implementing engineering works to reduce the impact of elevated groundwater levels.

8.0 References

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9.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Candor3. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Candor3 for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Yours faithfully

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Appendix A – Background Information from Gas Study (PDP, 2005)

Background regarding Scenario Modelling

Between 2003 and 2005, PDP carried out the GAS programme as part of the ICS looking at the groundwater system in the basalt aquifers that lie beneath the Auckland Isthmus.

The GAS project had several specific requirements and objectives that were documented in the Stage 1A report (PDP, 2003). These were:

- Identify potential sources of contaminants entering the aquifer to assess transport through the aquifer and potential impact on the environment;
- Evaluate the long-term, sustainable and optimal disposal of stormwater through soakage and identify new areas of soakage;
- Provide means for evaluating groundwater flow through regional and local models;
- Model the different management scenarios to enable optimal and prioritised remedial works to be assessed; and
- Support the resource consent process as required.

The study area covered the Auckland Isthmus and the area under the jurisdiction of the ACC (now defunct). The isthmus separates the Waitemata and Manukau harbours that form the northern and southern boundaries of the city. The land surface of the isthmus rises in poorly defined steps to the Waitakere Ranges with small volcanic hills scattered over the area. It is these volcanic hills and related lava flows that form the basalt aquifers which were the focus of the GAS project (Searle, 1981).

The basalt aquifers were formed following eruptions and the extrusion of lava where the basaltic lava fractured on cooling (shrinkage cracks). The fractures result in the rocks having a high permeability. Consequently, no significant surface waterways have developed on the lava surfaces with rainfall instead passing quickly through the lava to groundwater and downgradient surface waterways.

A Regional Model was developed that covered the basalt lava flows on the Auckland Isthmus excluding the Mt Roskill/Mt Albert flows, the Mt Richmond/McLennan Hills flows and CBD basalt flows. The information obtained from the Stage 1A and 1B phases of GAS Project were used to develop this regional conceptual model. This conceptual model was used as a basis for the final numerical model. In general, the model encompasses the two main aquifers on the Auckland Isthmus, viz. The Greater Onehunga and Greater Western Springs Aquifers.

Two modelling software programs were used in the development of the Regional Model: Visual Modflow (WHI, 2003) and MikeSHE (DHI, 2002). The Visual Modflow (Vmodflow) model was used to calibrate the regional model under steady state conditions and MikeSHE was used to calibrate the model under transient conditions.

Following suitable calibration, a range of scenarios were investigated to examine groundwater behaviour and potential effects on groundwater users and uses. These scenarios considered existing and future conditions, including likely extremes of the most probable 2050 climate scenario and maximum probable and maximum possible imperviousness.

The main conclusions of the scenario analysis were summarised as:

- The aquifers have the capacity to accept recharge of more than 160,000 cubic metres per day which is more than double the current recharge of 73,000 cubic metres per day.

- Less than 1 to 15%, depending upon scenario, of the aquifer area is affected by groundwater breakout.
- Disposal of stormwater generated outside the aquifer boundary is possible in the upper extents of the main aquifers.
- Aquifer groundwater volumes increase in greater recharge scenarios and thus the existing water supply users will not be affected in particular:
  - Watercare Onehunga water supply
  - Existing wetlands
  - Western Springs Lake
  - Motions and Meola Streams
  - Other industrial groundwater users

The study also identified areas where groundwater breakout is an issue, and these could be dealt with by implementing engineering works to reduce the impact of elevated groundwater levels.

Summary & Conclusions

What we aimed to do

The GAS project had a number of specific requirements and objectives that were documented in the Stage 1A report (PDP, 2003). These were:

- Identify potential sources of contaminants into the aquifer for assessment of their transport through the aquifer and their potential impact on the environment;
- Evaluate the long-term, sustainable and optimal disposal of stormwater through soakage and identify new areas of soakage;
- Provide means for evaluating groundwater flow through regional and local models;
- Model the optimal and prioritised remedial works;
- Support the resource consent process as required.

What we found out

These objectives were generally achieved and in some cases the focus of the objectives was changed to accommodate the progressive evaluation of the information during the progress of the project. The project did evaluate the following:

- The long term effects of soakage on the aquifer with respect to the volume of stormwater entering the aquifer;
- The potential of the aquifer to accommodate additional soakage;
- The effect of stormwater quality entering the aquifer as soakage has on the groundwater quality;
- The extent of potential groundwater breakout under current conditions and under potential future conditions.

In summary the GAS project has found that:

- The aquifers have the capacity to accept greater than double the existing recharge;

- Less than 1 to 15% of the aquifer area is affected by groundwater breakout;
- Disposal of stormwater generated outside the aquifer catchment boundary is possible;
- Aquifer groundwater volumes remain similar in all scenarios and thus the existing water supply users, wetlands, springs and the groundwater fed lake at Western Springs will not be affected;
- The aquifer continues to behave as it has in the past and that with increased recharge due to development and additional soakage the groundwater levels do increase slightly;
- The groundwater management plans for the two aquifers should be updated taking the results of this study into account;
- Clogging is unlikely to be a major issue in a regional sense. It will still be an issue for individual soakholes and these will still require regular maintenance;
- The unsaturated zone does filter out contaminants, effectively treating the stormwater as it flows to the permanent groundwater zone.

What we will do about the findings

These findings will be used to optimise soakage as stormwater disposal option for areas where stormwater is an issue. The possibility to take stormwater generated outside the extent of the aquifer and dispose of it through soakage is also another option that can be evaluated at a local level. Soakage therefore represents a real alternative to the handling and disposal of stormwater generated on the surface of Auckland City.

The study has also identified areas where groundwater breakout is an issue and these can be dealt with by implementing engineering works to reduce the impact of elevated groundwater levels.

Local project level solutions can now be examined in the light of these findings and soakage as a method of disposing of stormwater can be further examined.

Appendix B – Basis for Calculated Results in Soakage Interference Tables

The results relating to the assessment of the calculation of percentage interference in the presented tables is based on the comments and assumptions as follows:

- It is critical to understand that interference is configuration-specific both in terms of numbers of devices and layout. The configuration used for this assessment assumes a linear alignment of up to 4 devices with separations between devices being as shown in the tables. Other configurations will have different interference characteristics and the tables should not be used for these;
- A standard soakage device is taken to comprise three 100 mm diameter boreholes through the base of a soakage chamber mutually separated by 1 m;
- The calculations assume a 10 m unsaturated basalt thickness and a 20 m saturated thickness, although the results are not sensitive to changes in these parameters;
- The calculations assume a constant soakage inflow over a period of 1 day;
- Permeability of 5 x 10-4 m/s and storage of 8% are taken as representative for the basalt;
- It is assumed that the flow directed to each bore/device is the same;
- The maximum soakage rate is taken as the rate at which water levels in any of the soakage devices would reach ground level;

The calculations are based on the work of Theis which assumes a uniform and isotropic aquifer. Local conditions may vary significantly from this and therefore the results should be considered indicative only.

Appendix C: Stormwater Modelling Report

Candor³
ENGINEERING FOR LIFE

Kāinga Ora Oranga Redevelopment

STORMWATER MODELLING REPORT

6 APRIL 2020

1 DOCUMENT CONTROL RECORD

Client	Kāinga Ora
Project	Kāinga Ora Oranga Redevelopment
Document	1317_ KāingaOra _Oranga_StormwaterModellingReport

2 ISSUE INFORMATION

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4 EXECUTIVE SUMMARY

This document, and any attached, supports the proposed Stormwater Management Plan for the Kāinga Ora Oranga redevelopment. The report, and stormwater modelling results, show that the proposed redevelopment will have less than minor effects on the overall flooding within the One Tree Hill and Onehunga catchments.

A hazard risk assessment completed for the Kāinga Ora Oranga redevelopment has shown that the risk to people, buildings, infrastructure, and the environment has been mitigated as a part of the proposed redevelopment.

5 PURPOSE AND LIMITATIONS

5.1 Purpose

The scope of this flood analysis was to assess the impact the Kāinga Ora Oranga redevelopment would have on existing flooding and overland flows in the stormwater management area (SMA). This analysis was based on an existing stormwater hydraulic model completed by Tonkin + Taylor. The purpose of this assessment was to:

- Ensure the Kāinga Ora Oranga redevelopment does not cause adverse effects on existing flooding and overland flows during the 10 and 100 year ARI rainfall events within public road, public open spaces, and other private properties within the SMA.
- Ensure the risk from flooding within the Kāinga Ora Oranga redevelopment SMA on people, buildings, infrastructure, and environment is remedied, mitigated, or minimised.

5.2 Limitations

The hydraulic model completed by Tonkin + Taylor was built using relatively large sub-catchments. These can be up to 21 hectares in size, with an average of 1.8 hectares across the entire model. As a result, there may be internal overland flow paths and localised flooding areas present within these sub-catchments, which are not represented in the hydraulic model. All developers within the Kāinga Ora Oranga redevelopment area will carry out an additional assessment of effects of their development on any localised flooding areas and overland flowpaths within, or adjacent to their site, which are not shown or outlined in this report.

The flood modelling analysis completed by Candor³ is a high-level assessment and addresses the management of effects of flooding at a global scale. A detailed site-specific flood assessment and design subject to Auckland Council approval will be provided by Kāinga Ora and other private developers as a part of a resource consent application and Engineering Plan Approval (EPA) for individual super lots.

6 INTRODUCTION

The Kāinga Ora Oranga redevelopment is located in the suburb of Oranga and falls within the One Tree Hill and Onehunga catchments. The area is underlain by fractured basalt which sits above the Onehunga Volcanic Aquifer. Stormwater from the Kāinga Ora Oranga redevelopment is proposed to discharge to the fractured basalt.

A stormwater hydraulic model for the One Tree Hill Catchment was previously completed by Tonkin + Taylor. This model was updated to analyse the effects of the proposed redevelopment on the existing flooding and overland flow paths in the catchment. The analysis of effects was undertaken in accordance with the AUP Sections E8 and E36. Modelling was completed using DHI MIKE 2017 Software.

The flooding and overland flow analysis was used to complete a hazard risk assessment in accordance with AUP Section E36.9.

7 FLOOD MODELLING

The Kāinga Ora Oranga SMA has been modelled using the existing Auckland Council stormwater hydraulic model. This model has been updated to incorporate the proposed Kāinga Ora Oranga redevelopment.

Two redevelopment scenarios have been investigated. The first is the proposed development (PD) scenario incorporating the proposed Kāinga Ora Oranga redevelopment changes. The PD scenario simulated the effects of the Kāinga Ora Oranga redevelopment on the catchment under existing development conditions. This enabled flood analysis to ensure that there are no adverse effects on the surrounding catchment. The second is the maximum probable development (MPD) which assessed the entire catchment at the maximum development levels under the current Auckland Unitary Plan limits. The MPD model incorporated the bathymetry and soakage potential changes proposed as a part of the Kāinga Ora Oranga redevelopment only. Analysis of the MPD scenario allowed flood risk assessment to be carried out, and ensure that the proposed redevelopment will not increase the flooding risk in the area and cause long-term adverse effects within the catchment.

7.1 EXISTING DEVELOPMENT

The original Auckland Council model was run using 2014 MIKE software. To remove any possible discrepancies between versions, the original ED and MPD models were re-run using the 2017 version of MIKE. These re-run models became the benchmark for all the following flood analysis.

The existing flooding during 10 and 100 year ARI storm events extends beyond the Kāinga Ora Oranga SMA. Existing flood maps from the 2017 benchmark models have been included in Appendix C2.

In general, flooding is restricted to the public road reserve, however due to some lots in the catchment being situated below the height of the road, the overland flows do pass through private property. There are also several larger ponding areas such as Fergusson Domain and Bassant Reserve. These are shown within Appendix C2. The overall catchment has an imperviousness of roughly 48%, whilst the lots are approximately 39%.

7.2 PROPOSED DEVELOPMENT

For the PD scenario, the existing Auckland Council One Tree Hill model was used, including updates to catchments, imperviousness levels, roughness, and the bathymetry for the Kāinga Ora Oranga redevelopment area. This was done to assess how the proposed redevelopment would affect existing flooding within the Kāinga Ora Oranga SMA and the wider catchment.

7.2.1 BATHYMETRY

The topography of the Kāinga Ora Oranga SMA has been changed as follows;

- Residential lots within the proposed Kāinga Ora Oranga redevelopment have been elevated above the 100 year ARI flood levels;
- Proposed future legal roads, private accessways, and car parks have been modelled to accommodate existing overland flow paths where appropriate. This was based on the current concept development plan prepared by Isthmus. A copy of this plan is included in Appendix C1.

Existing overland flow paths have been retained within the existing flow corridor where possible.

It should be noted that superlots along Oranga Avenue (OL16, OL8, and OL3) have been modelled for increased imperviousness and roughness changes, however bathymetry changes have been excluded due to the large mesh spacing. The effects on overland flows through these superlots will be subject to detailed design.

12 Houpara Street has been included in the Kāinga Ora Oranga SMA. This lot was not included in the stormwater analysis; however we do not believe that it will cause adverse effects on flooding in the area. The effects of this lot on the existing overland flow paths will be subject to detailed design.

7.2.2 CATCHMENTS

Catchments within the Kāinga Ora Oranga SMA were amended to reflect the proposed redevelopment changes, including the updated bathymetry. Catchments outside of the Kāinga Ora Oranga SMA extents were not changed.

Drainage areas of catchments within the Kāinga Ora Oranga SMA were updated to maximum development levels as specified by the AUP (60% impervious for lots. This resulted in an increase in impervious area of approximately 5 hectares. The majority of this increase was due to the increase in private roof area.

7.2.3 ROUGHNESS

The surface roughness Manning's M coefficient was changed to 10 for all Kāinga Ora Oranga redevelopment areas. Manning's M is equal to the inverse of Manning's n ($M = \frac{1}{n}$).

Roughness sensitivity analysis, using Mannings M values of 33 and 50, was carried out to assess the impact roughness has on flooding within the SMA. Results, when compared to the Manning M value of 10, show increased runoff depth through superlots OL16, OR8, and OL3 - these lots are subject to detailed design as discussed in Section 7.2.1. Throughout the remainder of the redevelopment, there are increases in flood depth downstream of storage areas. To mitigate this a storage to RL of the peak flood water surface will be used to ensure flood attenuation volumes are maintained irrespective of future roughness. The storage to RL is a combination of dead and live storage. Dead storage is the volume of water contained below the point at which the overtopping from the storage area occurs. Live storage is the volume of water contained above the point at which the overtopping from the storage area occurs. For example, the point at which overtopping occurs could be represented by the crest of an accessway that is used as a storage area. Dead storage would be the volume contained within the accessway below the level of the crest. Live

storage would be the volume contained above the level of the crest, which is created by the depth of water required to convey the overflow over the crest.

7.2.4 MIKE URBAN TO MIKE 21 MAX FLOW RATE

The existing model allows for the disposal of stormwater runoff via soakage up to the 2 year ARI peak discharge rate for roof area in private lots, and 5 year ARI peak discharge rate for all public impervious areas. All runoff from the 'pervious' catchments is not considered in max flow capacity calculation.

The Kāinga Ora Oranga redevelopment SMP proposes to set the max flow (soakage capacity) for all private lot roof areas of the Kāinga Ora Oranga redevelopment lots to the 5 year ARI runoff discharge rate. This is to reflect the proposed upgrades to existing private soakage devices within the proposed redevelopment lots. Max flow for MIKE 21 to MIKE Urban links has been updated for all redevelopment catchments to incorporate the proposed increased soakage capacity of Kāinga Ora Oranga redeveloped lots.

In order to assess the effects of the proposed increased soakage capacity on the flooding in the area, a sensitivity analysis was carried out. The purpose of the sensitivity analysis was to quantify the effects of the increased flow capacity on the proposed flood mitigation measures. The ED10 and ED100 models were re-run with the max flowrates of the Kāinga Ora Oranga redevelopment catchments increased to allow for the 5 year ARI runoff from roof areas. This increase was calculated by adding the difference of the 2 year ARI and 5 year ARI ROOF catchments to the max flow for each node. This resulted in an overall peak flowrate increase of 0.586m^3/s across the entire Kāinga Ora Oranga redevelopment catchment area.

The comparison to the original ED10 scenario, showed minor improvements in flood depth spread throughout the SMA. Flood depth reductions of note occurred in; Fergusson Domain, of approximately 20mm; to the south of Mount Smart Road, of approximately 50mm; and to the east of Rockfield Road, of approximately 130mm. The comparison to the proposed PD10 scenario showed a notable change to the east of Rockfield Road. This area showed a flood depth increase of approximately 130mm, where there was previously none when compared to the original ED10 scenario. Within Fergusson Domain a flood depth increase of approximately 45mm increased to approximately 65mm, and a previous flood depth improvement of approximately 50mm to the south of Mount Smart Road showed no change. Flood depth comparison maps are included in Appendix C2.

The ED100 analysis shows similar results to the ED10. The largest flood depth reductions due to the soakage increase are to the east of Rockfield Road at approximately 120mm, south of Mount Smart Road at approximately 95mm, and to the west of Waitangi Road at approximately 105mm. Comparing the PD100 to this sensitivity run showed reduction of the flood depth improvements with no significant flood depth increases, in accordance with the computational limitations noted in Section 8.

The sensitivity analysis has shown limited effects of the increased flow capacity on the proposed flood mitigation measures. Due to the generally poor condition of the existing soakholes and the improvements being carried out as a part of the Kāinga Ora Oranga redevelopment, it is unlikely the existing soakholes will be operating at the same capacity as the new soakholes. We believe the risk of increased flood depths as shown by this sensitivity analysis is less than minor.

7.3 MAXIMUM PROBABLE DEVELOPMENT

The MPD scenario incorporated the same changes outlined in the above sections. However, the Kāinga Ora Oranga redevelopment lots have been incorporated with the MPD catchments supplied by Auckland Council. This was done to ensure that the effects of the proposed redevelopment on flooding in the wider catchment would be less than minor in the MPD scenario.

8 FLOOD ANALYSIS

Analysis of the PD and MPD scenarios was undertaken to assess the effects of the Kāinga Ora Oranga development on flooding within the One Tree Hill catchment. The analysis was undertaken for both the 10 and 100 year ARI rainfall events under proposed development conditions. The effects of the PD scenarios were assessed against the 2017 benchmarked version of the Auckland Council existing development model.

Any flood depth increase of less than 20mm was considered to be a result of computational inconsistencies (noise) and was assumed to be less than minor. The tolerance was determined by comparing the results of two separate runs. The first run served as the benchmark, whilst the second run was a trial incorporating minor changes. The changes were made outside of the overland flow network and floodplains affecting the proposed redevelopment. The second run had the following changes:

- Bathymetry raised by 500mm in an area
- Bathymetry and nodes raised by 400mm in an area
- Two nodes were relocated a small distance

The comparison of the two runs showed differences in the flooding depths of up to 100mm throughout the overall development. It was found that filtering out differences of less than 20mm left an acceptable level of dispersion in the model. This assessment was computed using the 100 year ED model.

8.1 EFFECTS OF FLOODING WITHOUT MITIGATION

To investigate the effects of the Kāinga Ora Oranga redevelopment on flooding within the area, the 10 year ARI and 100 year ARI flood models were assessed – including the proposed redevelopment model updates. Existing overland flow paths were maintained through Kāinga Ora Oranga redevelopment lots where appropriate.

The results showed increased flooding within private and public property outside of the Kāinga Ora Oranga redevelopment area in both the 10 year ARI and 100 year ARI scenarios.

8.1.1 10 YEAR ARI RAINFALL EVENT

When compared to the ED model, the 10 year ARI PD model shows increased flood depths of up to 300mm within private property outside of the Kāinga Ora Oranga redevelopment along Waitangi Road, Oranga Avenue, Felix Street, and Rockfield Road. A full flood map is included in Appendix C2.

Increase in flooding within the public road reserve was observed along Waitangi Road, State Avenue, Rockfield Road, Mount Smart Road, Roosevelt Avenue, Edmonton Avenue, Wallath Road, and Bow Place. Flooding depth increases are observed to be up to 190mm.

Flood depth in some areas within Fergusson Domain (public reserve area) also increased by up to 70mm.

Increased flood depths are attributed to the increased runoff from the proposed impervious surfaces, and the filling of existing floodplains in some areas. The effects of the proposed redevelopment, as detailed above, are considered to be more than minor. Flood mitigation measures need to be implemented to mitigate the adverse effects on existing flooding.

The model showed improved flood depths in public recreation courts at Fergusson Domain of up to 190mm, and in private lots to the south of Mount Smart Road.

8.1.2 100 YEAR ARI RAINFALL EVENT

The 100 year ARI PD scenario showed increases in flooding depths in both private lots outside of Kāinga Ora Oranga redevelopment lots, public reserve, and public road reserve.

Increased flood depths were observed in private properties to the east of Rockfield Road, on the southern side of Mount Smart Road, the southern side of State Avenue, the western side of Felix Street, the southern side of Oranga Avenue, and the western side of Waitangi Road. The maximum flood depth increase outside of Kāinga Ora Oranga redevelopment lots was observed to be 280mm.

Increased flood levels within public road reserve were along Waitangi Road, Wallath Road, State Avenue, Roosevelt Avenue, Bow Place, Edmonton Avenue, Melville Place, and Rockfield Road were observed. The increase in flood depth was up to 235mm.

Flood depth increase in public reserve areas was observed in Fergusson Domain. This was scattered with increased flood depths in the order of 25 – 45mm.

Increased flood depths are attributed to the increased runoff from the proposed impervious surfaces, and the filling of existing floodplains in some areas. The effects of the proposed redevelopment, as detailed above, are considered to be more than minor. Flood mitigation measures need to be implemented to mitigate the adverse effects on existing flooding.

An improvement in flood depth of 85mm was recorded in private lots to the south of Mount Smart Road.

8.2 EFFECTS OF FLOODING WITH FLOOD MITIGATION

As outlined above, the Kāinga Ora Oranga redevelopment requires flood mitigation to be implemented to ensure the adverse effects of the redevelopment on existing flooding in the area are mitigated.

Increased flooding depths and flood extents in the no mitigation scenarios were attributed to increased stormwater runoff from impervious areas and the loss of flood storage from filling of Kāinga Ora Oranga development lots within floodplains. The Oranga area is underlain by the Onehunga Volcanic Aquifer and the primary means of discharge for the area is via soakage. We believe the peak soakage rates discussed in Section 7.2.4 are appropriate for the purpose of this flood analysis and any further flood mitigation should be carried out via above ground storage areas. The following storage options were considered:

- **Storage Tanks**, when buried, have the benefit of a small land use footprint that efficiently utilises the available development area. Tanks generally require less

ground shaping than the other options considered. However, they can be expensive to install and require regular maintenance to ensure proper operation. As such, they carry a high risk of failure and may not be appropriate to use as flood mitigation. In addition, Oranga is underlain by fractured basalt and volcanic rock, so excavation for underground installation may be difficult.

- **Soakage basin** would add public amenity to the Kāinga Ora Oranga redevelopment and would provide reserve area for recreation. The implementation of soakage basins would require a large footprint and would significantly reduce the development yield. Due to the nature of the existing topography and overland flow layout, several soakage basins would be required to mitigate the adverse effects of the redevelopment, which would increase long-term maintenance costs.

- **Localised storage in private landscape areas, accessways, and car parking areas** provide good storage options spread throughout the redevelopment area. This means mitigation is carried out at source. Utilising car parking, accessways, and landscaped areas for flood mitigation allows for the effective use of the available Kāinga Ora Oranga redevelopment area. Localised ponding areas may require additional ground shaping.

Following a best practicable option (BPO) approach, providing localised storage within the Kāinga Ora Oranga redevelopment area is the most suitable option for the proposed redevelopment. The localised storage areas will have to be protected with a covenant or a similar instrument to ensure long-term performance of these areas is achieved. This will be implemented as a part of the detailed design for each superlot within the storage areas.

To model the proposed flood mitigation approach, storage has been added to car parking and private accessways proposed within the Kāinga Ora Oranga redevelopment lots. The proposed storage areas were modelled based on the layout of the current conceptual redevelopment plan. As the plan is not finalised, it is important to note that the proposed mitigation will remain adequate as long as the key overland flow paths and storage volumes are maintained, in the areas shown and with the associated overland flow path, throughout the proposed redevelopment area. A breakdown of the required storage volumes per storage area is outlined in Table 7.1 below. Appendix C3 shows where these have been implemented in the model. The volumes outlined in the table are minimum requirements and are a combination of dead and live storage (storage to RL).

Table 7.1 – Storage Area Minimum Storage Requirements

Storage Area	Flood RL	Minimum Storage Required Below Flood RL
A*	28.55 m	252 m³
B*	17.20 m	894 m³
C*	15.74 m	463 m³
D	15.91 m	59 m³
E*	23.94 m	248 m³
F	26.36 m	63 m³
G*	24.75 m	385 m³
H	20.19 m	265 m³

* Indicates that a storage area is associated with a key overland flow path.

The model results for the proposed flood mitigation approach are discussed in Sections 8.2.1 and 8.2.2 below.

8.2.1 10 YEAR ARI RAINFALL EVENT

The PD model with flood mitigation has resolved the increase in flood depths in private properties identified in Section 7.1. The flood map shows a small area of increased flooding of 50mm at 30 Waitangi Road. We believe this is due to computational errors, as the overall flooding in the area in the PD scenario is generally lower than the ED. There is also a small area within 31 and 33 Wallath Road that is showing inundation where there previously was not. This increased flooding is due to increased flows applied at the existing node location. These flows are from increased runoff downstream of 31 and 33 Wallath Road, and will not affect these properties.

There is a number of small isolated areas showing increase in flood depth up to 40mm in private property throughout the model. These are considered to be a result of modelling limitations, such as a large mesh size in some areas, and computational errors, as they are surrounded by a variety of positive and negative flood depth changes of up to 20mm.

Peak flood level increases within the road reserve have been mitigated along Rockfield Road and Mount Smart Road, and reduced along Waitangi Road. Increase in flood levels of up to 135mm within the legal road reserve have been observed on State Avenue, Edmonton Ave, on Wallath Road, and in small areas on Waitangi Road, Roosevelt Avenue, Bow Place, Melville Place, and Hull Place. These elevated levels are constrained completely within the legal road reserve and are considered to have less than minor effects.

Peak flood levels within the proposed storage areas reach approximately 310mm. The higher flooding depths are in low points where velocity of the flows is minimal. These depths do not pose a risk to people or vehicles, with the product of depth and velocity being below the safety limits of 0.4m^2/s and 0.6m^2/s respectively.

The proposed scenario has reduced flooding levels of 175mm to the east of Felix Road.

8.2.2 100 YEAR ARI RAINFALL EVENT

Flood levels increases in private lots outside of the Kāinga Ora Oranga redevelopment area identified in Section 7.1.2 have been mitigated. There is a small increase of 60mm observed at 1 Wallath Road, however the increase is completely contained within the lot frontage. This increase is not expected to cause inundation of the existing building and as such the adverse effects of this increase are considered to be less than minor and in accordance with AUP Section E8.6.1. Improvements in flood levels within private lots outside of the Kāinga Ora Oranga redevelopment have been observed along Waitangi Road, Rockfield Road, Mount Smart Road, Namata Road, and Edmonton Avenue. These improvement are up to 250mm in some areas.

Flood depths during the PD 100 year ARI Rainfall event reach a maximum of 550mm in storage area H along Waitangi Road. This is a reduction of 235mm from the ED scenario. Peak flood level increases shown in superlots along Oranga Avenue, and the Housing New Zealand (HNZ) property to the east of Olea Road are due to the mesh size modelling limitations discussed in Section 6.2.1. These lots are subject to a site specific detailed flood assessment.

Increases in peak flood levels of up to 205mm are observed within the legal road reserve during the PD 100 year ARI rainfall event. Flood levels have increased along Roosevelt Avenue, Bow Place, Waitangi Road, State Avenue, Wallath Road, Edmonton Avenue, and Mount Smart Road. These are restricted completely within the public road reserve and are considered to have less than minor effects. Improvement in flood levels within public road reserve of up to 105mm has been observed along Waitangi Road, Rockfield Road, Mount Smart Road, Hull Place, Roosevelt Avenue, and Felix Street.

The flooding within Fergusson Domain has increased in isolated areas throughout the park by no more than 45mm. A larger increase in the order of 130mm is shown at the exit point from Fergusson Domain to Roosevelt Avenue. This is due to the Kāinga Ora Oranga properties being raised above the floodplain in this area and constricting the overland flow path to a narrow channel. These increases within Fergusson Domain will have less than minor effects on the use of the park.

8.2.3 OVERLAND FLOWPATHS

Analysis of the results for the 10 and 100 year ARI has identified several existing overland flow paths that have been modified as a result of the Kāinga Ora Oranga redevelopment. This includes the redirection and depth changes of existing overland flow paths. A series of new overland flow paths have been created, however these are constrained within proposed private accessways, carparks, and designated overland flow areas.

The proposed redevelopment has resulted in an overall reduction in the extent of overland flow paths within the stormwater management area. Refer to Appendix C2 and C3 for further information. This includes reduction in flow depths in both public and private areas.

The redirection of overland flows to public roads, to improve flooding in the area, has resulted in increased flow depths in overland flow paths during the 10 and 100 year ARI within the public road reserves of up to 115mm - notably along Wallath Road, State Avenue, and Edmonton Avenue. Analysis of these instances has shown that the overland flows meet the product of depth and velocity safety limits for pedestrian and vehicle access and will not have adverse effects on the risk from flooding. Increased flow depths are expected to recede within hours following the peak rainfall event. Refer to Plan 4-821 in Appendix C2 for hazard map.

8.3 EFFECTS ON FLOODING IN THE MPD SCENARIO

The MPD scenario for the Kāinga Ora Oranga development was run to confirm that the proposed redevelopment would not have adverse effects on flooding in the MPD scenario.

The MPD scenario, as outlined in Section 6.3, simulates the Kāinga Ora Oranga redevelopment within the MPD environment as supplied by Auckland Council. Flood analysis comparing the MPD model to the Auckland Council MPD model, run in 2017 version of the MIKE software, shows localised increased flood depths outside of Kāinga Ora Oranga redevelopment lots up to a maximum depth of 385mm. However, these areas are generally limited to legal road reserves on State Avenue, Edmonton Avenue, Bow Place, and Roosevelt Avenue. Flood depths in overland flows within the road reserve have also increased up to a peak of 195mm on Wallath Road, State Avenue, Roosevelt Avenue, Edmonton Avenue, and Bow Place. The observed increases in depth are considered to have less than minor effects on the safety from flooding with the product of depth and velocity for all the above areas remaining below 0.4m²/s.

The effects of the Kāinga Ora Oranga redevelopment on the risk of flooding in the area is further discussed in Section 8 below.

9 FLOOD RISK ASSESSMENT

As per AUP Section E36 Natural Hazards and Flooding, a flood risk assessment has been undertaken for the Kāinga Ora Oranga redevelopment as it is affected by flooding during the 100 year ARI rainfall event. The risk assessment has been carried out with reference to the MPD scenario taking into account climate change.

The flooding risk assessment has been carried out in accordance with the following objectives and policies of AUP Section E36:

- Objectives
    - The redevelopment will only occur where the risks of adverse effects from natural hazards to people, buildings, infrastructure, and the environment are not increased overall and where practicable are reduced, taking into account the likely long term effects of climate change.
    - The redevelopment is managed to safely maintain the conveyance function of floodplains and overland flow paths.
    - Natural features and buffers will be used where appropriate in preference to hard protection structures to manage natural hazards.
- Policies
    - Minimise, remedy, or mitigate the risk from flooding hazards to people and property within the site.
    - Locate new habitable floor levels above the 100 year ARI floodplain; including climate change and 1m sea level rise.
    - Provide safe evacuation routes from buildings and sites.
    - Ensure the redevelopment does not increase adverse effects from flood hazards or increased flood depths and velocities to other properties upstream or downstream of the site.
    - Maintain the function of overland flowpaths to convey stormwater runoff safely without causing damage to property or the environment.

The Kāinga Ora Oranga redevelopment will intensify housing density in the catchment. This will expose more people and property to the potential risk of flooding.

As a part of the proposed redevelopment works, habitable floor levels will be elevated at least 500mm above the 100 year ARI flood levels - including climate change, and MPD catchment imperviousness. The flood levels will be based on the Kāinga Ora Oranga redevelopment MPD scenario. Implementation of freeboard to habitable floor levels will remedy and mitigate the risk of flooding to buildings and property within the redevelopment. The economic risk from repairs, cleaning, and replacement will be minimised as a result.

Elevation of habitable floor levels as a means to remedy and mitigate the flood risk to people is based on the assumption that residents are occupying their homes during the flood event. This means that the flood risk to people is dependent on the time of the flood occurrence. Weekends, public and school holidays carry a higher risk as opposed to work/school days as more people are expected to be involved in outdoor activities in the area. Similarly, the risk would be higher during daytime than nighttime.

Flood analysis completed for the Kāinga Ora Oranga redevelopment has shown that the product of the flood depth and velocity within the public roads and proposed private accessways and parking areas does not exceed the pedestrian safety limit of 0.4m²/s.

Flooding depths within storage area B reaches 655mm at the peak of the 100 year ARI MPD event. This flood depth is contained within a proposed parking and vehicle access area below Rockfield Road. We note that this exceedance is due to the development of the greater catchment without mitigation and is not a direct result of the proposed redevelopment. Chapter E36.6.2.1 of the AUP restricts surface parking areas to be located where depth of flood waters in the 100 year ARI event do not exceed 500mm above ground level. We are proposing for this area to be subject to detailed design, which will demonstrate that the typical section of the parking and vehicle is located where flood depths do not exceed 500mm in the 100 year ARI rainfall event, assuming the contributing catchment area at MPD. As the product of depth and velocity is below 0.4m²/s it is expected that vehicles and pedestrians will be safe within this area. Flood depth within storage area G also exceeds 500mm (reaching 880mm at the peak of the 100 year ARI MPD event). This is a reduction of approximately 420mm from the existing MPD scenario. If this area is to be used for parking or vehicle access, it will also be subject to further detailed design to ensure it complies with Chapter E36.6.2.1.

As outlined in Section 7, mitigation measures for the redevelopment have resulted in a reduction in the overall extent of the floodplain, removing areas of flooding from private property outside of the redevelopment area and the public road reserve. This minimises the flood risk to property, people, and buildings in these areas.

The flood analysis has shown that the existing flood levels within the Kāinga Ora Oranga redevelopment will not be exacerbated as a result of the proposed redevelopment works. The mitigation measures proposed in Section 7 of this report will ensure that adverse effects from flood hazards to people, buildings, and the environment will be less than minor.

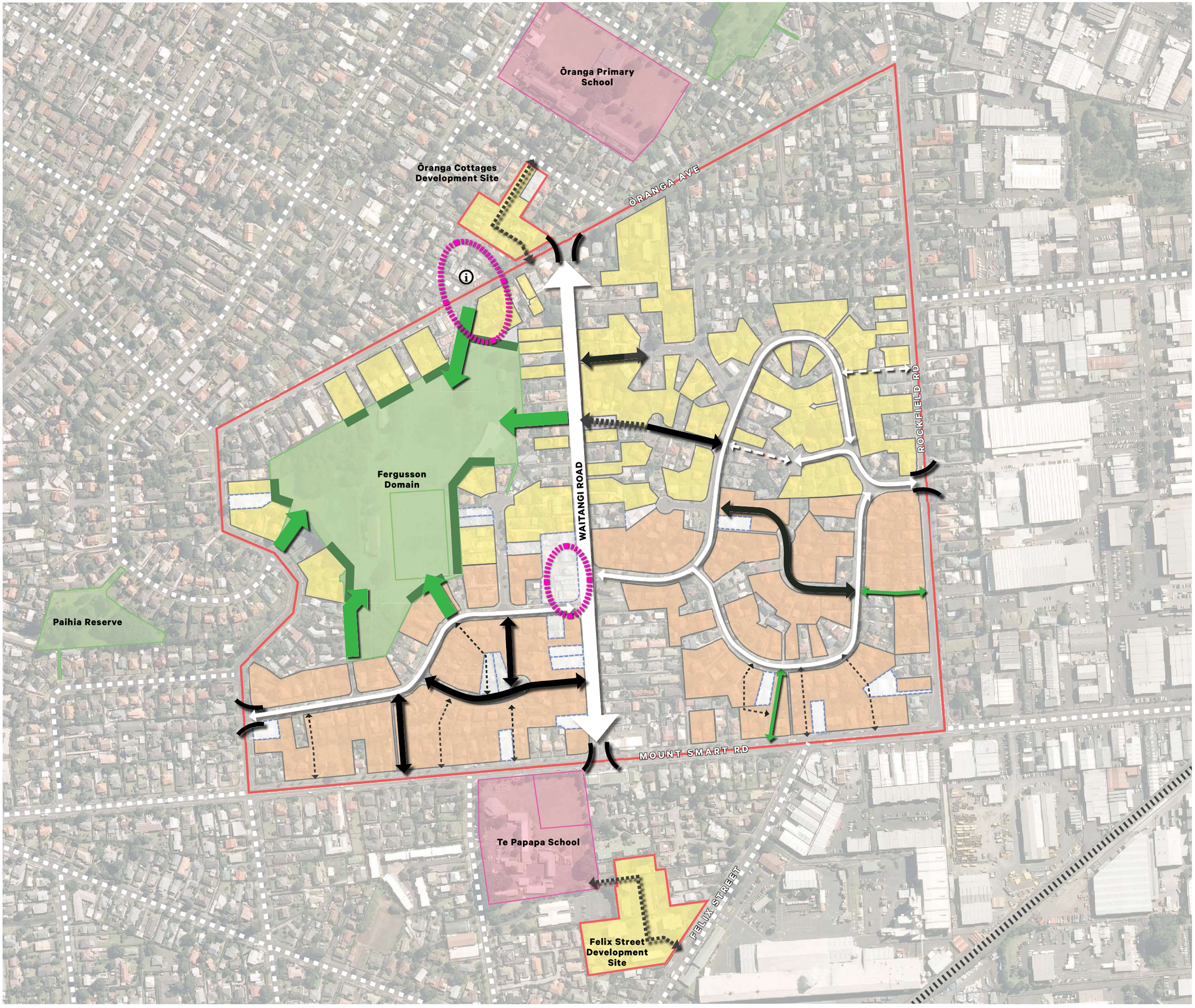
10 CONCLUSION

The analysis of the adverse effects on flooding as a result of the Kāinga Ora Oranga redevelopment has been completed using the existing Auckland Council One Tree Hill hydraulic model. The model has been updated to assess the proposed development (PD) and maximum probable development (MPD) scenarios.

Analysis of these results has shown that the Kāinga Ora Oranga redevelopment will have no adverse flooding effects on private lots and public roads outside of the redevelopment area. The proposed mitigation measures includes implementation of localised above ground ponding areas within the Kāinga Ora Oranga redevelopment superlots.

A flood risk assessment was completed as per AUP Section E36. The flood assessment has shown that the proposed mitigation measures will ensure that the risk to the public, property, buildings, or the environment is not exacerbated within the wider catchment.

Appendix C1: Isthmus Master Plan



Legend.

Development Enablers.

- Improve existing neighbourhood spine road
- Improve existing main connecting streets.
- Existing pedestrian link to remain.
- Build new streets increasing connectivity across the neighbourhood in both north west and east west directions.
- Encourage through connections in the form of JOALS within superlots to increase connectivity and decrease dead ends.
- Encourage through connections in the form of pedestrian only or in combination with a JOAL/carparking areas to increase connectivity and decrease dead ends.
- Proposed vested pedestrian link.
- Gateway into neighbourhood.
- Improve entrances to reserve.
- Improve edges to reserve.
- Acquisition lot (not secured)
- Enhance neighbourhood centre
- Information Centre

Existing Landuse.

- Masterplan development area
- Rail Line
- Kainga Ora Land - SH zone
- Kāinga Ora Land - MHS zone
- Kāinga Ora Land - MHU zone
- Kāinga Ora - post 2000 homes
- Existing green space
- Existing schools
- Existing rugby field

ACTIVE BASELINE MASTERPLAN REV **N5**

Ōranga.

2.2 Urban Development Enabling Plan.

Isthmus. Kāinga Ora Homes and Communities

Job: 4020 Date: 20 January 2020

Client: Kāinga Ora

Issued For: Information

N

0m 25m 50m 100m

Dw Nb: Scale: 1:1500@A0

Dw: AW Rv: AW

ACTIVE BASELINE MASTERPLAN REV **N5**

Ōranga.

2.3 Illustrative Masterplan.

Isthmus. Kāinga Ora Homes and Communities

Job: 4020 Date: 20 January 2020

Client: Kāinga Ora

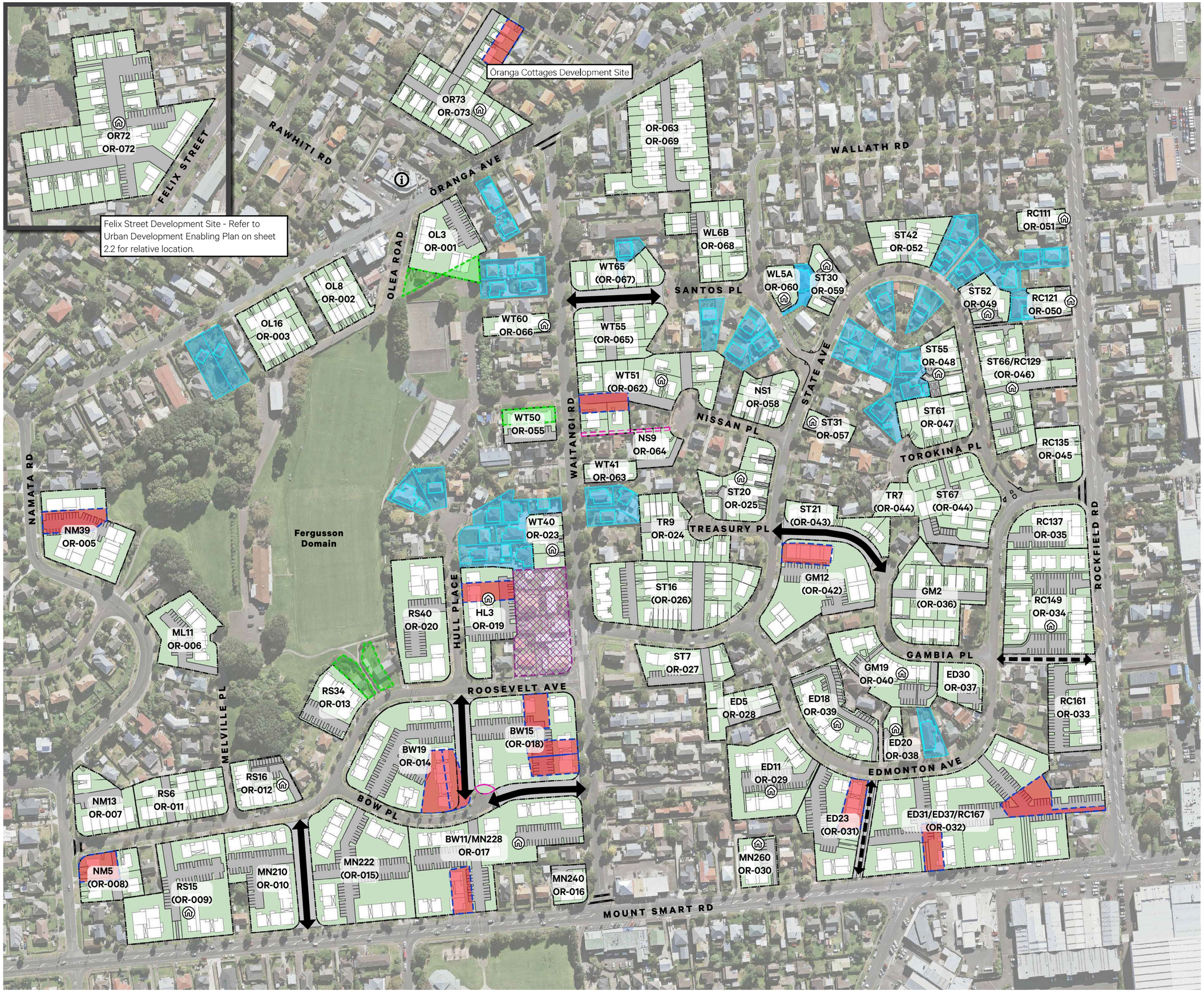
Issued For: Information

N

0m 20m 40m 100m

Scale: 1:1000@A0

Dw: AH Rv: AW



Legend.

- Superlot Boundaries
- Kāinga Ora Development to be retained
- Acquisition Lot (TBC)
- Waitangi Road Shops Proposed Acquisition
- Road Stop Required
- Land swap with Parks
- Proposed JOAL, Carpark Areas and Shared Driveways
- New Road Connections (5 total)
- Proposed vested pedestrian link.
- Proposed State Superlots
- Information Centre
- **OR-xxx** Corresponding Rev U Masterplan Superlot code

YIELD TOTALS

Total Existing homes (to be redeveloped)	**404**
TOTAL PROPOSED HOMES	**1,228**
Total houses (terrace/duplex/single)	**333**
Total apartments	**895**

LAND AREA CALCULATIONS

Total current land area owned by Kainga Ora	**213,786**
Total area of acquisitions to be purchased (m²)	10143
Total area of land to transfer from Parks to Kainga Ora (m²)	852
Total area of land to transfer from AT to Kainga Ora (m²)	262
Total area of land to transfer from Kainga Ora to AT (m²)	6619
Total area of land to transfer from Kainga Ora to Parks (m²)	1206
Total proposed land area of retained properties (m²)	21,532
TOTAL PROPOSED LAND AREA TO BE DEVELOPED	**203,511**

Yield 1228

Oranga Development N5

ACTIVE BASELINE MASTERPLAN REV

Ōranga.

2.4 Masterplan.

Isthmus. Kāinga Ora Homes and Communities

Job: 4020 **Date:** 20 January 2020

Client: Kāinga Ora

Issued For: Information

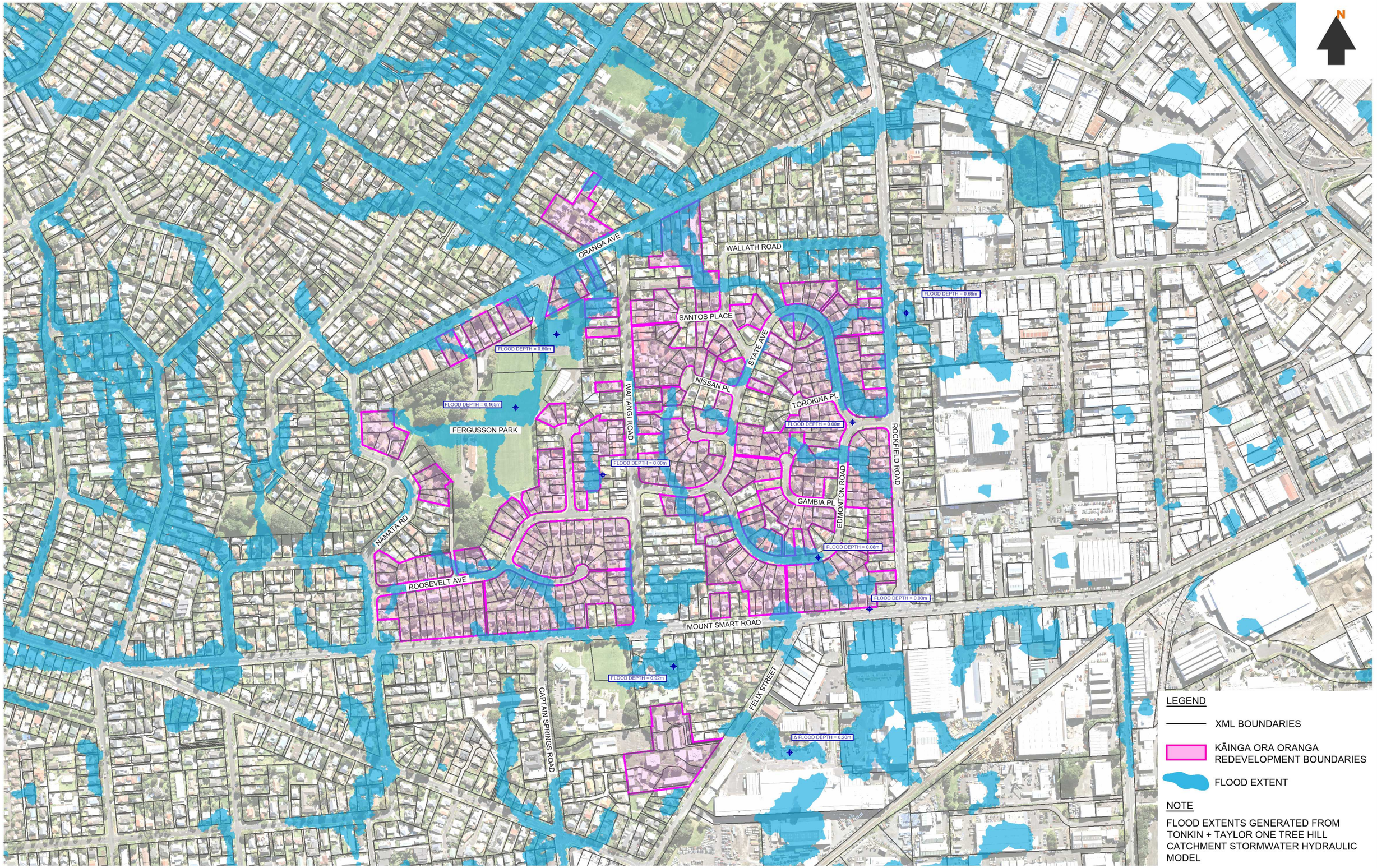
N

0m 20m 40m 100m

Scale: 1:1000@A0

Dw: TM Rv: AW

Appendix C2: Flood Maps



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B	UPDATED FOR T+T MODELLING REVIEW RESPONSE	MW	DS	23-01-20
C	ISSUED FOR SMP	MW	DS	03-04-20

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PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
10 YEAR ARI FLOOD EXTENTS
EXISTING DEVELOPMENT

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-800	REV. C	

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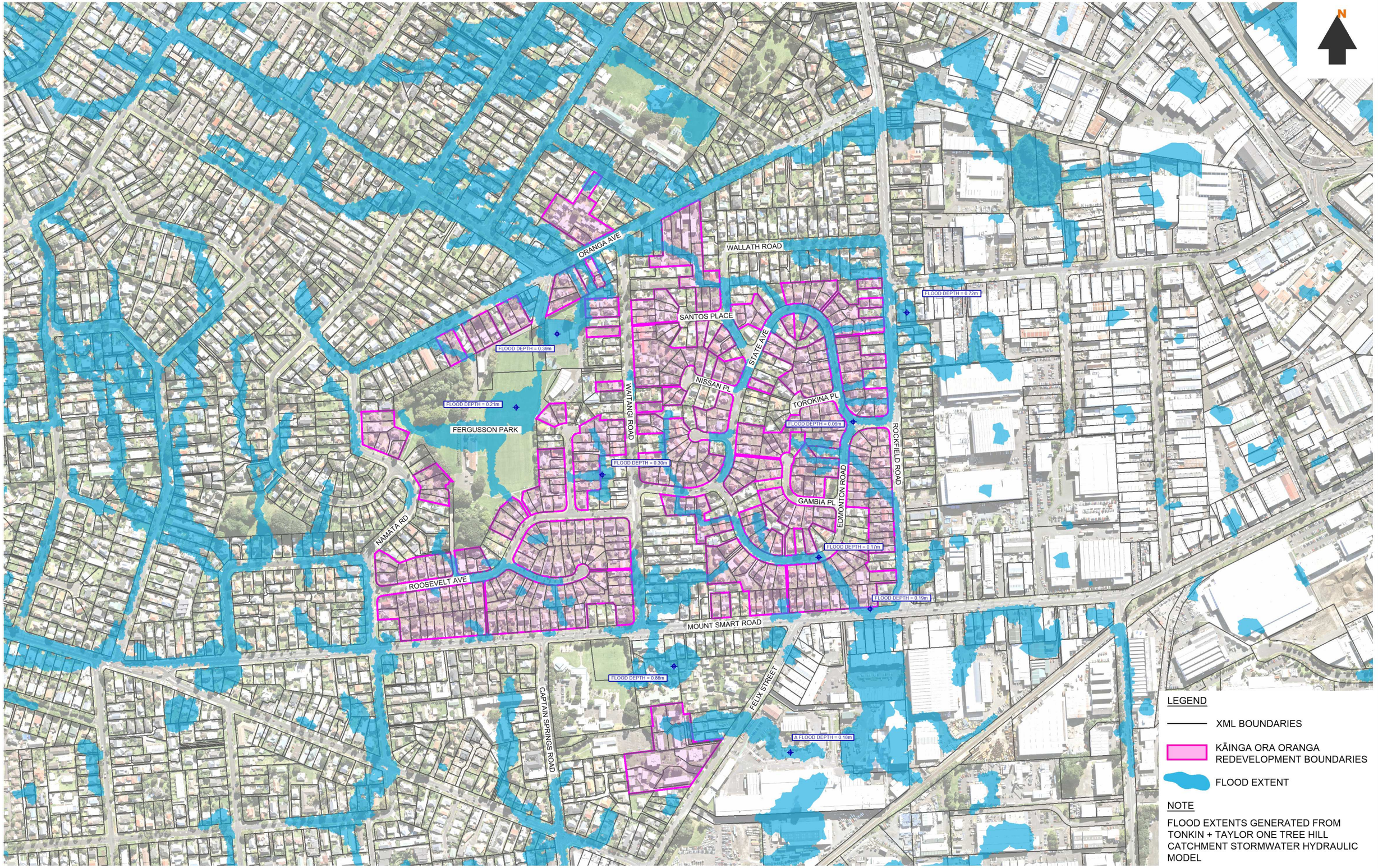

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PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
10 YEAR ARI FLOOD EXTENTS
PROPOSED DEVELOPMENT - NO MITIGATION

CLIENT

Kāinga Ora Homes and Communities

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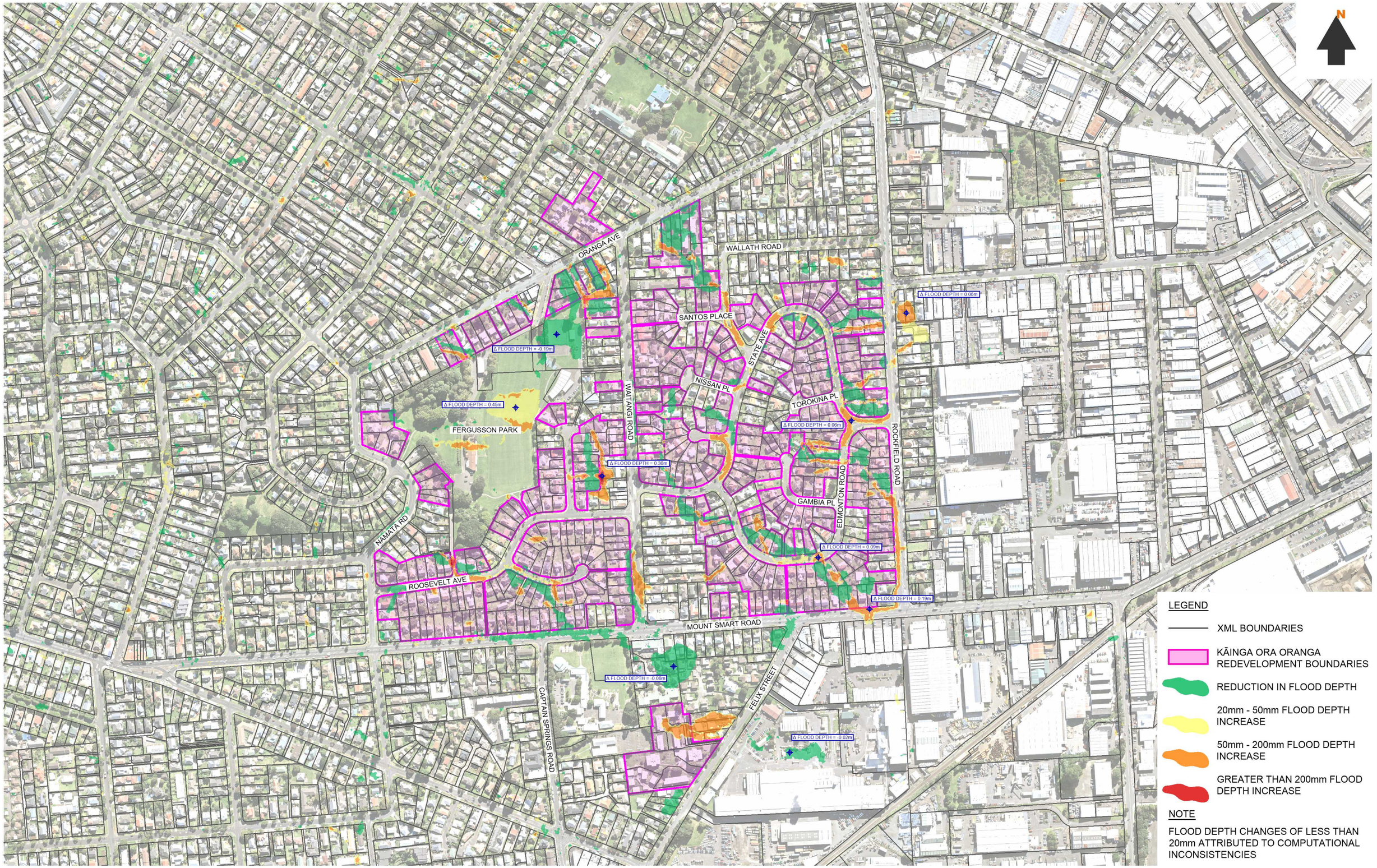

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KĀINGA ORA ORANGA REDEVELOPMENT
10 YEAR ARI FLOOD DEPTH COMPARISON
PROPOSED DEVELOPMENT - NO MITIGATION

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

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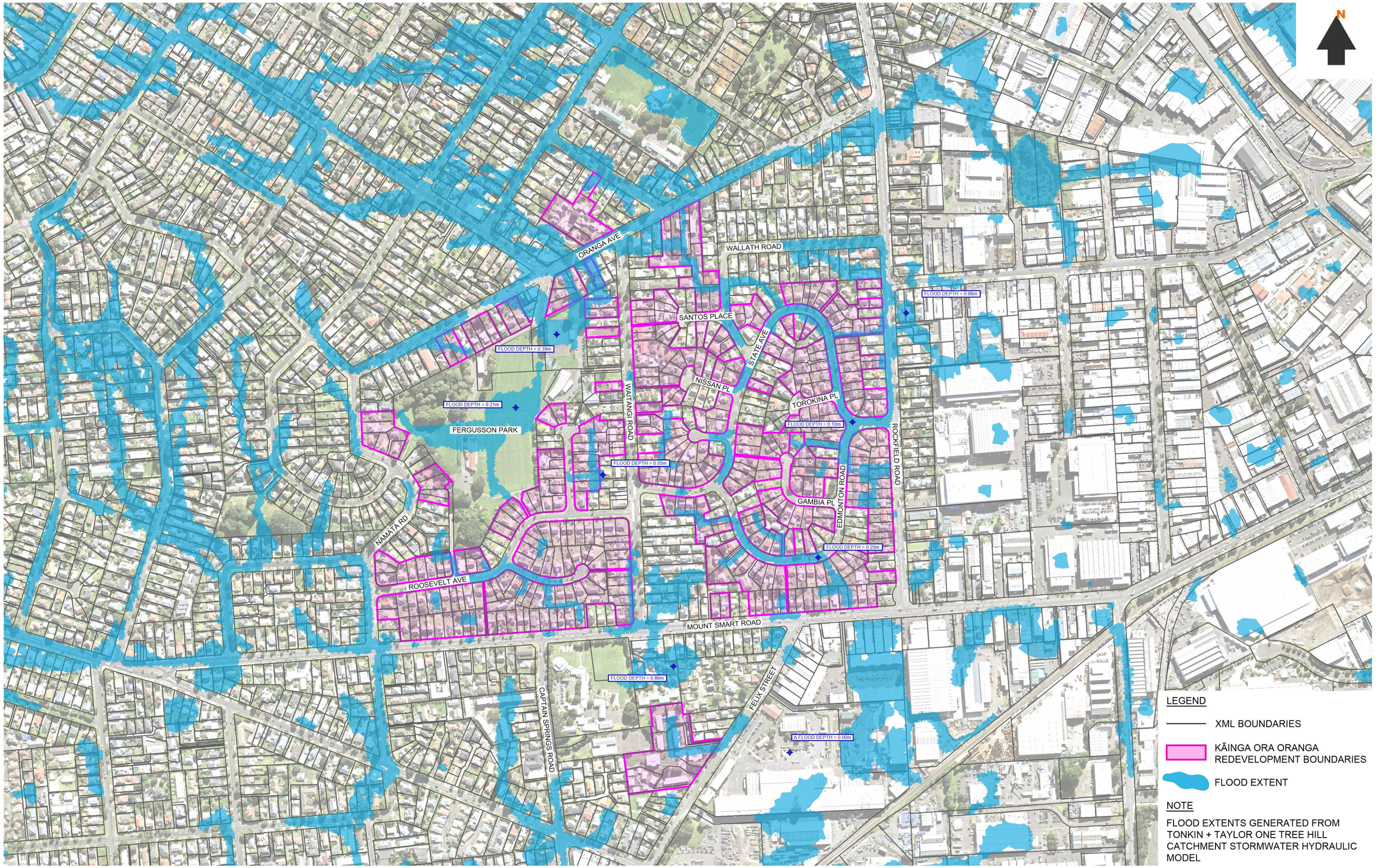

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KĀINGA ORA ORANGA REDEVELOPMENT
10 YEAR ARI FLOOD EXTENTS
PROPOSED DEVELOPMENT- MITIGATION

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Kāinga Ora Homes and Communities

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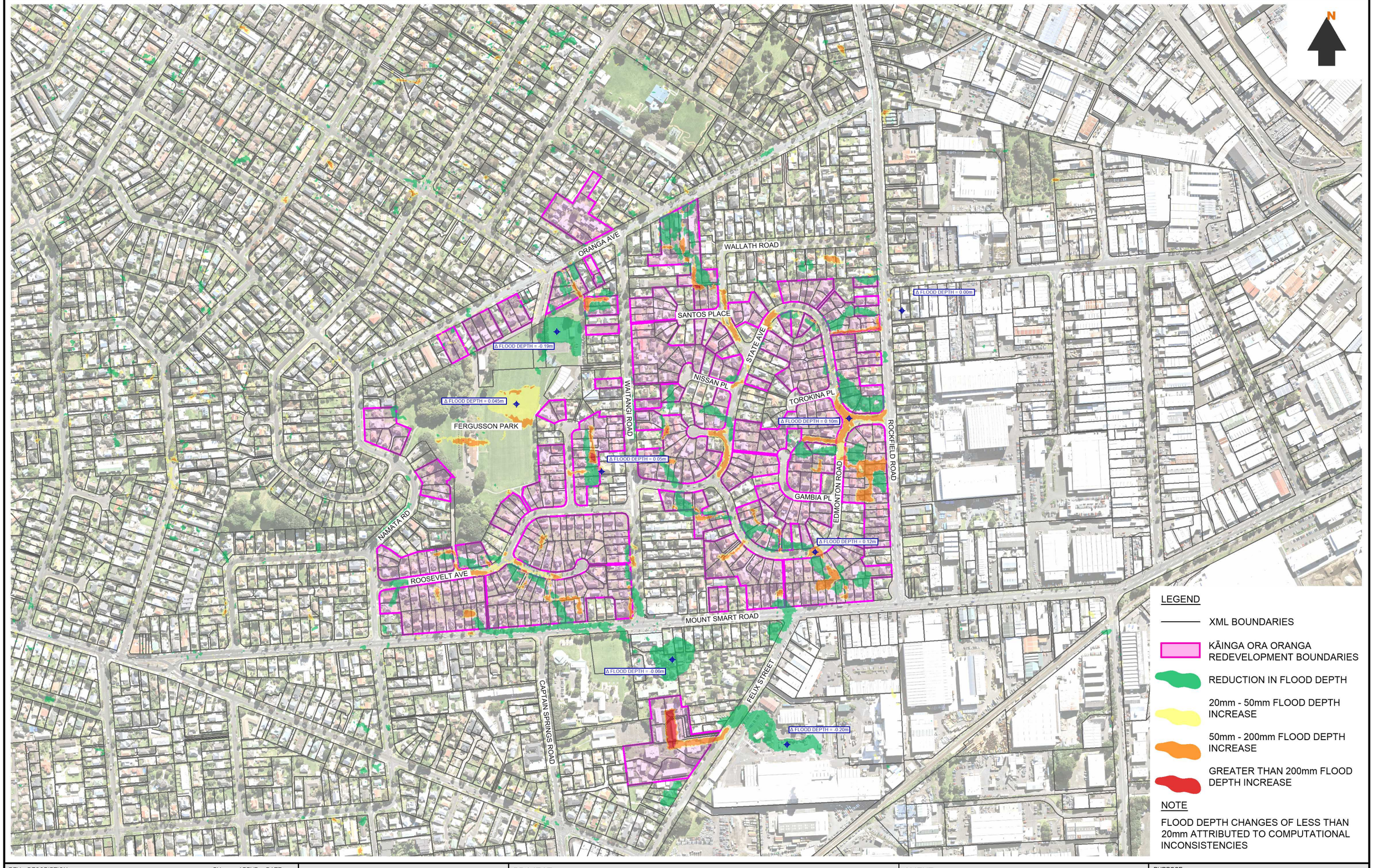

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KĀINGA ORA ORANGA REDEVELOPMENT
10 YEAR ARI FLOOD DEPTH COMPARISON
PROPOSED DEVELOPMENT - MITIGATION

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Kāinga Ora Homes and Communities

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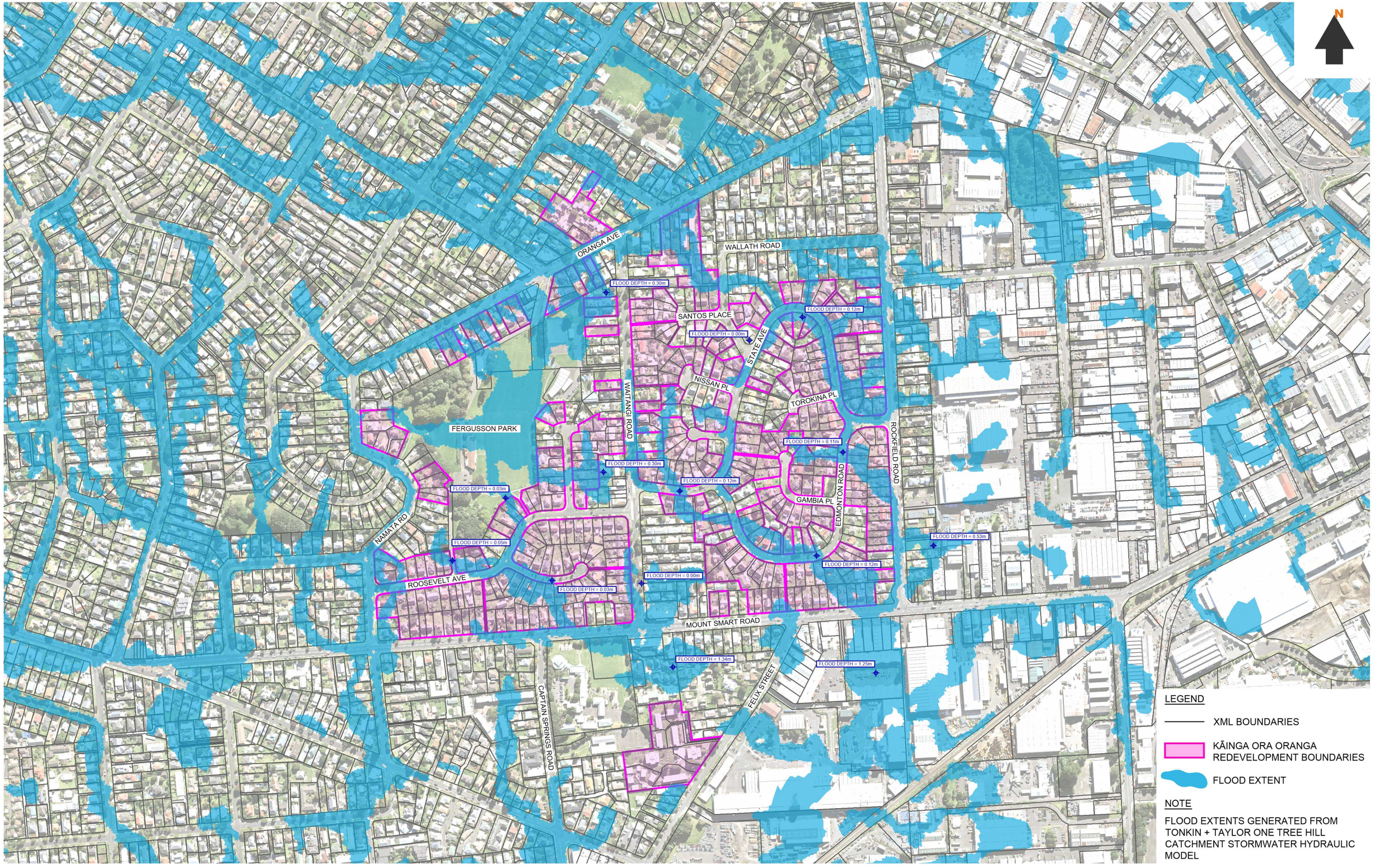

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PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
100 YEAR ARI FLOOD EXTENTS
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Kāinga Ora Homes and Communities

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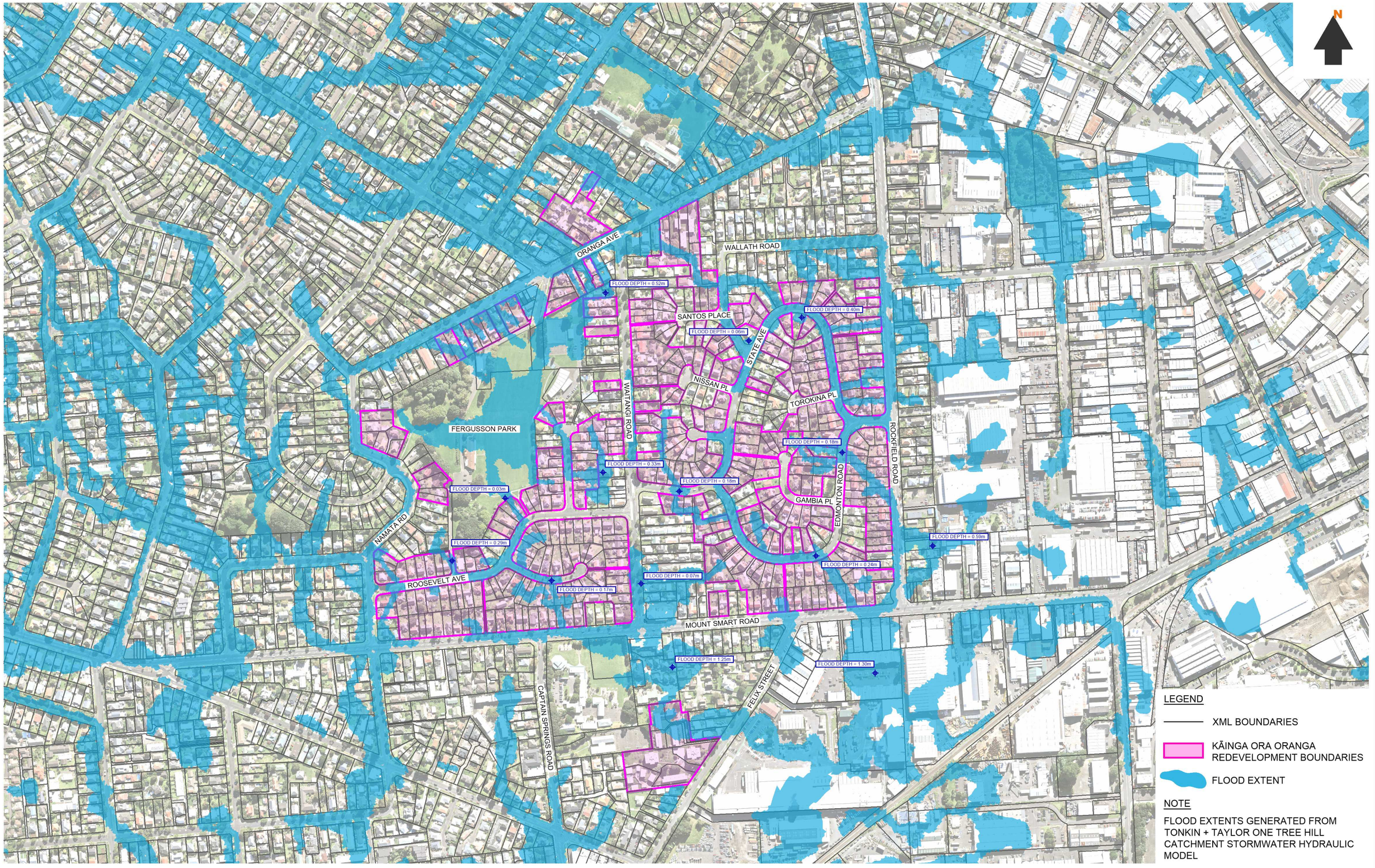

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PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
100 YEAR ARI FLOOD EXTENTS
PROPOSED DEVELOPMENT - NO MITIGATION

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

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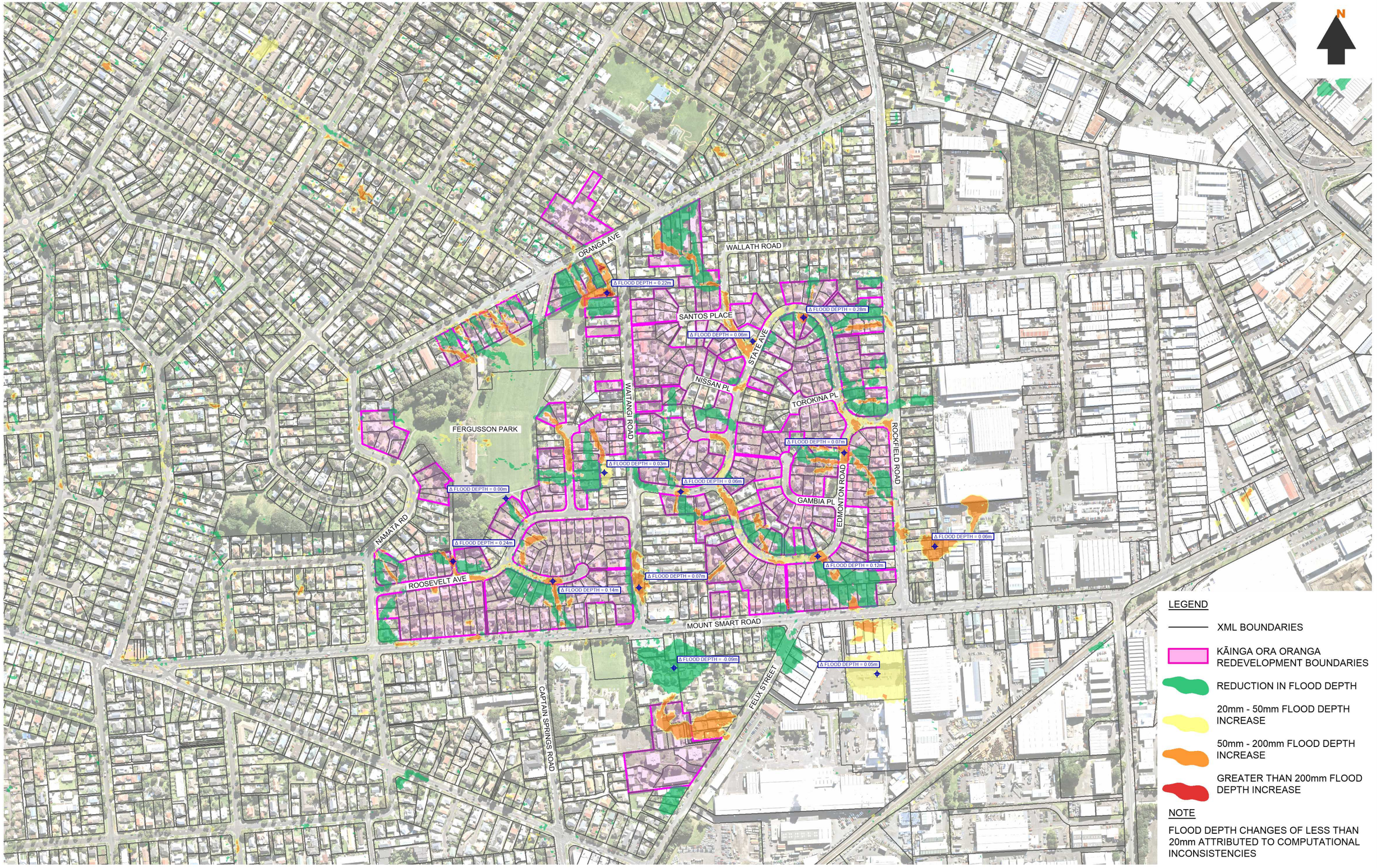

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Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
100 YEAR ARI FLOOD DEPTH COMPARISON
PROPOSED DEVELOPMENT - NO MITIGATION

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW	APPROVED	SCALE
DRAWN MW	BY DS	1:5500 @ A3
CHECK MAS	DATE 3 APR 2020	

PROJECT NO.	DRAWING NO.	REV.
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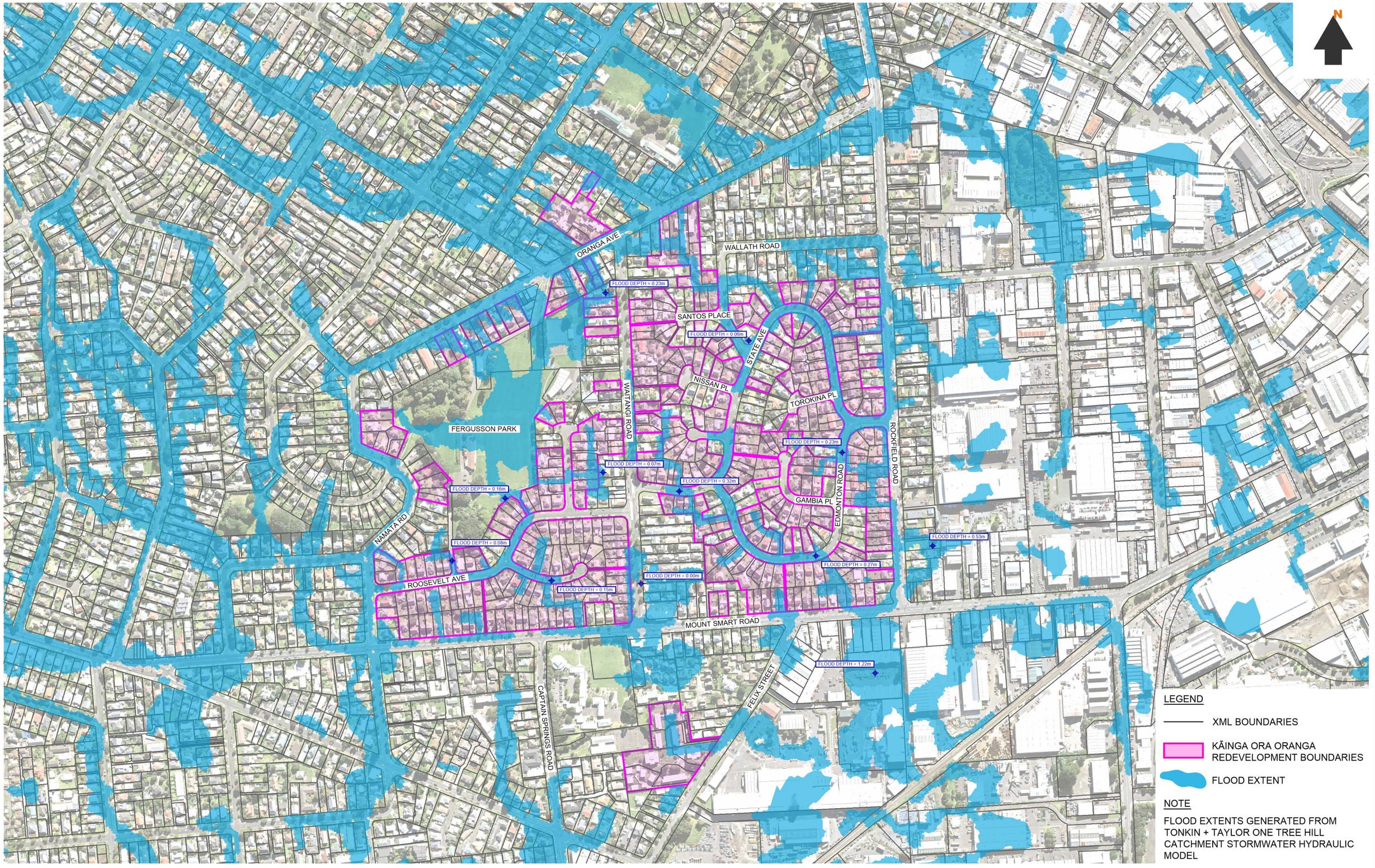

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Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
100 YEAR ARI FLOOD EXTENTS
PROPOSED DEVELOPMENT - MITIGATION

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

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PROJECT NO. 1317	DRAWING NO. 4-808	REV. D	

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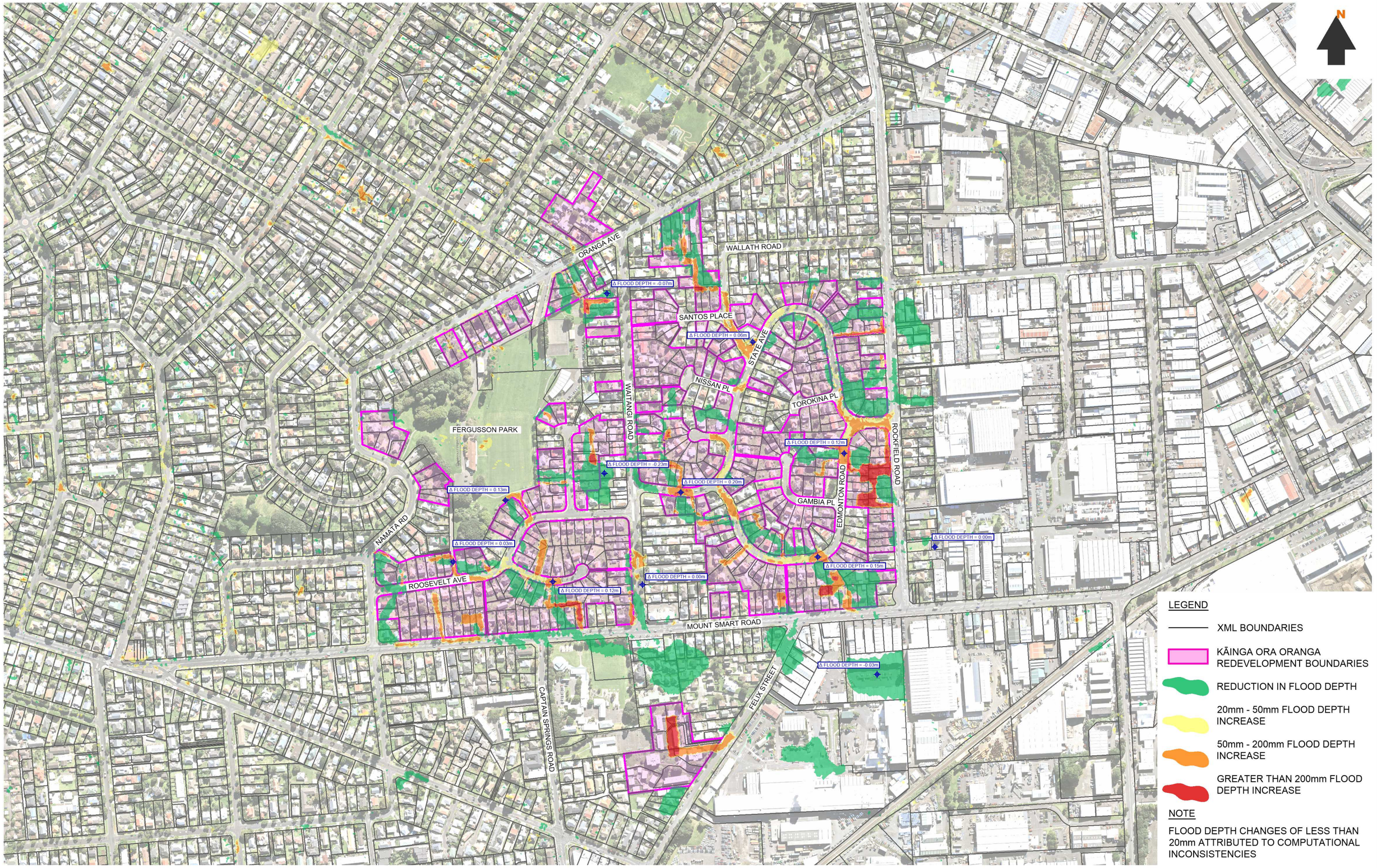

REV	DESCRIPTION	BY	APPVD	DATE
A	ISSUED FOR SMP	MW	DS	04-10-19
B	UPDATED FOR T+T MODELLING REVIEW RESPONSE	MW	DS	23-01-20
C	UPDATED FOR SMP	MW	DS	24-02-20
D	ISSUED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
100 YEAR ARI FLOOD DEPTH COMPARISON
PROPOSED DEVELOPMENT - MITIGATION

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-809	REV. D	

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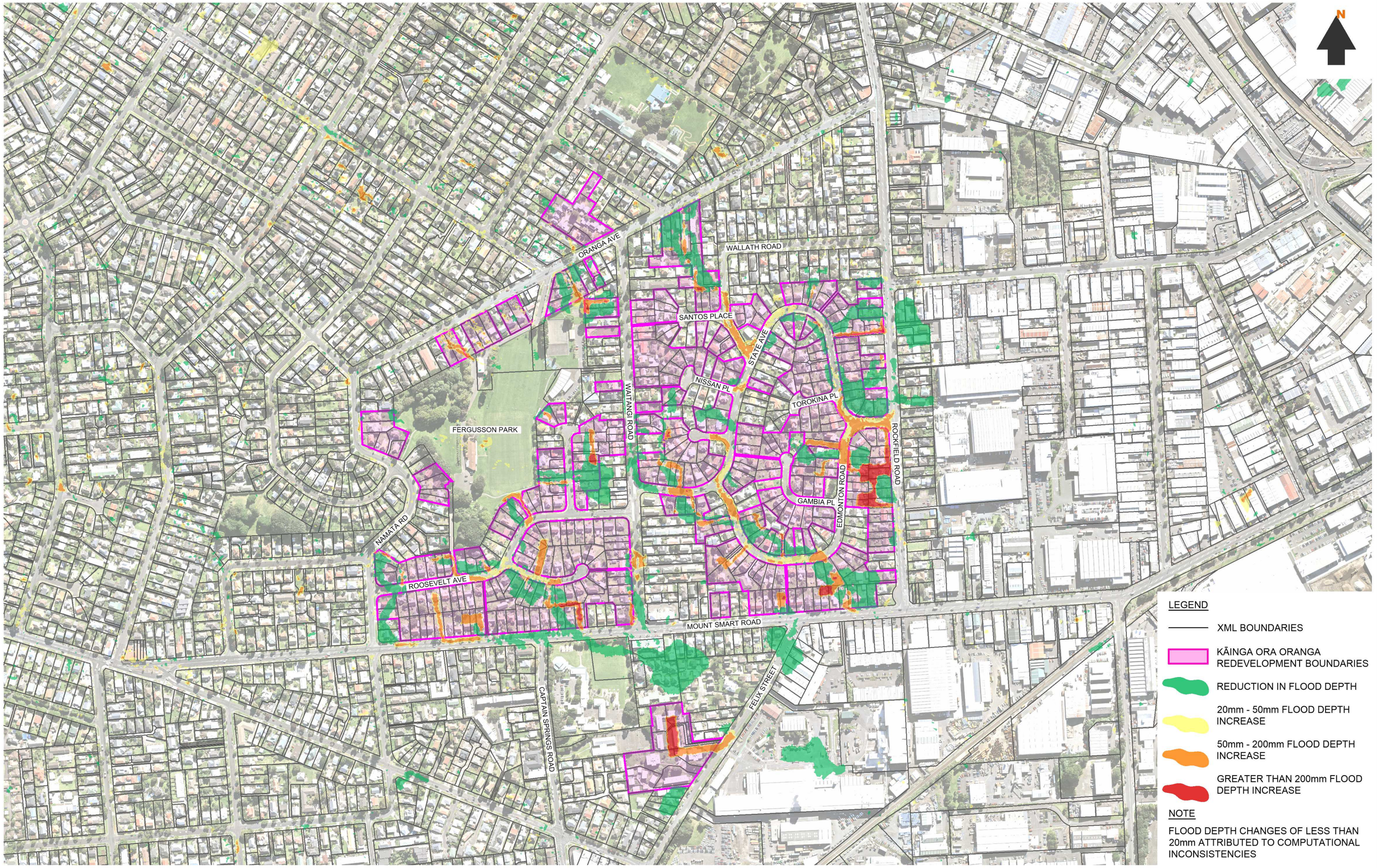

REV	DESCRIPTION	BY	APPVD	DATE
A	ISSUED FOR T+T MODELLING REVIEW RESPONSE	MW	DS	23-01-20
B	UPDATED FOR SMP	MW	DS	24-02-20
C	ISSUED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
PD100 ROUGHNESS SENSITIVITY ANALYSIS
(M33 vs M10) FLOOD DEPTH COMPARISON

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-811	REV. C	

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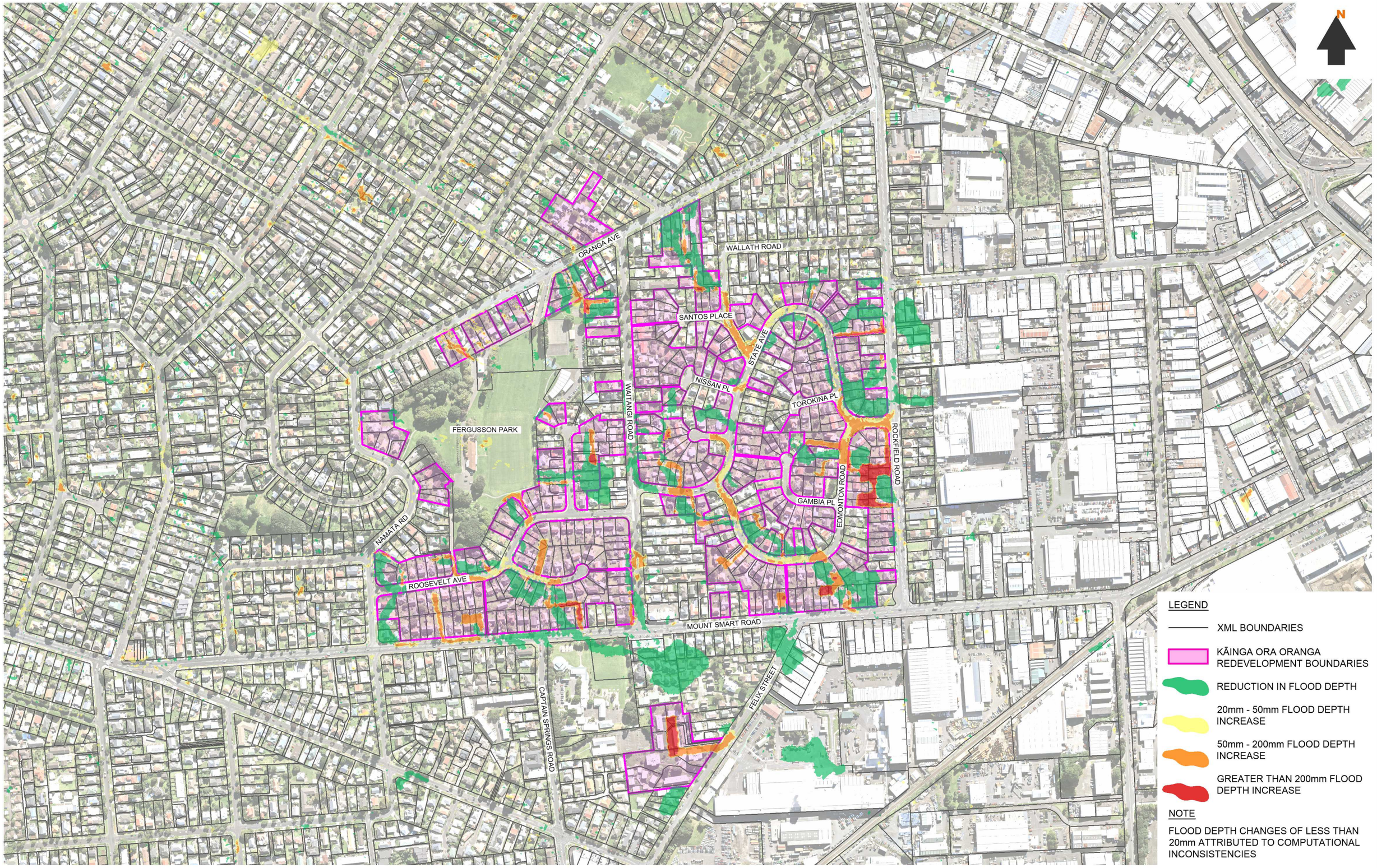


REV	DESCRIPTION	BY	APPVD	DATE
A	ISSUED FOR T+T MODELLING REVIEW RESPONSE	MW	DS	23-01-20
B	UPDATED FOR SMP	MW	DS	24-02-20
C	ISSUED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
PD100 ROUGHNESS SENSITIVITY ANALYSIS
(M50 vs M10) FLOOD DEPTH COMPARISON

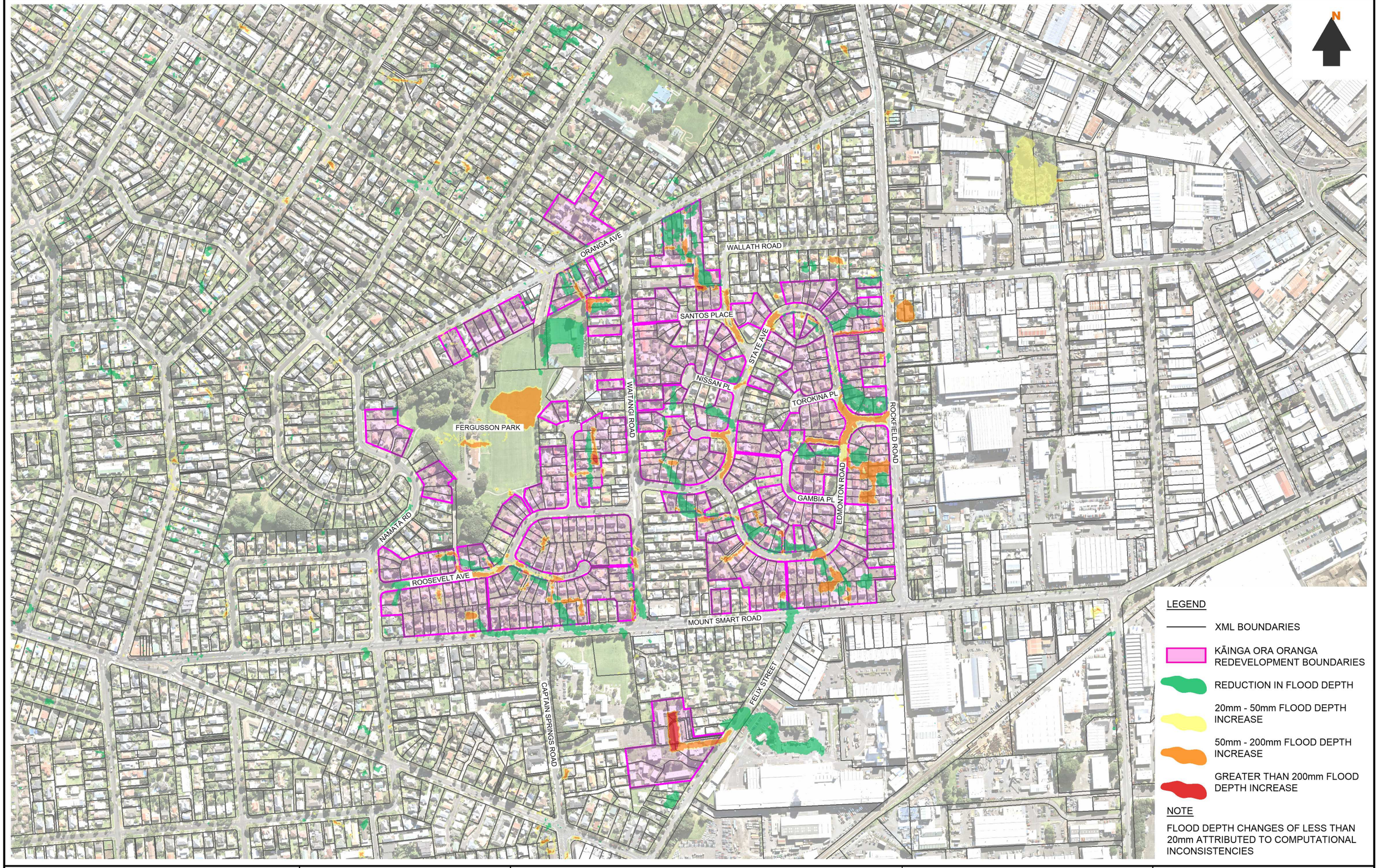
CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-812	REV. C	

PRINT DATE: 03.04.2020 C:\USERS\MATTW\DESKTOP\WORKING\1317 RESULTS PROCESSING\DRAWINGS\1317_FLOODMAPS.DWG



REV	DESCRIPTION	BY	APPVD	DATE
-	ISSUED FOR SMP	MW	DS	03-04-20

Candor³ ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
PD10 MAX FLOW (SOAKAGE) RATE SENSITIVITY ANALYSIS FLOOD DEPTH COMPARISON

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-813	REV. -	

PRINT DATE: 03.04.2020 C:\USERS\MATTW\DESKTOP\WORKING\1317 RESULTS PROCESSING\DRAWINGS\1317 FLOODMAPS MPD.DWG

N

ORANGA AVE
WALLATH ROAD
SANTOS PLACE
STATE AVE
NISSAN PL
TOROKINA PL
ROCKFIELD ROAD
WAITANGI ROAD
FERGUSSON PARK
EDMONTON ROAD
GAMBIA PL
NAMATA RD
ROOSEVELT AVE
MOUNT SMART ROAD
CAPTAIN SPRINGS ROAD
FELIX STREET

LEGEND

- XML BOUNDARIES
- KĀINGA ORA ORANGA REDEVELOPMENT BOUNDARIES
- REDUCTION IN FLOOD DEPTH
- 20mm - 50mm FLOOD DEPTH INCREASE
- 50mm - 200mm FLOOD DEPTH INCREASE
- GREATER THAN 200mm FLOOD DEPTH INCREASE

NOTE

FLOOD DEPTH CHANGES OF LESS THAN 20mm ATTRIBUTED TO COMPUTATIONAL INCONSISTENCIES

REV	DESCRIPTION	BY	APPVD	DATE
-	ISSUED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
PD100 MAX FLOW (SOAKAGE) RATE SENSITIVITY ANALYSIS FLOOD DEPTH COMPARISON

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-814	REV. -	

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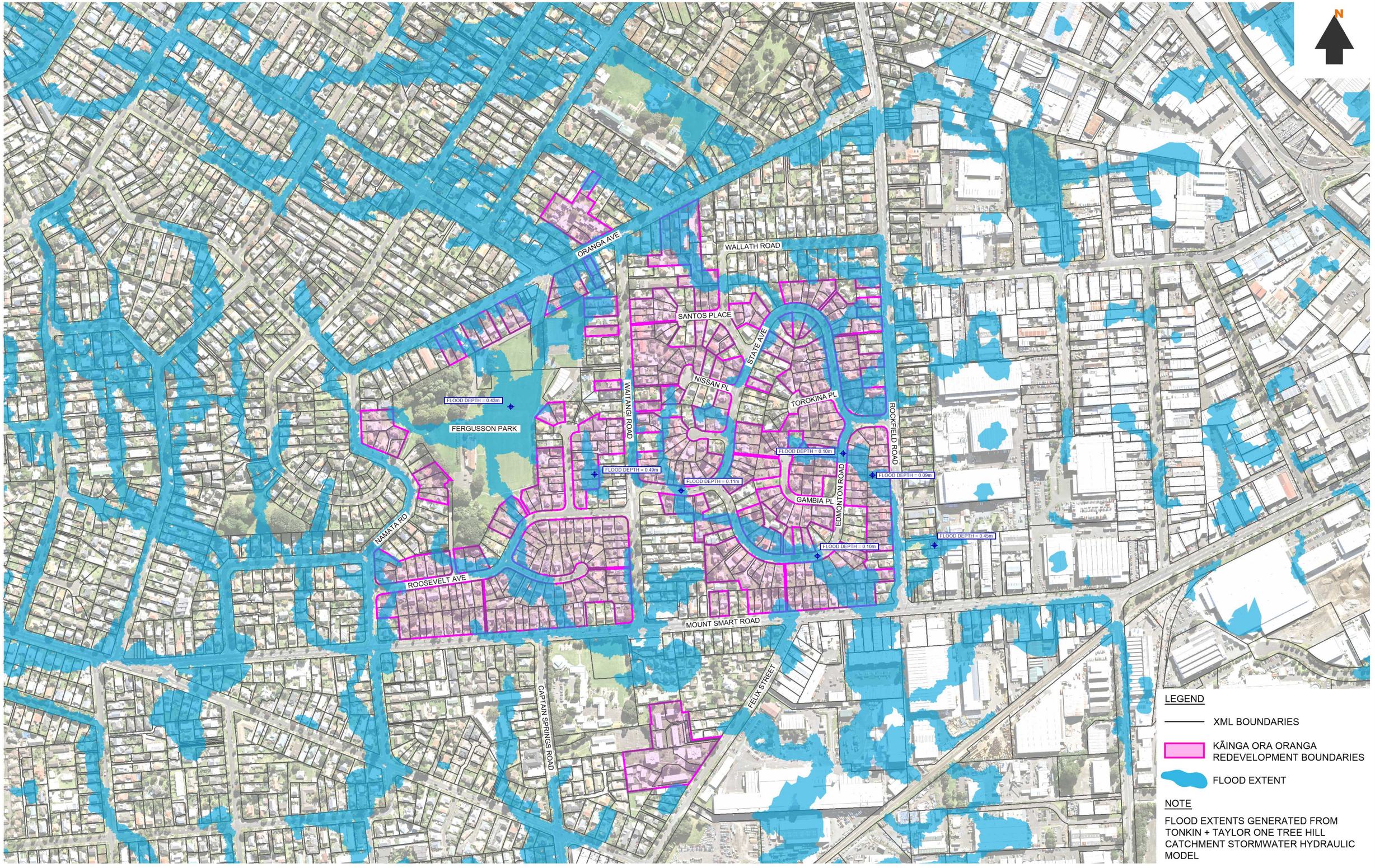

REV	DESCRIPTION	BY	APPVD	DATE
-	ISSUED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT MPD 10 YEAR ARI FLOOD EXTENTS PROBABLE DEVELOPMENT SCENARIO

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-815	REV. -	

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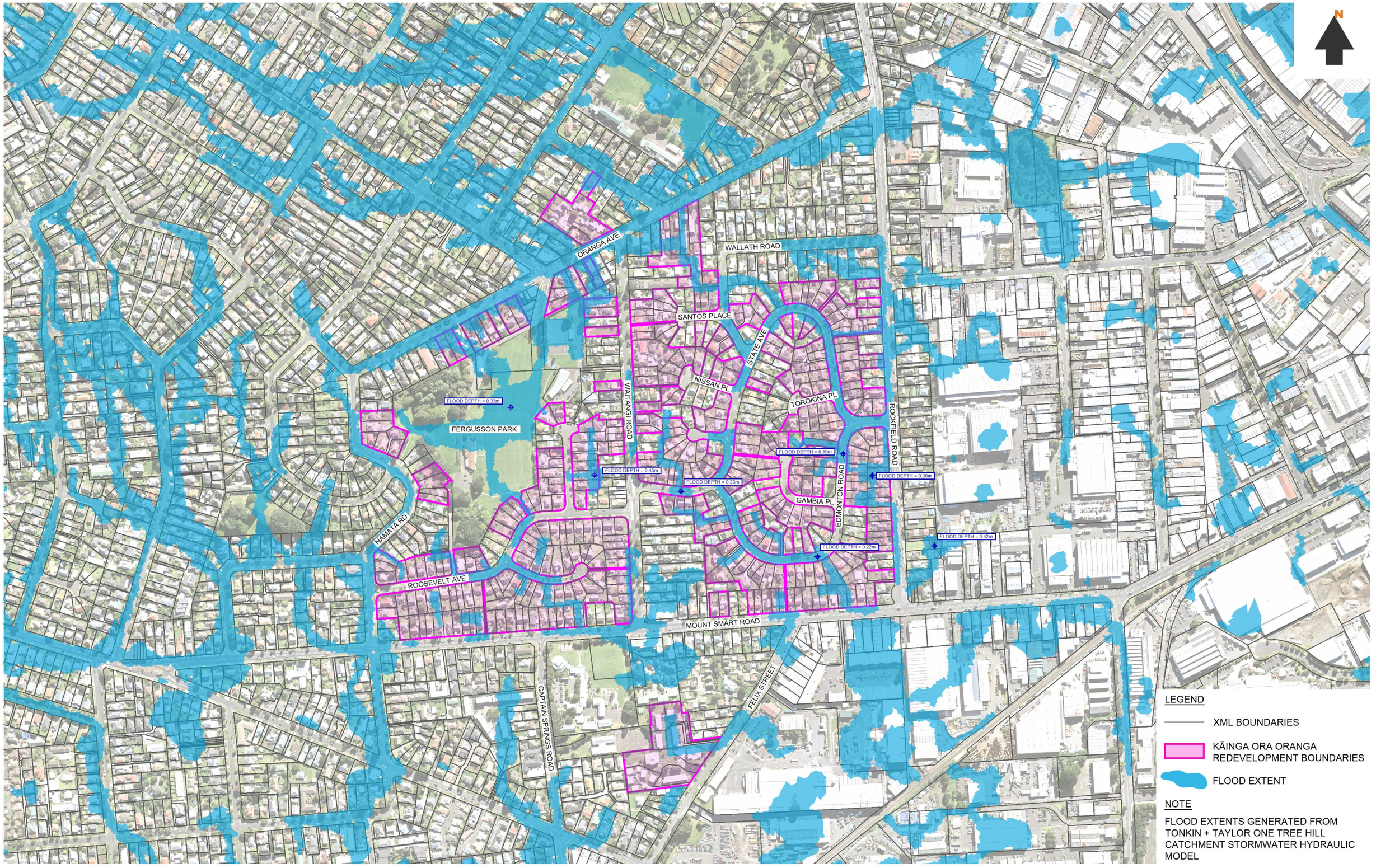

REV	DESCRIPTION	BY	APPVD	DATE
-	ISSUED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
MPD 10 YEAR ARI FLOOD EXTENTS
PROPOSED MITIGATION SCENARIO

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-816	REV. -	

PRINT DATE: 03.04.2020 C:\USERS\MATTW\DESKTOP\WORKING\1317 RESULTS PROCESSING\DRAWINGS\1317 FLOODMAPS MPD.DWG

N

ORANGA AVE
WALLATH ROAD
SANTOS PLACE
STATE AVE
NISSAN PL
TOROKINA PL
WAITANGI ROAD
ROCKFIELD ROAD
EDMONTON ROAD
GAMBIA PL
FERGUSSON PARK
NAMATA RD
ROOSEVELT AVE
MOUNT SMART ROAD
FELIX STREET
CAPTAIN SPRINGS ROAD

Δ FLOOD DEPTH = -0.10m
Δ FLOOD DEPTH = -0.05m
Δ FLOOD DEPTH = 0.12m
Δ FLOOD DEPTH = 0.09m
Δ FLOOD DEPTH = 0.21m
Δ FLOOD DEPTH = -0.03m
Δ FLOOD DEPTH = 0.12m

LEGEND

- XML BOUNDARIES
- KĀINGA ORA ORANGA REDEVELOPMENT BOUNDARIES
- REDUCTION IN FLOOD DEPTH
- 20mm - 50mm FLOOD DEPTH INCREASE
- 50mm - 200mm FLOOD DEPTH INCREASE
- GREATER THAN 200mm FLOOD DEPTH INCREASE

NOTE

FLOOD DEPTH CHANGES OF LESS THAN 20mm ATTRIBUTED TO COMPUTATIONAL INCONSISTENCIES

REV	DESCRIPTION	BY	APPVD	DATE
-	ISSUED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
MPD 10 YEAR ARI FLOOD DEPTH COMPARISON
PROPOSED MITIGATION SCENARIO

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-817	REV. -	

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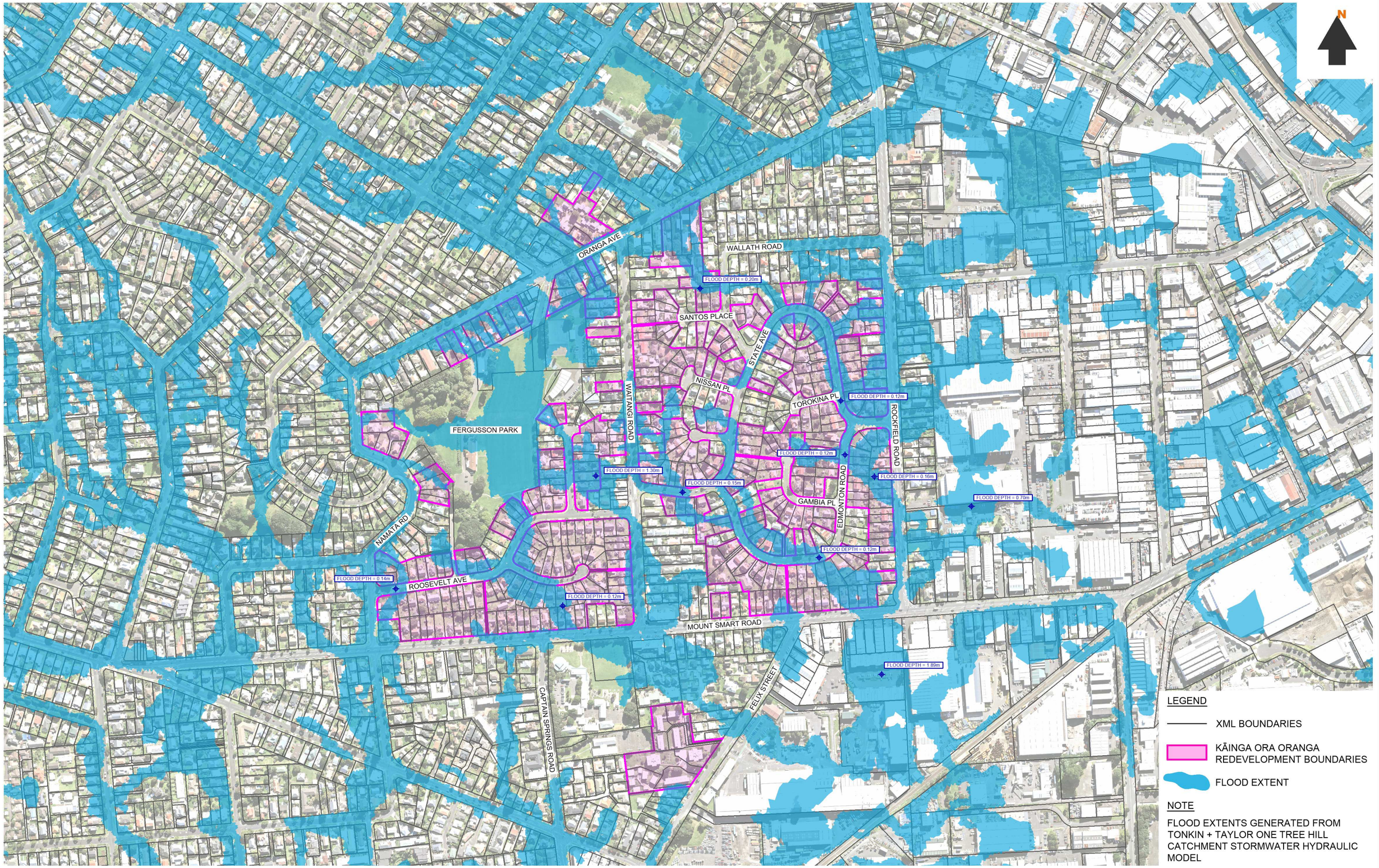


REV	DESCRIPTION	BY	APPVD	DATE
-	ISSUED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
MPD 100 YEAR ARI FLOOD EXTENTS
PROBABLE DEVELOPMENT SCENARIO

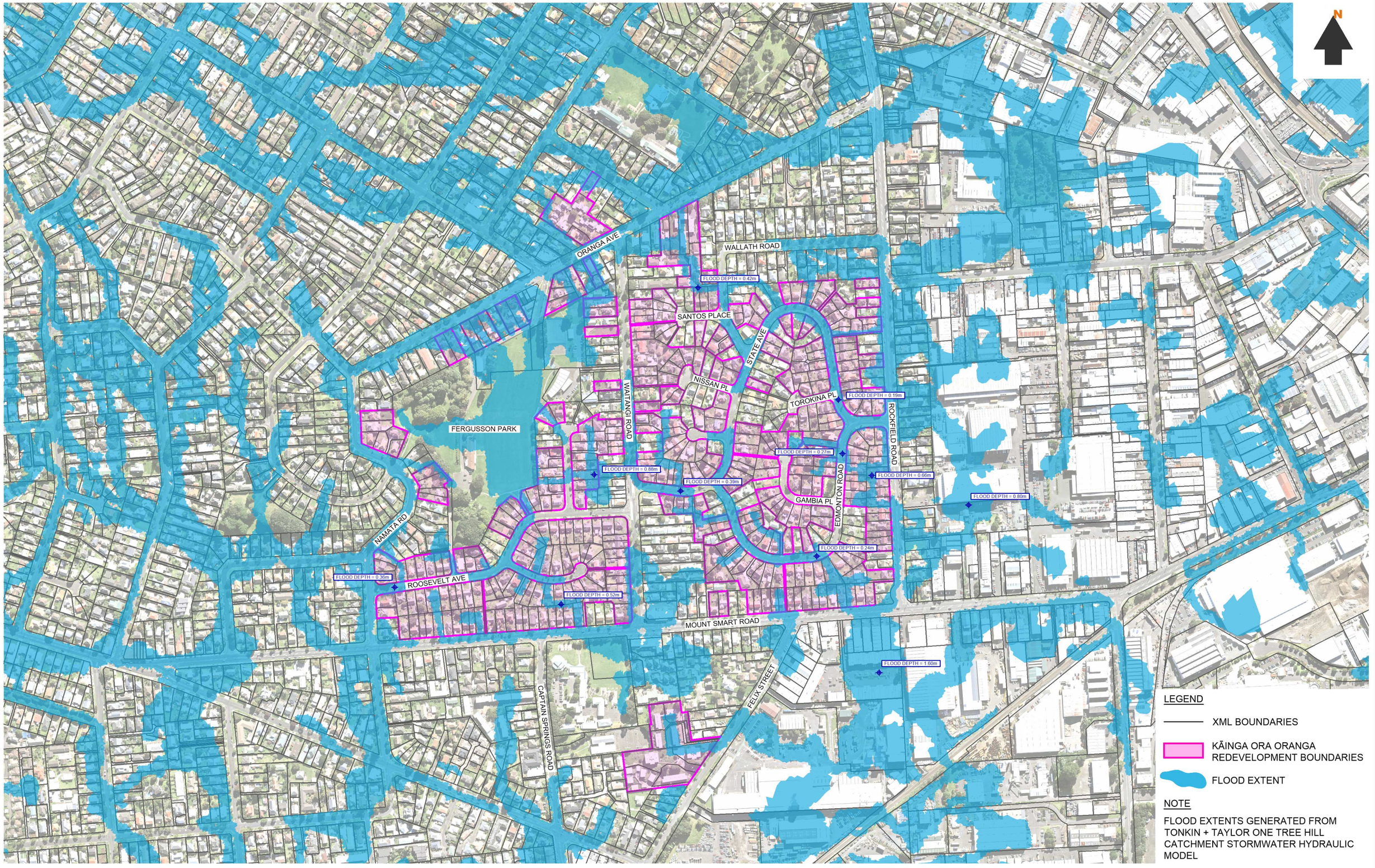
CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-818	REV. -	

PRINT DATE: 03.04.2020 C:\USERS\MATTW\DESKTOP\WORKING\1317 RESULTS PROCESSING\DRAWINGS\1317_FLOODMAPS_MPD.DWG



REV	DESCRIPTION	BY	APPVD	DATE
-	ISSUED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
MPD 100 YEAR ARI FLOOD EXTENTS
PROPOSED MITIGATION SCENARIO

CLIENT

Kāinga Ora Homes and Communities

PURPOSE

FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-819	REV. -	

PRINT DATE: 03.04.2020 C:\USERS\MATTW\DESKTOP\WORKING\1317 RESULTS PROCESSING\DRAWINGS\1317 FLOODMAPS MPD.DWG

N

ORANGA AVE
WALLATH ROAD
SANTOS PLACE
STATE AVE
NISSAN PL
TOROKINA PL
WAITANGI ROAD
ROCKFIELD ROAD
FERGUSSON PARK
GAMBIA PL
EDMONTON ROAD
NAMATA RD
ROOSEVELT AVE
MOUNT SMART ROAD
FELIX STREET
CAPTAIN SPRINGS ROAD

Δ FLOOD DEPTH = 0.22m
Δ FLOOD DEPTH = 0.07m
Δ FLOOD DEPTH = 0.15m
Δ FLOOD DEPTH = -.42m
Δ FLOOD DEPTH = 0.24m
Δ FLOOD DEPTH = 0.50m
Δ FLOOD DEPTH = -0.10m
Δ FLOOD DEPTH = 0.17m
Δ FLOOD DEPTH = 0.22m
Δ FLOOD DEPTH = 0.40m
Δ FLOOD DEPTH = -0.29m

LEGEND

- XML BOUNDARIES
- KĀINGA ORA ORANGA REDEVELOPMENT BOUNDARIES
- REDUCTION IN FLOOD DEPTH
- 20mm - 50mm FLOOD DEPTH INCREASE
- 50mm - 200mm FLOOD DEPTH INCREASE
- GREATER THAN 200mm FLOOD DEPTH INCREASE

NOTE

FLOOD DEPTH CHANGES OF LESS THAN 20mm ATTRIBUTED TO COMPUTATIONAL INCONSISTENCIES

REV	DESCRIPTION	BY	APPVD	DATE
-	ISSUED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
100 YEAR ARI FLOOD DEPTH COMPARISON
MAXIMUM PROBABLE DEVELOPMENT (MPD)

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3

PROJECT NO.	DRAWING NO.	REV.
1317	4-820	-

PRINT DATE: 03.04.2020 C:\USERS\MATTW\DESKTOP\WORKING\1317 RESULTS PROCESSING\DRAWINGS\1317 FLOODMAPS MPD.DWG

N

ORANGA AVE
WALLATH ROAD
SANTOS PLACE
STATE AVE
NISSAN PL
TOROKINA PL
ROCKFIELD ROAD
WAITANGI ROAD
FERGUSSON PARK
EDMONTON ROAD
GAMBIA PL
NAMATA RD
ROOSEVELT AVE
MOUNT SMART ROAD
FELIX STREET
CAPTAIN SPRINGS ROAD

LEGEND

- XML BOUNDARIES
- KĀINGA ORA ORANGA REDEVELOPMENT BOUNDARIES
- FLOOD DEPTH x VELOCITY PRODUCT <0.4 m²/s
- FLOOD DEPTH x VELOCITY PRODUCT 0.4 - 0.6 m²/s
- FLOOD DEPTH x VELOCITY PRODUCT >0.6 m²/s

REV	DESCRIPTION	BY	APPVD	DATE
-	ISSUED FOR SMP	MW	DS	03-04-20

Candor³ ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
100 YEAR ARI MPD
DEPTH x VELOCITY HAZARD MAP

CLIENT

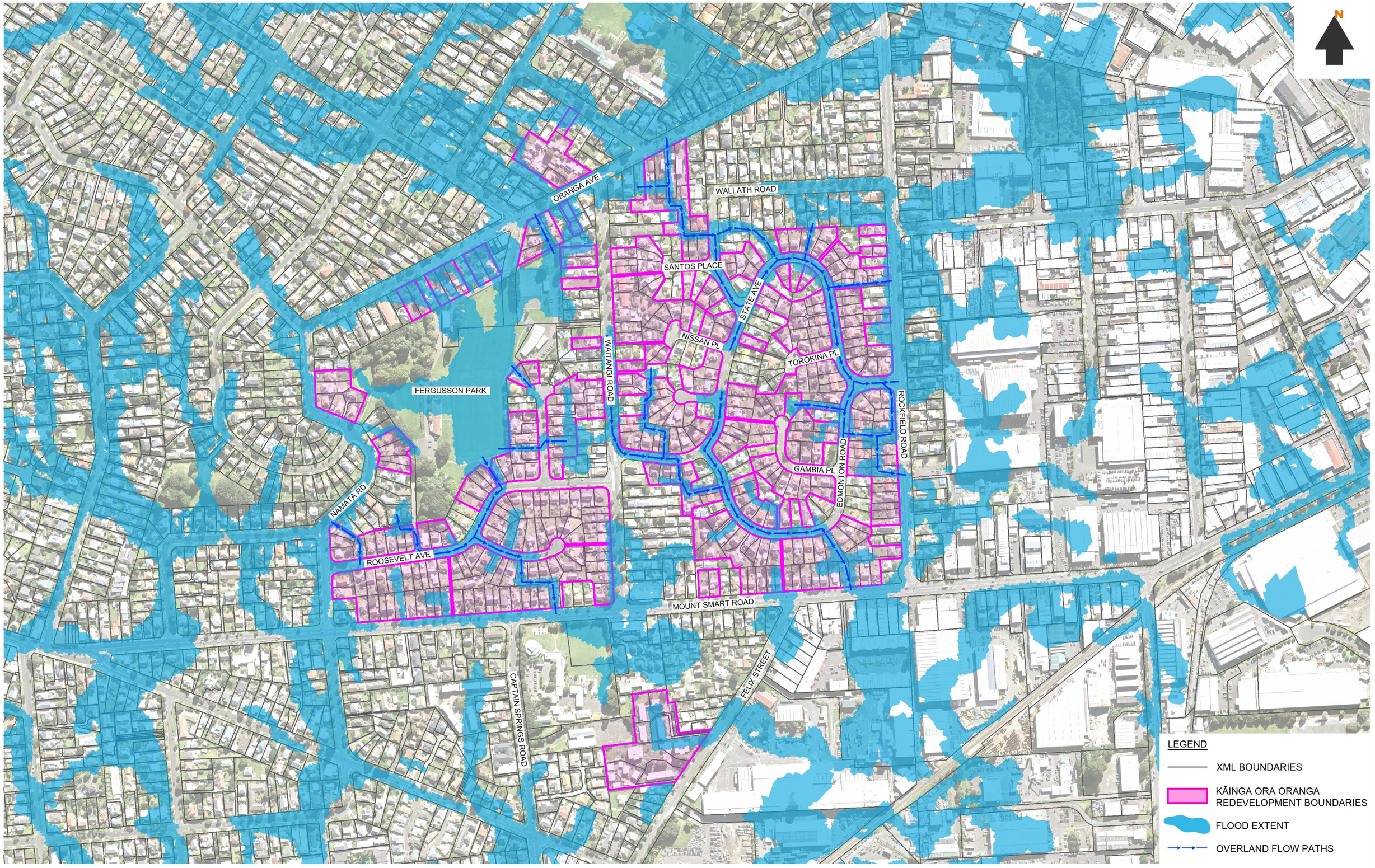
Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 3 APR 2020	SCALE 1:5500 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-821	REV. -	

PRINT DATE: 03.04.2020 C:\USERS\MATTW\DESKTOP\WORKING\1317 RESULTS PROCESSING\DRAWINGS\1317 FLOODMAPS MPD.DWG

Appendix C3: Overland Flow and Storage Maps



REV	DESCRIPTION	BY	APPVD	DATE
A	ISSUED FOR SMP	MW	DS	04-10-19
B	UPDATED FOR T+T MODELLING REVIEW RESPONSE	MW	DS	23-01-20
C	UPDATED FOR SMP	MW	DS	24-02-20
D	UPDATED FOR SMP	MW	DS	02-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
100 YEAR ARI MAXIMUM PROBABLE DEVELOPMENT OVERLAND FLOW PATHS

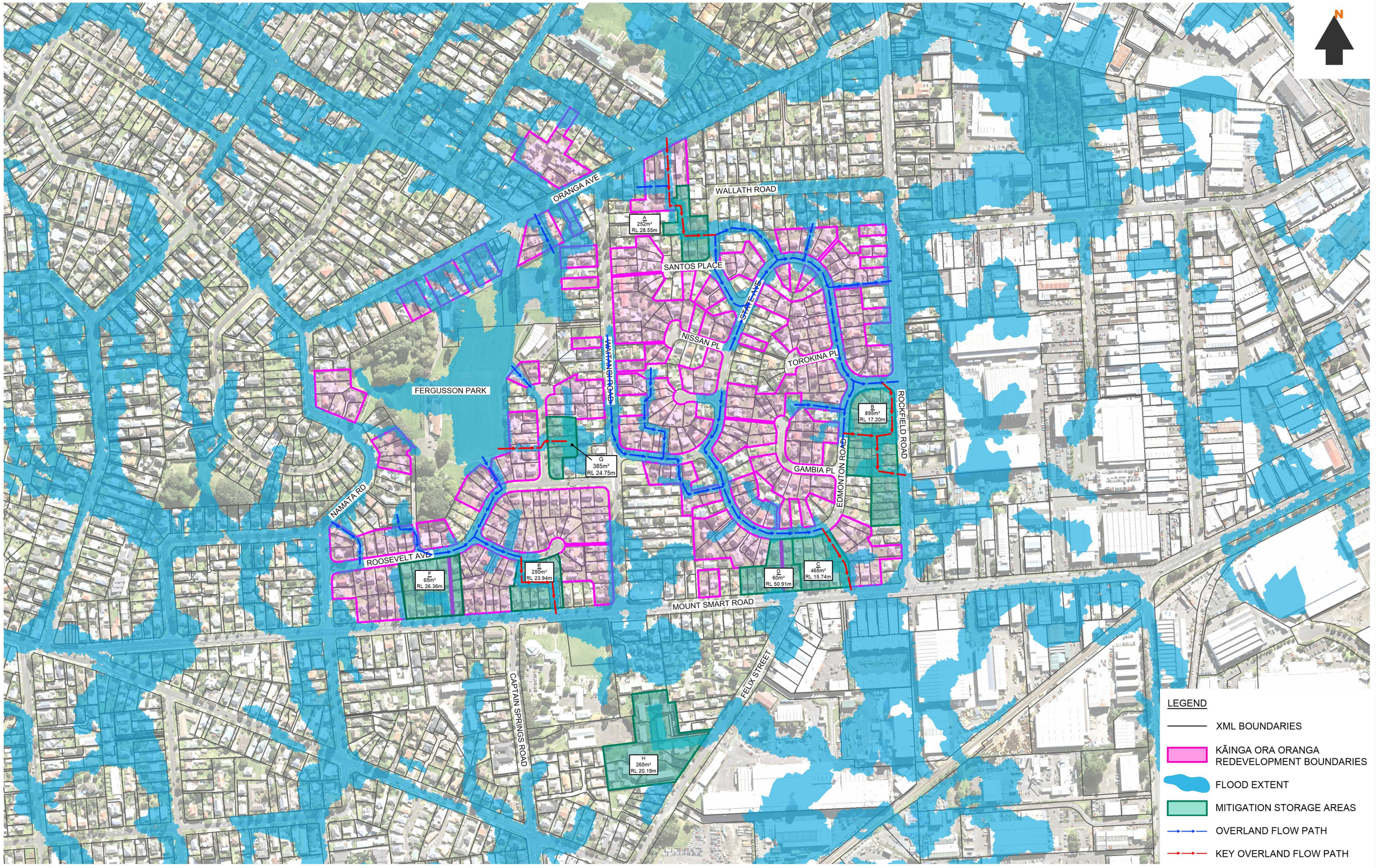
CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 2 APR 2020	SCALE 1:5000 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-900	REV. D	

PRINT DATE: 06.04.2020 C:\USERS\MATTW\DESKTOP\WORKING\1317 RESULTS PROCESSING\DRAWINGS\1317 OVERLANDFLOWPATHS.DWG



REV	DESCRIPTION	BY	APPVD	DATE
A	ISSUED FOR SMP	MW	DS	04-10-19
B	UPDATED FOR T+T MODELLING REVIEW RESPONSE	MW	DS	23-01-20
C	UPDATED FOR SMP	MW	DS	24-02-20
D	UPDATED FOR SMP	MW	DS	02-04-20

Candor³ ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
100 YEAR ARI MAXIMUM PROBABLE DEVELOPMENT STORAGE MITIGATION AREAS

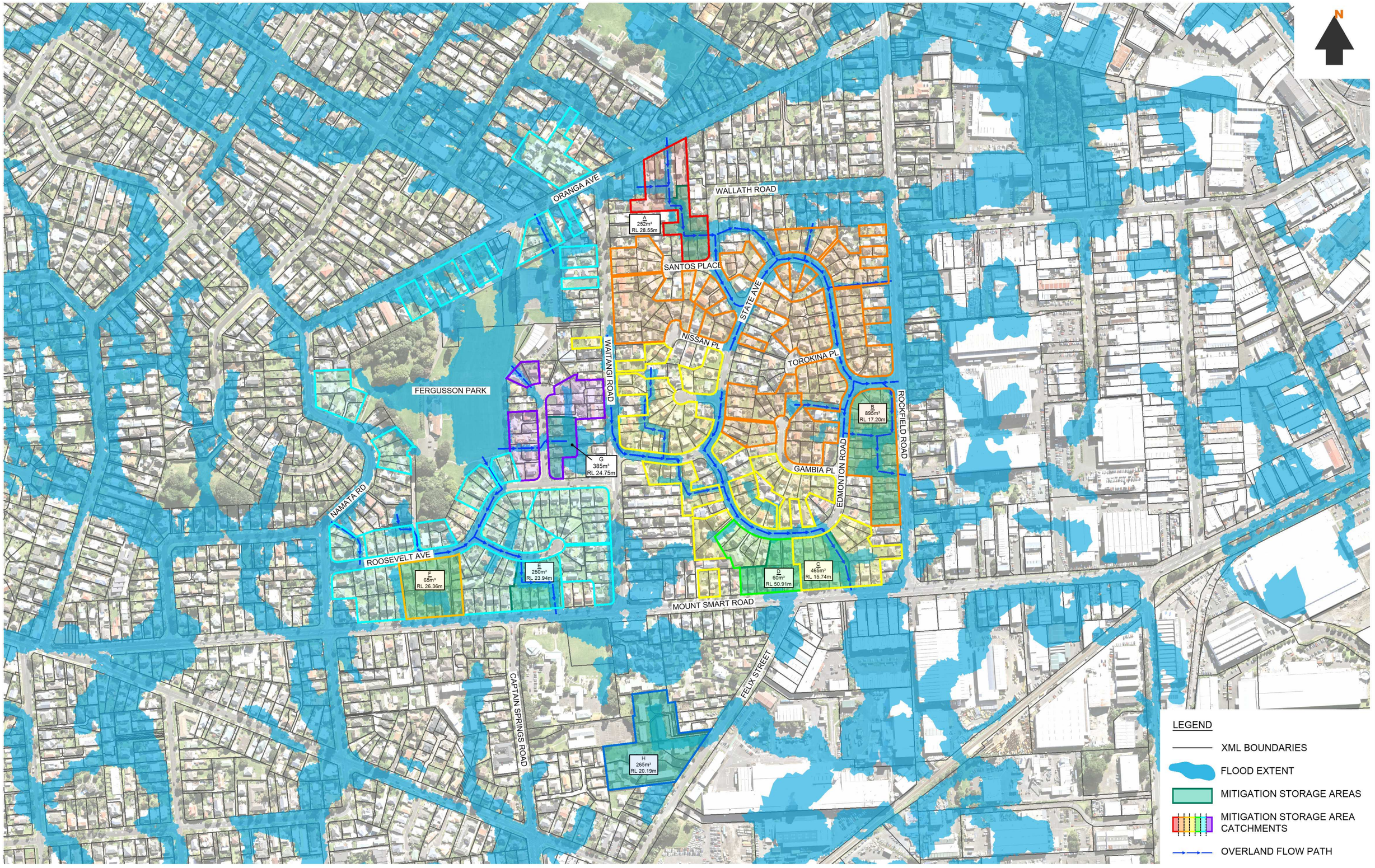
CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 2 APR 2020	SCALE 1:5000 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-901	REV. D	

PRINT DATE: 06.04.2020 C:\USERS\MATTW\DESKTOP\WORKING\1317 RESULTS PROCESSING\DRAWINGS\1317 OVERLANDFLOWPATHS.DWG



REV	DESCRIPTION	BY	APPVD	DATE
-	ISSUED FOR SMP	MW	DS	02-04-20

Candor³ ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
MITIGATION STORAGE AREA
DEVELOPMENT CATCHMENTS

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN MW DRAWN MW CHECK MAS	APPROVED BY DS DATE 2 APR 2020	SCALE 1:5000 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-902	REV. -	

PRINT DATE: 06.04.2020 C:\USERS\MATTW\DESKTOP\WORKING\1317 RESULTS PROCESSING\DRAWINGS\1317 OVERLANDFLOWPATHS.DWG

Appendix D: Offset Mitigation Correspondence and Memorandums

Appendix D1: Offset Mitigation Device Plan

LEGEND

- STORMFILTER - ON-LINE
- STORMFILTER - PFD
- STORMFILTER - CUSTOM OFFLINE
- TREATED CATCHMENT

N

OR1 SF
OR2 SF
OR3 SF
WT3 SF
ST5 SF
ST1 SF
RF1 SF
RF4 SF
ED1 SF
ED2 SF
ED3 SF
RS1 SF
RS2 SF
RS4 SF
MS1 SF
MS2 SF
MS3 SF
MS4 SF
MS5 SF
MS6 SF

ORANGA AVENUE
WALLATH ROAD
OLEA ROAD
WAITANGI ROAD
SANTOS PLACE
NISSAN PLACE
STATE AVENUE
TOROKINA PLACE
EDMONTON AVENUE
TREASURY PLACE
GAMBIA PLACE
ROCKFIELD ROAD
HULL PLACE
ROOSEVELT AVENUE
MELVILLE PLACE
BOW PLACE
NAMATA ROAD
MOUNT SMART ROAD

REV	DESCRIPTION	BY	APPVD	DATE
A	ISSUED FOR LIFECYCLE COST ANALYSIS	MAS	DS	14-02-20
B	UPDATED FOR SMP	MW	DS	24-02-20
C	UPDATED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
STORMWATER TREATMENT DEVICES
DEVICE LOCATION PLAN

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN LV DRAWN MW CHECK DS	APPROVED BY CW DATE 3 APR 2020	SCALE 1:3000 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-651	REV. C	

PRINT DATE: 06.04.2020 J:\PROJECTS LAND DEVELOPMENT\1317 HLC ORANGA STAGE 1 2\DOCS AND COMMS\SMP\1317 3-697 RD-TREATMENT DEVICES OVERALL PLAN FOR SMP.DWG

Appendix D2: Stormfilter Proprietary Device Information Spreadsheet

		Catchment										Cartridge									
#	Name	Pervious area (m^2)	Impervious area (m^2)	Total area (m^2)	$C_{pervious}$	$C_{impervious}$	Equivalent Impervious Area (m^2)	10% AEP + CC (L/s)	Suggested Increased 200mm Overflow Weir	WQF (L/s)	Type	Required	Additional Available	Suggested Additional	Suggested Total	Additional Manhole Required?	Traffic Management required?	Total Lifecycle life Cost per Annum ($)	Total Lifecycle life Cost for 100 years ($)	Device replacement required during 100years?	Reason for device type?
1	OR1 SF	250	582	832	0.4	1	682	17.85	NO	2.84	Online ✓	2	1	1	3	X	✓	$ 1,037.50	$ 103,750.00	YES	BPO: PFD There is a single catchpit picking up a high contaminant road. A PFD device reduces the risk of resuspension.
											PFD ✓	2	0	0	2	X	✓	$ 817.33	$ 81,733.33		
											Custom Offline X					X	✓				
2	OR2 SF	524	4716	5240	0.4	1	4925.6	128.94	NO	14.2	Online X					X	✓			YES	BPO: Custom Offline It is possible to install a bypass weir within an existing manhole. This reduces resuspension and allows for the reuse of existing infrastructure.
											PFD X					X	✓				
											Custom Offline ✓	10	0	0	10	X	✓	$ 2,750.67	$ 275,066.67		
3	OR3 SF	782	2378	3160	0.4	1	2690.8	70.44	YES	11.69	Online ✓	6	1	1	7	X	✓	$ 1,997.17	$ 199,716.67	YES	BPO: Online There is no space available to install a PFD device in this location due to narrow berms and existing services. An additional manhole would be required to install a PFD device in this location. Additional cartridges are suggested as they provide additional treatment capacity on a high contaminant generating road (therefore less risk of resuspension) without having to upsize the device.
											PFD X					X	✓				
											Custom Offline X					X	✓				
4	MS1 SF	297	1553	1850	0.4	1	1671.8	43.76	YES	6.68	Online ✓	4	0	0	4	X	✓	$ 1,290.67	$ 129,066.67	YES	BPO: Online Treating two existing CP's with a PFD device would require an additional manhole. Narrow berms and existing services means there is not enough space to accommodate an upsized PFD device and the additional manhole.
											PFD X					X	✓				
											Custom Offline X					X	✓				
5	MS2 SF	546	2698	3244	0.4	1	2916.4	76.34	YES	11.69	Online ✓	6	1	1	7	X	✓	$ 1,997.17	$ 199,716.67	YES	BPO: Online There is no space available to install a PFD device in this location due to narrow berms and existing services. An additional manhole would be required to install a PFD device in this location. An additional cartridge is suggested as they provide additional treatment capacity on a high contaminant generating road (therefore less risk of resuspension) without having to upsize the device.
											PFD X					X	✓				
											Custom Offline X					X	✓				
6	MS3 SF	191	1276	1467	0.4	1	1352.4	35.40	NO	4.26	Online ✓	3	0	0	3	X	✓	$ 1,037.50	$ 103,750.00	YES	BPO: PFD Sufficient space within the private lot for a PFD device. The catchments are high contaminant roads and a PFD device reduces the risk of resuspension.
											PFD ✓	3	0	0	3	X	✓	$ 1,070.00	$ 107,000.00		
											Custom Offline X					X	✓				
7	MS4 SF	521	1641	2162	0.4	1	1849.4	48.41	NO	5.68	Online ✓	4	0	0	4	X	✓	$ 1,290.67	$ 129,066.67	YES	BPO: PFD Sufficient space within the private lot for a PFD device. The catchments are high contaminant roads and a PFD device reduces the risk of resuspension.
											PFD ✓	4	0	0	4	✓	✓	$ 1,344.67	$ 134,466.67		
											Custom Offline X					X	✓				
8	MS5 SF	71	1345	1416	0.4	1	1373.4	35.95	NO	4.26	Online ✓	3	0	0	3	X	✓	$ 1,037.50	$ 103,750.00	YES	BPO: PFD Sufficient space within the private lot for a PFD device. The catchments are high contaminant roads and a PFD device reduces the risk of resuspension.
											PFD ✓	3	0	0	3	X	✓	$ 1,070.00	$ 107,000.00		
											Custom Offline X					X	✓				
9	MS6 SF	0	857	857	0.4	1	857	22.43	NO	2.84	Online ✓	2	1	1	3	X	✓	$ 1,037.50	$ 103,750.00	YES	BPO: PFD Sufficient space within the private lot for a PFD device. The catchments are high contaminant roads and a PFD device reduces the risk of resuspension.
											PFD ✓	2	0	0	2	X	✓	$ 817.33	$ 81,733.33		
											Custom Offline X					X	✓				
10	RS1 SF	1060	3285	4345	0.4	1	3709	97.09	YES	13.36	Online ✓	8	2	0	8	X	✓	$ 2,261.33	$ 226,133.33	YES	BPO: Online Device is treating an internal, low contaminant generating road, therefore resuspension poses less of a risk due to the reduced contaminants. The proposed treatment solution utilises an existing soakhole and the existing arrangement does not allow for a PFD device to be installed. There are two additional cartridge slots available within this devices that can be used to increase the WQF of the device. This is not recommended as BPO because in our opinion the reduction of resuspension risk is not proportionate to the increase in lifecycle costs.
											PFD X					X	✓				
											Custom Offline X					X	✓				
11	RS2 SF	550	1641	2191	0.4	1	1861	48.72	NO	5.68	Online ✓	4	0	0	4	X	✓	$ 1,290.67	$ 129,066.67	YES	BPO: PFD Existing catchpits terminate at one soakhole. Existing services in the area means that the easiest option is to convert the soakhole to a manhole, and a PFD device can be installed on Kainga Ora property. A PFD device has reduced risk of resuspension when compared to an online device
											PFD ✓	4	0	0	4	X	✓	$ 1,321.67	$ 132,166.67		
											Custom Offline X					X	✓				
12	RS4 SF	352	2084	2436	0.4	1	2224.8	58.24	YES	8.35	Online ✓	5	2	0	5	X	✓	$ 1,540.83	$ 154,083.33	YES	BPO: Online Device is treating an internal, low contaminant generating road, therefore resuspension poses less of a risk due to the reduced contaminants. There are two additional cartridge slots available within this devices that can be used to increase the WQF of the device. This is not recommended as BPO because in our opinion the reduction of resuspension risk is not proportionate to the increase in lifecycle costs.
											PFD ✓	5	0	0	5	✓	✓	$ 1,574.33	$ 157,433.33		
											Custom Offline X					X	✓				
13	ST1 SF	718	1896	2614	0.4	1	2183.2	57.15	YES	8.35	Online ✓	5	2	0	5	X	✓	$ 1,540.83	$ 154,083.33	YES	BPO: Online Device is treating an internal, low contaminant generating road, therefore resuspension poses less of a risk due to the reduced contaminants. There are two additional cartridge slots available within this devices that can be used to increase the WQF of the device. This is not recommended as BPO because in our opinion the reduction of resuspension risk is not proportionate to the increase in lifecycle costs. The proposed treatment solution utilises an existing soakhole and the existing arrangement does not allow for a PFD device to be installed.
											PFD X					X	✓				
											Custom Offline X					X	✓				
14	ST5 SF	354	1349	1703	0.4	1	1490.6	39.02	YES	5.01	Online ✓	3	0	0	3	X	✓	$ 1,037.50	$ 103,750.00	YES	BPO: Online Device is treating an internal, low contaminant generating road, therefore resuspension poses less of a risk due to the reduced contaminants. The proposed treatment solution utilises an existing soakhole and the existing arrangement does not allow for a PFD device to be installed.
											PFD X					X	✓				
											Custom Offline X					X	✓				
15	ED1 SF	601	1832	2433	0.4	1	2072.4	54.25	YES	8.35	Online ✓	5	0	0	5	X	✓	$ 1,540.83	$ 154,083.33	YES	BPO: Online Device is treating an internal, low contaminant generating road, therefore resuspension poses less of a risk due to the reduced contaminants. The proposed treatment solution utilises an existing soakhole and the existing arrangement does not allow for a PFD device to be installed.
											PFD X					X	✓				
											Custom Offline X					X	✓				
16	ED2 SF	614	1799	2413	0.4	1	2044.6	53.52	YES	6.68	Online ✓	4	0	0	4	X	✓	$ 1,290.67	$ 129,066.67	YES	BPO: Online Device is treating an internal, low contaminant generating road, therefore resuspension poses less of a risk due to the reduced contaminants. PFD would require an increased device size and an additional manhole.
											PFD ✓	4	0	0	4	✓	✓	$ 1,344.67	$ 134,466.67		
											Custom Offline X					X	✓				
17	ED3 SF	356	1056	1412	0.4	1	1198.4	31.37	YES	5.01	Online ✓	3	0	0	3	X	✓	$ 1,037.50	$ 103,750.00	YES	BPO: Online Device is treating an internal, low contaminant generating road, therefore resuspension poses less of a risk due to the reduced contaminants. PFD would require an increased device size and an additional manhole.
											PFD ✓	3	0	0	3	✓	✓	$ 1,093.00	$ 109,300.00		
											Custom Offline X					X	✓				
18	RF1 SF	387	1313	1700	0.4	1	1467.8	38.42	NO	4.26	Online ✓	3	0	0	3	X	✓	$ 1,037.50	$ 103,750.00	YES	BPO: PFD Device is treating a high contaminant generating road catchment. This is considered BPO over an online device due to the reduced risk of resuspension
											PFD ✓	3	0	0	3	✓	✓	$ 1,093.00	$ 109,300.00		
											Custom Offline X					X	✓				
19	RF2 SF	0	2330	2330	0.4	1	2330	60.99		0	Online						✓				No longer being installed due to limitations identified in the PDP assessment of soakage
											PFD						✓				
											Custom Offline						✓				
20	RF3 SF	1773	4387	6160	0.4	1	5096.2	133.41		0	Online						✓				No longer being installed due to limitations identified in the PDP assessment of soakage
											PFD						✓				
											Custom Offline						✓				
21	RF4 SF	115	1432	1547	0.4	1	1478	38.69	NO	4.26	Online ✓	3	0	0	3	X	✓	$ 1,037.50	$ 103,750.00	YES	BPO: PFD Device is treating a high contaminant generating road catchment. This is considered BPO over an online device due to the reduced risk of resuspension
											PFD ✓	3	0	0	3	X	✓	$ 1,070.00	$ 107,000.00		
											Custom Offline X					X	✓				
22	WT3 SF	1135	2787	3922	0.4	1	3241	84.84	NO	9.94	Online ✓	7	0	0	7	X	✓	$ 1,997.17	$ 199,716.67	YES	BPO: PFD An extra manhole is required to enable the use of a PFD device however, in this context, there is adequate space to do so. This device is treating a high contaminant generating catchment and a PFD device will offer reduced risk of resuspension.
											PFD ✓	7	0	0	7	✓	✓	$ 2,132.67	$ 213,266.67		
											Custom Offline X					X	✓				
																	Total ($):	$ 26,271.17	$ 2,627,116.67		

Appendix D3: Offset Mitigation Device Maintenance Cost Comparison

RAIN GARDEN

COST (GST Incl.) OF TREATING AVERAGE SIZED (1000m² IMPERVIOUS) CATCHMENT

	Landcare Research COSTnz Model					Maintenance Contractor					Auckland Council			
On-Going Maintenance	**Frequency**	**Cost (Low)**	**Subtotal Over 25 Years**	**Cost (High)**	**Subtotal Over 25 Years**	**Frequency**	**Cost (Low)**	**Subtotal Over 25 Years**	**Cost (High)**	**Subtotal Over 25 Years**	**Frequency**	**Cost (Low)**	**Subtotal Over 25 Years**	
Routine General Maintenance (removing debris, cleaning inlets and outlets, maintaining vegetation)	12 per year	$2.16 per m²	$14,580	$5.0 per m²	$33,750	2 per year	$125	$6,250	$250	$12,500	12 per year	$68	$20,268	
Inspections	1 per year	$100	$2,500	$260	$6,500	1 every three years	$250	$2,000	$250	$2,000				
Minor Repairs		$80	$2,000	$100	$2,500									
Initial After Care of Plants (for first three years only)	4 per year	$1 per m²	$270	$2.9 per m²	$783	6 per year	$150	$2,700	$150	$2,700				
Total On-Going			*$19,350*		*$43,533*			*$10,950*		*$17,200*			*$20,268*	
Corrective Maintenance														
Removal and Disposal of Sediments (including replacemnt of new media)	1 every 25 years	$450 per m³	$5,063	$1920 per m³	$21,600	1 every 25 years	$250 per m³	$5,625	$1500 per m³	$16,875	1 every 25 years	$250 per m³	$2,813	
Replacement of Parts		$1,000	$1,000	$3,250	$3,250							$250 per m²	$5,625	
Replanting		$30 per m²	$675	$47.5 per m²	$1,069									
Total Corrective			*$6,738*		*$25,919*			*$5,625*		$16,875			*$8,438*	
Total Maintenance over 25 Years			**$26,088**		**$69,452**			**$16,575**		**$34,075**			**$28,706**	Average = **$34,979**

STORMWATER 360 DEVICE

COST (GST incl.) OF TREATING AVERAGE SIZED (1000m² IMPERVIOUS) CATCHMENT

On-Going Maintenance	**Frequency**	**Cost**	**Subtotal Over 25 Years**
Indicative StormFilter Maintenance Pricing (includes confined space entry charge)	2	$1,037.50	**$25,938**

Appendix D4: Stormfilter Proprietary Device Approvals

Memo

25 February 2020

To: Matt Wilkins, Civil Engineer, Candor3

cc: Brendon Hosken, Development Manager, Kainga Ora

From: Camilla Needham, Principal Engineer, Healthy Waters

Subject: Oranga - On-line Stormfilters

The purpose of this memorandum is to summarise the outcome of the review carried out by Healthy Waters and Engineering Technical Services (ETS) of the proposed on-line Stormfilter configuration for Kainga Ora's Oranga neighbourhood redevelopment.

The proposed Stormfilter device itself is approved by ETS for use in the standard off-line arrangement. Alternative configurations may be approved by the asset owner. In this case both Auckland Transport and Healthy Waters have concerns about the treatment efficiency, maintenance and life cycle costs of the proposed Stormfilters.

It is agreed that the Best Practicable Option BPO is the off-line configuration (otherwise known as a Peak Flow Device, PFD). This is the optimum configuration with regard to water quality treatment efficiency, ease of maintenance and life cycle costs.

The risk related to online configuration includes resuspension of settled solids during peak flows and potentially increased maintenance costs. It is acknowledged that where there are infrastructure or space constraints, such as in the Oranga situation which is an existing brownfield neighbourhood, that the BPO may be an online device with additional overflow height and additional cartridges (where necessary).

The overall plan for the treatment devices for Oranga has identified approximately 20 stormfilters in either on-line, off-line (PFD) or custom on-line configurations.

Detailed design of each proposed stormfilter installation will be subject to the Engineering Plan Approval (EPA) process. Detailed drawings for each sub-catchment must be reviewed carefully before approval.

Please ensure the following information is provided with the EPA applications:

- Reason for selecting the device configuration (e.g as stated in 1317_HW_ StormfilterCosts.xls)
- Confirm which method has been used for the 10% AEP
- Confirm the Water Quality Flow (WQF) estimation for each sub-catchment. Please note that the WQF in spreadsheet (1317_HW_ StormfilterCosts.xls) appears to have been estimated based on the proposed design Cartridge number. Some of the Cartridge numbers are significantly overdesigned.
- Please provide clear catchment characteristics including; sub-catchment boundaries, slope, length, rainfall intensity, etc
- According to the Stormwater Code of Practice, the design storm (i.e. 10% AEP + Climate Change) shall be estimated based on TP108.
- Water Quality Flow for each sub-catchment shall be an estimate based on GD01- refer to section B1.7.2 in GD01
- Provide the Soakage rate (L/s) for each borehole (preferred test method: constant head percolation tests)

- Where Stormfilters discharge to soakage, please provide detailed drawings for each soakage device
- Please provide an O& M manual for each system including;
    - frequency of appropriate maintenance,
    - the items needed for each Stormfilter device and soakage device
    - traffic management plan

Matt Wilkins

From: Carl Whitten
Sent: Friday, 6 December 2019 7:50 AM
To: Lachlan Van der Meij; Dali Suljic; Matt Wilkins
Subject: FW: Oranga StormFilter arrangement
Attachments: Oranga_HW_AT Device plan mark up.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Correspondence and mark-up plan from AT/HW.

Let's discuss sometime today and also a response to Abbie's comment yesterday about SW360 only have Certification for offline devices.

From: Sarah Karlsen <sarah.karlsen@aucklandcouncil.govt.nz>
Sent: Thursday, 5 December 2019 12:19 PM
To: Carl Whitten <Carl.Whitten@candor3.co.nz>
Cc: Cathy Bebelman (AT) <Cathy.Bebelman@at.govt.nz>; Mark Iszard <Mark.Iszard@aucklandcouncil.govt.nz>; Jason McGregor <jason@transvalueconsultants.co.nz>; Rebecca Phillips (AT) <Rebecca.Phillips@at.govt.nz>; Camilla Needham <camilla.needham@aucklandcouncil.govt.nz>
Subject: RE: Oranga StormFilter arrangement

Hi Carl

Please see attached device plan mark up. The plan proposes to remove 9 of the devices by prioritising devices with higher traffic volumes, intersections and those servicing larger catchment areas. The 9 selected on the attached plan uses the traffic volumes presented in the drawing pack (which I understand are existing/historic) and a visual estimate of the catchment size. Can you please confirm these are the most appropriate by undertaking this assessment using predicted traffic volumes and calculated catchment size? Traffic volume x length of road could be a good metric to use.

At the locations where StormFilters are to be removed, pre-treatment prior to discharge to the aquifer is to be provided via deepened sumps and half syphon catchment leads, as mentioned by Camilla.

Me ngā mihi

Sarah Karlsen

From: Camilla Needham <camilla.needham@aucklandcouncil.govt.nz>
Sent: Thursday, 5 December 2019 10:26 AM
To: Sarah Karlsen <sarah.karlsen@aucklandcouncil.govt.nz>; Sarah Karlsen <SKarlsen@tonkintaylor.co.nz>
Cc: Cathy Bebelman (AT) <Cathy.Bebelman@at.govt.nz>; Mark Iszard <Mark.Iszard@aucklandcouncil.govt.nz>; Carl Whitten <carl.whitten@candor3.co.nz>; Jason McGregor <jason@transvalueconsultants.co.nz>; Rebecca Phillips (AT) <Rebecca.Phillips@at.govt.nz>
Subject: RE: Oranga StormFilter arrangement

Hi all
I reported at the PCG meeting that the SW design had been reviewed and revised by AT and HW.

The proposed revised solution is to remove 9 stormfilters from the original 31 and in these locations replace with deep sumps and half siphon leads to capture floatables.

@Sarah Karlsen
Can you please send Carl Whitten at Candor (CCd to this email) the marked up plans as reviewed by AT?

Me ngā mihi | Thanks

Camilla Needham | Principal – Strategic Development
Healthy Waters
Mobile 021 573 095
Auckland Council, Level 3, Bledisloe House, 24 Wellesley Street, Auckland
Visit our website: www.aucklandcouncil.govt.nz

From: Mark Iszard <Mark.Iszard@aucklandcouncil.govt.nz>
Sent: Wednesday, 4 December 2019 4:42 PM
To: Camilla Needham <camilla.needham@aucklandcouncil.govt.nz>; Cathy Bebelman (AT) <Cathy.Bebelman@at.govt.nz>
Cc: Rebecca Phillips (AT) <Rebecca.Phillips@at.govt.nz>; Sarah Karlsen <sarah.karlsen@aucklandcouncil.govt.nz>; Jason McGregor <jason@transvalueconsultants.co.nz>
Subject: Re: Oranga StormFilter arrangement

Hi all,

Just spoke to Cathy who had been following the emails but hadn't had a chance to reply.

Essentially she's comfortable with the updated number of storm filters (9removed) and using deeper sumps and 1/2 syphons elsewhere.

If she can't make tomorrow AT are comfortable for us to confirm this with KO.

Thanks
Mark

Regards
Mark Iszard
Growth and Development Manager
Healthy Waters
Auckland Council
021913296
mark.iszard@aucklandcouncil.govt.nz

From: Camilla Needham <camilla.needham@aucklandcouncil.govt.nz>
Sent: Monday, 2 December 2019, 16:02
To: Cathy Bebelman (AT)
Cc: Rebecca Phillips (AT); Mark Iszard; Sarah Karlsen; Jason McGregor
Subject: RE: Oranga StormFilter arrangement

Hi Cathy,

I'm happy with the proposed revised solution as discussed below, ie remove 9 stormfilters and replace with deep sumps and half siphons.

Could you please confirm that you are ok with this before I go back to Kaianga Ora and advise them of our (AT/HW) recommendations.

Me ngā mihi | Thanks

Camilla Needham | Principal – Strategic Development
Healthy Waters
Mobile 021 573 095
Auckland Council, Level 3, Bledisloe House, 24 Wellesley Street, Auckland
Visit our website: www.aucklandcouncil.govt.nz

From: Mark Iszard <Mark.Iszard@aucklandcouncil.govt.nz>
Sent: Monday, 2 December 2019 8:47 AM
To: Sarah Karlsen <sarah.karlsen@aucklandcouncil.govt.nz>; Jason McGregor <jason@transvalueconsultants.co.nz>; Cathy Bebelman (AT) <Cathy.Bebelman@at.govt.nz>
Cc: Camilla Needham <camilla.needham@aucklandcouncil.govt.nz>; Rebecca Phillips (AT) <Rebecca.Phillips@at.govt.nz>
Subject: RE: Oranga StormFilter arrangement

Thanks Sarah,
Hi
Jason, AT CoP drawing RD00021 looks to have this covered, though it does lack details for the actual syphon materials and details.

Kind Regards / Ngā Mihi Mahana

Mark Iszard | Growth and Development Manager
Healthy Waters, Infrastructure and Environmental Services
DDI: +64 9 890 7961 I EXT: (46)7961 I MOB: +64 21 913 296
Auckland Council, Level 3, Bledisloe House, 24 Wellesley Street, Auckland
Private Bag 92300, Victoria Street West, Auckland 1142

Visit our website: www.aucklandcouncil.govt.nz

From: Sarah Karlsen <sarah.karlsen@aucklandcouncil.govt.nz>
Sent: Thursday, 28 November 2019 3:19 PM
To: Jason McGregor <jason@transvalueconsultants.co.nz>; Mark Iszard <Mark.Iszard@aucklandcouncil.govt.nz>; Cathy Bebelman (AT) <Cathy.Bebelman@at.govt.nz>
Cc: Camilla Needham <camilla.needham@aucklandcouncil.govt.nz>; Rebecca Phillips (AT) <Rebecca.Phillips@at.govt.nz>
Subject: RE: Oranga StormFilter arrangement

Hi all

Mark and I have discussed with the HW Lifecycle Planning team and from a maintenance perspective they do not have an issue with half syphons. Ideally the catchpit will be fitted with a rodding eye so that maintenance can he undertaken from the catchpit end. On this basis sense to target both floatables (with the half syphon) and sediments (with the deepened sump) at the catchpit and protect and reduce maintenance needs on the soakholes.

Does AT need to review this any further or can we provide this feedback to Kianga ora? Can you please let me know if you would like me to do that on behalf of HW & AT?

Thanks all,
Sarah

From: Jason McGregor <jason@transvalueconsultants.co.nz>
Sent: Tuesday, 26 November 2019 8:44 PM
To: Mark Iszard <Mark.Iszard@aucklandcouncil.govt.nz>; Cathy Bebelman (AT) <Cathy.Bebelman@at.govt.nz>; Sarah Karlsen <sarah.karlsen@aucklandcouncil.govt.nz>
Cc: Camilla Needham <camilla.needham@aucklandcouncil.govt.nz>; Rebecca Phillips (AT) <Rebecca.Phillips@at.govt.nz>
Subject: RE: Oranga StormFilter arrangement

Hi

Do we know if the ops teams have any concerns with maintenance of half syphons in general and particularly for this application e.g. any rodding would need to be done from the downstream MH, which in this case will be a soakhole with several filter cages sticking up from the bottom.

Candor3 would also need to ensure that they can achieve cover requirements for half syphon leads in the road. May not be an issue with the suggested deeper CPs.

*The correspondence above is carried out on a "**without prejudice**" basis, and any agreements and/or decisions are subject to formal approval by Auckland Transport.*

Regards

Jason McGregor
TRANSVALUE CONSULTANTS LTD

Ph. 027 216 9063 **I** Jason@transvalueconsultants.co.nz **I** PO Box 60-514, Titirangi, Auckland

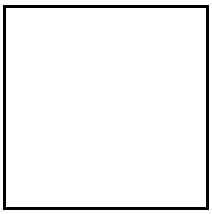
Trăns-văl'yū – "To evaluate by a new standard or principle, especially by one that varies from conventional standards"

From: Mark Iszard <Mark.Iszard@aucklandcouncil.govt.nz>
Sent: Tuesday, 26 November 2019 10:38 AM
To: Cathy Bebelman (AT) <Cathy.Bebelman@at.govt.nz>; Sarah Karlsen <sarah.karlsen@aucklandcouncil.govt.nz>
Cc: Camilla Needham <camilla.needham@aucklandcouncil.govt.nz>; Rebecca Phillips (AT) <Rebecca.Phillips@at.govt.nz>; Jason McGregor <jason@transvalueconsultants.co.nz>
Subject: Re: Oranga StormFilter arrangement

Just thinking about floatables, would it be beneficial to consider 1/2 syphons as well?

Mark

Regards
Mark Iszard
Growth and Development Manager
Healthy Waters
Auckland Council
021913296
mark.iszard@aucklandcouncil.govt.nz



Appendix E: Offset Mitigation Plan

LEGEND

- STORMFILTER - ON-LINE
- STORMFILTER - PFD
- STORMFILTER - CUSTOM OFFLINE
- TREATED CATCHMENT

N

OR1 SF
OR2 SF
OR3 SF
WT3 SF
ST5 SF
ST1 SF
RF1 SF
RF4 SF
ED1 SF
ED2 SF
ED3 SF
RS1 SF
RS2 SF
RS4 SF
MS1 SF
MS2 SF
MS3 SF
MS4 SF
MS5 SF
MS6 SF

ORANGA AVENUE
WALLATH ROAD
OLEA ROAD
WAITANGI ROAD
SANTOS PLACE
NISSAN PLACE
STATE AVENUE
TOROKINA PLACE
EDMONTON AVENUE
TREASURY PLACE
GAMBIA PLACE
ROCKFIELD ROAD
HULL PLACE
ROOSEVELT AVENUE
MELVILLE PLACE
BOW PLACE
NAMATA ROAD
MOUNT SMART ROAD

REV	DESCRIPTION	BY	APPVD	DATE
A	ISSUED FOR LIFECYCLE COST ANALYSIS	MAS	DS	14-02-20
B	UPDATED FOR SMP	MW	DS	24-02-20
C	UPDATED FOR SMP	MW	DS	03-04-20

Candor3 ENGINEERING FOR LIFE

PROJECT

KĀINGA ORA ORANGA REDEVELOPMENT
STORMWATER TREATMENT DEVICES
DEVICE LOCATION PLAN

CLIENT

Kāinga Ora Homes and Communities

PURPOSE: FOR SMP

DESIGN LV DRAWN MW CHECK DS	APPROVED BY CW DATE 3 APR 2020	SCALE 1:3000 @ A3	
PROJECT NO. 1317	DRAWING NO. 4-651	REV. C	

PRINT DATE: 06.04.2020 J:\PROJECTS LAND DEVELOPMENT\1317 HLC ORANGA STAGE 1 2\DOCS AND COMMS\SMP\1317 3-697 RD-TREATMENT DEVICES OVERALL PLAN FOR SMP.DWG

Appendix F: Iwi Consultation Minutes

HUI

Purpose: **Hui:** Te Ākitai Waiohua

Date: 22 March 2019, 10.30am – 12:26pm

Location: HLC Mangere Information Centre

Attendees: HLC – Amos Kamo, Dane Grey, Savanna Steele, Jackie Layt (notetaker)

Piritahi: Mel Drumm, Liam Sinden

HNZC, Gurv Singh, Nick Seymour

Te Ākitai Waiohua (TAW): Kathleen Wilson, Nigel Denny (Snr), Nigel Denny (Jnr)

Apologies: Nicola Mochrie, Aileen Maniti, James Copley

		Action By Who
10.30 am	**Mihimihi/Karakia** Introduction HLC – Te Akitai Waiohua: Savanna Steele, Kathleen, Nigel (snr), Nigel (jnr)	
10.35 am 11.15am	**Precinct Updates** - Amos outlined briefly how the Precinct structure is evolving across HLC. - Amos discussed Archaeological Authority process. Piritahi taking lead role. **ACTION: Mel/Amos/Savanna – set up time to meet and coordinate Strawman around developing up a cultural monitoring programme.** - **Mangere (Aorere, Middlemore, Mangere West)** Dane provided overview of Aorere neighbourhood and presented Masterplan map. **ACTION: To explore opportunities with mana whenua regarding narrative for Aorere.** **ACTION: Explore potential korero/narrative opportunities re Middlemore Crescent with Nigel D (snr).** • **Mt Roskill** Owairaka Greenway update. Roskill South – Puketapapa (Maunga Authority) update on progress. • **Oranga** Programme delivery update	 Amos Amos/Dane Amos/Dane
10:45 am	**HNZC Update** • Updated provided across Mt Roskill, Mangere and Oranga.	
10.55 am	**Placemaking** • **SDS – Spatial delivery strategy (Amos)** – provided brief outline of SDS across AHP, at a precinct level for Mangere and Mt Roskill	

	ACTION: Amos/Savanna to coordinate dates/location and consult with TAW regarding SDS workshops.. • **Road Naming – Mt Roskill, Mangere (Savanna)** - Outlined road naming process provided on behalf of Kathleen Waldock, who has engaged with TAW previously. **Noted** by TAW that it is positive to see PIritahi/HLC building relationships with LB to support this process. TAW support this process.	**Amos/Savanna**
11.00am	**Piritahi Updates (Mel/Liam)** • **Work programme update (Liam)** o Provided update on works in Oranga. o Piritahi team are involved in design and consulting work. Active in Mangere West – handovers, ground condition assessment etc. Ongoing in Roskill South area too. Next focus is Oranga; Owairaka may come on board. o Recruiting community engagement team – in progress. **ACTION: Amos to work up a cultural induction programme opportunity for community engagement teams (HLC/Piritahi) for later in the year (Aug/Sept).** **ACTION: Amos to work with Mel and arrange site tour for Piritahi/TAW with Liam/Nigel Denny (snr).** • **Cultural Induction** - Cultural Induction planning discussed TAW discussed a tailored opportunity for on the ground staff (can be guided by Nigel). Higher level bigger picture context for cultural induction **ACTION: Amos/Mel to develop content which will formulate and guide a cultural induction programme.**	**Amos** **Mel/Amos** **Amos/Mel**
	Karakia whakamutunga (12.26pm) - Amos	

AGENDA

Purpose: **Hui:** Te Ākitai Waiohua

Date: 22 March 2019, 10.30am – 12:26pm

Location: HLC Mangere Information Centre

Attendees: HLC – Amos Kamo, Dane Grey, Savanna Steele, Jackie Layt (notetaker)

Piritahi: Mel Drumm, Liam Sinden

HNZC, Gurv Singh, Nick Seymour

Te Ākitai Waiohua (TAW): Kathleen Wilson, Nigel Denny (Snr), Nigel Denny (Jnr)

Apologies: Nicola Mochrie, Aileen Maniti, James Copley

Discussion Point		Who
10.30 am	**Mihimihi/Karakia** Introduction HLC – Te Akitai Waiohua: Savanna Steele, Kathleen, Nigel (snr), Nigel (jnr)	
	Apologies	
	Governance Structure Plan	
10.35 am 11.15am	**Precinct Updates** - Amos outlined briefly how the Precinct structure is evolving across HLC and will increase number of precincts in the near future. - Amos discussed Archaeological Authority process. Piritahi taking lead role. Hans presently lead archaeologist (Stage 2 Mangere, Stage 2&3 assessments in Northcote, helping to shape up HLC SOPs. however Clough will also engage in works as the work demands. Nigel Denny (snr) is happy to work with Clough going forward. Amos – intention is to create collaborative approach with Heritage NZ and seek to include mana whenua/archaeologist at future hui. Amos looking to set up a work programme around this. **ACTION**: Mel/Amos/Savanna – set up time to meet and coordinate Strawman around developing up a cultural monitoring programme. • **Mangere (Dane Grey)** Aorere, Middlemore, Mangere West, Archaeology authority - Dane provided overview of Aorere neighbourhood and presented Masterplan map. Outlined big issues i.e. road connectivity network to community. Outlined key moves – creating open community park spaces as an extension of community back yards, better links for schools, upgrade networks across streets for pedestrian access, upgrades to park amenity (Aorere Park) i.e. grounds. **ACTION**: Dane –to explore discussion re mana whenua narrative for Aorere opportunities re: Aorere/Middlemore (Middlemore Crescent) and consider narrative.. **ACTION**: Explore potential korero/narrative opportunities re	**Amos** **Amos/Dane** **Amos/Dane**

	Middlemore Cresent with Nigel D (snr). - Review forward programme. Also there will be road naming. Working on stormwater management plan – flows down to rear of Rogers Garden Centre. To update further when more information regarding receiving environment. • **Mt Roskill (Amos)** Owairaka Greenway – contract about to start on this. Roskill South – Puketapapa (Maunga Authority) –brief update on progress. • **Oranga** Programme delivery update	
10:45 am	**HNZC Updates (Gurv Singh)** • Mt Roskill, Mangere, Oranga	
10.55 am	**Placemaking** • **SDS – Spatial delivery strategy (Amos)** – provided brief outline of SDS across AHP, at a precinct level for Mangere and Roskill looking at key moves i.e. light rail, Tararata Stream, Greenway (Oakley Creek), soft infrastructure – parks, connectivity, stormwater. To have further consultation with TAW and have higher level of engagement with Mana Whenua (MW) which will include future workshops on SDS – proposed mid April. Facilitated by Rau Hoskins re: Māori Design Guidelines workstream in Māori outcomes. - To determine with TAW whether to hold in line with current MW hui forum or one of collective workshops. Savanna - Propose rangatahi presence at this forum. Kathleen – this is own separate kaupapa to create context in this space. Propose holding one of collective for MW at Mangere location. **ACTION**: Amos/Savanna to coordinate dates/location and consult with TAW. • **Road Naming – Mt Roskill, Mangere (Savanna)** - Outlined road naming process provided on behalf of Kathleen Waldock, who has engaged with TAW previously. Nigel (jnr) how do we reconcile the road naming? Kathleen – depends on local board (LB) and MW relationship and who they engage with as a priority. Outcome of names – LB will defer to their preference. Some developers have a good relationship with LB and can influence on behalf. Good to see PIritahi/HLC building relationships with LB to support this process more positively. TAW support this process.	**Amos/Savanna**
11.00am	**Piritahi Updates (Mel/Liam)** • **Work programme update (Liam)** o Provided update on works in Oranga – April/May timeline for getting works underway. Roskill South Stage 2 – doing work in amongst other work HLC currently working across. Have started in this area. Similarly getting into infrastructure works – approx 9 month project. Also in	

	Northcote area – another stage of HLC development. ○ Piritahi team get involved in design and consulting work. Active in Mangere West – handovers, ground condition assessment etc. Ongoing in Roskill South area too. Nothing standing out in results. Completed 1km of hand overs so far – no outcome to date. Don't anticipate much happening in the next few months. Next focus is Oranga; Owairaka may come on board – in early days - pending. ○ Mel's team – still building the team. Recruiting community engagement team – in progress. Onboarded two more community liaison reps - to keep neighbours informed; larger initiatives to bring to MW as it arises. Still in building up phase – team to grow. Will work more closely with HLC community engagement coordinator team. **ACTION**: Amos to work up a cultural induction programme opportunity for community engagement teams (HLC/Piritahi) for later in the year (Aug/Sept). ○ Liam – resourcing across PIritahi work programme with MW. Regular project updates to inform and prompt and identify types of cultural monitoring advice. Could be an opportunity for a cultural monitoring induction for team. Nigel Denny (snr) is sole resource in the cultural monitoring space for TAW. **ACTION**: Amos to work with Mel and arrange site tour for Piritahi/TAW with Liam/Nigel Denny (snr). • **Cultural Induction** - Amos advises constantly tracking with Heritage NZ Authority – working through efficient ways to work through processes. - Cultural Induction planning discussed to be held at local marae. - Kathleen – more tailored opportunity for on the ground staff (can be guided by Nigel). Higher level bigger picture context for cultural induction – first upfront sense of who we are, what we are doing currently, historical picture, commercial aspirations, baseline principles (why certain practices are important to us and for people to know). **ACTION**: Amos/Mel to develop content which will formulate and guide cultural induction programme. - Link in cultural monitoring programme for staff on the ground, tool box regulatory meetings and cultural induction for high level (DMs, Exec, etc) - Nigel D (jnr) touched on Southwest Gateway project experience presentation re commercial aspiration. - House relocation/demolition/deconstruction focus programme – Amos – early days not too much to report back on – draft paper. A few recommendations on how this could work.	**Amos** **Mel/Amos** **Amos/Mel**
11:20 am	**Māori Outcomes** ▪ Work streams x4	

	Events	
	Comms	
	Upcoming work	
	Any other business	
	Karakia whakamutunga (12.26pm) - Amos	

MEETING

Purpose: **Hui:** Te Ākitai Waiohua

Date: 5th April 2019, 10.30am – 12:20pm

Location: HLC Mangere Information Centre

Attendees: HLC: Amos Kamo, Jackie Layt (note taker), James Copley,
Piritahi: Mel Drumm
Te Ākitai Waiohua: Kathleen Wilson
By invitation: Maurice Sinclair and Julie Tuineau (Tararata Stream Series)

Apologies: HLC: Savanna Steele, Aileen Maniti, Dane Grey, Lucy Smith, Brendon Hosken
HNZC: Gurv Singh, Mattew Hulett
Te Ākitai Waiohua: Nigel Denny (Snr)

Discussion Point		Action by
10.30 am	**Mihimihi/Karakia**	**Amos Kamo**
	Apologies	**Jackie Layt**
10.40 am	**Precinct Updates** **<u>Aorere, Middlemore, Mangere West, Archaeology authority</u>** • Tararata Steam Series (TSS) - Maurice Sinclair and Julie Tuineau provided overview of Tararata Creek catchment area in which their team are currently cleaning up; ecology of stream needed; and community input required. • Seeking ongoing relationship with Mana Whenua (MW). • ACTION: On-going discussions and opportunities in this space and open to TSS channelling queries via James Copley. **<u>Mangere update</u>** • Overview and update on the Mangere Neighbourhood. • Working to have civils work in place pre opening July. Realistically August to move tenants in. • Develop stakeholder relationship next steps, and then work out approach to MW involvement with consultant appointments. Expressed interest in appointing Piritahi for engineering works. Kathleen - TAW supports leveraging existing relationship with Piritahi to be considered for these works. • ACTION: Amos/James to organise a meeting with Mark Lewis.	**Maurice Sinclair and Julie Tuineau** **James Copley** **Amos Kamo**

	Amos Kamo **Aorere** • Brief update on Aorere - busy with business case. A couple of rounds of community consultation in progress. Dane and Amos meeting with Matt Campbell (archaeology). **Mt Roskill** • Overview and Update on the Mt Roskill precinct. **Ōwairaka Greenway** • Overview on the Ōwairaka Greenway Project. • This initiative identifies green connections and plantings linking maunga with parks/reserves. • ACTION: Amos to organise Aileen to provide project update at next hui. **Roskill South** • Puketapapa (Maunga Authority) – nil update. **Oranga** • Programme delivery update – nil update.	**Amos Kamo**
11:45 am	**Piritahi Updates** **Mt Roskill** • Visited onsite today. Currently doing earthworks – digging through rock. Geo tech is basalt. Will be a simpler process re site investigations going forward in Roskill South. **Relocation & De-construction** • Only demolished houses in Oranga which are mostly in a poor state and minimal could be salvaged. • Looking at efficient ways to reuse/salvage materials.	**Mel Drumm**
	HNZC Updates – nil update	
	Placemaking **SDS Wānanga Series** • Workshop - First workshop will be 18th April. ACTION: Details will be sent out to MW by Savanna.	**Amos Kamo** **Savanna**
12.05pm	**Māori Outcomes** • 5x Workshop Series for each Māori Outcome Area • Amos provided overview of Māori Outcomes – Engagement Relationships.	**Amos Kamo**

12:20pm	**Karakia whakamutunga**	**Amos Kamo**

MEETING

Purpose: **Hui:** Te Ākitai Waiohua

Date: 3rd May 2019, 10.30am – 12:00pm

Location: HLC Mangere Information Centre

Attendees: HLC: Amos Kamo, Aileen Maniti, James Copley, Dane Grey, Savanna Steele, Lucy Smith, Brendon Hosken, Jackie Layt (minute taker) Rau Hoskins (Contractor)
Archaeology – Hans Bader, Mat Campbell
Te Ākitai Waiohua (TAW): Kathleen Wilson, Nigel Denny (Snr)

Discussion Point		Action by
10.30 am	**Mihimihi/Karakia**	
	Apologies HLC: James Copley (written update provided) Piritahi: Mel Drumm	
	Kawenata (Savanna Steele) - SDS workshop held on 30 April - Would like to gather feedback from TAW over next few days and also invite Nicola Mochrie to future hui to further refine this.	
	Māori Outcomes (Amos Kamo) - Making good progress - Board signed off Construction Plus programme which fits under Maori social outcomes. Will launch with Piritahi initially. **ACTION**: Amos to present Construction Plus programme at next hui.	**Amos**
10:35 am	**Culture Monitoring Programme (Amos Kamo)** • Overview • Amos - Development of a comprehensive programme applies across whole of Tamaki. Also developing a compliance tracking system for reporting. • Hans - Balancing out Ngati Whatua narrative. A matter of acknowledging different groups have different points of view. • Nigel – each iwi have different narrative however should only involve those involved in the project. • Mat – propose earlier engagement with Heritage NZ in the process to identify what information is required. • Kathleen – how do we get Heritage NZ to understand the iwi approach to the narrative. It's not always 19 iwi perspective. • **ACTION**: Cultural Monitoring Induction process to be defined. Co-design with Hans/Nigel.	**Nigel/Hans**
10:50 am	**Precinct Updates** • **Mt Roskill (Lucy Smith / Aileen Maniti)** **Owairaka Greenway** – no further update.	

	Roskill South – Puketapapa (Maunga Authority) – BAU at the moment. Meeting with Authority. **Waikowhai Neighbouhood** - Early stages of this neighbourhood – test case for Maori outcomes to apply frameworks we have developed to date. • **Oranga (Brendon Hosken)** Programme delivery update (SMP) • **Mangere (Dane Grey / James Copley)** **Aorere** Neighbourhood information day 18 May coming up. Informing key moves. To be held at Kingsford. o 2 outfalls identified – storm water management. No designs yet. o High ground water table – few approaches to consider and will keep TAW updated. o Created new park (placemaking) o Existing unused park – looking at land swap with Parks to acquire it. **Mangere West (James Copley)** Provided written update and photos as below: • No further progress to report on the Te Ararata creek unfortunately. Struggling to get our second meeting with Council and Shaun Jones has just resigned which will probably put things back further. • SW outlet in Te Ararata Creek is progressing well. Photos attached. • Work on the temporary detention basins adjacent the Creek will begin soon. • HNZ working hard to complete Bader Mckenzie Apartments and houses to be complete by end July 19. **Archaeology authority** – Amos went over approach with NZ Heritage. **ACTION**: Ensure all PMs attend next hui to provide updates on projects.	**Savanna**
11:10 am	**Placemaking** • SDS – Wānanga details (Savanna Steele / Rau Hoskins) • Rau –spatial delivery strategy – zoom out approach - big picture aspirations – expressed by mana whenua. Concerns – key aspirations – developing up key moves. • Key tool is to create a cultural landscape layer – everything TAW are comfortable to be recorded in a GIS type way. To inscribe the narrative for the specific sites. • Opportunity for TAW to consider spatial connectivity to waahi kainga ora options • Savanna - Any thoughts around what success looks like for TAW in	

	this space? (Social/economic/environmental/physical). Education, employment, environmental, spiritual, recreational. • Amos – desire for TAW to help shape. This is a beginning of a series of conversations. • Savanna – 20 May 2019 proposed for next SDS workshop – 10am-1pm. TAW available on this date. Rau – TAW provide feedback to verbalise or input to presentation at workshop.	
	HUDA Update – Sarah Chapman - 13 May – stand up as Urban Development Group – delivery arm of HUDA. John Duncan (Chair) will be calling a hui for iwi chairs. Kathleen – what's happening in the relationship space i.e. with HNZ. Sarah – evolving space.	
12:20 pm	**Karakia whakamutunga (Amos)**	

URBAN DEVELOPMENT GROUP

HLC kiwibuild Housing New Zealand

MEETING

Purpose: **Hui:** Te Ākitai Waiohua

Date: 17 May, 2019, 10.30 am – 12.00 pm

Location: 12 Waddon Place, Mangere Development Information Centre

Attendees: UDG-HLC: Amos Kamo, Savanna Steele, Jackie Layt (minute taker), Lucy Smith, Andrew Looker, Kathleen Waldock

Piritahi: Mel Drumm

Te Āakitai Waiohua (TAW): Kathleen Wilson

Apologies: TAW: Nigel Denny, HLC: Karla Beazley, Dane Grey, James Copley, Brendon Hosken, HNZC

Discussion Point		Action by
10.30 am	**Mihimihi/Karakia**	
	Apologies : , HNZC, Nigel Denny	
	Kawenata (Amos Kamo)	
10.33 am	**Precinct Updates** • **Mt Roskill (Lucy Smith)** - Roskill South – Puketapapa (Maunga Authority) - Well into civil works in Stage 2, completing civil works, remediation ad house removal. Going from 91 houses to region of 350 houses. - Kathleen Waldock working on a place making project around 'play street' and inclusion of amenity initiatives in the park. - Working on innovation project with builder partners showcasing innovative technology. - Into design of stage 3 and 4. Whole development due to finish in 2022. - Looking at improving access way to the Maunga. Amos has been in discussions with council. Want to link narrative and stories. **Waikowhai** - This is the next neighbourhood off the ranks in Roskill South. - Going into 6-9 month feasibility stage. Working with Piritahi and Isthmus, doing geo tech, pipes etc. Will produce business case at end of feasibility. - Approximately 300 state houses. Under existing zoning mixed housing suburban – to grow to approx. 770 houses. - Considering undergrounding high power lines along main arterial. - Engaged positively with Transpower and CCOs. **ACTION**: Amos to organise a meeting with Nigel Denny to establish the cultural monitoring for Waikowhai. Consider an addendum.	**Amos**

11.05 am	**ACTION:** Amos to organise a site visit for TAW to Northcote (Tamsyn). • **Owairaka (Aileen Maniti/Kathleen Waldock)** - Greenway initiative – Te Auaunga/Oakley Creek - Opportunities to better connect local parks, maunga and amenities and improve safety, lighting, pedestrian walkways access and visibility. - Proposed projects – seeking guidance from MW as an opportunity to co-design these spaces and potential for improvement of sites and connectivity. - Safer Routes for Schools initiative to improve access ways and connection links and visibility for pedestrians/cyclists, and drop off/parking zones. • **Oranga** - Nil report. • **Northcote** - Nil report. • **Mangere** - Aorere, Middlemore, Mangere West update.	**Amos/Savanna**
11.25 am	**Piritahi (Mel Drumm)** - Overview of works to date across sites. - Stakeholder and Communications Manager has now joined Piritahi – Vanessa Kennedy. • **ACTION:** Savanna to coordinate with Mel a site tour across Mangere and Roskill with Piritahi. Liam is available later in May.	**Savanna/Mel**
11.40 am	**Placemaking** • SDS – Wānanga Update (Savanna Steele) – next workshop to be held on 20 May at Mangere. • Puketapapa Matariki Event (Karla Beazley) – item to be included at next hui.	
11.50 am	**Māori Outcomes (Amos Kamo)** • Work streams 2019	
12.00pm	**Karakia whakamutunga**	

HUI

Purpose: **Hui:** Te Aakitai Waiohua

Date: 9 August, 2019, 9.30-11.00am

Location: Headquarters Room, HLC

Attendees: HLC – Amos Kamo, Savanna Steele, Jackie Layt (minute taker), James Copley, Brendon Hosken, Chanelle, Kevin Liu, John Tubberty

Te Aakitai Waiohua: Jeff Lee

Piritahi: Mel Drumm

Engineer: Dali (Candor 3), Auckland Council – Dave Little

Discussion Point		Action by who
	Mihimihi/Karakia	
	Apologies	
	Kawenata (Savanna)	
	Precinct Updates **Roskill/Mangere/Oranga** **Mangere –** James Copley - Not much change. Carrying on with Civils. New buildings on Bader/Mackenzie and Bader/Ventura opening in December. Social housing – tenants moving in later this year. - Lot E consent to be lodged in approx. 6 months. - Jeff: acknowledge sincere partnership and positive Māori outcomes being drafted across HLC, in terms of a technical point of view – signalling major concerns and disappointment around how application for these consents are being lodged – no cultural consultation, in particular Piritahi consent lodging. - Amos: **ACTION: discuss concerns at hui next week to be scheduled with Project Managers – tentatively Friday 16 Aug.** Need to address documenting demonstration of cultural consultation. Immediate need of cultural induction – keen for Jeff to progress. Also address schedule of activities (Jeff). - Jeff: discussed need to review SMPs. Keen to appreciate cultural responsiveness within Piritahi. • **Storm Water management plans** **Mangere West Stage 2 (Dali)** – overview (stage 2 and including stage 3) - Preliminary draft seen by Healthy Waters and Auckland Transport. • Jeff: Has there been any formal process around which iwi has an interest in a specific area? Amos: yes- in reference to expressions of interest i.e. CVA. • 2 key elements – water quality of storm water discharge, and risk of flooding away from community. Manage areas better than currently and make safer. Keeping away from properties adjacent to the Creek to avoid impeding. • Jeff: How does SMP ensure the restoration and uphold the mauri etc...?	**Amos Kamo**

	James: Council involved and starting a project group with stakeholders, looking at improving amenities, access way, design and whether a need to widen Creek. Jeff: How does MW fit into that? James: Council will run this. Jeff: Outfalls included in SMP to be lodged? James: Yes Dali – Creek is heavily degraded habitat based on testing. No treatment currently. Looking to improve storm water discharge. Eliminate contaminants, debris diverters, pollutant traps on public new infrastructure. Discussions with HW to identify suitable pollutant traps. Net trap option for outlets installed for contaminants to be visible. **ACTION: Dali/James to discuss SMP further with Jeff.** - SMP – copy in draft form to be circulated to MW for feedback. - Bio retention more appropriate for this region. **ACTION: Dali to circulate draft SMP to Jeff Lee and James Copley** **.** To note – Dali will provide Jeff with a Table with regards APU operative to demonstrate what is being done in these areas. • **SMP – Oranga (Dali)** - Looking to improve stormwater discharge and mitigate flooding issues. Improve quality of water discharge. Very high volume roads in Oranga. 360 treatment filtration to reduce contaminants/pollutants. - Currently working through consultation process. Currently 31 existing influential locations for treatment filtration devices proposed. - Improving flooding and risk to community to ensure houses don't get flooded and area is safe. **ACTION: Dali to circulate draft SMP to Jeff Lee.** • Jeff: Signalled expression of interest from Te Aakitai Waiohua to submit formal response in relation to initial lodgement of consent. Jeff: Archaeological awareness to be noted. • **Fergusson Domain (Dave Little)** Overview of concept refresh for the Park project to address overlook/visibility issues. Boundaries to be reconfigured, in future upgrade of assets. Improvement to cycleway/walkway, active space i.e. bmx track, thin out dense bush (midstory). Jeff: concerns AC Parks have not included MW in cultural consultation for this project. What is AC approach to engagement with MW and how does this fit in with HLC? Dave: We will follow AC engagement process with MW. Jeff: Noted expression of interest in this project on behalf of Te Aakitai Waiohua. **ACTION: Dave/Jeff to exchange email and arrange meeting.** **Northcote**: • Cultural design integration Northcote – ITEM DEFERRED	**James** **James/Dali** **Dali** **Dave/Jeff**
	Piritahi (Mel Drumm) **Update:** Nothing to update. Currently weekly induction session to work an opportunity to include cultural awareness. Jeff: Keen to map out a 30 mins cultural induction process. **ACTION: Mel to coordinate a time to meet with Jeff to set up a regular cultural induction programme alongside existing Piritahi induction programme.**	**Mel**
	Placemaking • Road naming (Savanna)	

	• House relocations (Amos)	
	Māori Outcomes Updates (Savanna) • **Te Aranga-** Cultural Design Guidelines / Spatial delivery strategy (SDS) draft • **Te Taiao-** Environmental Standards	
	Consenting and Approvals (Amos) - **Heritage** - **Consenting**	
	▪ **Any other business (Savanna)** - Meeting Actions to be circulated.	
	• **Karakia whakamutunga**	

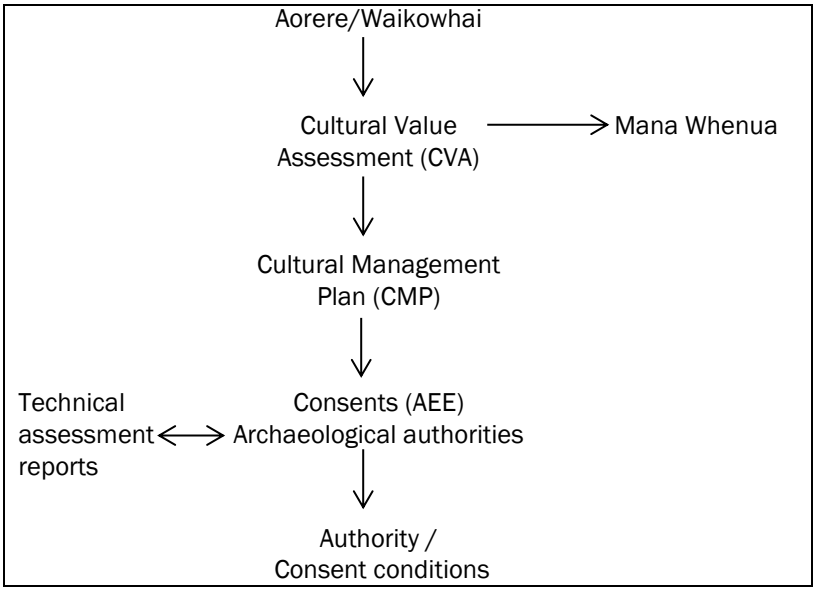
MEETING MINUTES

Purpose:	**Hui:** Te Āakitai Waiohua
Date:	23 August 2019, 10.15am – 12.15pm
Location:	Mangere Information Centre, 12 Waddon Place, Mangere

Attendees:
HLC: Amos Kamo, Savanna Steel, Jackie Layt (note taker), James Copley
Te Āakitai Waiohua (TAW): Jeff Lee
Piritahi: Shannon Richardson
HNZ: Iain Butler

Apologies:
HLC: Dane Grey

		Action by Who
10.15am	**Mihimihi/Karakia**	
10.20am	**HNZ update** **ACTION: Meet and collate document to set out development projects across HNZ/HLC for mana whenua (Wednesday 27 August – 12.30 pm – Mangere)** **ACTION: Sod Turning process – engagement process to be worked through HLC/HNZ.**	**Amos/Iain** **Savanna**
10.35am	**Placemaking** • **SDS – Wānanga (Te Aranga)** (Savanna Steele) Feedback provided by TAW **ACTION: CVA korero - Jeff to collate points and send through to Savanna. Signalling sign off (with more additions to responsiveness).** o Whare manaaki centres – TAW support to high level but request further info and korero. o **FOR NOTING:** Key Action 1 Mangere - **TAW note**: do not support proposal in relation to the Pukaki crater. Leave out Pukaki. o Separating off and giving own mana to areas of SDS. TAW offering to help in this space to get these split off. o Managing of expectations is important and TAW acknowledged this. o *Overall statement from TAW:* Signalling support of the direction subject to more meaningful engagement, identifying who has expressed interest and offering of TAW services. • **Cultural monitoring:** (Amos Kamo) A high level process for CVA is being developed. A retrofit of how UDG has been doing this to date. Sample process below. o TAW will consider archaeologists coming on board in future. **ACTION: Send another letter re CVA Oranga**	**Jeff** **Savanna**

		
10.45am	**Precinct/Consenting Approvals Updates** • **Consenting** (Shannon Richardson) Update on consenting works across Northcote and Roskill Sth, TOCs across Tamaki, Oranga.. **ACTION: Send full application of Stage3/4 consenting for Owairaka to Jeff (TAW)** **ACTION: Circulate consenting schedule for review prior to next hui.** **ACTION: Send copy of TAW CVA to Shannon Richardson.** **RECOMMENDATION: TAW recommend** meaningful engagement for future lodgements prior to lodging. i.e. James discharge consent for Candor SMP submission **ACTION: James to advise current approach by Council to SMP in Mangere and contextualise where we are at pre project status. James to obtain copy of SMP docs from Dali (Candor) and circulate.**	**Amos/Savanna** **Shannon/Amos** **Amos** **James**
	• **Mangere (Mangere West, Aorere)** To be updated at next hui. • **Mt Roskill (Owairaka, Roskill South, Waikowhai)** Discussion on Waikowhai. Shannon advised technical reports are being produced - desktop draft of archaeological report, arborist report. Other geo tech reports etc still a few weeks away and preliminary drawings are coming together. **FOR NOTING:** Jeff requested TAW have input into masterplanning process and requested an outline of Wakowhai approach.. Amos noted Lucy Smith (HLC) has already presented to TAW on Waikowhai overview and approach. • **Oranga** Programme delivery update	

11.30am	**Māori Outcomes** Work streams 2019 (Amos Kamo) 5x Workshop Series for each Māori Outcome Area (Savanna Steele)	
12pm 12.15pm	▪ **Any other business** ▪ **ACTION: Copy of hui minutes to be circulated.** ▪ **Programme activity/Invoicing** Savanna noted clarity of invoicing descriptions required and adjustment of invoicing. **ACTION: Amos to review current invoices with Precinct Directors and seek direction/approval for work already completed.** **ACTION: Savanna to email invoicing guidelines/schedule of POs to Jeff.** • **Karakia whakamutunga (Jeff Lee)**	**Savanna** **Amos** **Savanna**

Appendix G: Stormwater Management User Manual