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FLOOD DESIGN REPORT

A2I | Albury to Illabo

Package: A2I – Uranquinty Yard

CONTRACT NUMBER: 0052

PROJECT DOCUMENT NUMBER:

5-0052-210-IHY-W1-RP-0001

Document Control

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Revision History

REVISION	REVISION DATE	AMENDMENT	DATE TO CLIENT
A	17/09/2024	PDR Issue for review	17/09/2024
B	11/03/2025	DDR Issue for review	11/03/2025
0	23/09/2025	Issued for Use	23/09/2025

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GLOSSARY

Specific terms and acronyms used throughout this plan and sub-plans are listed and described in Table 0-1 below.

Table 0-1: Definitions

Term	Definition
A2I	Albury to Illabo
A2P	Albury to Parkes Enhancement Project
AEP	Annual Exceedance Probability
ADC	Assumptions, Dependencies and Constraints
AHD	Australian Height Datum
ALCAM	Australian Level Crossing Assessment Model
ARF	Areal Reduction Factor
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
ARTC	Australian Railway Track Corporation
BoD	Basis of Design
BoM	Bureau of Meteorology
CIZ	Construction Impact Zone
CO	Construct Only
CRS	Coordination Reference System
CSSI	Critical State Significant Infrastructure
D&C	Design and Construct
DCN	Design Change Notice
DDR	Detailed Design Review
EMC	Electromagnetic compatibility
EDPM	Engineering, Design and Project Management
ECMP	Electromagnetic compatibility management plan
EIS	Environmental Impact Statement
FDR	Feasibility Design Review
FFA	Flood Frequency Analysis
FS	Finish-Start constraint type
FSL	Finished Surface Level
GDA	Geocentric Datum of Australia
GIR	Geotechnical Interpretative Report
HF	Human Factors
I2S	Illabo to Stockinbingal
IFC	Issued for Construction
IR	Inland Rail
ITC	Incentivised Target Cost
IV	Independent Verifier

Km	Kilometres
LPA	Licensed Project Area
LiDAR	Light Detection and Ranging
MGA	Map Grid of Australia
MIRDA	Master Inland Rail Development Agreement
NCR	Non-Conformance Report
NLPA	Non-Licensed Project Area
NtP	Notice to Proceed
PDR	Preliminary Design Review
PMF	Probable Maximum Flood
PSR	Project Scope and Requirements
QDL	Quantitative Design Limits
RCP	Representative Concentration Pathways
REF	Review of Environmental Factors
RFI	Request for Information
S2P	Stockinbingal to Parkes
SAQP	Sampling, Analysis and Quality Plan
SDR	Systems Definition Review
SEMP	System Engineering Management Plan
TfNSW	Transport for New South Wales
TWL	Tail Water Level
UMM	Updated Mitigation Measures
V & V	Verification and Validation
WAD	Works Authorisation Deed
WAE	Work-as-Executed

1 A2P PROJECT INTRODUCTION

1.1 Albury to Parkes (A2P)

As part of the Inland Rail program of projects, the Australian Rail Track Corporation (ARTC) has appointed Martinus as the delivery contractor for the Albury to Parkes (A2P) project, which comprises the brownfield sections between Albury and Illabo (A2I) and Stockinbingal to Parkes (S2P). The greenfield portion between Illabo to Stockinbingal (I2S) is not a part of the A2P project scope.

1.2 Project Scope

The S2P section will be delivered under an REF and as such construction works associated with the two (2) Construct Only packages can commence at Contract Award. The Design and Construct for the other seven (7) projects sites will also commence at Contract Award.

The A2I section will be delivered under an EIS and will require a Notice to Proceed from ARTC before works can commence on site. Design for A2I will however commence at Contract Award. The project received State Planning approval on 8th Oct 2024, and Martinus received the Notice to Proceed from IRPL on 18 Oct 2024.

Within the A2I section there are twenty (20) locations with twenty-nine (29) Design and Construct (D&C) projects of varying degrees of design gate development:

- Murray River bridge (Structure modifications)
- Albury Station Yard (Track slews, track reconfigurations)
- Albury Station Yard Track Slews (retained 3-track alignment)
- Albury Station Yard Footbridge (footbridge replacement), both pre- and post- SDRP-response
- Riverina Highway bridge (Track lowering)
- Billy Hughes bridge (Track lowering)
- Tabletop Yard (Structure modification)
- Culcairn Station Yard (Track slews and bridge removal)
- Henty Yard (Track slews)
- Yerong Creek Yard (Track slews)
- The Rock Yard (Structure modification)
- Uranquinty Yard (Track slews)
- Pearson Street bridge (Track lowering)
- Cassidy Parade footbridge (Bridge replacement), both pre- and post- SDRP-response
- Edmondson Street Bridge (stand-alone road bridge)
- Edmondson Street Footbridge (stand-alone road bridge)
- Edmondson Street bridge and footbridge (combined Bridge replacement), post- SDRP-response
- Wagga Wagga Station Yard (Track slews)
- Wagga Wagga Footbridge (footbridge replacement), both pre- and post- SDRP-response
- Bomen Yard (Track slews)
- Harefield Yard (Track slews)
- Kemp Street Bridge (stand-alone road bridge)
- Kemp Street Footbridge (stand-alone footbridge)
- Kemp Street bridge and footbridge (combined Bridge replacement)
- Junee Station Yard (Track slews and bridge removal)
- Olympic Highway Underbridge (Track reconfiguration and Structure modification)
- Junee to I2S dual track section (Track slews)
- LX605 & LX1472 Activations
- LX605 relocation and LX1472 closure, both 16m and 4m slew options

Within the S2P section, there are two (2) Construct only projects:

- Darroobalgie New Loop
- Wyndham Avenue (Track lowering)

and seven (7) Design and Construct (D&C) projects:

- Milvale Yard (Structure modification)
- Bribbaree Yard (Track slews)
- Quandialla Yard (Structure modification)
- Caragabal Yard (Track slews)
- Wirrinya Yard (Track slews)
- Lachlan River bridge (Structure modifications)
- Forbes Station (Track slews and awning modifications)

The D&C scope typically includes works associated with route clearance to accommodate the new F2M clearance envelope, necessary to accommodate the double-stacked freight container trains and this includes.

- Structure modifications
- Track reconfigurations
- Bridge replacements
- Track lowering
- Track slews and level crossing upgrades
- Bridge removal

1.3 Site Description

This study involves a flood assessment for the Uranquinty Yard Clearances located in the middle of the town of Uranquinty as shown in Figure 1-1. Uranquinty Yard is approximately 15km southwest of Wagga Wagga City. The background and previous studies related to the site are listed in the following sections.



Figure 1-1: Site Location

1.3.1 Background

The Uranquinty Yard forms part of the Albury to Illabo Section works between Chainages 535+284km to 536+468km. The project extent is located between Uranquinty Street and Old Station Road. The proposed solution involves track slews and modification of the Main Line in conjunction with associated site drainage design.

1.4 Objectives

This report has been prepared to support the delivery of the Uranquinty Yard by providing a flood impact assessment for the Issued for Construction (IFC) stage. The flood assessment aims to estimate the flood behaviour within the study area and assess the potential flood impacts as a result of the design.

1.5 Scope

The scope of this study includes:

- Carrying out the flood assessment for the design in the IFC stage for the design events of 5%, 2%, 1%, 0.5% (Climate Change Scenario 1), and 0.2% Annual Exceedance Probability (AEP) (Climate Change Scenario 2) and the Probable Maximum Flood (PMF).
- Checking flood assessment results against the criteria specified in Section 2, including flood impact and flood immunity.
- Proposing any mitigation measures if required.

1.6 Previous Studies

1.6.1 Flood Studies

Table 1-1 summarises all the flood studies associated with the Uranquinty Yard area.

Table 1-1: Summary of the Previous Flood Studies

Item No.	Flood Study	Description	Comments
1	Tarcutta, Ladysmith and Uranquinty Flood Studies – Design Flood Modelling (Lyll & Associates, 2014)	This study was conducted to define flood behaviour at the three villages under existing conditions for design flood events ranging between 5 and 500 year Average Recurrence Interval (ARI)*, as well as for the PMF.	N/A
2	Tarcutta, Ladysmith and Uranquinty Floodplain Risk Management Studies and Plans (GRC Hydro, 2021)	This study was conducted to undertake Floodplain Risk Management Studies and Plans for the townships of Tarcutta, Ladysmith and Uranquinty. This study adopted the 2014 hydrologic and hydraulic modelling as a starting point and updated the models.	TUFLOW model from this study was adopted and updated. The TUFLOW model parameters can be found in Table 4-2.

*Note: 5 year ARI = 20% AEP; 500 year ARI = 0.2% AEP

1.6.2 Reference Design

The Albury to Illabo (A2I) and Stockinbingal to Parkes (S2P) Projects Reference Design Report – Wagga Wagga (June 2022) outlines details of the Reference Design.

No flood impact modelling was undertaken for the Uranquinty Yard under the Reference Design. However, a qualitative assessment was carried out based on the Tarcutta, Ladysmith, and Uranquinty Floodplain Risk Management Studies and Plans (TLU FRMSP) (GRC Hydro, 2021). Based on the FRMSP, it was determined that the site is affected by regional flooding, and overtopping of the rail embankment east of Sandy Creek Underbridge (Chainage 535+760km to 535+900km) is expected for the 1% and 2% AEP flood events. According to the report, flood immunity of the track is estimated at 5% AEP.



Figure 1-2: 1% AEP Regional Flooding (Image source: A2I and S2P Projects Reference Design Report - Wagga Wagga (June 2022))

1.6.3 Environmental Impact Statement

The Albury to Illabo Environmental Impact Statement (EIS) Technical Paper 11 – Hydrology, flooding and water quality (July 2022) details the Uranquinty Yard Clearances that were investigated as part of the - EIS. The Tarcutta, Ladysmith and Uranquinty FRMSP (GRC Hydro, June 2021) was used in the EIS as a reference document. Based on the flood modelling, both upstream and downstream of the proposed development site are subject to flooding. Also, as per the Reference Design, it was confirmed that there is an overtopping of the track on the east of Sandy Creek for the 1% and 2% AEP flood events. Flood immunity for the track corridor was observed to be at the 5% AEP flood event level.

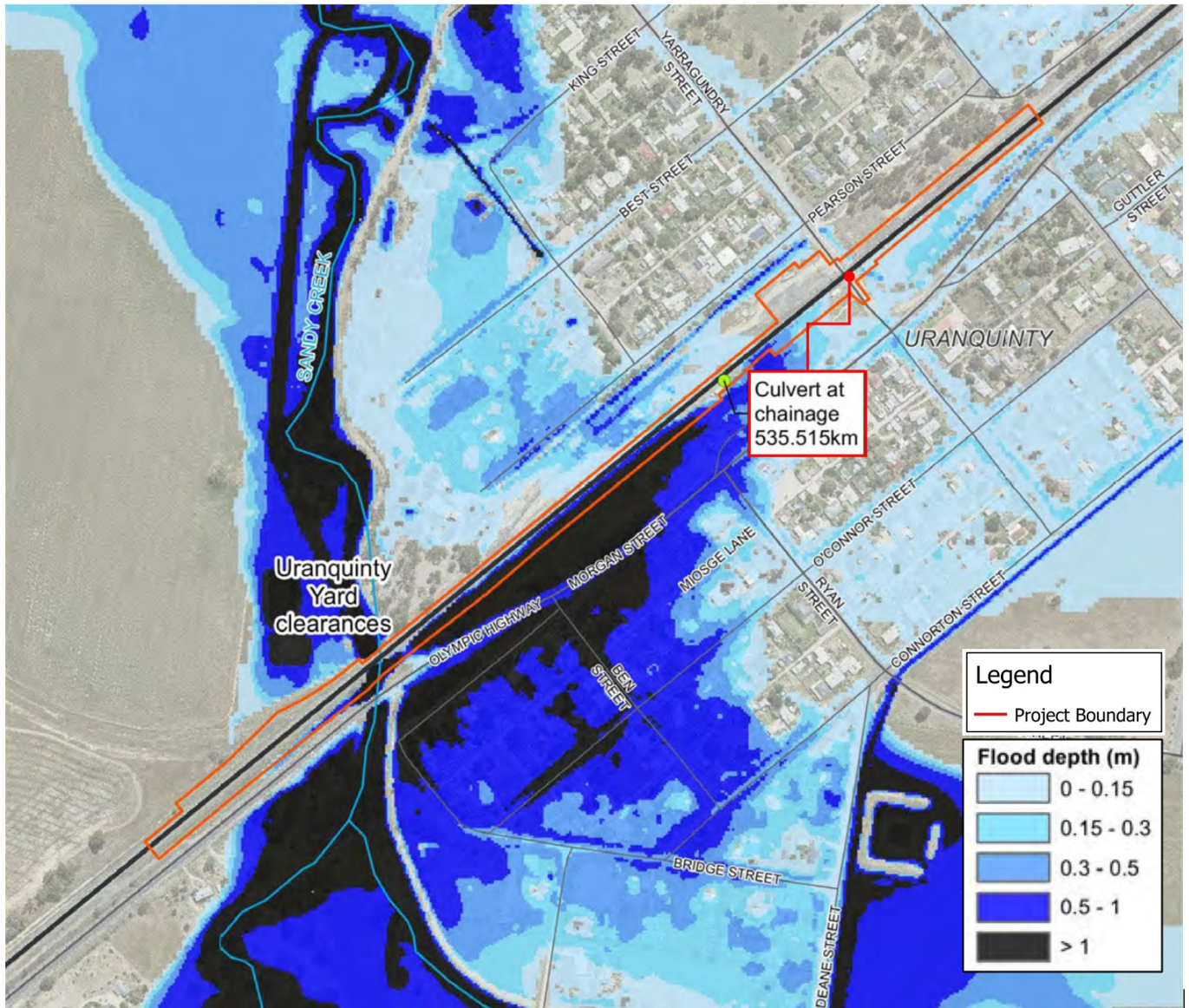


Figure 1-3: 1% AEP Regional Flooding (Image source: Albury to Illabo EIS Technical Paper 11 (July 2022))

1.7 Purpose and Requirements

The primary purpose of this IFC flood assessment report is to describe how the design development and the associated review process will be managed.

The secondary purpose of this report is to provide evidentiary documentation on consultation with external stakeholders, and review by the independent suitably-qualified flood consultant. This is to demonstrate compliance with the CSSI conditions of approval – refer Section 2.2. Refer to Appendix B for the ARTC review, Appendix C for the Independent Flood Consultant Review and Appendix D for the External Flood Consultant Review.

1.8 Information Documents

The following documents have been provided 'For Information' and have been referenced/ reviewed as part of the design development:

- Tarcutta, Ladysmith and Uranquinty Flood Studies - Design Flood Modelling (Lyll & Associates, 2014)
- Tarcutta, Ladysmith and Uranquinty Floodplain Risk Management Studies and Plans (GRC Hydro, 2021)
- Albury to Illabo (A2I) and Stockinbingal to Parkes (S2P) Projects Reference Design Report – Wagga Wagga (WSP, June 2022), 2-0008-210-PEN-03-RP-0002
- Albury to Illabo Environmental Impact Statement (EIS) Technical Paper 11 – Hydrology, flooding and water quality (WSP, July 2022), 2-0008-210-EAP-00-RP-0010

1.9 Inputs

1.9.1 Input Data

Table 1-2 outlines the available information relevant to the site and used for flood modelling.

Table 1-2: Available Information

Item	Information	Type	Description / Comments
1	Tarcutta, Ladysmith and Uranquinty Floodplain Risk Management Studies and Plans (GRC Hydro, 2021)	TUFLOW model in GDA94 projection No hydrology was provided.	Received from ARTC on 28/07/2023
2	LiDAR 2020 (The data used to create this DEM has an accuracy of 0.3m (95% Confidence Interval) vertical and 0.8m (95% Confidence Interval) horizontal)	TIF format in 1m resolution in GDA2020 projection	Downloaded from https://elevation.fsdf.org.au/ on 25/07/2024.
3	1m 2015 LiDAR and High Resolution Aerial Imagery. The data derived points have an accuracy of 0.15m (68% confidence interval) ARTC LiDAR	Tif format in GDA94	The existing 1m LiDAR (flown by ARTC in 2015) was received from Martinus on 12/11/2024. However, the LiDAR2020 (Item 2) is newer and in GDA2020, therefore, only LiDAR 2020 (Item 2) was adopted for the IFC assessment.
4	A2P UQY EXT GDA20Z55 COMBINED.12da A2P UQY EXT GDA20Z55 COMBINED.dxf	12da 12D file DXF CAD file	Site Survey in the GDA2020 MGA Zone 55 projection Received from Martinus on 23/07/2024
5	5-0052-210-CAL-W1-CA-0101-URANQUINTY_YARD_RAIL_PLAN.dwg	DWG CAD file	Surveyed existing track line. Received from DJV Civil Team on 22/07/2024
6	A2P UQY EXT GDA20Z55 FLOOD MODELLING_240108.dxf	DXF CAD file	Site survey of drainage in the GDA2020 MGA Received from Martinus on 07/01/2025
7	5-0052-210-CDR-W1-MD-0001-URANQUINTY_YARD_3D_DRAINAGE_STRINGS_12DA.12da 240725 PIT SCHEDULE.xlsx	12da file Excel file	IFC Design drainage and pit schedule Received from DJV Drainage Team on 24/07/2025
8	250716 Uranquinty Lowered Alignment.dwg	DWG CAD file	IFC Design railway track line. Received from DJV Civil Rail team on 17/07/2024
9	250729 BUNDS 21 W1 0.2m grid.dem 230725 CAPPING 21 W1 MR21W1001.dem 250723 BALLAST 21 W1 0.2m grid.dem	Dem Raster file	IFC Design bund capping and ballast surface. Received from DJV Civil Team on 29/07/2025

1.10 Outputs

The list of flood maps and the flood maps are included in Appendix A.

1.11 Limitations and Assumptions

The following limitations and assumptions are applied to the Uranquinty site:

- The hydrologic model and results of the previous TLU FRMSP (GRC Hydro, 2021) are currently unavailable.
- An assessment of temporary works and staging has not been undertaken.

- According to Clause 5.4.2 and Clause 5.4.3 in Annexure B of PSR (Table 2-1), the highest flood event shall be the one stipulated by the ARTC Safety Management System (SMS). As per Section 10.1.3 of Track and Civil Code of Practice Section 10 Flooding, the 1% AEP shall be used. The flood impact would be assessed up to the 1% AEP event for the project.
- Blockage assessment is carried out for the 1% AEP design scenario as per the guidance set out in ARR2019 for the culverts within the project boundary, while 20% blockage was adopted for all the other culverts, pits and pipes outside the site boundary.
- Due to the unavailability of the hydrology model and 1%AEP + Climate change (RCP8.5 Year 2090) inflow data in the TUFLOW model, this single scenario (1%AEP + Climate change (RCP8.5 Year 2090)) could not be run. Therefore, 0.5% AEP and 0.2% AEP were used to represent the climate change scenario. The rainfall depth comparison among these three events was made and the clarification was included in Section 6.5.2.

2 COMPLIANCE WITH REQUIREMENTS

2.1 Project Scope and Requirements

Assessment of the IFC against the Project Scope and Requirements (PSR) has been undertaken. This is demonstrated throughout the flood assessment with Table 2-1 below summarising the compliance of Uranquinty Yard with the PSR.

Table 2-1: Flooding Criteria within PSR Annexure B Technical Requirements

Requirement	Identifier	A2P Technical Requirements Description	Compliance Evidence Reference
Project Wide	5.4.10	Without limiting the environmental management requirements in Annexure F, section 6.1.1, all D&C Works in watercourses shall comply with the NSW Department of Primary Industries Standards: Policy and Guidelines for Fish Friendly Waterway Crossings; Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings; and Policy and Guidelines for Fish Habitat Conservation and Management Update.	N/A (No watercourse D&C work associated with this site.)
Project Wide	5.4.2	Where existing flood immunity is lower than ARTC SMS minimum requirements, the functional requirements for flood immunity take precedence over the ARTC SMS.	The ARTC minimum requirement is 1% AEP. However, the railway is overtopped in the 2% AEP in the existing scenario but not in the 5% AEP event. Thus, the existing immunity will be 5% AEP. The existing immunity is maintained under design conditions. Refer to Section 6.3.
Project Wide	5.4.3	Where existing flood immunity is higher than ARTC SMS minimum requirements, the ARTC SMS requirements for flood immunity take precedence over the functional requirements.	Refer to Identifier 5.4.2 above. The existing immunity is maintained under design conditions. Refer to Section 6.3.
Project Wide	5.4.5	Bridge and culvert hydraulics shall comply with Austroads Guide to Bridge Technology Part 8: Hydraulic Design of Waterway Structures.	N/A (There are no new waterway structures associated with this site.)
A2I Technical Requirements*	IR-SR-A2I-116	The System shall comply with 0-0000-900-ESS-00-ST-0001 Inland Rail Climate Change Risk Assessment Framework.	Compliant (refer to Section 6.5.2). Adopted 0.5% AEP (Climate Change Scenario 1) and 0.2% AEP (Climate Change Scenario 2) results to inform, the climate change risk assessment
A2I Technical Requirements*	IR-SR-A2I-349	The Corridor System for Enhancement Corridors shall have a flood immunity of no worse than existing.	The existing immunity is maintained under design conditions. Refer to Section 6.3.
A2I Technical Requirements*	IR-SR-A2I-350	The Corridor System, where the existing track is lowered, shall maintain the existing flood immunity.	The existing immunity is maintained under design conditions. Refer to Section 6.3.
A2I Technical Requirements*	IR-SR-A2I-352	The Corridor System shall prevent damage of the formation due to ponding of water.	There is no change in flood conditions and hence no additional damage to the formation will be incurred. Refer to Section 6.2
A2I Technical Requirements*	IR-SR-A2I-458	The Corridor System shall prevent ponding in longitudinal open channels.	N/A (There are no proposed open channels)
A2I Technical Requirements*	IR-SR-A2I-459	The Corridor System for Enhancement Corridors shall provide mitigation for flood impacts no worse than existing condition.	The design does not cause flood impact worse than the existing outside of the project boundary. Refer to Section 6.4
A2I Technical Requirements*	IR-SR-A2I-464	The Corridor System shall cause no adverse impacts either inside or outside the rail corridor when diverting water away from the track.	Existing condition is maintained. Flood conditions are not worse than existing condition. See Section 6.4.

Requirement	Identifier	A2P Technical Requirements Description	Compliance Evidence Reference
A2I Technical Requirements*	IR-SR-A2I-465	The Corridor System shall minimise changes to the existing or natural flow patterns.	Existing condition is maintained. flood impacts no worse than existing condition. See Section 6.4.
A2I Technical Requirements*	IR-SR-A2I-541	The Structures System new underbridges shall withstand the 0.05% annual exceedance probability design flood event.	N/A (No underbridge for Uranquinty Yard site.).
A2I Technical Requirements*	IR-SR-A2I-735	The Third Party System private roads shall have flood immunity no worse than existing.	No third-party private roads are impacted.
A2I (Annexure F)	6.1.1	Without limiting clauses 8 and 14 of the Deed, the Contractor shall ensure that the Contractor's Activities and the Works comply with the following for A2I, the Conditions of Approval and the environmental assessment reports available on: https://www.planningportal.nsw.gov.au/major-projects/projects/inland-rail-albury-illabo	Refer to Table 2-2.

*A2I Technical requirements are used in A2P as A2P is a part of A2I.

2.2 Conditions of Approval – Flooding

The Conditions of Approval (CoA) have been provided under cover of IR2140-TRANSMIT-002001. The detailed design has been assessed to check if it meets the CoA and the compliance is presented in Table 2-2.

Table 2-2: Conditions of Approval Compliance Table – Flooding

Condition	Condition or Criteria	Compliance Evidence Reference
E38	All practicable measures must be implemented to ensure the design, construction and operation of the CSSI will not adversely affect flood behaviour, or adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.	Compliant. Refer to Section 6.4
E39	The CSSI must be designed with the objective to meet or improve upon the flood performance identified in the documents listed in Condition A1 . Variation consistent with the requirements of this approval at the rail corridor is permitted to effect minor changes to the design with the intent of improving the flood performance of the CSSI.	Compliant Refer to Section 5
E40	Updated flood modelling of the project's detailed design must be undertaken for the full range of flood events, including blockage of culverts and flowpaths, considered in the documents listed in Condition A1 . This modelling must include:	Compliant Refer to Sections 4 and Section 5
E40	a) Hydrologic and hydraulic assessments consistent with <i>Australian Rainfall and Runoff – A Guide to Flood Estimation</i> (GeoScience Australia, 2019);	Compliant. Section 4 methodology shows that ARR2019 guidelines were used for this assessment.
E40	b) Use of modelling software appropriate to the relevant modelling task;	Compliant. Section 4 shows that appropriate software (TUFLOW) was used
E40	c) Field survey of the existing rail formation and rail levels, should be included within the models; and	Compliant. Section 4 Inputs show that existing field survey and rail levels were used in the models.
E40	d) Confirmation of predicted afflux at industrial properties adjacent to Railway Street, Wagga Wagga based on field survey.	N/A. Railway Street in Wagga Wagga is not relevant to this site.

Condition	Condition or Criteria	Compliance Evidence Reference
E40	Updated flood modelling must be made publicly available in accordance with Condition B18 .	Flood design report and independent review of the flood design report have been sent to IR, through this submission, for IR to upload on the IR website, as per CoA B18 responsibility allocation.
E41	The Proponent's response to the requirements of Conditions E38 and E40 must be reviewed and endorsed by a suitably qualified flood consultant, who is independent of the project's design and construction and approved in accordance with Condition A16 , in consultation with directly affected landowners, DCCEEW Water Group, TfNSW, DPI Fisheries, BCS, NSW State Emergency Service (SES) and relevant Councils.	Independent review of the flood modelling, model and Flood Design Report is undertaken by the Independent Flood Consultant, who satisfies and complies with the requirements of A16 (Refer to Appendix C). Consultation with Council and other stakeholders will be undertaken through a formal review of this Flood Design Report.
E42	The CSSI must be designed and constructed to limit impacts on flooding characteristics in areas outside the project boundary during any flood event up to and including the 1% AEP flood event, to the following:	See items below
E42	(a) a maximum increase in inundation time of one hour, or 10%, whichever is greater;	Compliant. Refer to Section 6.4.4
E42	(b) a maximum increase of 10 mm in above-floor inundation to habitable rooms where floor levels are currently exceeded;	Compliant. Refer to Section 6.4.1
E42	(c) no above-floor inundation of habitable rooms which are currently not inundated;	Compliant. Refer to Section 6.4.1
E42	(d) a maximum increase of 50 mm in inundation of land zoned as residential, industrial or commercial;	Compliant. Refer to Section 6.4.1
E42	(e) a maximum increase of 100 mm in inundation of land zoned as environment zone or public recreation;	Compliant. Refer Section 6.4.1
E42	(f) a maximum increase of 200 mm in inundation of land zoned as rural or primary production, environment zone or public recreation;	Compliant. Refer to Section 6.4.1
E42	(g) no increase in the flood hazard category or risk to life; and	Compliant. Refer to Section 6.4.3
E42	(h) maximum relative increase in velocity of 10%, or to 0.5m/s, whichever is greater, unless adequate scour protection measures are implemented and/or the velocity increases do not exacerbate erosion as demonstrated through site-specific risk of scour or geomorphological assessments	Compliant. Refer to Section 6.4.2
E42	Where the requirements set out in clauses (d) to (f) inclusive cannot be met alternative flood levels or mitigation measures must be agreed to with the affected landowner.	N/A, Clause (d) to (f) are compliant
E43	A Flood Design Report confirming the:	
E43	a) final design of the CSSI meets the requirements of Condition E42 ; and	Compliant. Refer to Section 6.4
E43	b) the results of consultation with the relevant council in accordance with Condition E46	Refer to E46
E43	must be submitted to and approved by the Planning Secretary prior to the commencement of permanent works that would impact on flooding.	This report will be submitted to the Planning Secretary for approval prior to the commencement of permanent works that would impact on flooding.

Condition	Condition or Criteria	Compliance Evidence Reference
E44	The Flood Design Report required by Condition E43 must be approved by the Planning Secretary prior to works that may impact on flooding or the relevant council's stormwater network.	This report will be submitted to the Planning Secretary for approval prior to the commencement of permanent works that would impact on flooding.
E45	Flood information including flood reports, models and geographic information system outputs, and work as executed information from a registered surveyor certifying finished ground levels and the dimensions and finished levels of all structures within the flood prone land, must be provided to the relevant Council, BCS and the SES in order to assist in preparing relevant documents and to reflect changes in flood behaviour as a result of the CSSI. The Council, BCS and the SES must be notified in writing that the information is available no later than one (1) month following the completion of construction. Information requested by the relevant Council, BCS or the SES must be provided no later than six (6) months following the completion of construction or within another timeframe agreed with the relevant Council, BCS or the SES.	Flood information will be provided to the relevant Council, BCS and the SES in order to assist in preparing relevant documents and to reflect changes in flood behaviour as a result of the CSSI in accordance with the requirements of CoA E45.
E46	The design, operation and maintenance of pumping stations and storage tanks and discharges to council's stormwater network must be developed in consultation with the relevant council. The results of the consultation are to be included in the report required in Condition E47 .	Local drainage flow regime, catchment area and imperviousness remain the same as per existing condition, there is no additional flow towards the existing Council's stormwater network. The design has not worsened the existing flow conditions. Consultation with Wagga Wagga City Council has been carried out through attendance at design briefing workshops, and provision of design packages for review. No review comments have been received to date from Council on Uranquinty Yard design. Further consultation with the Council will be undertaken through a formal review of this Flood Design Report.

* The Quantitative Design Limits (QDLs) of Environmental Impact Assessment (EIS) Technical Paper 11 in Condition A1 are superseded by the design limits set in CoA E46.

2.3 Updated Mitigation Measures - Flooding

The Updated Mitigation Measures (UMM) have been provided and the detailed design has been assessed to meet the UMM and the compliance is presented in Table 2-3 below.

Table 2-3 Updated Mitigation Measures Compliance Table - Flooding

Condition	Condition or Criteria	Compliance Evidence Reference
HFWQ3	Further consultation will be undertaken with local councils and other relevant authorities to identify opportunities to coordinate the proposal with flood mitigation works committed to as part of the council's flood management plans, or other strategies.	Consultation with the Council and other relevant authorities will be undertaken through a formal review of this Flood Design Report.
HFWQ4	At Wagga Wagga Yard enhancement site, flood modelling would be carried out during detailed design to confirm predicted afflux at industrial properties located at Railway Street and compliance with the Quantitative Design Limits for Inland Rail. This would be informed by topographic and building floor surveys and a review of localised drainage structures (as required). Quantitative assessment of the sites of low and moderate hydraulic complexity will be carried out during detailed design, and will consider the impact of the Possible Maximum Flood event at built-up areas (where information is available) and the tenure of the upstream areas that are	This report is not related to Wagga Wagga Yard but the Uranquinty site and hence is not relevant. Compliant. A quantitative assessment has been undertaken. Refer to Section 5.

Condition	Condition or Criteria	Compliance Evidence Reference
	impacted by drainage and/or flooding. The outcomes of the assessment are to be provided to DCCEW– BCS	
HFWQ5	At Riverina Highway bridge enhancement site, flood and drainage network modelling (including capacity and operation of the stormwater storage and pump system) will be carried out during detailed design to confirm predicted compliance with the Quantitative Design Limits (QDLs)* for Inland Rail. The modelling would be undertaken in consultation with Albury City Council.	Not relevant. This report relates to the Uranquinty site and is not relevant to the Riverina Highway track-lowering site.

3 CHANGE MANAGEMENT

This section summarises the changes made to this design package due to changes in the project scope and/or evolution of the design.

3.1 Concept Design to SDR

Flood modelling is not applicable to this stage.

3.2 SDR to PDR

The flood impact assessment discussed in this report, was carried out for the IFC stage. Key design changes between the PDR and the SDR Design are listed in the table below.

Table 3-1: Design Differences Between SDR and PDR

Item	Difference	Reason for Change
1	Incorporation of the latest available LiDAR data	The latest LiDAR data (2020) was added in order to represent the terrain more accurately.
2	Incorporation of the latest existing condition survey (Point cloud data)	A new existing condition survey was provided to represent the terrain accurately.
3	Incorporation of Rail Design	New railway alignment and profile, new ballast design
4	Incorporation of Civil Design	New civil design for capping and cess drain channel

3.3 PDR to DDR

The flood impact assessment discussed in this report, was carried out for the IFC stage. Key design changes between the DDR and the PDR Design are listed in the table below.

Table 3-2: Design Differences Between PDR and DDR

Item	Difference	Reason for Change
1	Incorporation of Rail Design	Updated rail vertical alignment as per the optimised DDR track and civil design
2	Incorporation of Civil Design	Updated formation levels corresponding with the updated DDR vertical track alignment.
3	Incorporation of cess drain	Updated cess drain design corresponding with the updated DDR civil design.
4	Incorporation of Bund	Implementation of a cess drain has created a local low point. As the corridor quite narrow near the level crossing, to contain impacts to within the corridor and comply with the CoA, a new earthworks bund design has been introduced.
5	Incorporation of Culvert next to Sandy Creek	Receipt of RFI response confirmed that ARTC wished to retain this existing hi-rail access point. As such the existing crossing point needed to be retained, and a cess culvert sized accordingly.

3.4 DDR to IFC

The flood impact assessment discussed in this report, was carried out for the IFC stage. Key design changes between the IFC and the DDR Design are listed in the table below.

Table 3-3: Design Differences Between DDR and IFC

Item	Difference	Reason for Change
1	The Sandy Creek section near the Olympic Highway bridge was transformed from a one-dimensional (1D) to a two-dimensional (2D) representation. This conversion also included the Olympic Highway bridge and the adjacent railway bridge.	Modifications were made to the model in response to comments from the Independent Flood Consultant regarding the representation of the Olympic Highway bridge and the adjacent railway bridge along Sandy Creek (Refer to Appendix C). These bridges were initially modelled using a one-dimensional (1D) approach, which resulted in an oversized representation of the Sandy Creek cross section beneath the bridges. This approach was deemed inaccurate, prompting the removal of the 1D cross

Item	Difference	Reason for Change
		section and the adoption of a two-dimensional (2D) approach. Consequently, both the Olympic Highway bridge and the adjacent railway bridge were incorporated into the model as a 2d_bg layer, and the section of Sandy Creek in the area vicinity was also modelled using a 2D dimensional representation.
2	Incorporation of Civil Design	Updated Bund, Ballast and capping design for IFC stage
3	Incorporation of Drainage Design	Updated drainage design for IFC stage
4	Incorporation of Track	Updated track design for IFC stage

4 MODELLING METHODOLOGY

The overall approach to the flood modelling and impact assessment is detailed below:

- Update of the received TUFLOW model by incorporating the latest LiDAR (Section 4.2.1) and survey. The updated TUFLOW model has been used to predict hydraulic behaviour and formed the existing condition for this assessment.
- Update of the adopted existing condition TUFLOW model to include the proposed IFC design including the new design railway alignment and profile, new design ballast, and new design capping and bund (Refer to Section 4.2.2).
- Conduct a blockage assessment as per ARR 2019 procedures.
- Assessment of flood impact for events up to the 0.2% AEP (Climate Change Scenario 2) and presentation/mapping of the flood modelling results.

4.1 Hydrologic Modelling

DRAINS-RAFTS software packages were used to generate flow hydrographs from the hydrology model for input to the TUFLOW hydraulic model as detailed in TLU FRMSP (GRC, 2021). The hydrology model covers the Sandy Creek catchment upstream of Uranquinty and presents the hydrology sub-catchment extents. As part of the TLU FRMSP the hydrology model approach to design events was updated to comply with ARR2019 requirements.

The updated hydrology model was used to generate the inflows for the TUFLOW hydraulic model for the 5%, 2%, 1%, 0.5% (Climate Change Scenario 1) and 0.2% AEP (Climate Change Scenario 2) events. The TLU FRMSP only adopted a single Generalised Short Duration Method (GSDM) temporal pattern for the PMF event, while ARR2019 recommends using 11 temporal patterns. Therefore, the PMF approach was updated to be in line with ARR2019.

As detailed in Table 1-2, the previous hydrology models were not able to be procured for this current assessment. Therefore a DRAINS-RAFTS model was built (Figure 4-2) using the catchment delineation shown in Figure 4-1 to generate PMF inflows in line with the approach detailed in ARR2019. A peak flow comparison was made at the location shown in Figure 4-1 for the 180mins GSDM temporal pattern and Table 4-1 demonstrates that a good match was achieved. Therefore, the rebuilt hydrology model was deemed suitable for generating the PMF event inflows.

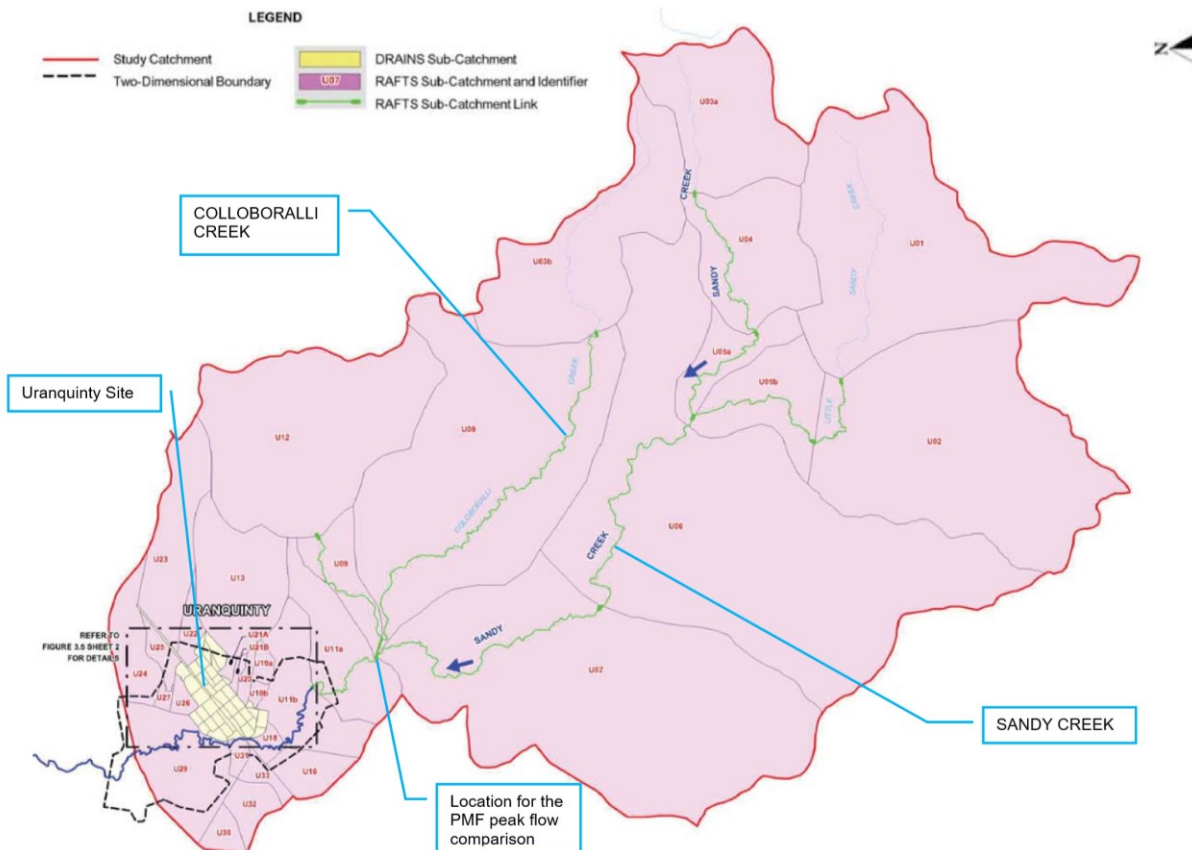


Figure 4-1: Hydrology Sub-catchment Extent (Source: Figure 3.5 of Tarcutta, Ladysmith and Uranquinty Flood Studies, Lyall Associates, 2014)

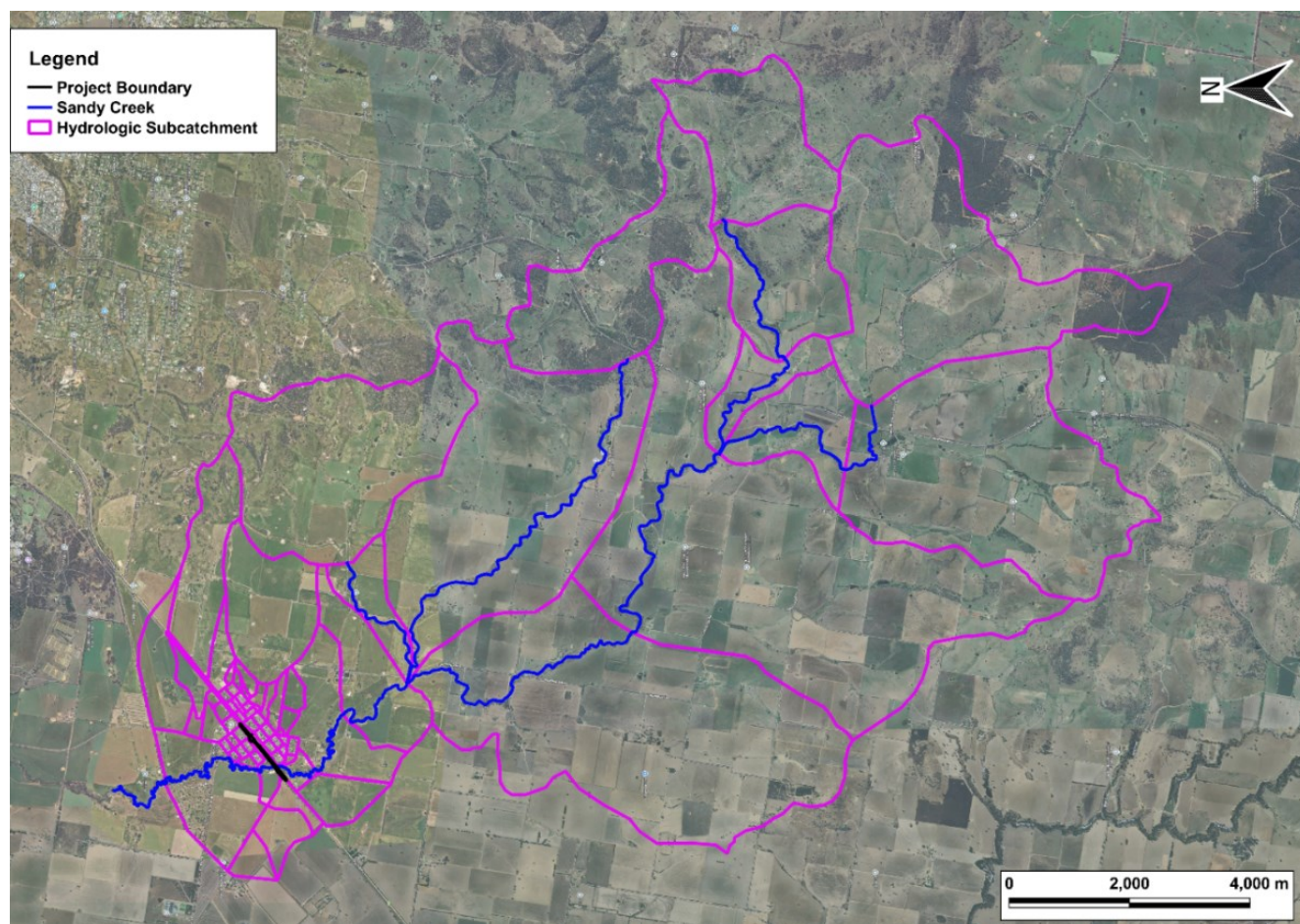


Figure 4-2: Re-built Hydrology Subcatchment Extent

Table 4-1: PMF Peak Flow Comparison at Sandy Creek for 180mins GSDM Temporal Pattern

Location	PMF Peak Flow for TLU FRMSP	PMF Peak Flow from Reproduced Hydrology Model
Sandy Creek (shown in Figure 4-2)	2630 m ³ /s	2639 m ³ /s

4.2 Hydraulic Modelling

4.2.1 Existing Model Update

The TUFLOW model from the TLU FRMSP (GRC Hydro, 2021) was received and used as the basis for the flood assessment with a number of updates. A summary of the received model and updated model parameters is presented in Table 4-2. The hydraulic model extent encompasses the town of Uranquinty and surrounding areas situated along the southern floodplain of Sandy Creek (Refer to Figure 4-3).

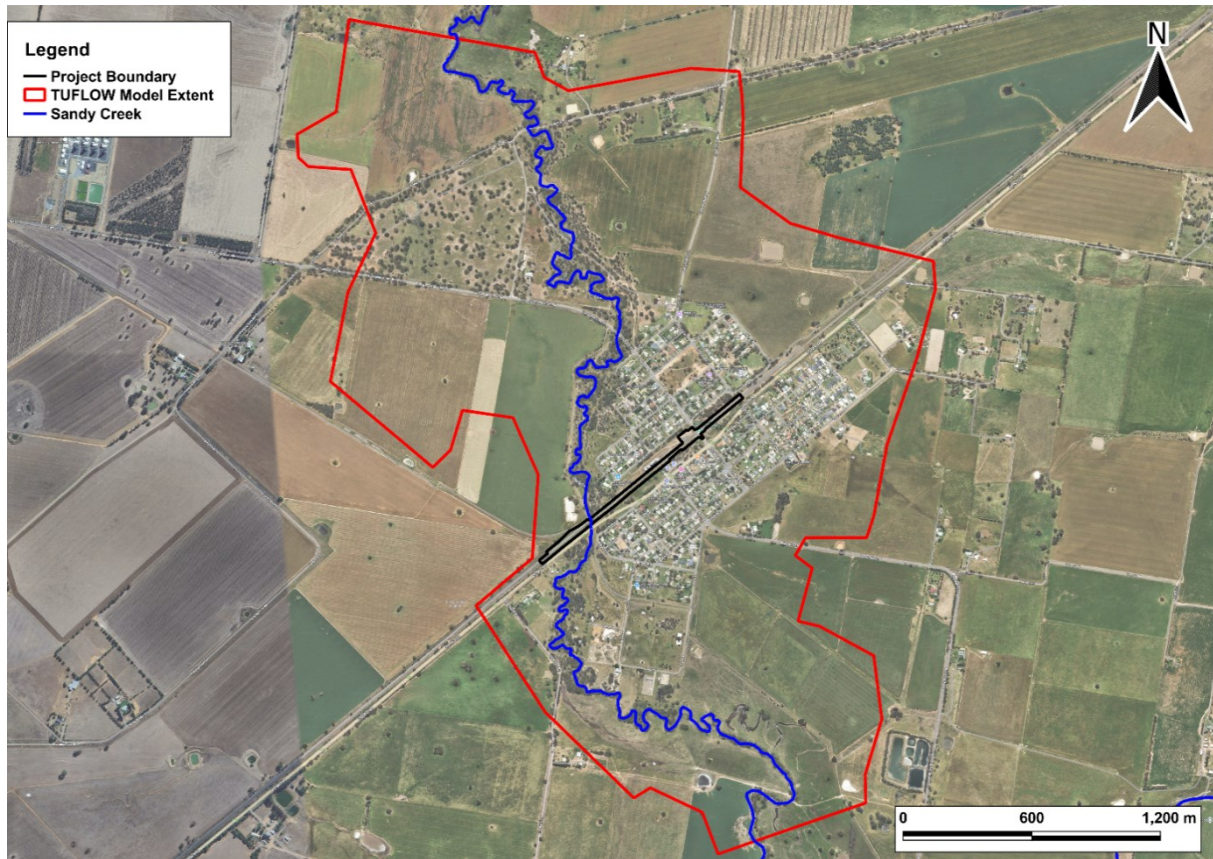


Figure 4-3: TUFLOW Model Extent - Uranquinty Yard Model

Table 4-2: TUFLOW Model Parameters in the TLU FRMSP and Updated IFC TUFLOW Models

Parameters	TLU FRMSP TUFLOW Model	Updated IFC TUFLOW Model
Build	TUFLOW 2020-10-AC HPC	TUFLOW.2023-03-AE HPC (Refer to Section 4.1.1 – “TUFLOW model version and grid size” for more details)
Coordination Reference System (CRS)	GDA94 MGA 55	GDA2020 MGA 55
Grid Size	5m	1.25m within the level 3 quadtree area (Site area) and 5m outside of the quadtree area (Refer to Figure 4-4). (Refer to “TUFLOW Model Version and Grid Size” for more details)
Inflow type	SA Polygon External BC Lines	SA Polygon External BC Lines
Extent	Uranquinty Town proper and areas within 2 km upstream and downstream of Sandy Creek	Uranquinty Town proper and areas within 2 km upstream and downstream of Sandy Creek
Downstream Boundary	Downstream water boundary (HX)	Downstream water boundary (HX)
Timestep	Dynamic	Dynamic
Building Representation	Null polygon	Null polygon
Topography	0.5 m resolution LiDAR collected in 2009	1 m x 1 m resolution photogrammetry was obtained from Geoscience Australia – Elevation Information System (ELVIS) collected in 2020 Site survey (Refer to Item 2 in Table 1-2)
Roughness	Road and Railway 0.02 Concrete Surface Channel 0.01 Well Maintained Grass Cover 0.03 Grass/Lawns 0.05 Macrophytes 0.06	Road and Railway 0.02 Concrete Surface Channel 0.01 Well Maintained Grass Cover 0.03 Grass/Lawns 0.05 Macrophytes 0.06

Parameters	TLU FRMSP TUFLOW Model	Updated IFC TUFLOW Model
	Lightly Vegetated Area 0.07 Trees 0.08 Trees and Scrub 0.06 Mildly Dense Vegetation 0.12 Dense Vegetation 0.14 Allotments 1.00 Buildings 10.00 Water/Wetlands 0.04 Pastural Grass 0.05 Fenced Houses 0.10 Channel Bed 0.04 Channel in-bank 0.08 Channel out-of-bank 0.05 Dirt Road 0.03	Lightly Vegetated Area 0.07 Trees 0.08 Trees and Scrub 0.06 Mildly Dense Vegetation 0.12 Dense Vegetation 0.14 Allotments 1.00 Buildings 10.00 Water/Wetlands 0.04 Pastural Grass 0.05 Fenced Houses 0.10 Channel Bed 0.04 Channel in-bank 0.08 Channel out-of-bank 0.05 Dirt Road 0.03 Bund 0.035
Design Events	5%, 2%, 1%, 0.5% and 0.2% AEP events	5%, 2%, 1%, 0.5% (Climate Change Scenario 1) and 0.2% (Climate Change Scenario 2) AEPs and PMF events

4.2.1.1 Geocentric Datum of Australia (GDA) 2020 Conversion

The conversion to GDA 2020 represents a crucial update to modernise and align the model with the latest geodetic standards and reference systems and to meet project requirements on the CRS. The model layers and the rasters were converted into GDA2020 Map Grid Australia (MGA) 55 from GDA94 MGA 55.

4.2.1.2 TUFLOW Model Version and Grid Size

The initial 5 metre (m) grid size and TUFLOW 2020-10-AC HPC were adopted from the TLU FRMSP model (GRC Hydro, 2021). However, a 5m grid was found to be insufficient to represent the required detail within the study area. Consequently, a more refined grid size was required. The application of a finer grid to the whole model extent would require long runtimes. Therefore, applying the quadtree tool (only available in TUFLOW versions from 2020 onwards) with defined areas at 1.25m (Level 3) within the site area was adopted. Refer to Figure 4-4 for the adopted quadtree extent. The latest TUFLOW model version, 2023-03-AE, was utilised for this study.

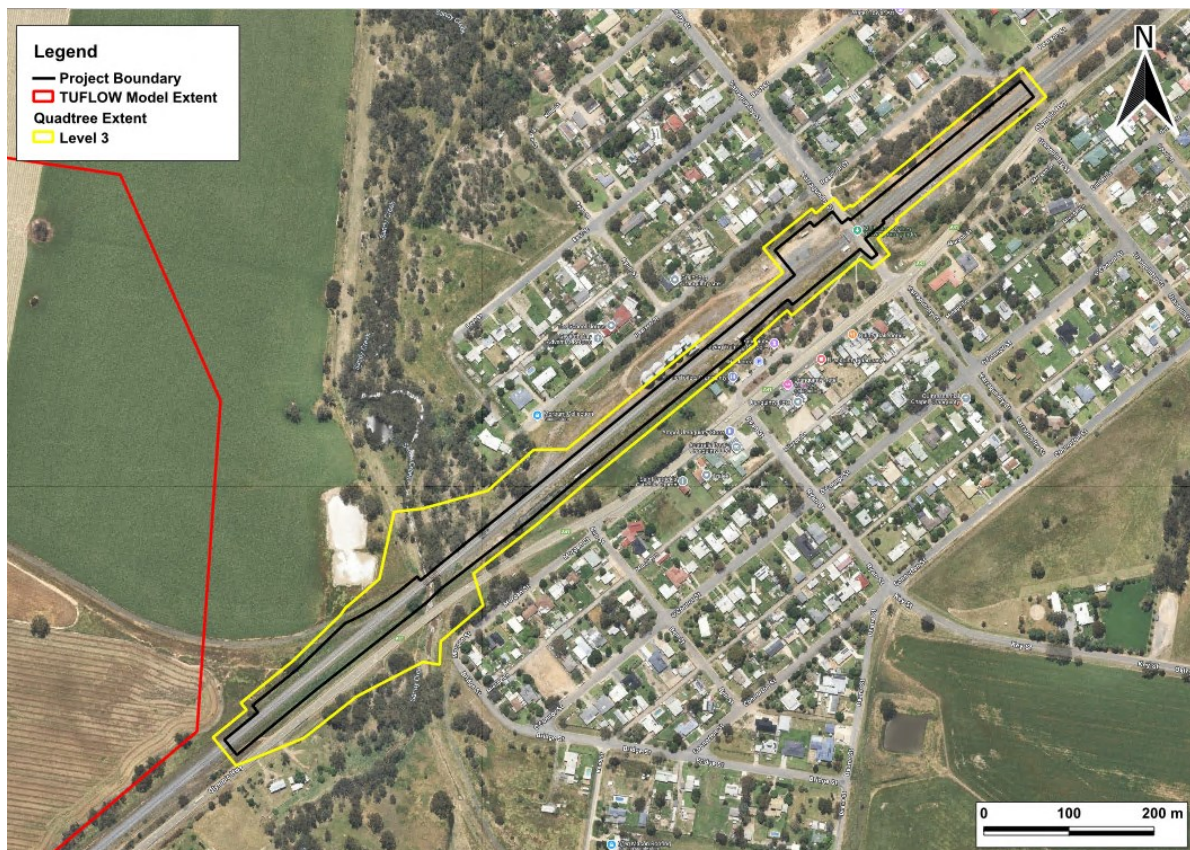


Figure 4-4: Quadtree Extent - Uranquinty Yard

4.2.1.3 Topography

The model topography was updated by incorporating the 2020 Light Detection and Ranging (LiDAR) for the whole TUFLOW model extent. On top of the LiDAR model topography was updated by incorporating the site survey. This update was performed to enhance the accuracy of the hydraulic model, ensuring the hydraulic model represents the current topography within the study area.

4.2.2 Design Model Update

The design model was updated from the existing condition by incorporating the Inland Rail Project Works as part of the IFC stage, including:

- Proposed alignment of the rail (top of the rail) and corresponding capping and ballast levels.
- Proposed a ballast drain culvert between Chainage 535+700km and 535+780km.
- Proposed a bund between Chainage 535+560km and 535+810km.

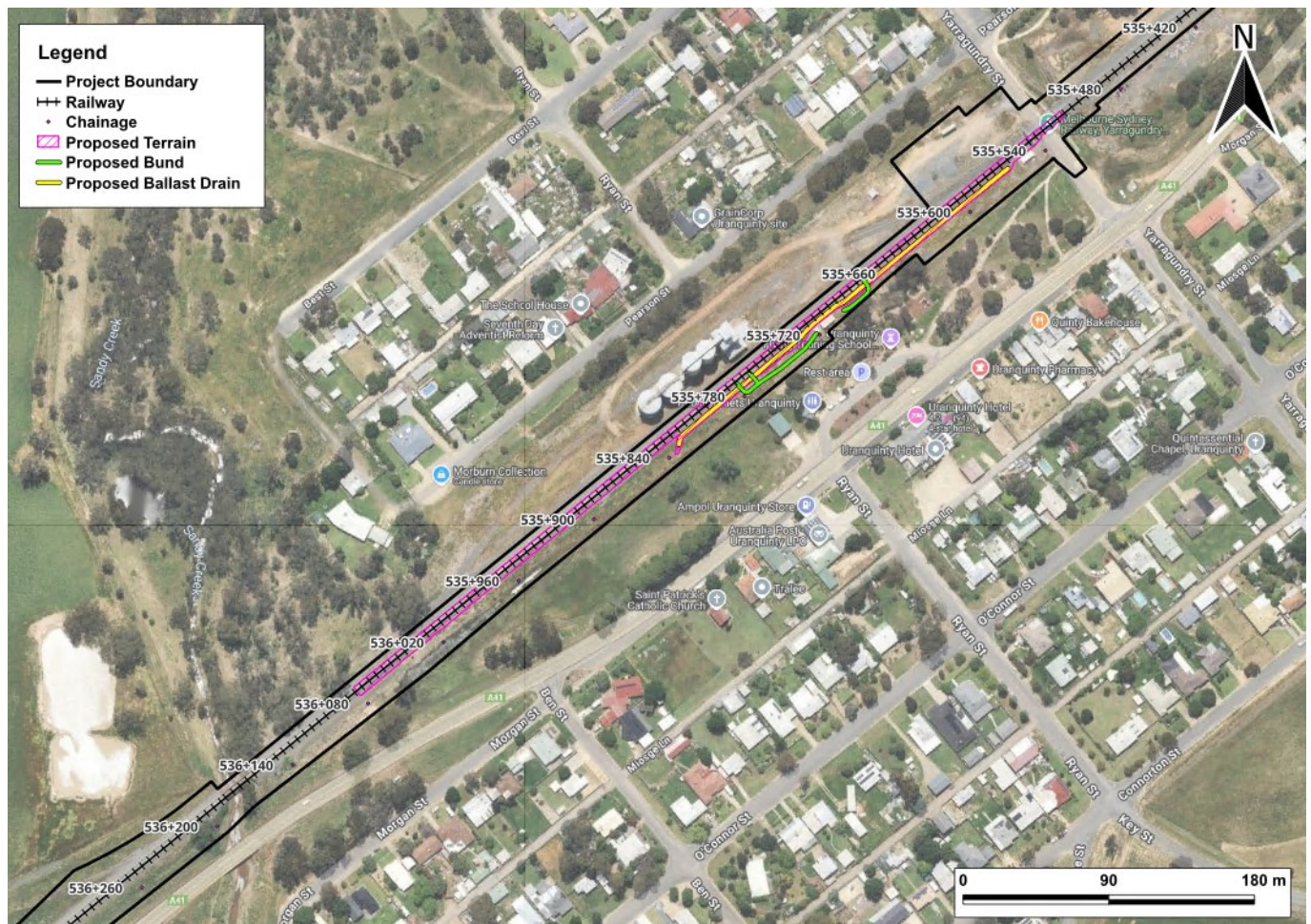


Figure 4-5: Design Extent

The inclusion of the proposed project works did not result in any alterations to the sub-catchment topography. Therefore, the hydraulic model inflow locations remained consistent with the existing hydraulic model. Figure 4-6 shows the changes in site topography around the site.

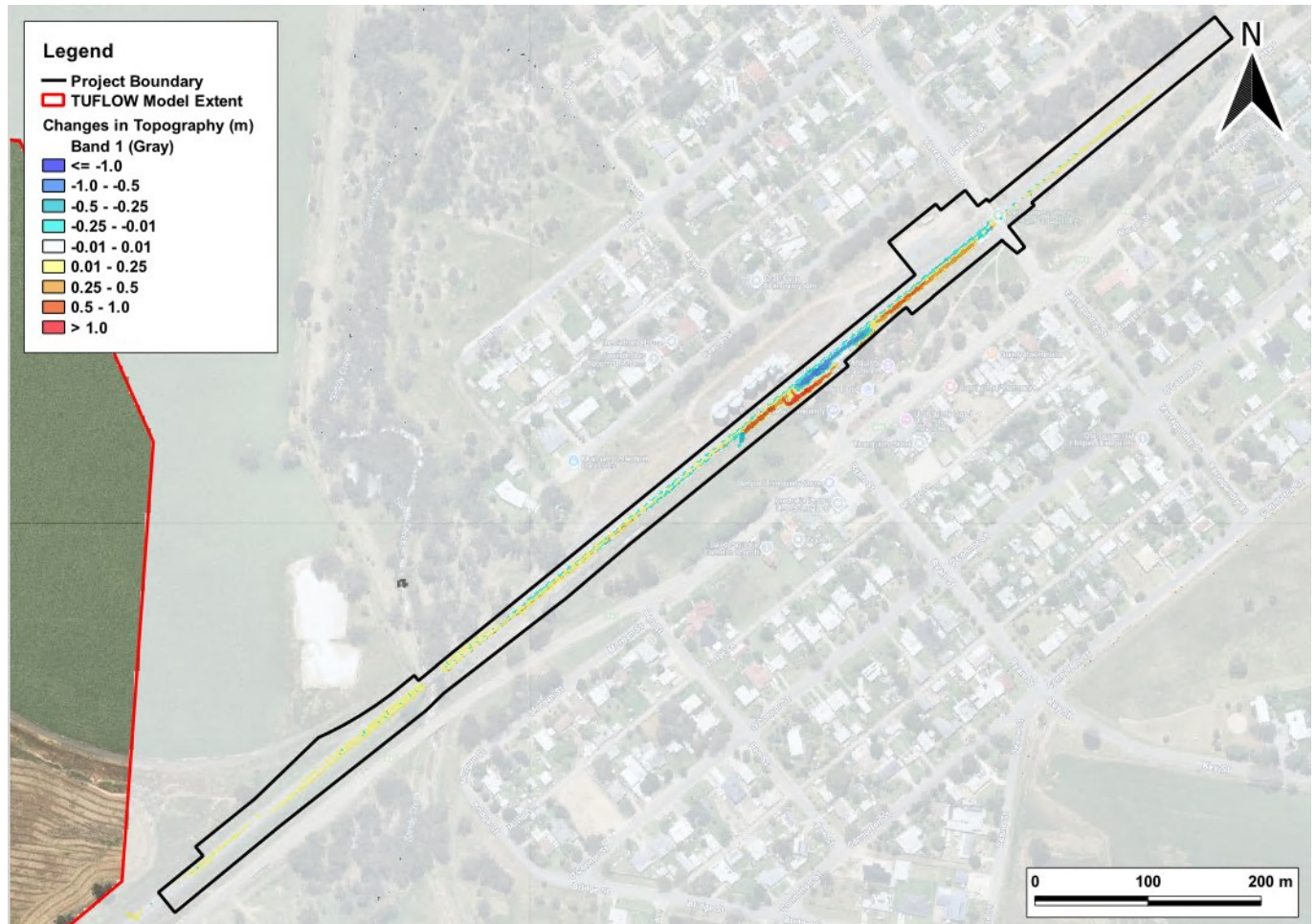


Figure 4-6: Changes in Site Topography – Design vs Existing

4.2.3 Design Events

The model was run for the design events of 5%, 2%, 1%, 0.5% (Climate Change Scenario 1), 0.2% (Climate Change Scenario 2) AEPs and PMF events for both regional and overland flow scenarios. The regional flow is the flood behaviour of Sandy Creek and its associated upstream catchment areas, while the overland flow is derived from the local overland catchments specific to the site

This study adopted the critical duration and temporal pattern from the TLU FRMSP (GRC Hydro, 2021) for events up to 0.2% AEPs. The PMF critical duration was determined by running 11 temporal patterns for the durations between 15 minutes and 6 hours. The critical durations were determined based on the maximum envelope method across the assessed durations. The critical durations and associated temporal patterns are summarised in Table 4-3.

Table 4-3: Critical Duration and Temporal Patterns

Design Event	Critical Duration	Temporal Pattern
Regional Flow		
5% AEP	12 hours	TP01
2% AEP	12 hours	TP01
1% AEP	12 hours	TP01
0.5% AEP (Climate Change Scenario 1)	12 hours	TP01
0.2% AEP (Climate Change Scenario 2)	12 hours	TP01
PMF	1 hour and 3 hours	11 Temporal patterns

Design Event	Critical Duration	Temporal Pattern
Overland Flow		
5% AEP	2 hours	TP02
2% AEP	1.5 hours	TP08
1% AEP	1.5 hours	TP01
0.5% AEP (Climate Change Scenario 1)	1.5 hours	TP08
0.2% AEP (Climate Change Scenario 2)	2 hours	TP06
PMF	1 hour and 3 hours	11 Temporal patterns

5 HYDRAULIC MODEL COMPARISON

Using the 1% AEP event, a comparison was carried out that involved comparing the modelling results from the updated IFC TUFLOW model (existing condition) against the results from the TLU FRMSP TUFLOW model. (refer to Figure 5-1).

Modifications were made to the model in response to comments from the Independent Flood Consultant regarding the representation of the Olympic Highway bridge and the adjacent railway bridge along Sandy Creek. These bridges were initially modelled using a one-dimensional (1D) approach, which resulted in an oversized representation of the Sandy Creek cross section beneath the bridges. This approach was deemed inaccurate, prompting the removal of the 1D cross section and the adoption of a two-dimensional (2D) approach. Consequently, both the Olympic Highway bridge and the adjacent railway bridge were incorporated into the model as a 2d_bg layer, and the section of Sandy Creek in the area vicinity was also modelled using a 2D dimensional representation.

This conversion resulted in an approximate increase of 0.6 meters in water level immediate upstream of the bridge and about 0.3 meters near the Eastern railway corridor area. The difference in peak flood level also is attributed due to the changes in the updated terrain (2024 survey+ 2020 LiDAR vs 2009 LiDAR). In addition, the IFC TUFLOW model incorporates the top of rail level which the TLU FRMSP TUFLOW model did not, which results in further flood level increases upstream of the rail.

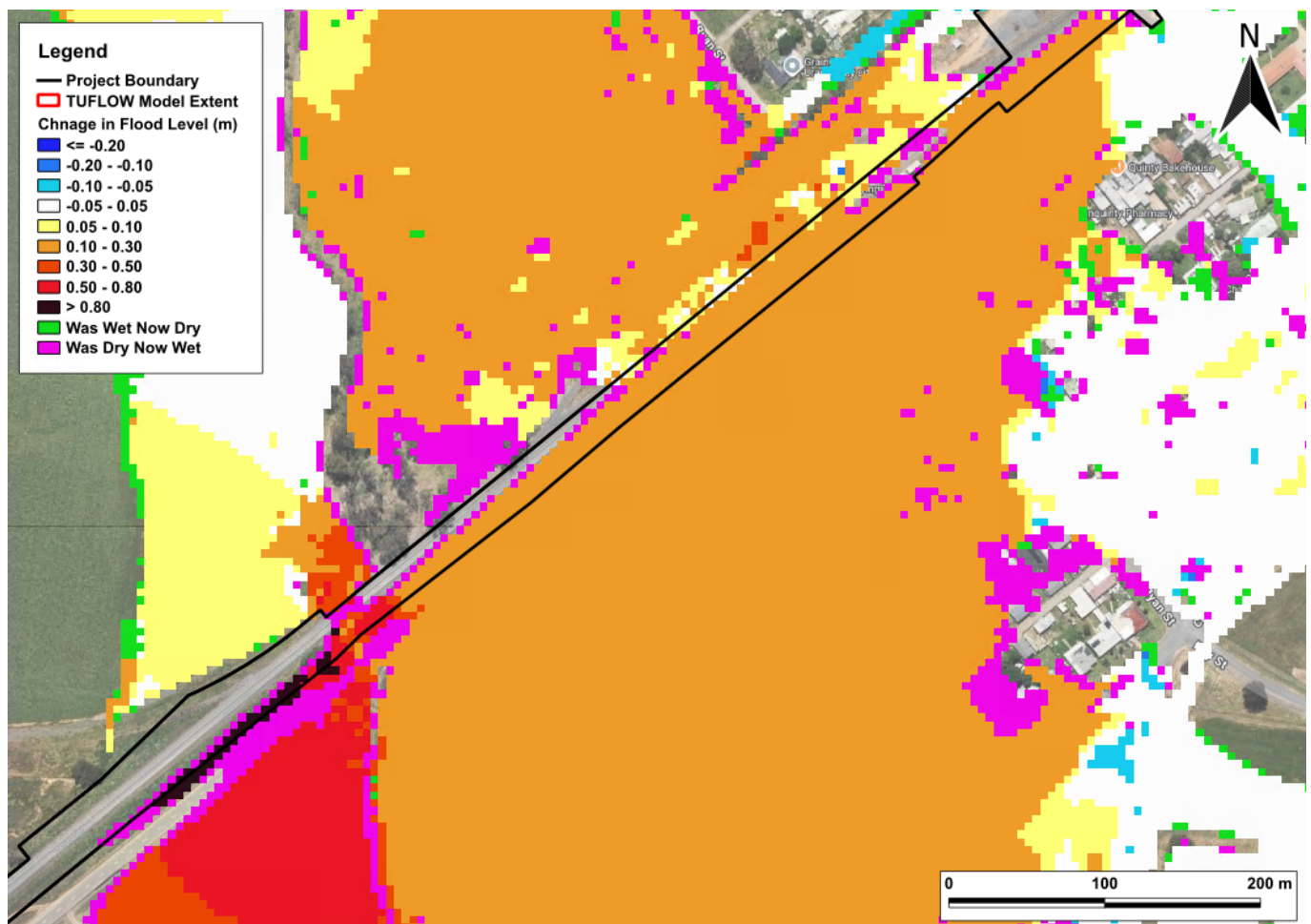


Figure 5-1: Comparison - Changes in Peak Flood Levels (Updated IFC Existing Condition TUFLOW Model vs the TLU FRMSP TUFLOW Model)

6 FLOOD ASSESSMENT

6.1 Existing Conditions

Existing condition flood maps, including peak flood depth and levels, peak flood velocities, and peak flood hazard for the modelled events are provided in Appendix A.

In the existing condition, the area east of the project site is inundated with the water flowing southwest towards Sandy Creek. The railway line is overtopped near the silos (from Chainage 535+680km to 535+920km), inundating the middle of the project site. The water that overtops the rail line then flows northwest from the project site and eventually enters Sandy Creek. The railway overtops the track levels in the 1% AEP event. Figure 6-1 shows points of interest (from point 1 to 7) used in the following tables below.

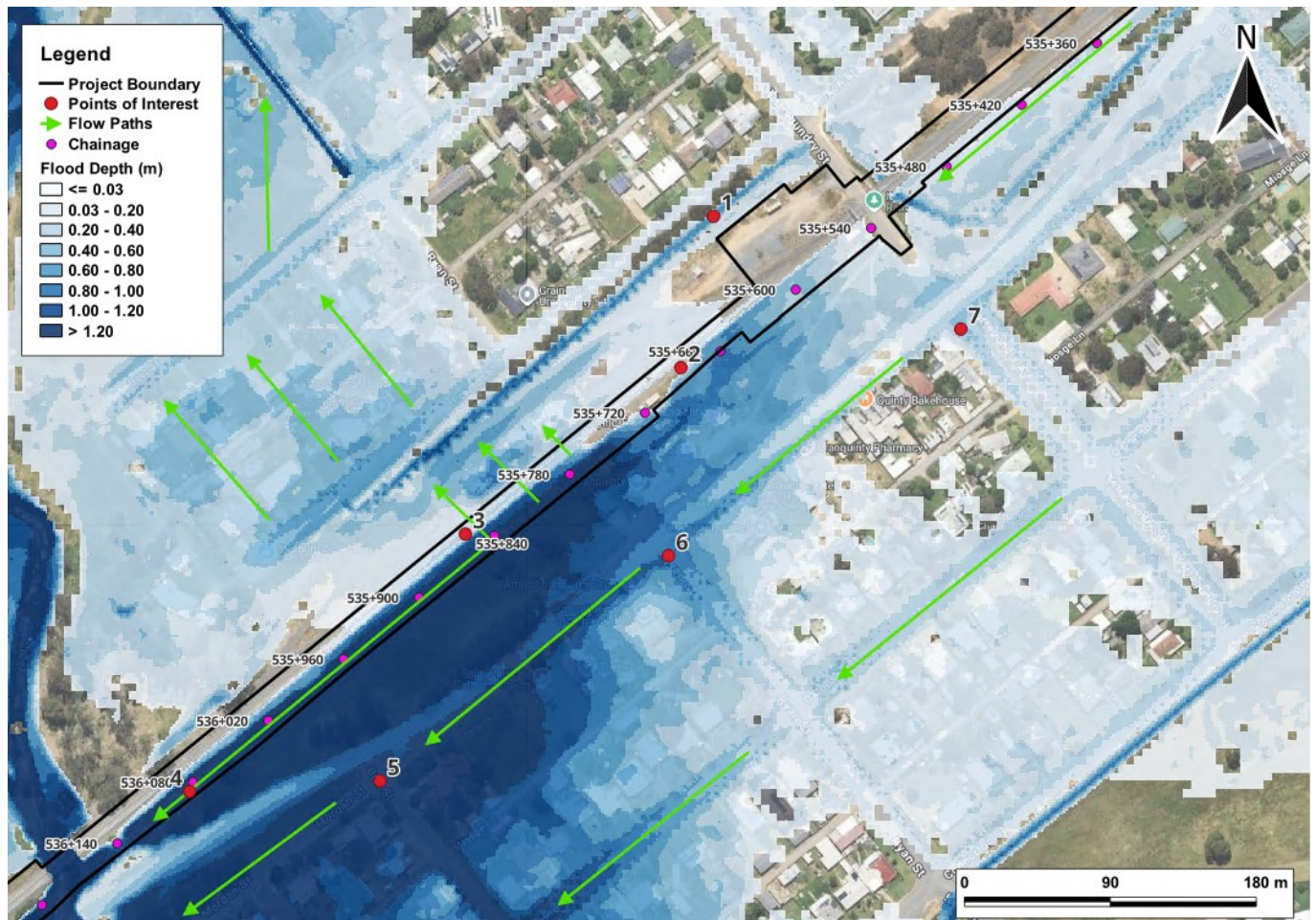


Figure 6-1: Existing Conditions 1% AEP Peak Flood Depth with Points of Interest

The table below describes the Points of Interest as indicated above. Points 2, 3 and 4 are located inside project boundary.

Table 6-1: Points of Interests

Point of Interest	Notes
1	Location at Chainage 535+560km along the channel that crosses Yarragundy Street through a culvert
2	Location at Chainage 535+685km along the bund
3	Location at Chainage 535+850km along the rail line
4	Location at Chainage 536+085km along the east of the rail
5	Location at Ben Street corner Morgan Street
6	Location at Ryan Street corner Olympic Highway
7	Location at Yarragundy Street corner Olympic Highway

Table 6-2 summarises the peak flood level results for the existing conditions at the Uranquinty Yard.

Table 6-2: Peak Flood Levels - Existing Conditions

Design Events	Flood Levels
5% AEP	- No overtopping along the railway corridor. - Refer to Table 6-3 for flood level comparison based on points of interest.
2% AEP	- The flood waters overtop the existing railway track level within the site by 0.18m. - Refer to Table 6-3 for flood level comparison based on points of interest.
1% AEP	- The flood waters overtop the existing railway track level within the site by 0.35m. - Refer to Table 6-3 for flood level comparison based on points of interest.
0.5% AEP (Climate Change Scenario 1)	- The flood waters overtop the existing railway track level within the site by 0.45m. - Refer to Table 6-3 for flood level comparison based on points of interest.
0.2% AEP (Climate Change Scenario 2)	- The flood waters overtop the existing railway track level within the site by 0.55m. - Refer to Table 6-3 for flood level comparison based on points of interest.
PMF	- The flood waters overtop the existing railway track level within the site by 2.6m. - Refer to Table 6-3 for flood level comparison based on points of interest.

Table 6-3: Peak Flood Levels (mAHD) at Points of Interest - Existing Conditions

Point of Interest	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	PMF
1	199.23	199.25	199.27	199.41	199.48	201.81
2	Not Flooded	Not Flooded	Not Flooded	Not Flooded	200.57	201.99
3	Not Flooded	200.07	200.28	200.37	200.47	202.26
4	199.54	200.15	200.36	200.48	200.61	202.91
5	199.54	200.15	200.37	200.49	200.61	202.81
6	199.58	200.15	200.36	200.47	200.58	202.56
7	200.67	200.72	200.77	200.83	200.92	202.26

Table 6-4 summarises the peak flood velocity results for existing conditions at the Uranquinty Yard.

Table 6-4: Peak Flood Velocity - Existing Conditions

Design Events	Flood Velocity
5% AEP	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - General flood velocity within the project boundary is generally up to 0.7m/s.
2% AEP	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - The peak velocity along the rail corridor is generally up to 0.8m/s
1% AEP	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - The peak velocity along the rail corridor is generally up to 1.5 m/s
0.5% AEP (Climate Change Scenario 1)	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - The peak velocity along the rail corridor is generally up to 1.8 m/s

Design Events	Flood Velocity
0.2% AEP (Climate Change Scenario 2)	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - The peak velocity along the rail corridor is generally up to 2.1 m/s
PMF	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - The peak velocity along the rail corridor is generally up to 4 m/s

Table 6-5: Peak Flood Velocity (m/s) at Points of Interest - Existing Conditions

Point of Interest	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	PMF
1	0.8	0.8	0.8	0.8	0.8	1.2
2	Not Flooded	Not Flooded	Not Flooded	Not Flooded	0.1	2.4
3	Not Flooded	<0.1	0.5	0.7	0.8	2.2
4	0.3	0.4	0.4	0.4	0.4	2.7
5	0.3	0.4	0.4	0.4	0.4	1.5
6	0.7	0.8	0.8	0.9	1.0	2.2
7	0.2	0.3	0.5	0.6	0.7	2.1

The flood hazard assessment is based on the general flood hazard classification set by the Australian Institute for Disaster Resilience in Australian Disaster Resilience Handbook Collection - Flood Hazard, 2017. Figure 6-2 and Table 6-6 describe the hazards.

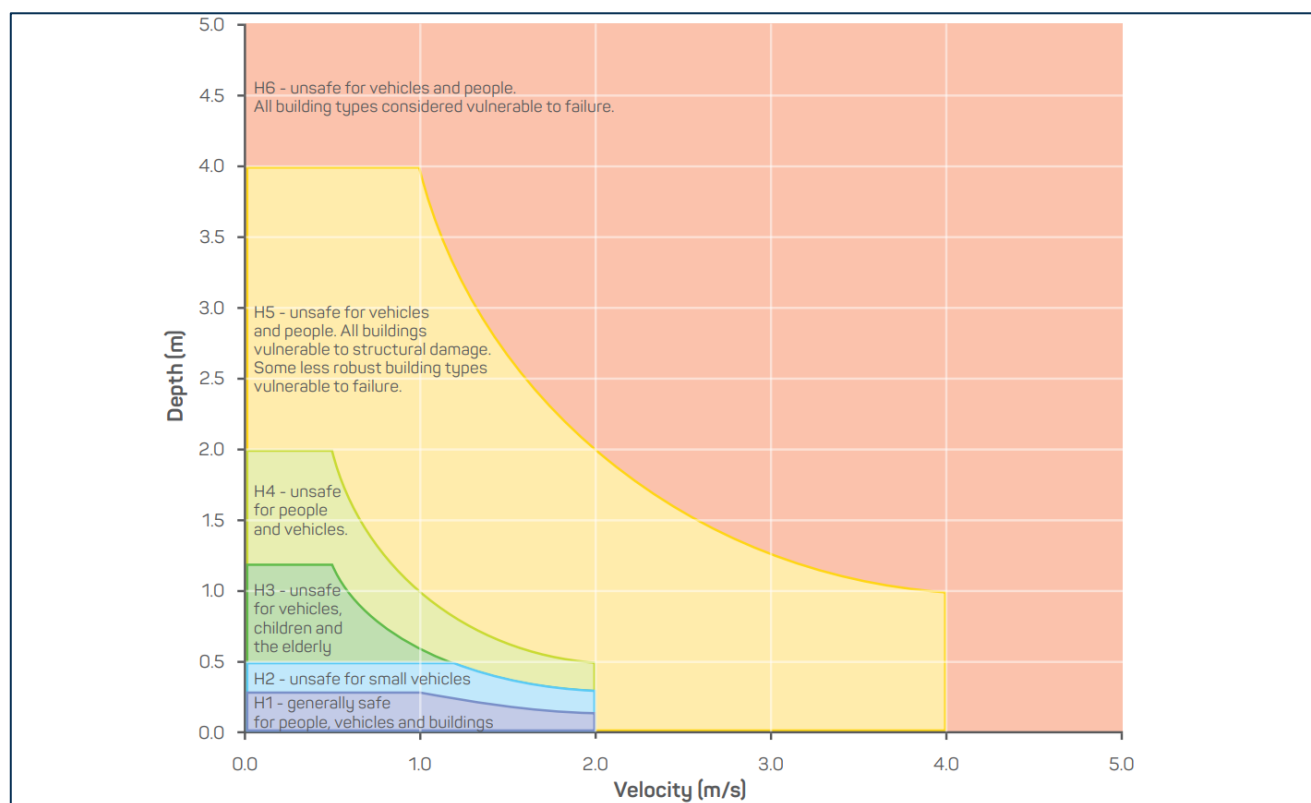


Figure 6-2: General Flood Hazard Vulnerability Curves - (Image Source: Australian Disaster Resilience Handbook Collection - Flood Hazard)

Table 6-6: Combined Hazard Curves - Vulnerability Thresholds

Hazard Vulnerability Classification	Description
H1	Generally safe for vehicles, people and buildings.
H2	Unsafe for small vehicles
H3	Unsafe for small vehicles, children and the elderly
H4	Unsafe for vehicles and people.
H5	Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure

Table 6-7 describes the general risk for all the events, while Table 6-8 summarises the hazard for the reporting locations.

Table 6-7: Flood Hazard - Existing Conditions

Design Events	Flood Hazard
5% AEP	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - No overtopping along the railway corridor.
2% AEP	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - The peak hazard along the rail corridor is up to H3.
1% AEP	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - The peak hazard along the rail corridor is up to H3.
0.5% AEP (Climate Change Scenario 1)	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - The peak hazard along the rail corridor is up to H3.
0.2% AEP (Climate Change Scenario 2)	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - The peak hazard along the rail corridor is up to H4
PMF	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - The peak hazard along the rail corridor is generally H6.

Table 6-8: Peak Flood Hazard at Points of Interest - Existing Conditions

Point of Interest	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	PMF
1	H3	H3	H3	H3	H3	H5
2	Not Flooded	Not Flooded	Not Flooded	Not Flooded	H1	H5
3	Not Flooded	H1	H2	H2	H2	H6
4	H4	H4	H5	H5	H5	H6
5	H3	H4	H4	H4	H4	H6
6	H1	H3	H3	H3	H4	H6
7	H2	H2	H2	H3	H3	H5

6.2 Design Condition

Design conditions flood maps, including peak flood depth and levels, peak flood velocity, and peak flood hazard for the events modelled, are provided in Appendix A.

The design conditions incorporate the track design, design drainage as well as proposed bund upstream of the rail line. The incorporation of these causes a reduction in overtopping of the rail.

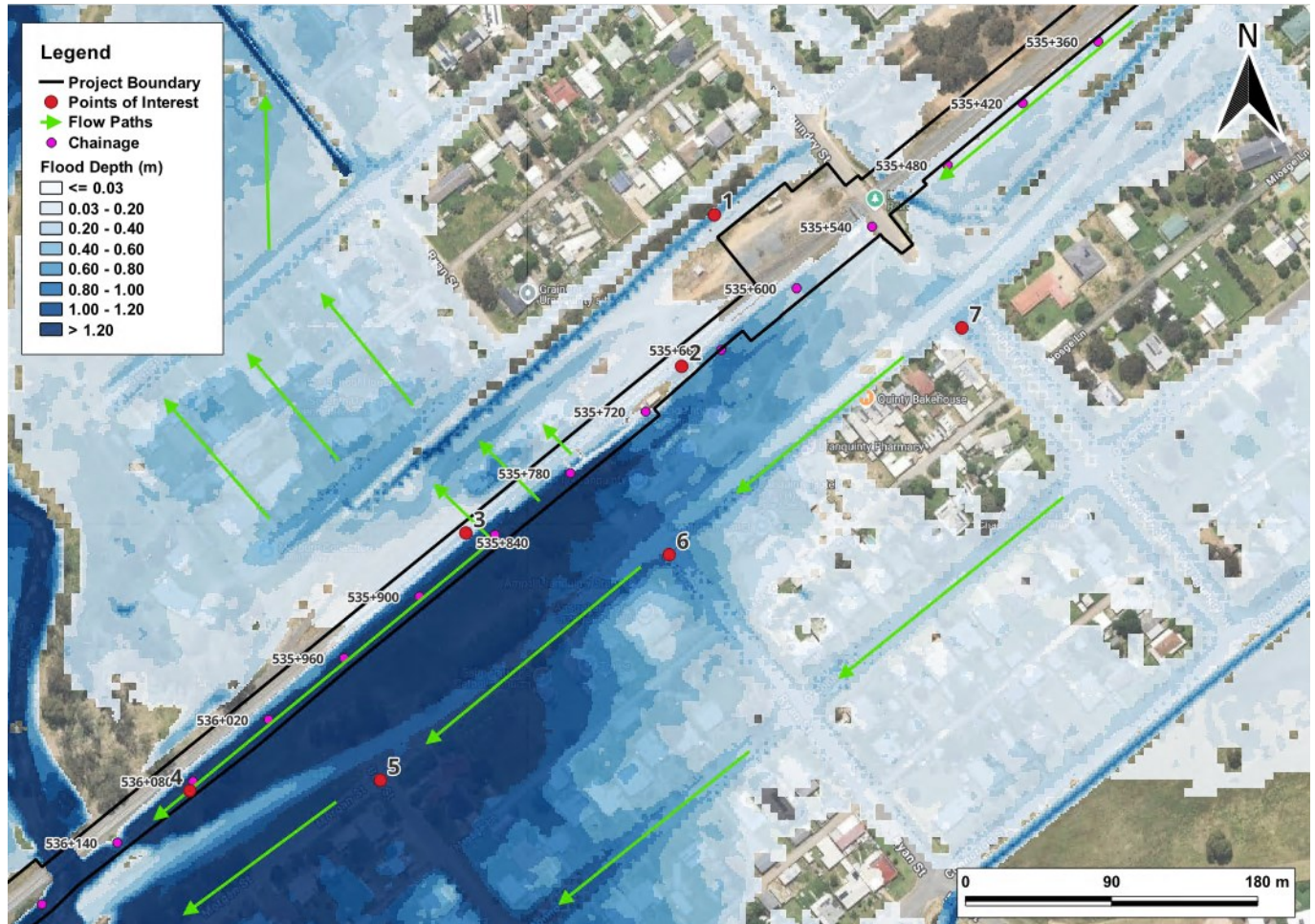


Figure 6-3: 1% AEP Peak Flood Depth with Points of Interest - Design Condition

Table 6-9 summarises the peak flood level results for design conditions at the Uranquinty Yard.

Table 6-9: Peak Flood Levels - Design Conditions

Design Events	Flood Levels
5% AEP	- No overtopping along the railway corridor. - Refer to Table 6-10 for flood level comparison based on points of interest.
2% AEP	- The flood waters overtop the existing railway track level within the site generally up to 0.18m. - Refer to Table 6-10 for flood level comparison based on points of interest.
1% AEP	- The flood waters overtop the existing railway track level within the site generally up to 0.30m. - Refer to Table 6-10 for flood level comparison based on points of interest
0.5% AEP (Climate Change Scenario 1)	- The flood waters overtop the existing railway track level within the site generally up to 0.41m. - Refer to Table 6-10 for flood level comparison based on points of interest

Design Events	Flood Levels
0.2% AEP (Climate Change Scenario 2)	- The flood waters overtop the existing railway track level within the site generally up to 0.53m. - Refer to Table 6-10 for flood level comparison based on points of interest
PMF	- The flood waters overtop the existing railway track level within the site generally up to 2.56m. - Refer to Table 6-10 for flood level comparison based on points of interest

Table 6-10: Peak Flood Levels (mAHD) at Points of Interest - Design Conditions

Point of Interest	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	PMF
1	199.23	199.25	199.28	199.44	199.50	201.82
2	Not Flooded	200.09	200.28	200.39	200.48	202.05
3	Not Flooded	200.08	200.28	200.37	200.45	202.25
4	199.54	200.15	200.36	200.47	200.59	202.94
5	199.54	200.15	200.37	200.48	200.59	202.83
6	199.58	200.15	200.36	200.46	200.56	202.57
7	200.67	200.72	200.77	200.83	200.92	202.27

In the design condition, the flow velocity is generally low along the railway corridor. Table 6-11 summarises the peak flood velocity results for design conditions at the Uranquinty Yard.

Table 6-11: Peak Flood Velocity - Design Conditions

Design Events	Flood Velocity
5% AEP	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - General flood velocity within the project boundary is within 0.7m/s.
2% AEP	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - General flood velocity within the project boundary is within 0.8m/s
1% AEP	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - The peak velocity along the rail corridor is 1.2 m/s
0.5% AEP (Climate Change Scenario 1)	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - The peak velocity along the rail corridor is 1.4 m/s
0.2% AEP (Climate Change Scenario 2)	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - The peak velocity along the rail corridor is 2.0 m/s
PMF	- Refer to Table 6-5 for flood velocity comparison based on points of interest. - The peak velocity along the rail corridor is 3.9m/s

Table 6-12: Peak Flood Velocity (m/s) at Points of Interest - Design Condition

Point of Interest	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	PMF
1	0.8	0.8	0.8	0.8	0.8	1.2
2	Not Flooded	<0.1	0.3	0.5	0.6	1.7

Point of Interest	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	PMF
3	Not Flooded	<0.1	0.5	0.7	0.8	2.3
4	0.3	0.4	0.4	0.4	0.4	2.7
5	0.3	0.4	0.4	0.4	0.4	1.4
6	0.7	0.8	0.8	0.9	0.9	2.1
7	0.2	0.3	0.5	0.6	0.7	2.1

The flood hazard for the design conditions is presented in Table 6-13 with the maps presented in Appendix A.

Table 6-13: Flood Hazard - Design Conditions

Design Events	Flood Hazard
5% AEP	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - No overtopping along the railway corridor.
2% AEP	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - The peak hazard along the rail corridor is up to H1.
1% AEP	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - The peak hazard along the rail corridor is up to H2.
0.5% AEP (Climate Change Scenario 1)	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - The peak hazard along the rail corridor is up to H3.
0.2% AEP (Climate Change Scenario 2)	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - The peak hazard along the rail corridor is up to H3
PMF	- Refer to Table 6-8 for flood hazard comparison based on points of interest. - The peak hazard along the rail corridor is generally H6.

Table 6-14: Peak Flood Hazard at Points of Interest - Design Condition

Point of Interest	5% AEP	2% AEP	1% AEP	0.5% AEP (Climate Change Scenario 1)	0.2% AEP (Climate Change Scenario 2)	PMF
1	H3	H3	H3	H3	H3	H5
2	Not Flooded	H1	H1	H2	H2	H5
3	Not Flooded	H1	H1	H2	H2	H6
4	H4	H4	H5	H5	H5	H6
5	H3	H4	H4	H4	H4	H6
6	H1	H3	H3	H3	H3	H6
7	H2	H2	H2	H3	H3	H6

6.3 Flood Immunity and Scour Protection

The flood immunity of the railway corridor remains same in both existing and design scenario (5% AEP) which complies with the criteria in PSR for a no-worsening impact. The design is compliant with the CoA Condition E42 for up to the 1% AEP event with the proposed development having minimal impacts on areas outside of the site.

A comparison between top of rail, top of formation and overtopping flood depth for each flood event for the design and existing conditions at Chainage 535+780km (deepest overtopping location in 1% AEP) is presented in Table 6-15. In flood events greater than the 1% AEP event, the overtopping depth is almost the same as compared to existing conditions, which is due to the regional flooding.

Table 6-15: Comparison of Flood Level at Chainage 535+780km (up to 1% AEP)

Chainage	Top of the Rail Level (mAHD)		Top of the Formation Level (mAHD) *		5% AEP Flood Level (mAHD)		2% AEP Flood Level (mAHD)		1% AEP Flood Level (mAHD)	
	Existing	Design	Existing	Design	Existing	Design	Existing	Design	Existing	Design
Chainage 535+780km	200.094	200.059	199.427	199.392	Not overtopped		200.14	200.07	200.34	200.21

*Note that the top of the formation level has been assumed to be 667mm below the top of the rail level.

Table 6-16: Comparison of Flood Level at Chainage 535+780km (0.5%AEP, 0.2% AEP and PMF)

Chainage	Top of the Rail Level (mAHD)		Top of the Formation Level (mAHD) *		0.5% AEP Flood Level (mAHD)		0.2% AEP Flood Level (mAHD)		PMF Flood Level (mAHD)	
	Existing	Design	Existing	Design	Existing	Design	Existing	Design	Existing	Design
Chainage 535+780km	200.094	200.059	199.427	199.392	200.44	200.31	200.53	200.39	202.44	202.38

*Note that the top of the formation level has been assumed to be 667mm below the top of the rail level.

6.4 Flood Impact Assessment

Due to the addition of bund between Chainage 535+680km and 535+780km generally existing condition water levels are maintained at in existing and design conditions up to 1% AEP.

6.4.1 Changes in Peak Flood Level

Table 6-17 provides the peak flood level changes associated with the proposed design conditions.

Table 6-17: Flood Level Impact Assessment

Design Events	Changes in Peak Flood Levels
5% AEP	- Increases in flood levels are localised to Chainage 535+600km where there are increases up to 40mm that extend slightly outside the project boundary (refer to Figure A37 in Appendix A). However, this is within the CoA afflux limits (50mm) and hence compliant. - No newly wetted area occurs outside the project boundary.
2% AEP	- Increases in flood levels are localised to Chainage 535+840km where there are increases up to 40mm that extend slightly outside the project boundary (Refer to Figure A38 in Appendix A). However, this is within the CoA afflux limits (50mm) and hence compliant. - Newly wet area occurs outside the project boundary are generally less than 50mm.
1% AEP	- Increases in flood levels are localised to Chainage 535+660km where there are increases up to 40mm that extend slightly outside the project boundary (Refer to Figure A39 in Appendix A). However, this is within the CoA afflux limits (50mm) and hence compliant. - Generally, no newly wetted area occurs outside the project boundary.

The changes in flood level outside the project boundary in the surroundings of residential buildings, other urban and roads are less than 0.05m up to 1% AEP events. Thus, the design complies with the CoA project requirements.

Table 6-18: Changes in Flood Level (mAHD) at Points of Interest

Point of Interest	5% AEP	2% AEP	1% AEP
1	No change	No change	0.01
2*	No change	0.07	0.27
3*	No change	No change	No change
4*	No change	No change	No change
5	No change	No change	No change
6	No change	No change	No change
7	No change	No change	No change

*Points located inside the Project boundary

6.4.2 Changes in Peak Flood Velocity

Table 6-19 details changes in peak flood velocity associated with the proposed design conditions. The points of interest 1 to 7 experiences less than 0.5m/s of changes in velocity for the 5% AEP, 2% AEP and 1% AEP events.

Table 6-19: Flood Velocity Impact Assessment

Design Events	Changes in Peak Flood Velocity
5% AEP	- The velocity increase is generally less than 0.5m/s both inside and outside of the project boundary (Refer to Figure A42 in Appendix A). - No newly wetted area occurs outside the project boundary.
2% AEP	- The velocity increase is generally less than 0.5m/s both inside and outside of the project boundary (Refer to Figure A43 in Appendix A). - Velocity of newly wet area occurs outside the project boundary is generally less than 0.5m/s.
1% AEP	- The velocity increase is generally less than 0.5m/s both inside and outside of the project boundary (Refer to Figure A44 in Appendix A). - Generally, No newly wetted area occurs outside the project boundary.

The changes in flood velocity outside the project boundary comply with the PSR and CoA clause E42 (h) project requirements.

6.4.3 Changes in Peak Flood Hazard

Table 6-20 details the flood hazard changes associated with the proposed design conditions.

Table 6-20: Flood Hazard Impact Assessment

Design Events	Changes in Peak Flood Hazard
1% AEP	There are some localised pixels showing one category increase in flood hazard in 1% AEP (Appendix A, Figure A47). In these areas, a check against the velocity depth product (VxD) was undertaken to assess the potential increase in hazard. It was found the increases in VxD is less than 0.01m²/s at those scattering locations, which is small that it should not be interpreted as an increase in risk to life. Based on the above, the changes in flood hazard between the existing and design cases comply with CoA E42(g). Minor localised pixels increase in hazard (from H2 to H3) experienced North to the Silo area. The changes in VxD are generally less than 0.025m²/s, and the design condition VxD is less than 0.2m²/s, which is below the safe limit (0.4m²/s). The increase is mainly due to additional water flow during the 1% AEP design scenario where the depth is increased by approximately 13mm. This Minor increase occurs at land area classified as Bulk grain storage which does not increase in the risk to life.
All other % AEP Events	There are no increases in the Hazard Category as a result of the design works, and therefore, they are in compliance with the CoA.

Changes in hazard for the points of interest are provided in Table 6-21.

Table 6-21: Changes in hazard (mAHD) at Points of Interest

Point of Interest	5% AEP	2% AEP	1% AEP
1	No change in hazard	No change in hazard	No change in hazard
2*	Not flooded	Increased 1 Class	Increased 1 Class
3*	No change in hazard	No change in hazard	Decreased 1 Class
4*	No change in hazard	No change in hazard	No change in hazard
5	No change in hazard	No change in hazard	No change in hazard
6	No change in hazard	No change in hazard	No change in hazard
7	No change in hazard	No change in hazard	No change in hazard

*Points located inside the Project boundary

The changes in flood hazard outside the project boundary comply with the PSR and CoA clause E42 (g) project requirements.

6.4.4 Changes in Duration of Inundation

The analysis of the change in duration of inundation was undertaken by comparing flood level vs time upstream and downstream of the site in the existing and design conditions. As shown in the figures below, for the 5% AEP, 2% AEP and the 1% AEP event, there is negligible change between the existing and design conditions, and the durations are almost similar. Overall, there is no increase in duration of inundation as a result of the project works and this complies with CoA E42(a).

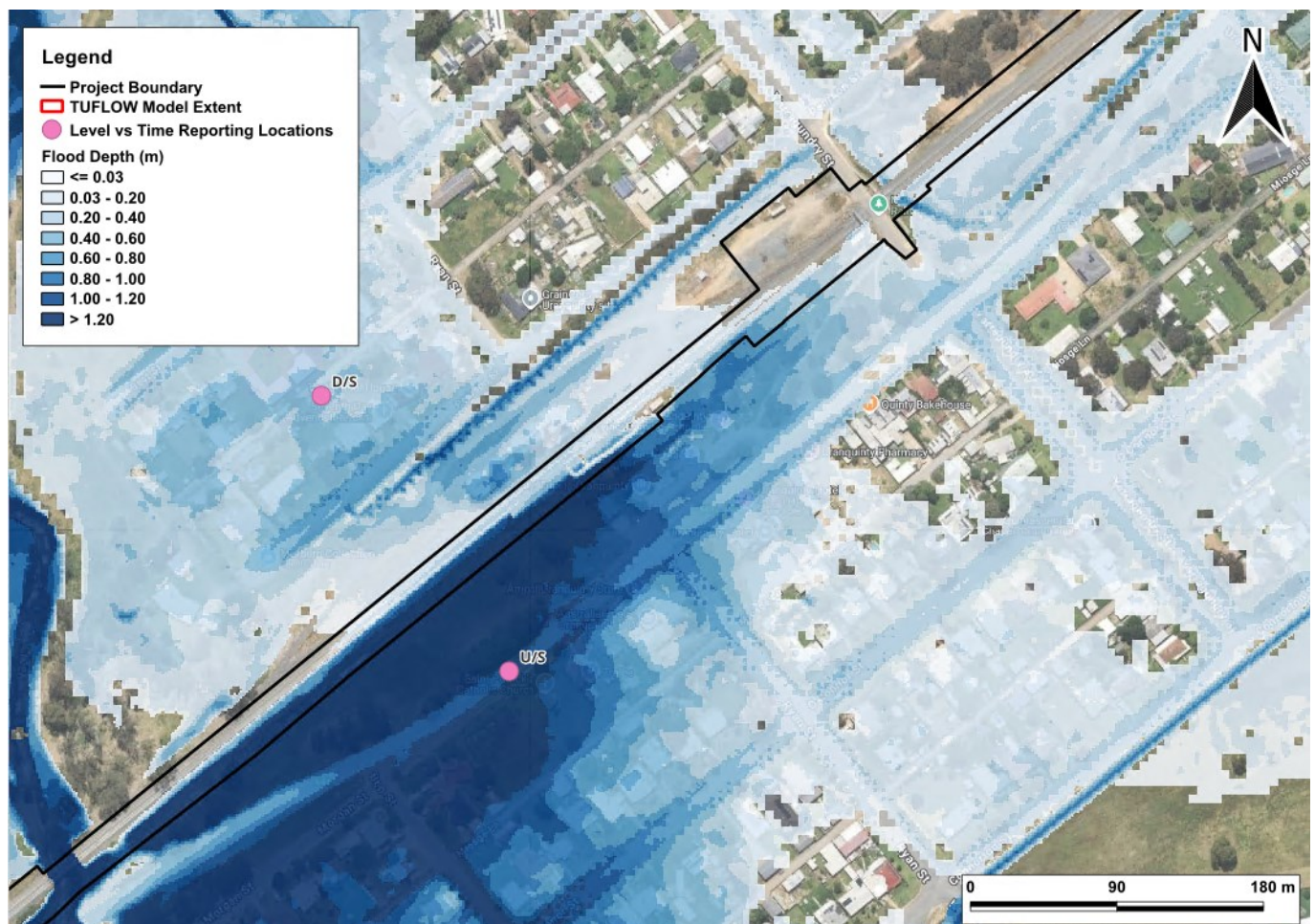


Figure 6-4: 1% AEP Peak Flood Depth - Reporting Location

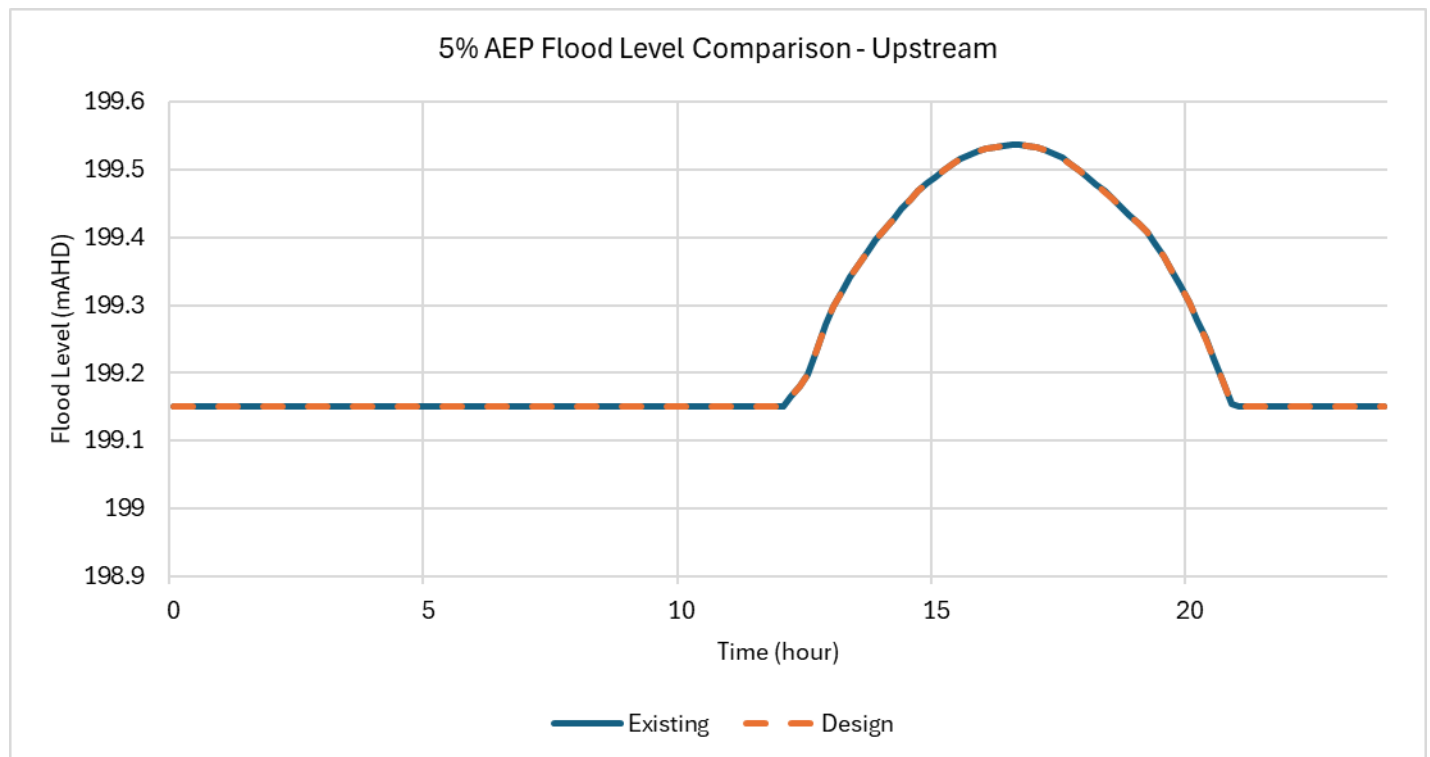


Figure 6-5: 5% AEP – Flood Level vs Time - Upstream of the Site

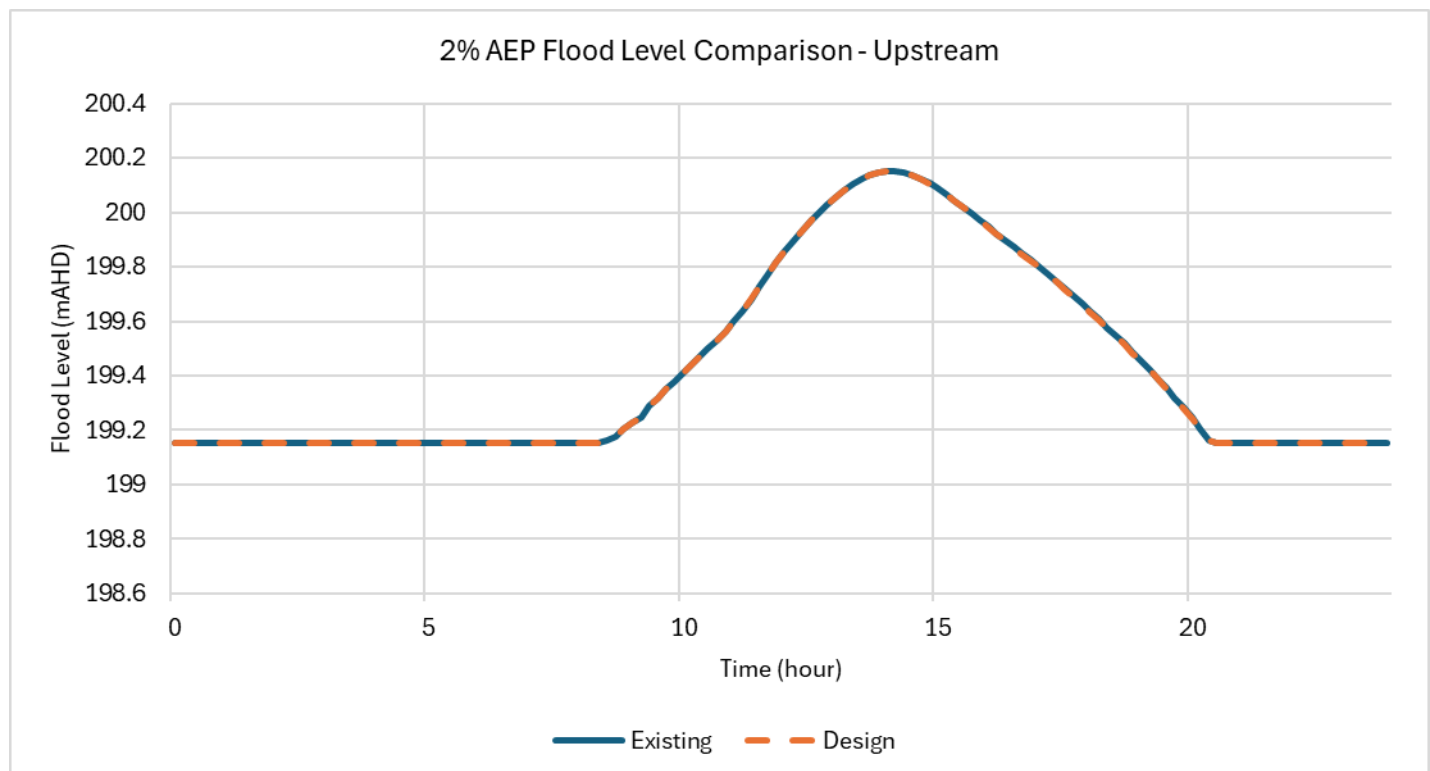


Figure 6-6: 2% AEP - Flood Level vs Time - Upstream of the Site

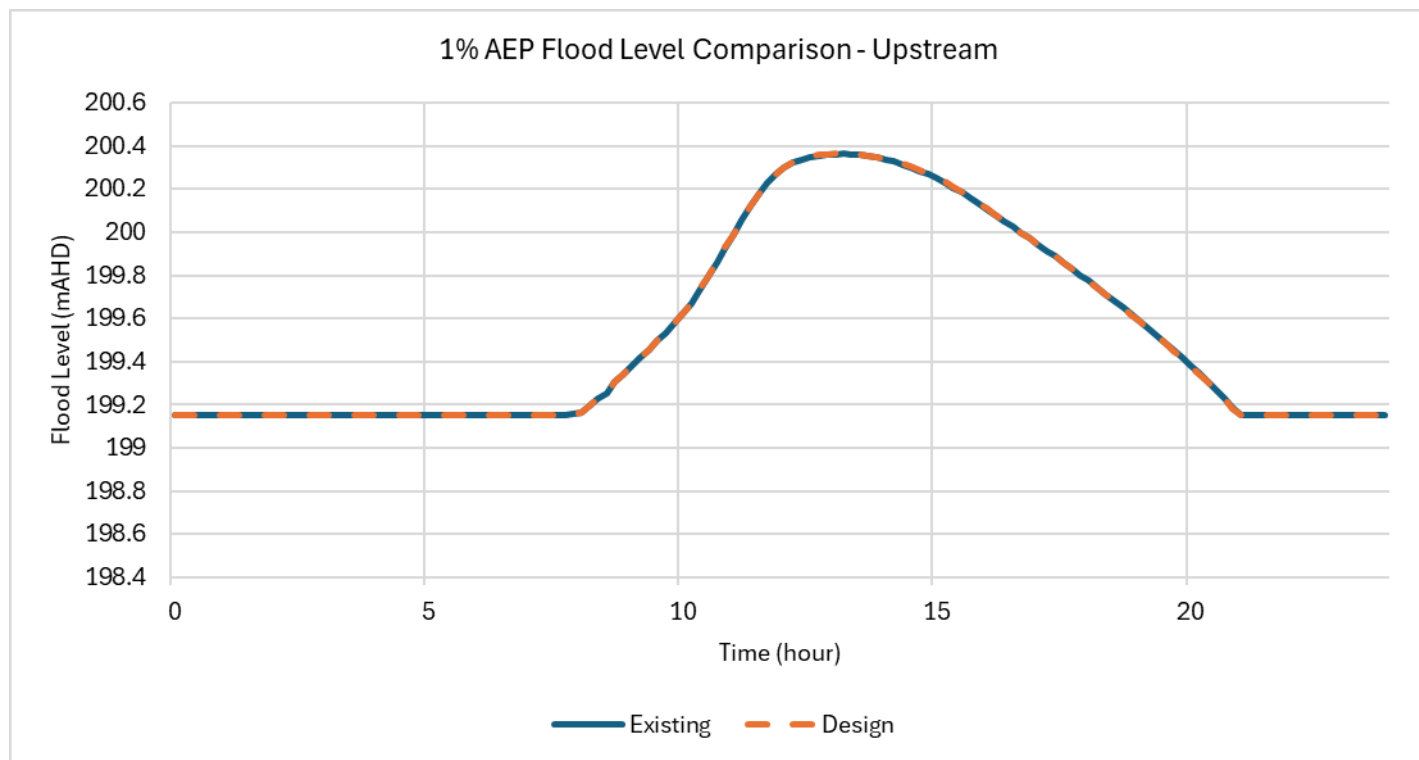


Figure 6-7: 1% AEP - Level vs Time - Upstream of the Site

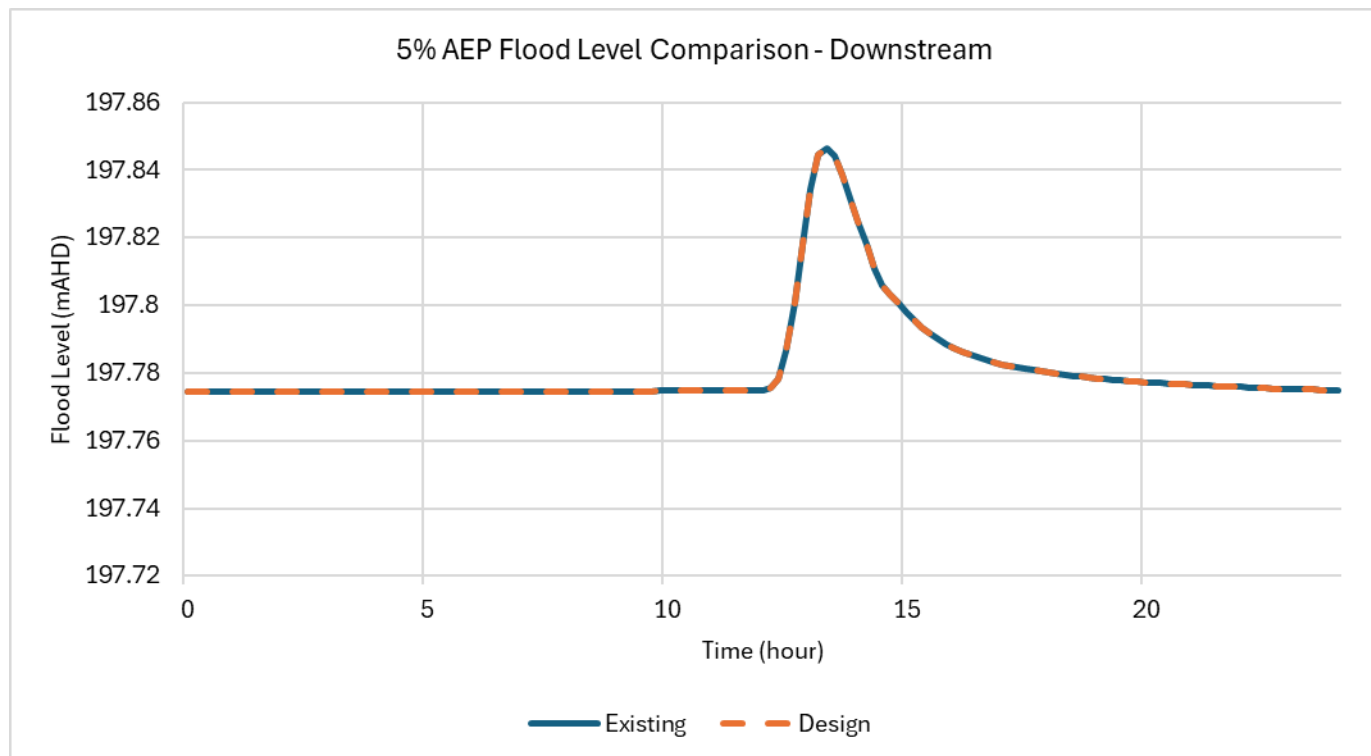


Figure 6-8: 5% AEP - Flood Level vs Time - Downstream of the Site

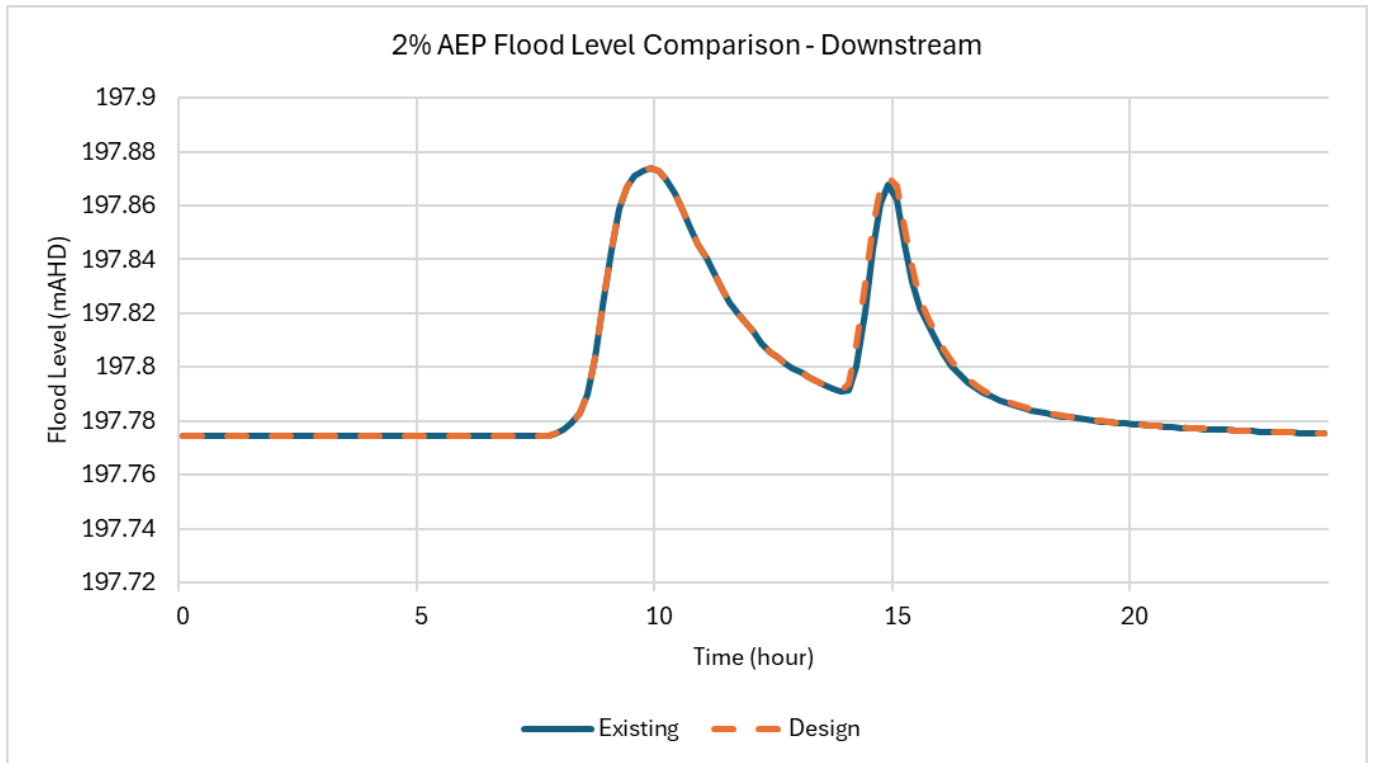


Figure 6-9: 2% AEP – Flood Level vs Time - Downstream of the Site

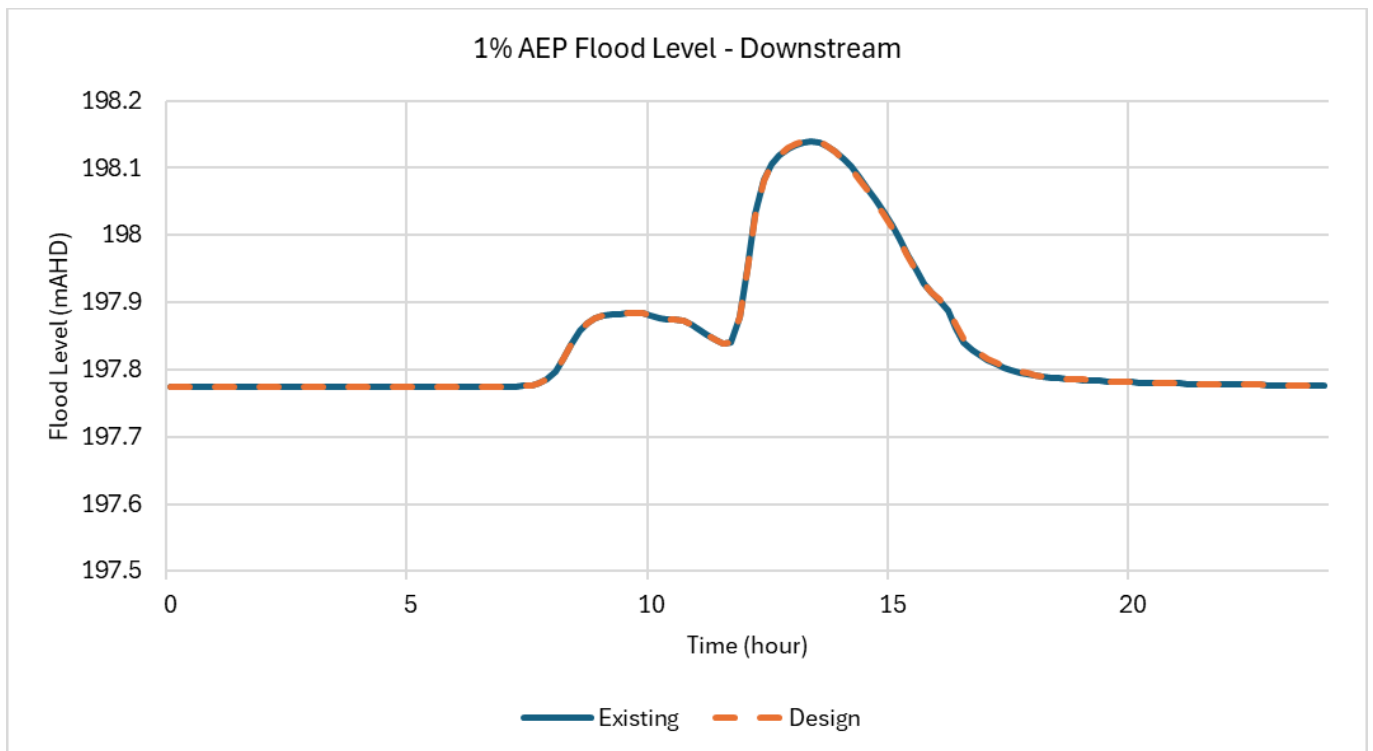


Figure 6-10: 1% AEP - Flood Level vs Time - Downstream of the Site

6.5 Sensitivity Test

6.5.1 Blockage Assessment

A hydraulic blockage assessment was carried out for the 1% AEP event for design conditions as per Book 6 Chapter 6 of ARR2019. The assessment involved assessing the site area for debris availability, mobility and transportability and this, in conjunction with culvert size was used to determine the relevant blockage factors shown in Table 6-22 and Table 6-23. Culverts within the project boundary are shown in Figure 6-11. A 20% blockage was adopted for all the other culverts, pits and pipes outside the project boundary.

The above methodology was adopted by considering the following items:

- ARR2019 does not require blockage assessments in all design runs. ARR Book 6 Sections 6.4.3 and 6.4.5 allow for an "All Clear" condition, when there is no long-term history of blockage at a particular structure. There is no reporting of long-term historical blockage around the site to cause major flooding risk. Therefore, only 1% AEP design was run as a sensitivity test.
- The approach matches the Environmental Impact Statement (EIS) report as per CoA Condition E40, ensuring consistency and reliability.
- For detailed information, please refer to 5-0052-210-IHY-99-ME-0001.

A flood level comparison between the blockage scenario and design conditions is presented in Figure 6-12. The overall flood behaviour is influenced by the blockage of bridges in Sandy Creek. This blockage caused an approximate 6mm increase in water levels, which then led to overflow along the tracks east of Sandy Creek. The overflow water results in up to 20mm of afflux downstream. Additionally, water levels increased by as much as 100mm around the northeast area of the project due to culvert blockage at Yarragundry Street. The flood incorporation of blockage makes minimal impact on the flood immunity on the rail line as the rail line is still overtopped in the 1% AEP event with a similar overtopping length to the non-blockage scenario.



Figure 6-11: Structures Location

Table 6-22: Structure Blockage Percentage

Drainage Component	Blockage Percentage (1% AEP)	Comments
Chainage 535+540km (5 cell/0.6m RCP)	25%	Inside the project boundary
Chainage 536+140km (1cell /0.9m RCP)	50%	Inside the project boundary
Railway Bridge (Chainage 536+180 km)	10%	Inside the project boundary
All other pits	20% (on grade pit), 50% (Sag pits)	Inside the project boundary
All others (culvert, pit and pipe)	20%	Outside of the project boundary
Bridge along Olympic Highway	20%	Outside of the project boundary

Table 6-23: Structure Blockage Parameters

Structure	Debris Availability	Debris Mobility	Debris Transportability	AEP Adjusted Debris Potential
Culverts (Inside project boundary)	Medium	Medium	Low	Low
Culvert (Chainage 535+540km)	Medium	Medium	Low	Low
Culvert (Chainage 536+140km)	Medium	Medium	High	Medium
Railway Bridge (Chainage 536+180km)	Medium	High	High	High

Note: L10 value of 1.0m was adopted for the site culverts blockage calculation

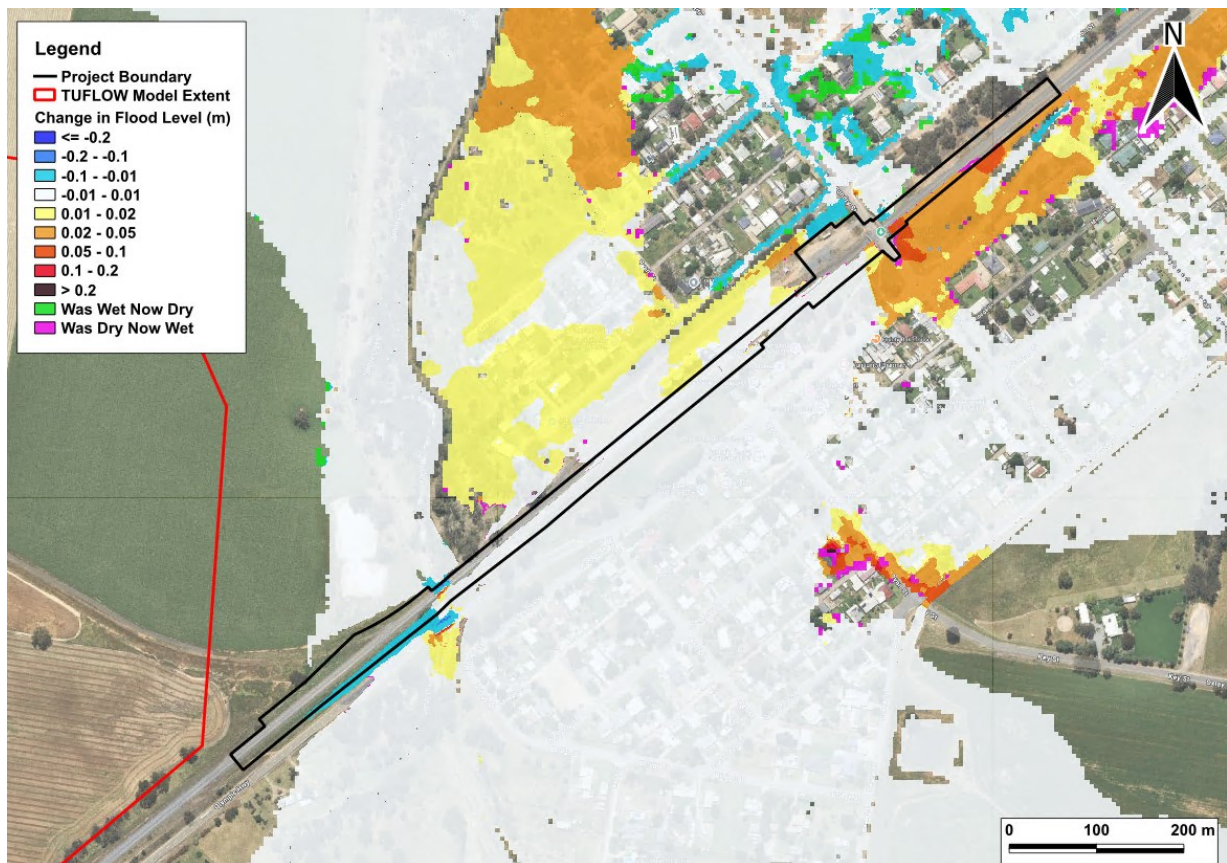


Figure 6-12: Flood Level Comparison for 1% AEP Design Condition - Blockage vs Design Conditions

6.5.2 Climate Change Risk Assessment

The received TLU FRMSP model did not include climate change flow scenarios for the 1% AEP + Year 2090 Representative Concentration Pathway (RCP) 8.5. The TUFLOW model was run for the 0.5% AEP and 0.2% AEP events to inform the climate change risk assessment with the following justification.

Based on the ARR DataHub, the interim climate change factors for the Year 2090 RCP 8.5 for Uranquinty are 20.2%. Table 6-24 summarises the design rainfall depth values for Uranquinty and shows that climate change values fall between the 0.5% AEP and 0.2% AEP events. Therefore, using 0.5% AEP (Climate Change Scenario 1) and 0.2% AEP (Climate Change Scenario 2) results to inform, the climate change risk assessment was considered appropriate.

Table 6-24: ARR DataHub Design Rainfall Depth for Uranquinty

Duration (hour)	Design Rainfall Depth (mm)			
	1% AEP	0.5% AEP (Climate Change Scenario 1)	1% AEP + 20.2%	0.2% AEP (Climate Change Scenario 2)
1.0	53.80	60.60	64.67	69.10
1.5	59.80	67.30	71.88	76.80
2.0	64.00	72.00	76.93	82.20
3.0	70.10	79.00	84.26	90.20
4.5	76.60	86.50	92.07	98.90
6.0	81.60	92.30	98.08	106.00
9.0	89.40	101.00	107.46	116.00
12.0	95.60	108.00	114.91	124.00
18.0	105.00	119.00	126.21	136.00

The results of flood depth, flood velocity and flood hazard can be found in Section 6.1 and Section 6.2. The corresponding flood maps can be found in Appendix A. The assessment is summarised below:

- The floodwaters from 0.5% and 0.2% AEP events overtop the railway like the 1% AEP event, however the length of the rail that is overtopped, is decreased:
 - 0.5% AEP: overtopping length decreased by 10m to the west (was 363m, now 353m)
 - 0.2% AEP: overtopping length decreased by 30m to the west (was 415m, now 395m)

7 MITIGATION MEASURES

No instances of non-compliance in terms of flood impact were documented. Therefore, no additional mitigation measures are necessary at this IFC stage.

8 RECOMMENDATIONS AND NEXT STAGE

This is the IFC stage of the report, and the following are finalised:

- No instances of non-compliance have been identified through the assessment.
- All comments raised by relevant parties have been resolved (refer to Appendices B, C and D)

Consequently, there are no further recommendations.

APPENDIX A

Flood Maps



Table A- 1: List of Maps in Appendix A

Map ID	Map description
Figure A1	5% AEP Peak Flood Depth and Levels - Existing Condition
Figure A2	2% AEP Peak Flood Depth and Levels - Existing Condition
Figure A3	1% AEP Peak Flood Depth and Levels - Existing Condition
Figure A4	0.5% AEP (Climate Change Scenario 1) Peak Flood Depth and Levels - Existing Condition
Figure A5	0.2% AEP (Climate Change Scenario 2) Peak Flood Depth and Levels - Existing Condition
Figure A6	PMF Peak Flood Depth and Levels - Existing Condition
Figure A7	5% AEP Peak Flood Velocity - Existing Condition
Figure A8	2% AEP Peak Flood Velocity - Existing Condition
Figure A9	1% AEP Peak Flood Velocity - Existing Condition
Figure A10	0.5% AEP (Climate Change Scenario 1) Peak Flood Velocity - Existing Condition
Figure A11	0.2% AEP (Climate Change Scenario 2) Peak Flood Velocity - Existing Condition
Figure A12	PMF Peak Flood Velocity - Existing Condition
Figure A13	5% AEP Peak Flood Hazard - Existing Condition
Figure A14	2% AEP Peak Flood Hazard - Existing Condition
Figure A15	1% AEP Peak Flood Hazard - Existing Condition
Figure A16	0.5% AEP (Climate Change Scenario 1) Peak Flood Hazard - Existing Condition
Figure A17	0.2% AEP (Climate Change Scenario 2) Peak Flood Hazard - Existing Condition
Figure A18	PMF Peak Flood Hazard - Existing Condition
Figure A19	5% AEP Peak Flood Depth and Levels - Design Condition
Figure A20	2% AEP Peak Flood Depth and Levels - Design Condition
Figure A21	1% AEP Peak Flood Depth and Levels - Design Condition
Figure A22	0.5% AEP (Climate Change Scenario 1) Peak Flood Depth and Levels - Design Condition
Figure A23	0.2% AEP (Climate Change Scenario 2) Peak Flood Depth and Levels - Design Condition
Figure A24	PMF Peak Flood Depth and Levels - Design Condition
Figure A25	5% AEP Peak Flood Velocity - Design Condition
Figure A26	2% AEP Peak Flood Velocity - Design Condition
Figure A27	1% AEP Peak Flood Velocity - Design Condition
Figure A28	0.5% AEP (Climate Change Scenario 1) Peak Flood Velocity - Design Condition
Figure A29	0.2% AEP (Climate Change Scenario 2) Peak Flood Velocity - Design Condition
Figure A30	PMF Peak Flood Velocity - Design Condition
Figure A31	5% AEP Peak Flood Hazard - Design Condition
Figure A32	2% AEP Peak Flood Hazard - Design Condition
Figure A33	1% AEP Peak Flood Hazard - Design Condition
Figure A34	0.5% AEP (Climate Change Scenario 1) Peak Flood Hazard - Design Condition
Figure A35	0.2% AEP (Climate Change Scenario 2) Peak Flood Hazard - Design Condition
Figure A36	PMF Peak Flood Hazard - Design Condition
Figure A37	5% AEP Changes in Peak Flood Levels - Design Condition vs Existing Condition
Figure A38	2% AEP Changes in Peak Flood Levels - Design Condition vs Existing Condition
Figure A39	1% AEP Changes in Peak Flood Levels - Design Condition vs Existing Condition

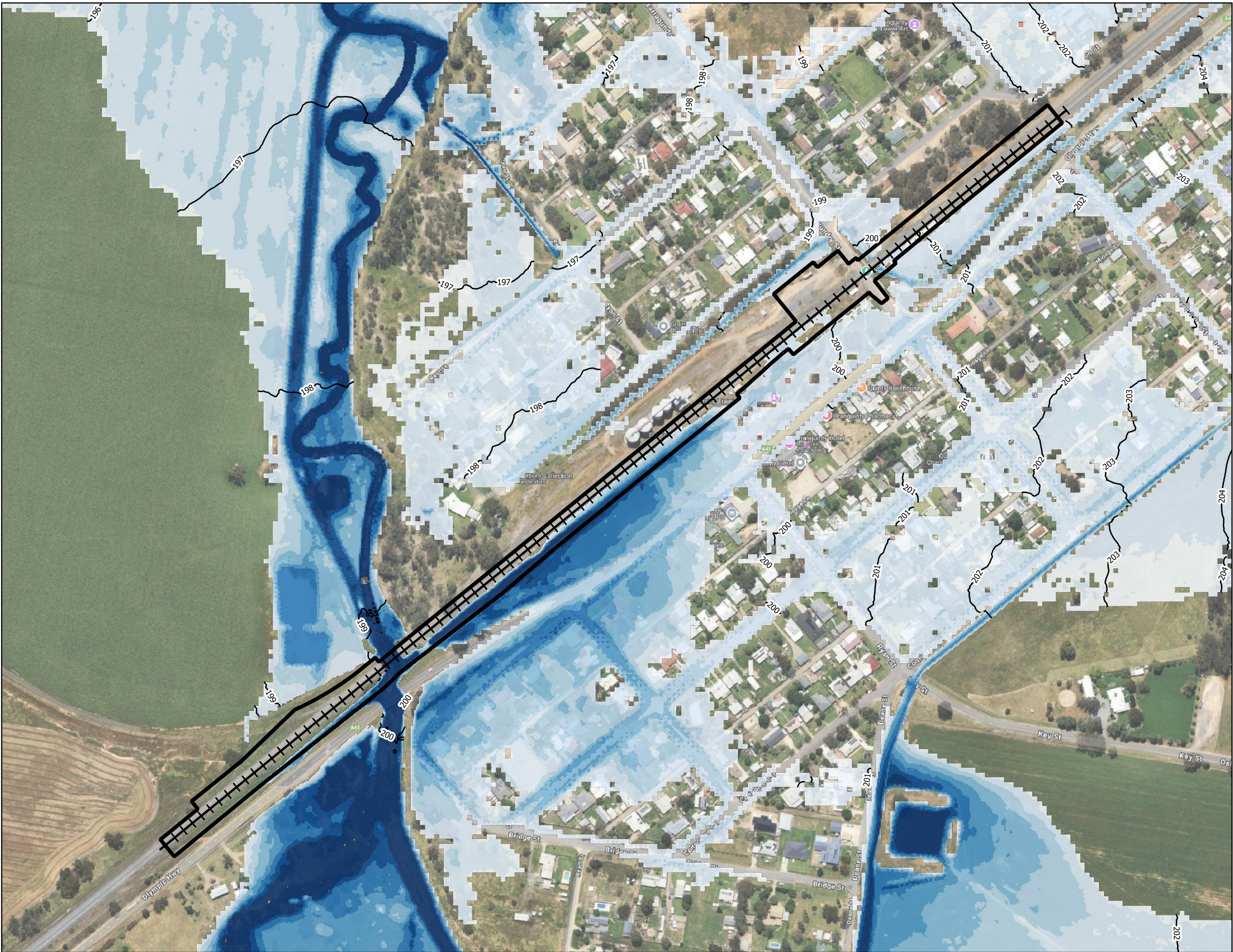
Map ID	Map description
Figure A40	0.5% AEP (Climate Change Scenario 1) Changes in Peak Flood Levels - Design Condition vs Existing
Figure A41	0.2% AEP (Climate Change Scenario 2) Changes in Peak Flood Levels - Design Condition vs Existing
Figure A42	5% AEP Changes in Peak Flood Velocity - Design Condition vs Existing Condition
Figure A43	2% AEP Changes in Peak Flood Velocity - Design Condition vs Existing Condition
Figure A44	1% AEP Changes in Peak Flood Velocity - Design Condition vs Existing Condition
Figure A45	0.5% AEP (Climate Change Scenario 1) Changes in Peak Flood Velocity - Design Condition vs Existing
Figure A46	0.2% AEP (Climate Change Scenario 2) Changes in Peak Flood Velocity - Design Condition vs Existing
Figure A47	5% AEP Changes in Peak Flood Hazard - Design Condition vs Existing Condition
Figure A48	2% AEP Changes in Peak Flood Hazard - Design Condition vs Existing Condition
Figure A49	1% AEP Changes in Peak Flood Hazard - Design Condition vs Existing Condition
Figure A50	0.5% AEP (Climate Change Scenario 1) Changes in Peak Flood Hazard - Design Condition vs Existing
Figure A51	0.2% AEP (Climate Change Scenario 2) Changes in Peak Flood Hazard - Design Condition vs Existing
Figure A52	1% AEP Peak Flood Depth and Levels - Blockage Assessment
Figure A53	1% AEP Peak Flood Velocity - Blockage Assessment
Figure A54	1% AEP Peak Flood Hazard - Blockage Assessment

Legend

- Project Boundary
- Existing Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

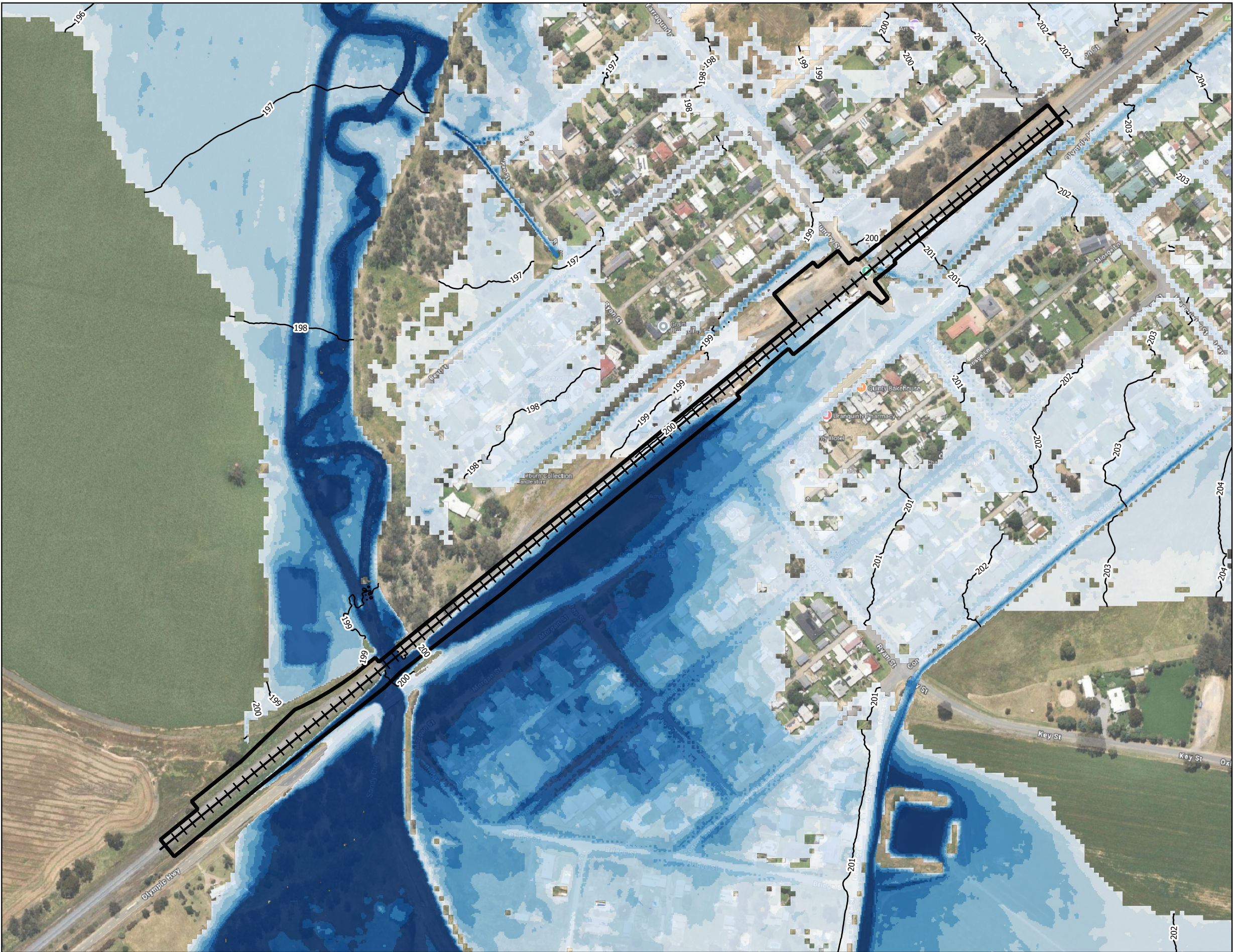
Figure A1 : 5% AEP Peak Flood Depth and Levels - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

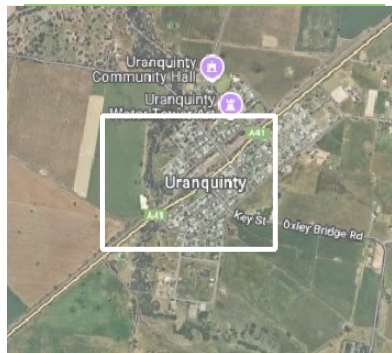
A3 Scale: 1:4,000,000,000

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A2 : 2% AEP Peak Flood Depth and Levels - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

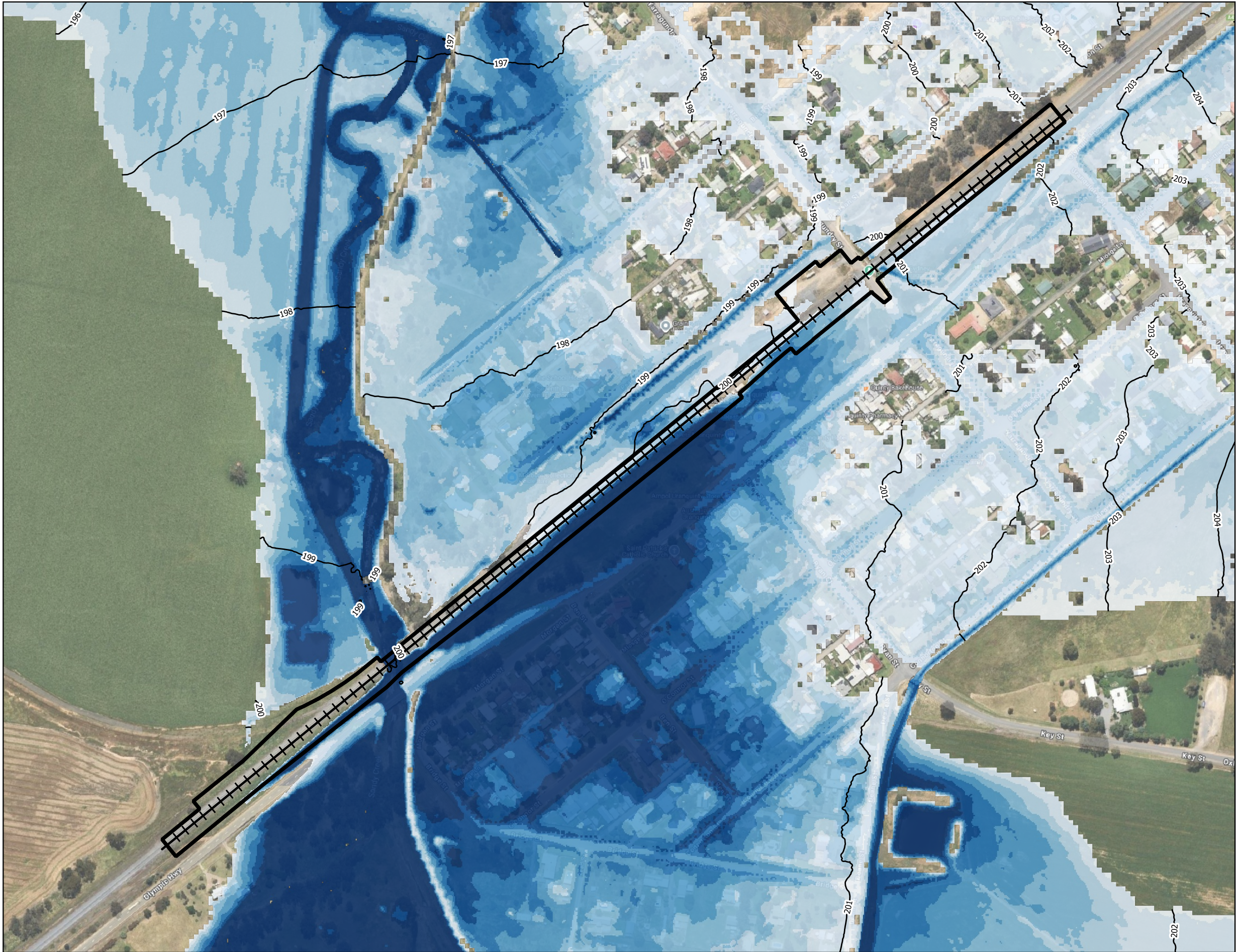
Figure A3 : 1% AEP Peak Flood Depth and Levels - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:



Map by: TT



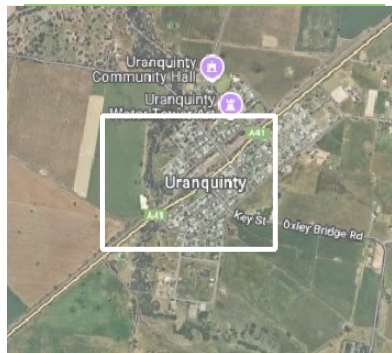
0 160 320 m
A3 Scale: 1:4,000,000,000
7/8/2025 MGA 55

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

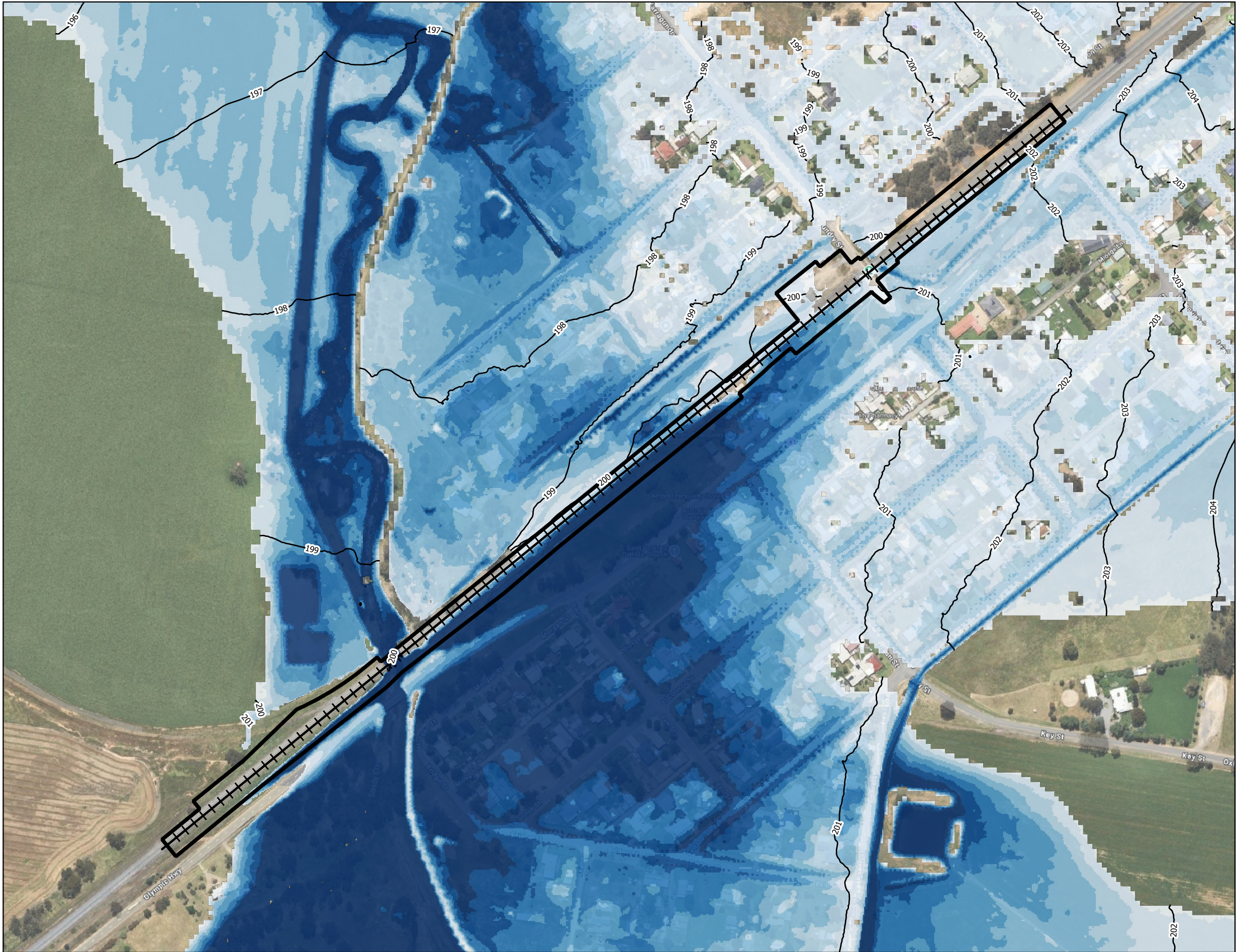
Figure A4 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Depth and Levels - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:



Map by: TT



0 160 320 m
7/8/2025 MGA 55
A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A5 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Depth and Levels - Existing Condition

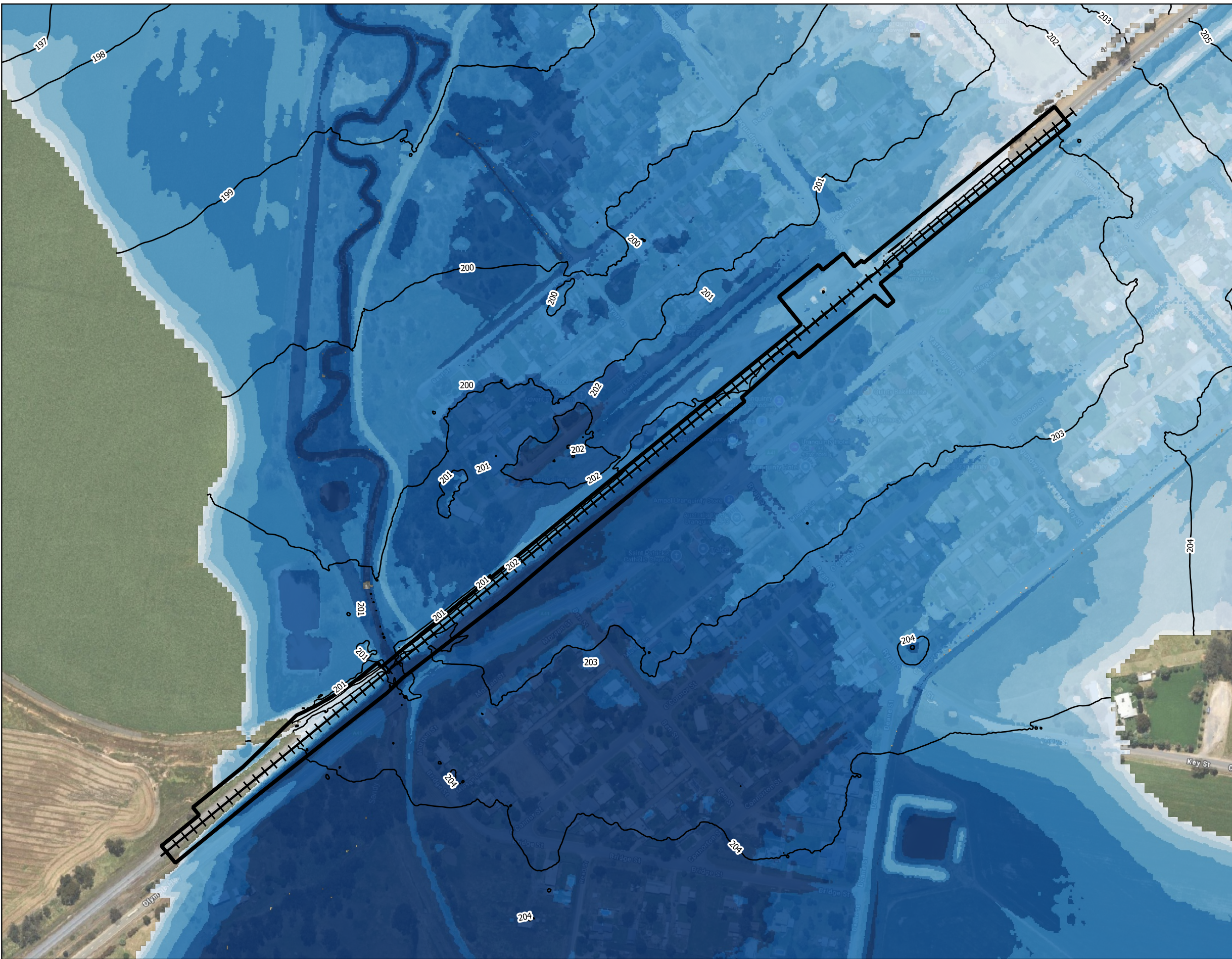
Legend

-  Project Boundary
-  Existing Railway
-  Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 -  ≤ 0.05
 -  0.05 - 0.25
 -  0.25 - 0.50
 -  0.50 - 1.00
 -  1.00 - 2.00
 -  2.00 - 3.00
 -  3.00 - 4.00
 -  > 4.00



Notes:

Map by: TT



0 160 320 m
 A3 Scale: 1:4,000,000,000
 7/8/2025 MGA 55

Uranquinty Yard - Inland Rail (A2P) - IFC Stage
Figure A6 : PMF Peak Flood Depth and Levels - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Velocity (m/s)
 - <= 0.25
 - 0.25 - 0.50
 - 0.50 - 0.75
 - 0.75 - 1.00
 - 1.00 - 1.50
 - 1.50 - 2.00
 - 2.00 - 2.50
 - 2.50 - 3.00
 - > 3.00



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage
Figure A7 : 5% AEP Peak Flood Velocity - Existing Condition

Legend

— Project Boundary

⊢ Existing Railway

Peak Flood Velocity (m/s)

≤ 0.25

0.25 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

2.50 - 3.00

> 3.00



Notes:

Map by: TT



0 160 320 m

7/8/2025

MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A8 : 2% AEP Peak Flood Velocity - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Velocity (m/s)
 - <= 0.25
 - 0.25 - 0.50
 - 0.50 - 0.75
 - 0.75 - 1.00
 - 1.00 - 1.50
 - 1.50 - 2.00
 - 2.00 - 2.50
 - 2.50 - 3.00
 - > 3.00



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage
Figure A9 : 1% AEP Peak Flood Velocity - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Velocity (m/s)
 - <= 0.25
 - 0.25 - 0.50
 - 0.50 - 0.75
 - 0.75 - 1.00
 - 1.00 - 1.50
 - 1.50 - 2.00
 - 2.00 - 2.50
 - 2.50 - 3.00
 - > 3.00



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A10 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Velocity - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Velocity (m/s)
 - <= 0.25
 - 0.25 - 0.50
 - 0.50 - 0.75
 - 0.75 - 1.00
 - 1.00 - 1.50
 - 1.50 - 2.00
 - 2.00 - 2.50
 - 2.50 - 3.00
 - > 3.00



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A11 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Velocity - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Velocity (m/s)
 - <= 0.25
 - 0.25 - 0.50
 - 0.50 - 0.75
 - 0.75 - 1.00
 - 1.00 - 1.50
 - 1.50 - 2.00
 - 2.00 - 2.50
 - 2.50 - 3.00
 - > 3.00



Notes:

Map by: TT



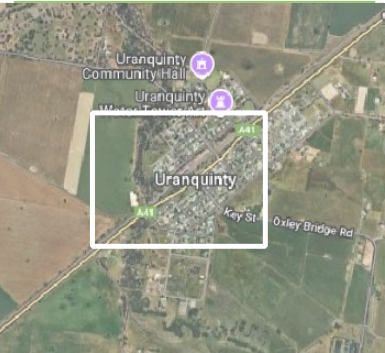
0 160 320 m
A3 Scale: 1:4,000.000004
7/8/2025 MGA 55

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A12 : PMF Peak Flood Velocity - Existing Condition

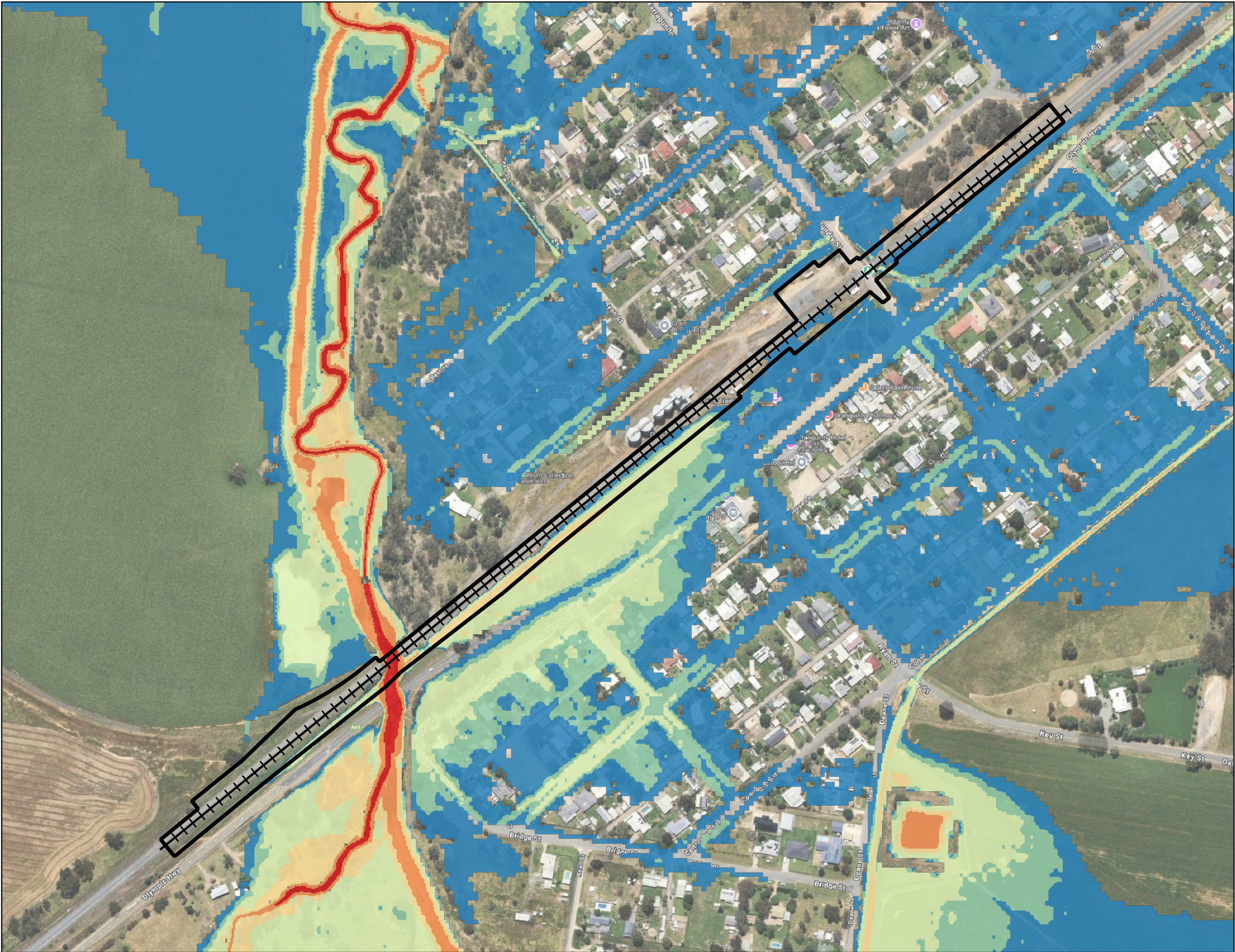
Legend

- Project Boundary
- Existing Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55

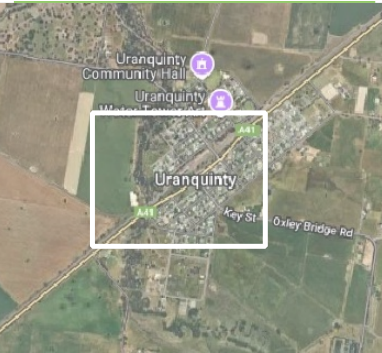
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

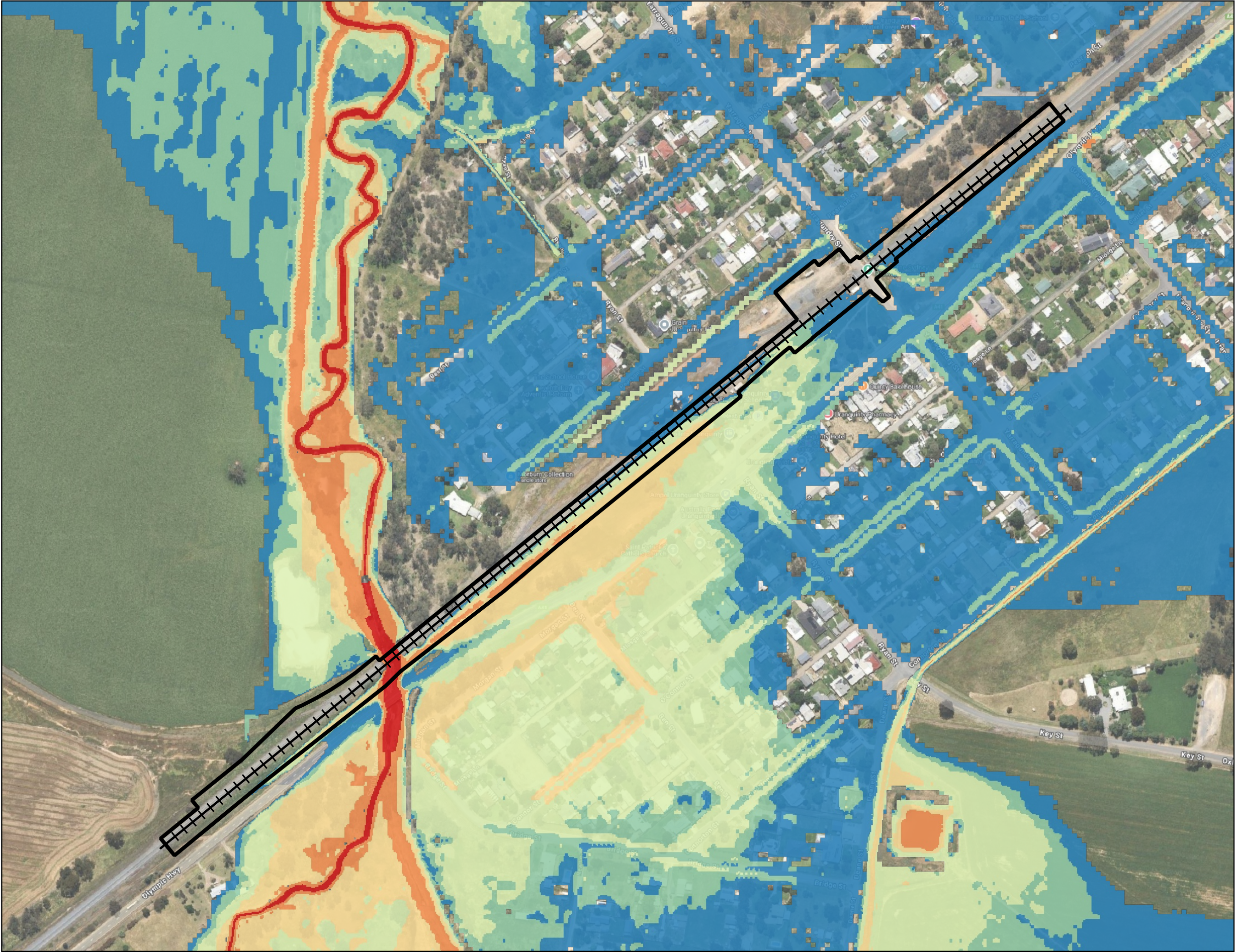
Figure A13 : 5% AEP Peak Flood Hazard - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

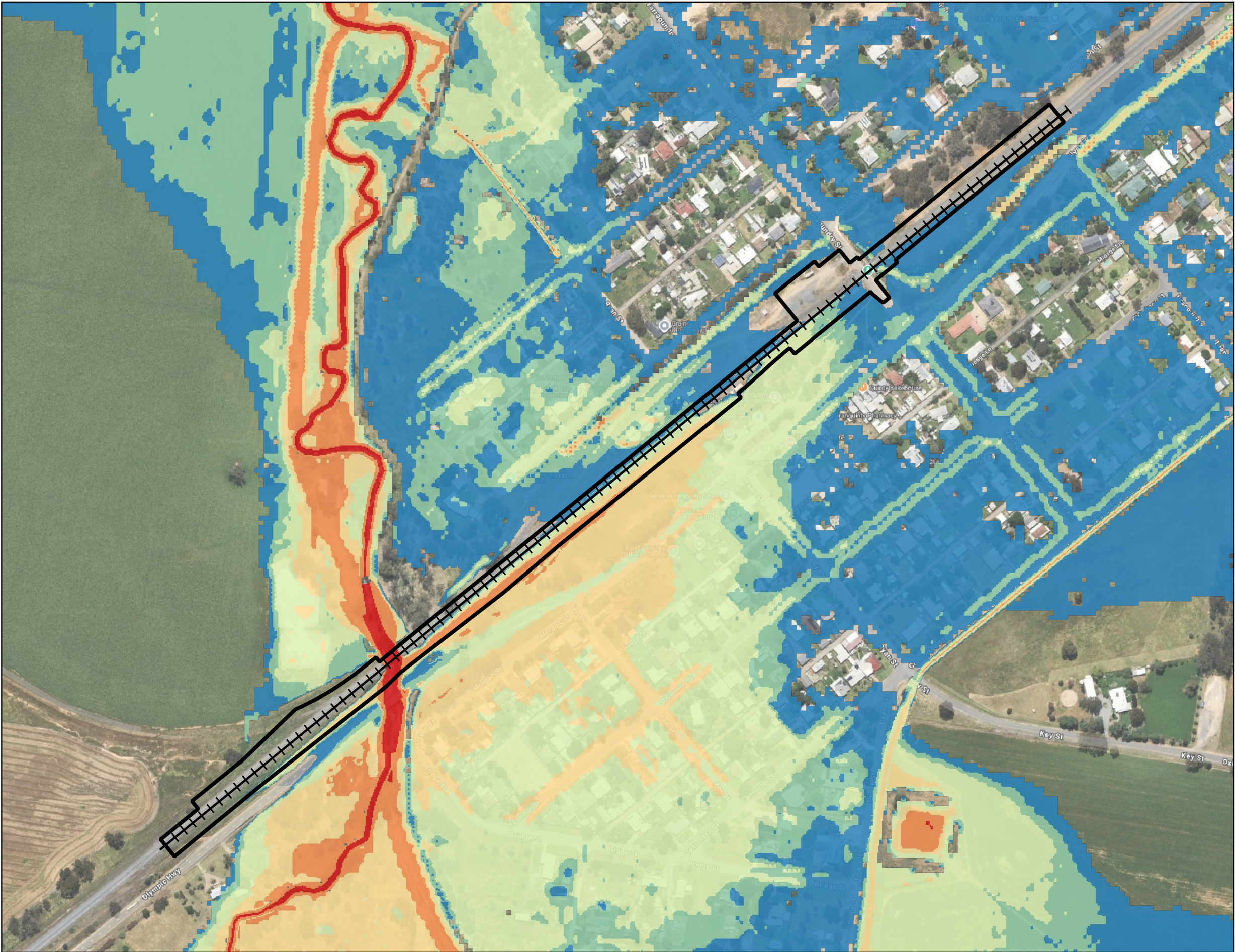
Figure A14 : 2% AEP Peak Flood Hazard - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

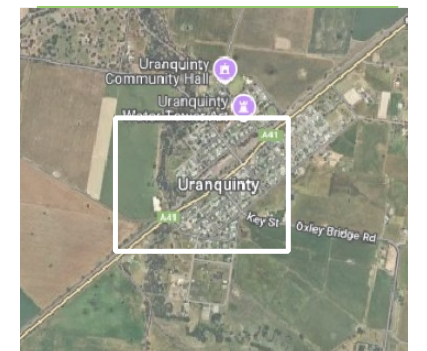
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A15 : 1% AEP Peak Flood Hazard - Existing Condition

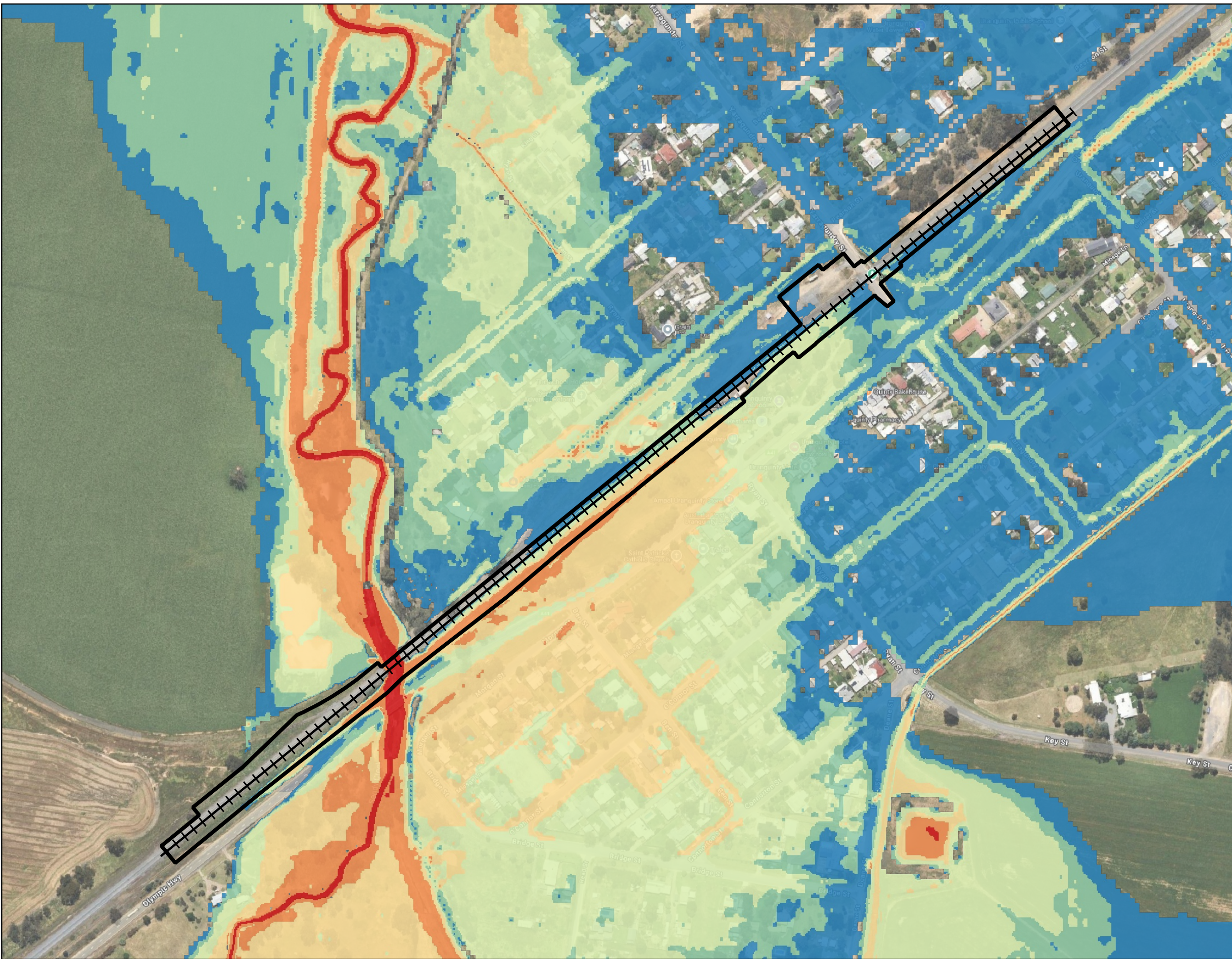
Legend

- Project Boundary
- ⊥ Existing Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

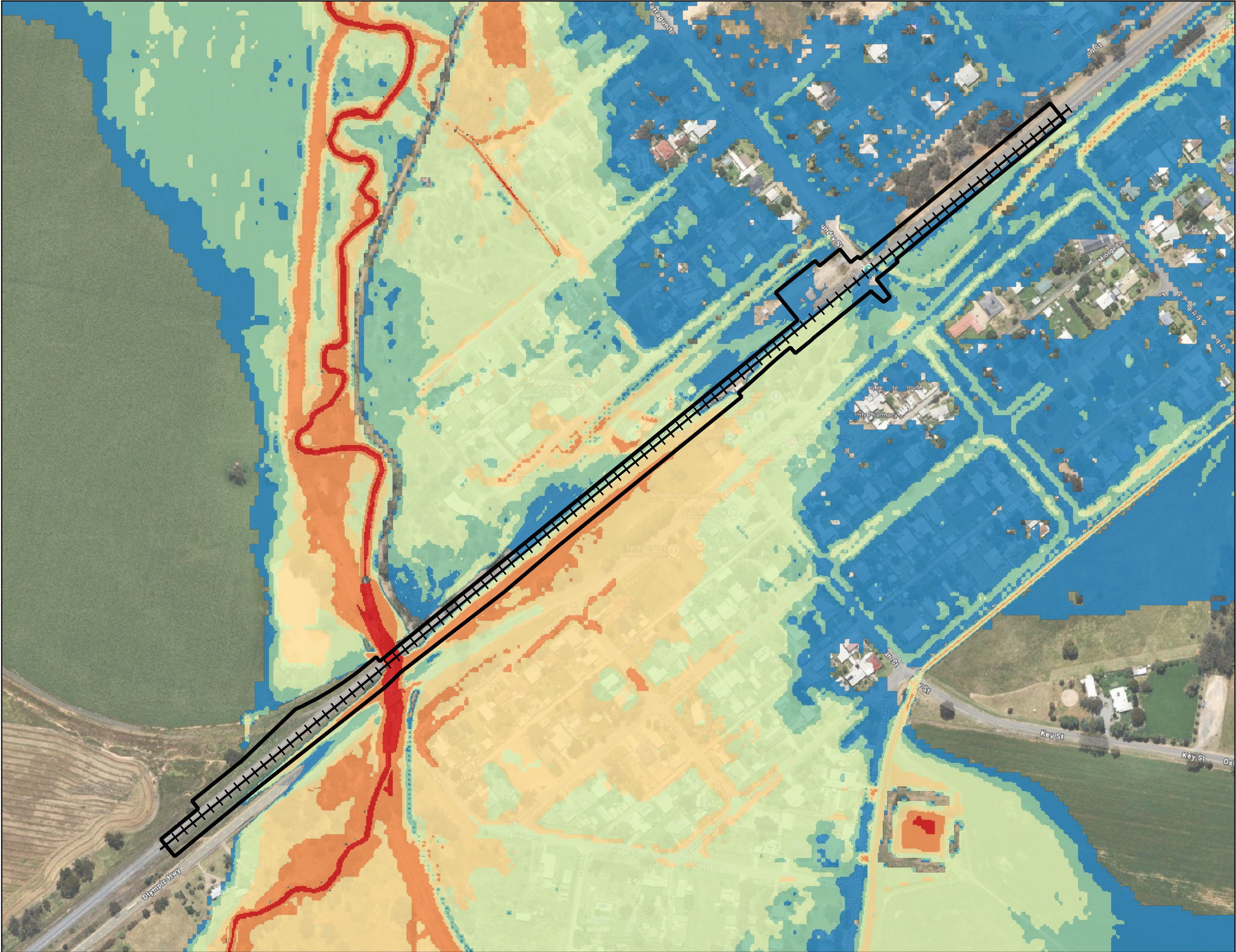
Figure A16 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Hazard - Existing Condition

Legend

- Project Boundary
- Existing Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:



Map by: TT



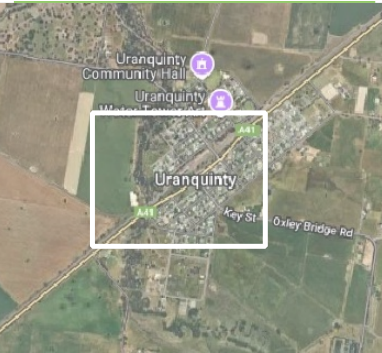
0 160 320 m
7/8/2025 MGA 55
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A17 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Hazard - Existing Condition

Legend

- Project Boundary
- ⊢ Existing Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:

Map by: TT



0 160 320 m
A3 Scale: 1:4,000,000004
7/8/2025 MGA 55

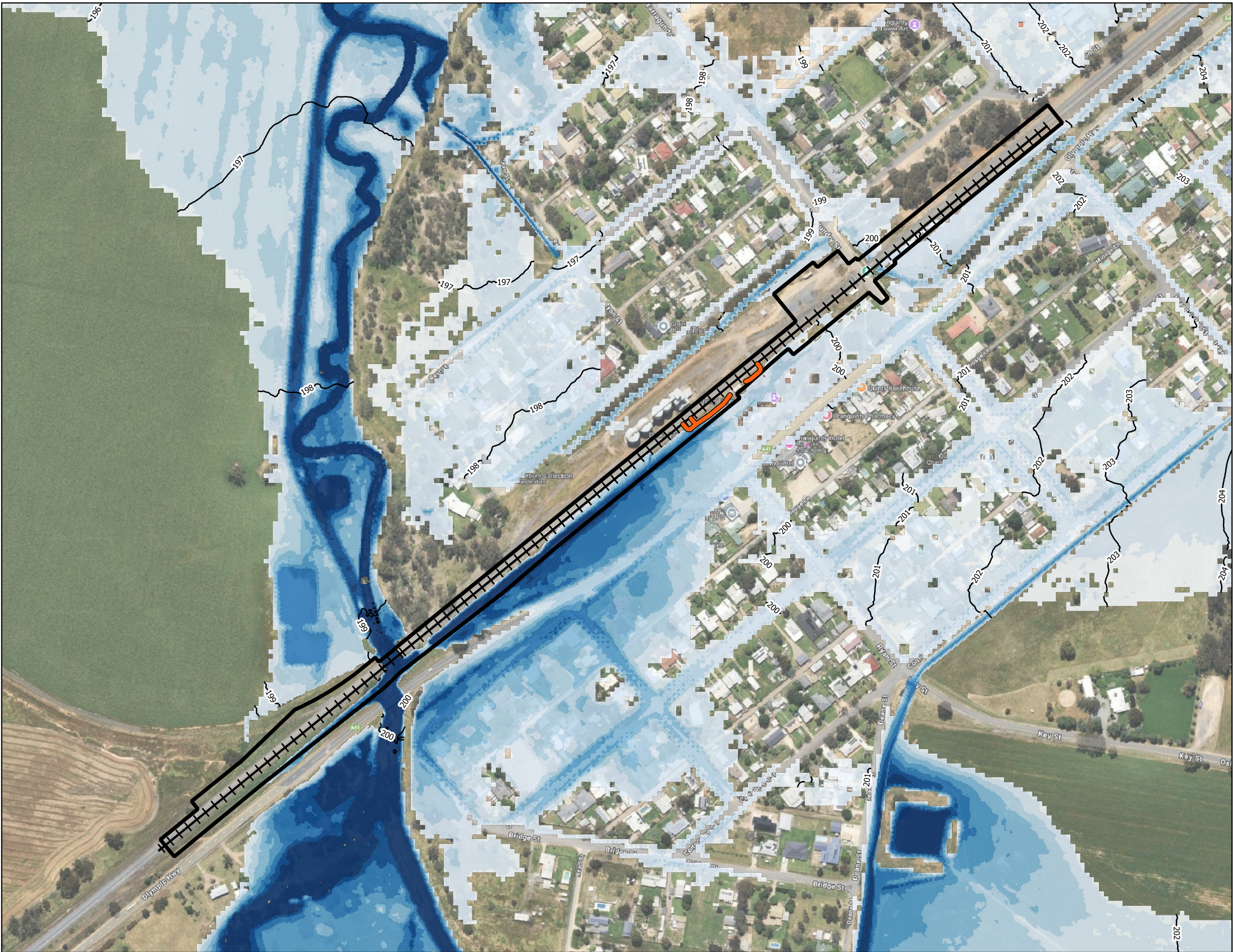
Uranquinty Yard - Inland Rail (A2P) - IFC Stage
Figure A18 : PMF Peak Flood Hazard - Existing Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:



Map by: TT



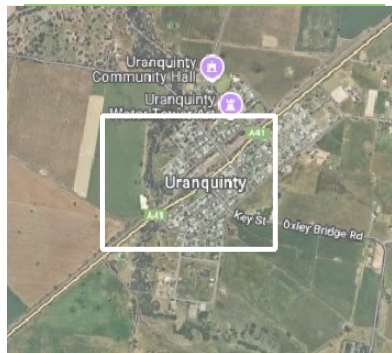
0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

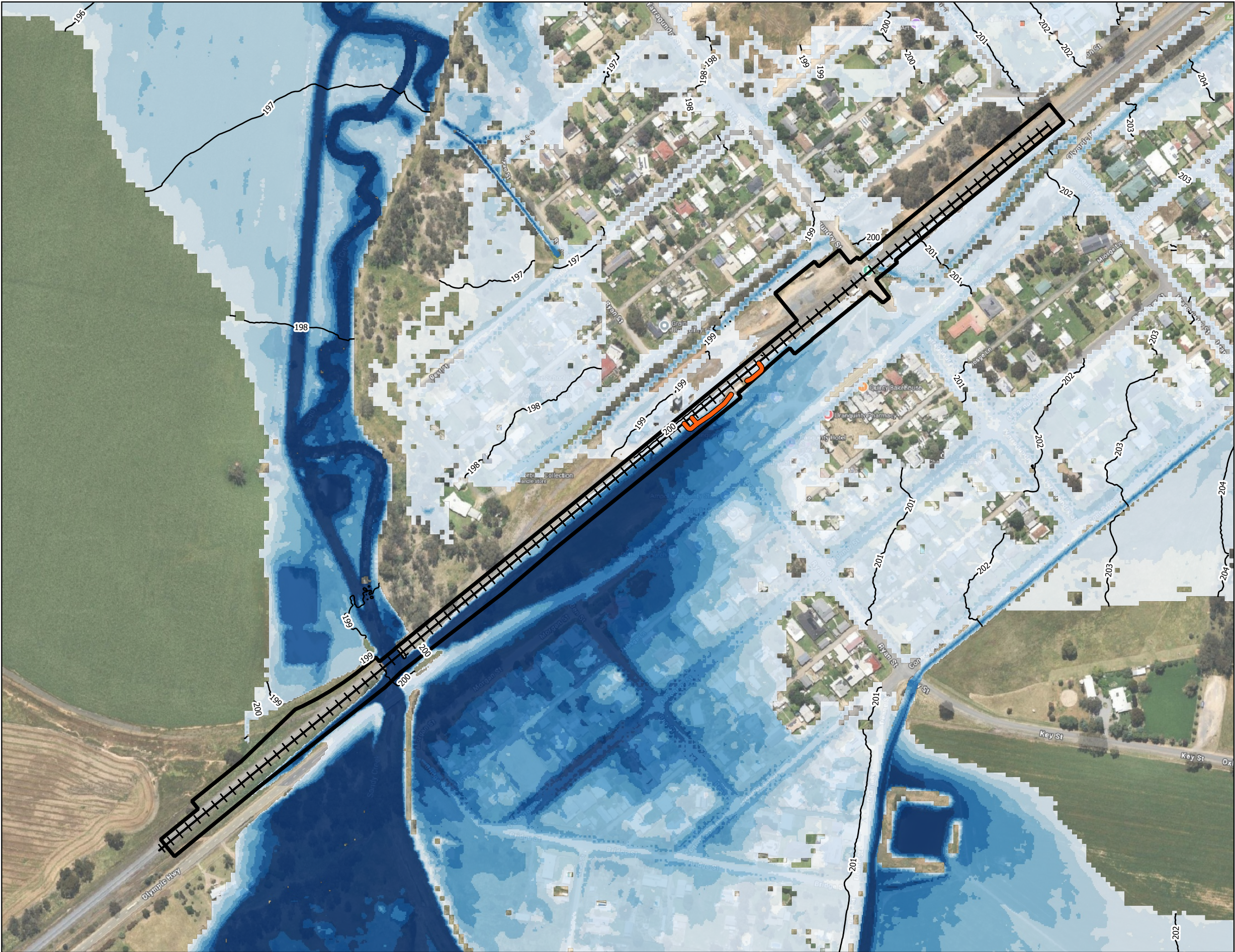
Figure A19 : 5% AEP Peak Flood Depth and Levels - Design Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:



Map by: TT



0 160 320 m
A3 Scale: 1:4,000,000,000

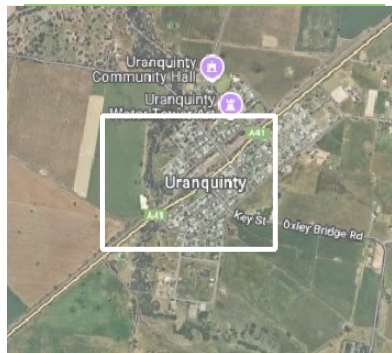
7/8/2025 MGA 55

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A20 : 2% AEP Peak Flood Depth and Levels - Design Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:

Map by: TT



0 160 320 m

A3 Scale: 1:4,000,000004

7/8/2025 MGA 55

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

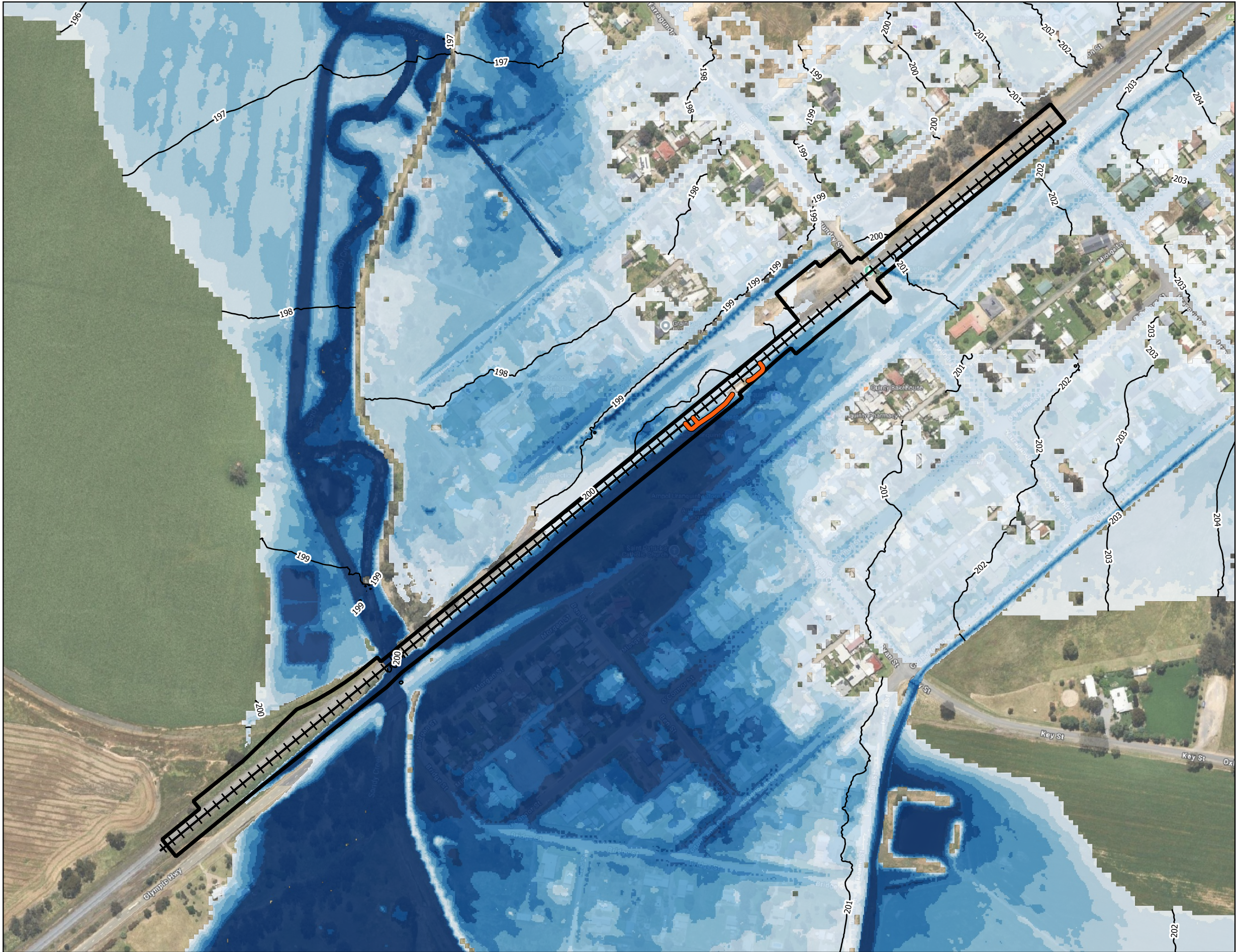
Figure A21 : 1% AEP Peak Flood Depth and Levels - Design Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

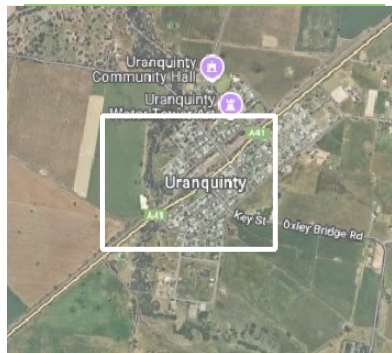
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

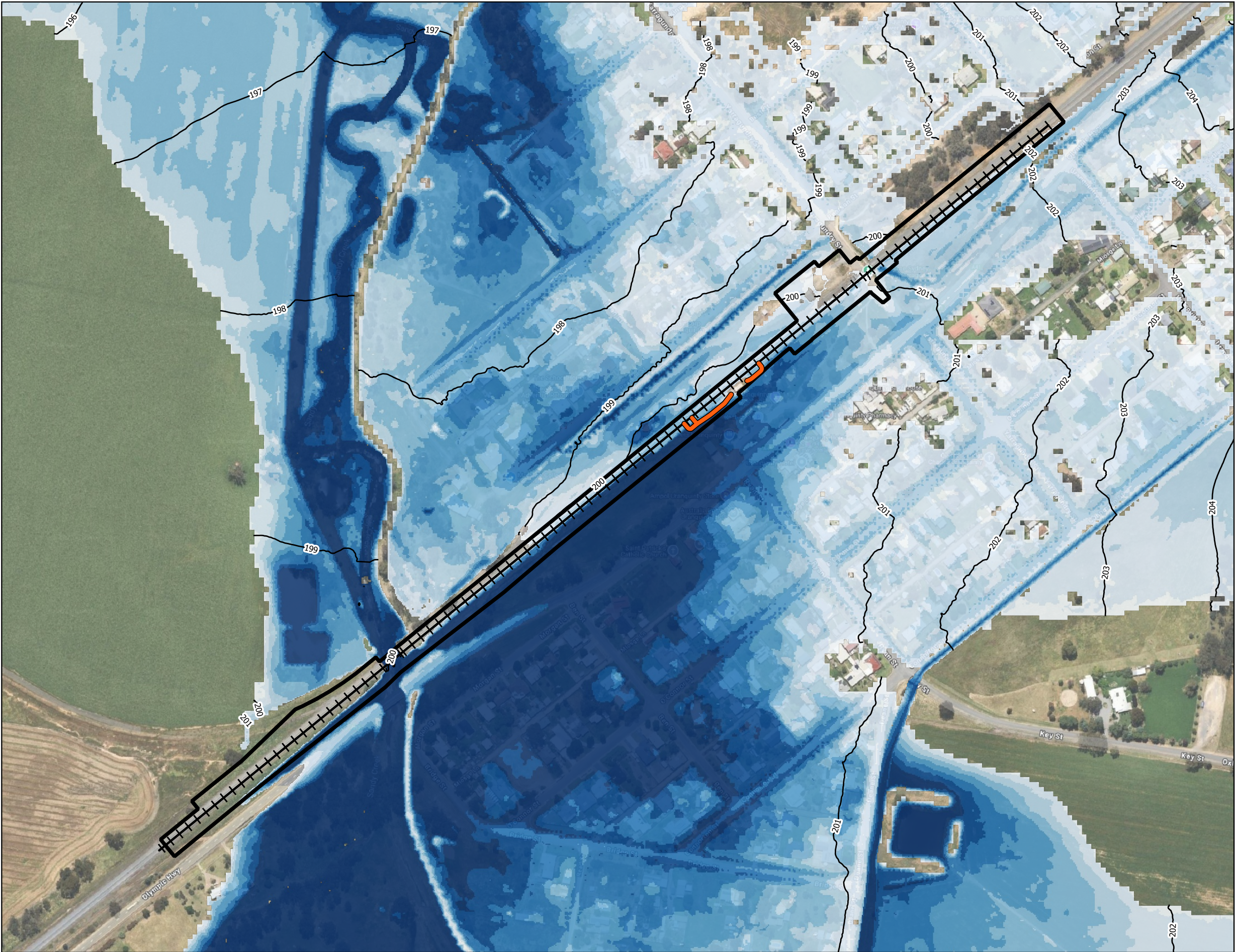
Figure A22 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Depth and Levels - Design Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A23 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Depth and Levels - Design Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:

Map by: TT



0 160 320 m

A3 Scale: 1:4,000,000004

7/8/2025 MGA 55

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A24 : PMF Peak Flood Depth and Levels - Design Condition

Legend

— Project Boundary

— Proposed Bund

+ Design Railway

Peak Flood Velocity (m/s)

<= 0.25

0.25 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

2.50 - 3.00

> 3.00



Notes:

Map by: TT



0 160 320 m

7/8/2025

MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A25 : 5% AEP Peak Flood Velocity - Design Condition

Legend

— Project Boundary

— Proposed Bund

+ Design Railway

Peak Flood Velocity (m/s)

<= 0.25

0.25 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

2.50 - 3.00

> 3.00



Notes:

Map by: TT



0 160 320 m

7/8/2025

MGA 55

A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A26 : 2% AEP Peak Flood Velocity - Design Condition

Legend

— Project Boundary

— Proposed Bund

+ Design Railway

Peak Flood Velocity (m/s)

<= 0.25

0.25 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

2.50 - 3.00

> 3.00



Notes:

Map by: TT



0 160 320 m

7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A27 : 1% AEP Peak Flood Velocity - Design Condition

Legend

— Project Boundary

— Proposed Bund

+ Design Railway

Peak Flood Velocity (m/s)

<= 0.25

0.25 - 0.50

0.50 - 0.75

0.75 - 1.00

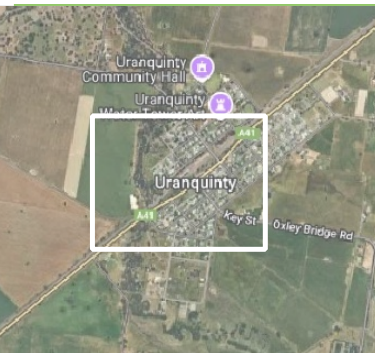
1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

2.50 - 3.00

> 3.00



Notes:

Map by: TT



0 160 320 m

7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A28 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Velocity - Design Condition

Legend

— Project Boundary

— Proposed Bund

+ Design Railway

Peak Flood Velocity (m/s)

<= 0.25

0.25 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

2.50 - 3.00

> 3.00



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A29 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Velocity - Design Condition

Legend

— Project Boundary

— Proposed Bund

+ Design Railway

Peak Flood Velocity (m/s)

<= 0.25

0.25 - 0.50

0.50 - 0.75

0.75 - 1.00

1.00 - 1.50

1.50 - 2.00

2.00 - 2.50

2.50 - 3.00

> 3.00



Notes:

Map by: TT



0 160 320 m

A3 Scale: 1:4,000.000004

7/8/2025 MGA 55

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A30 : PMF Peak Flood Velocity - Design Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:

Map by: TT



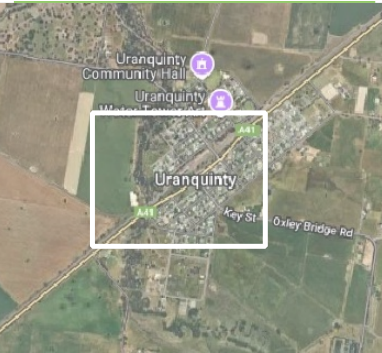
0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

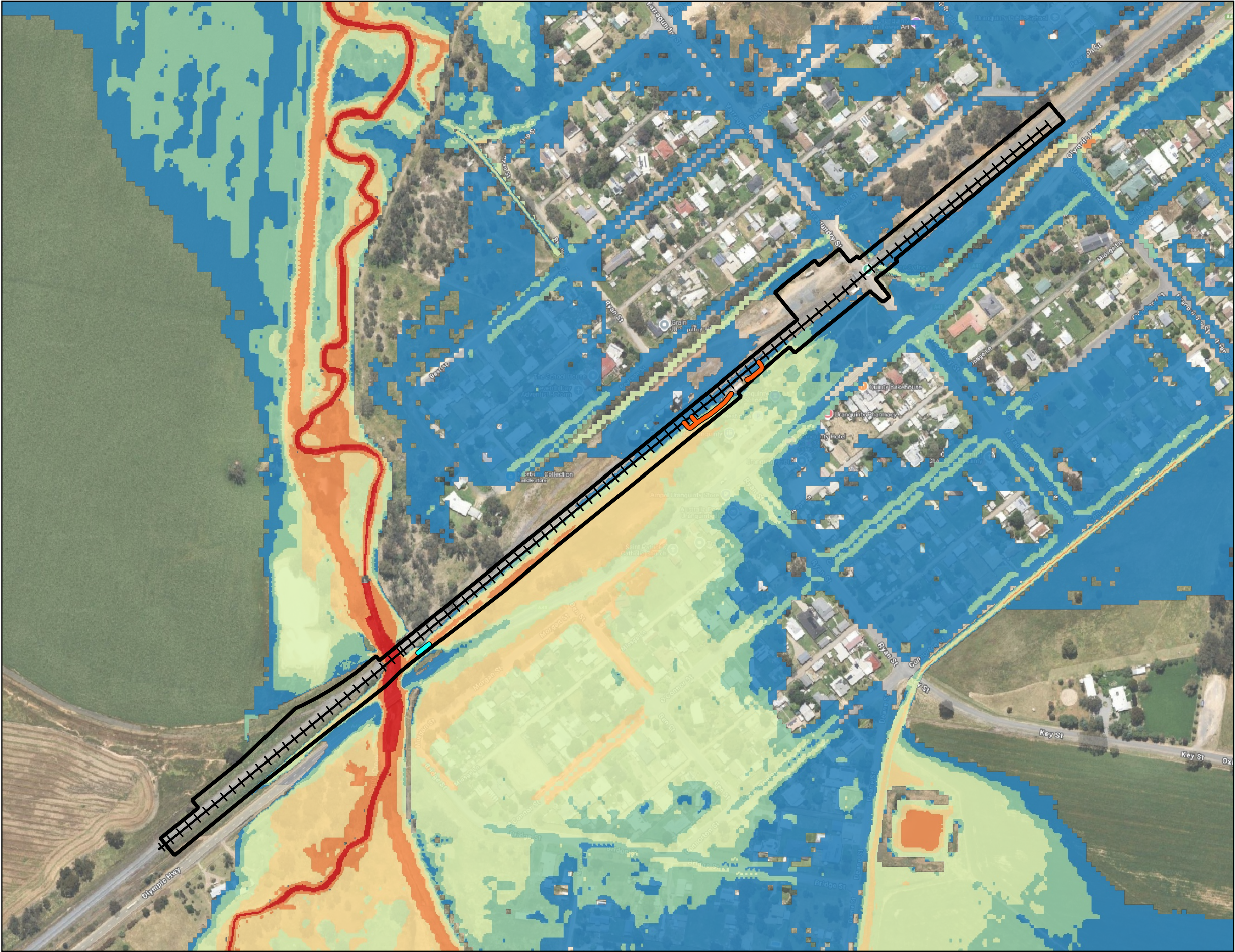
Figure A31 : 5% AEP Peak Flood Hazard - Design Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage
Figure A32 : 2% AEP Peak Flood Hazard - Design Condition

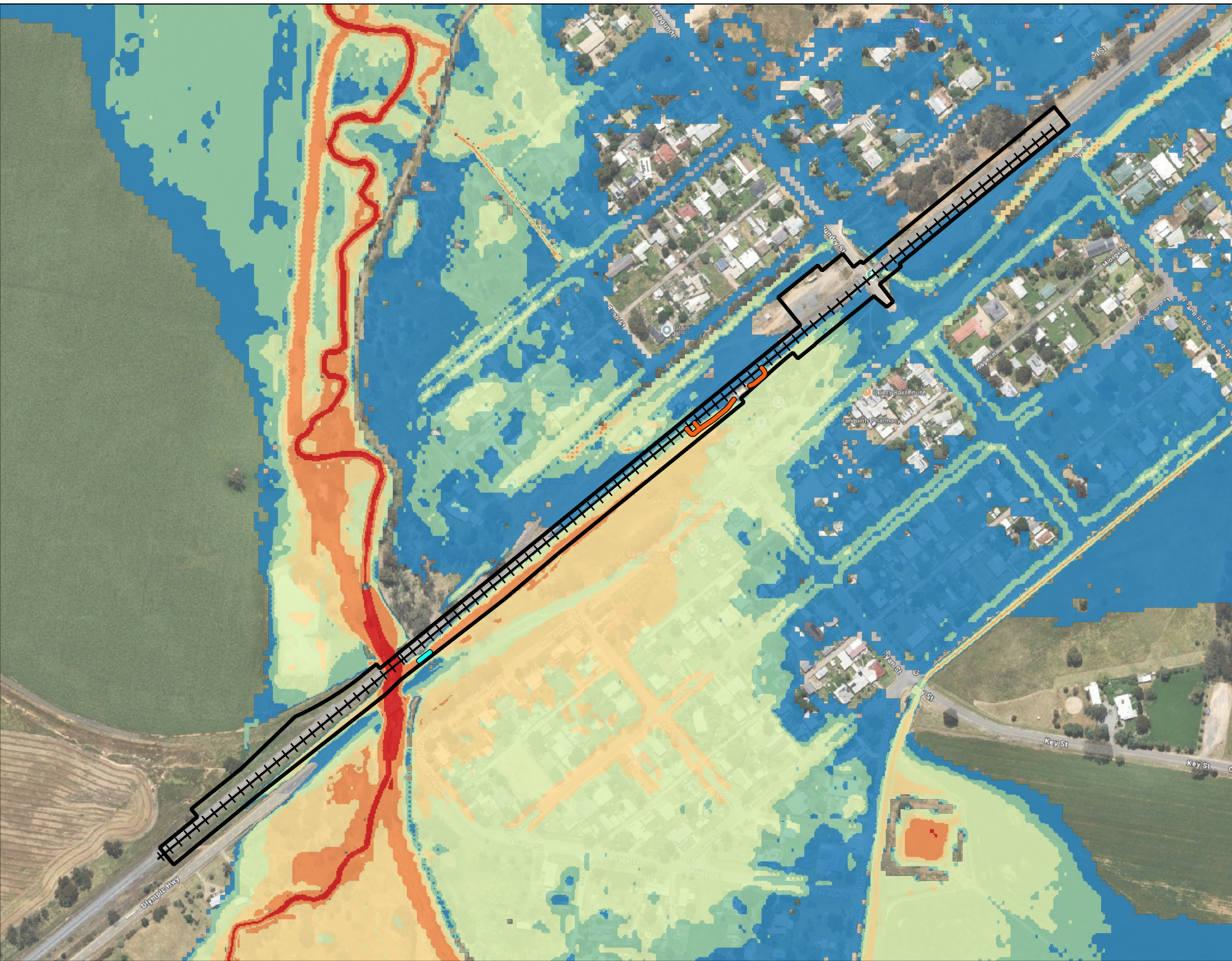
Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage
Figure A33 : 1% AEP Peak Flood Hazard - Design Condition

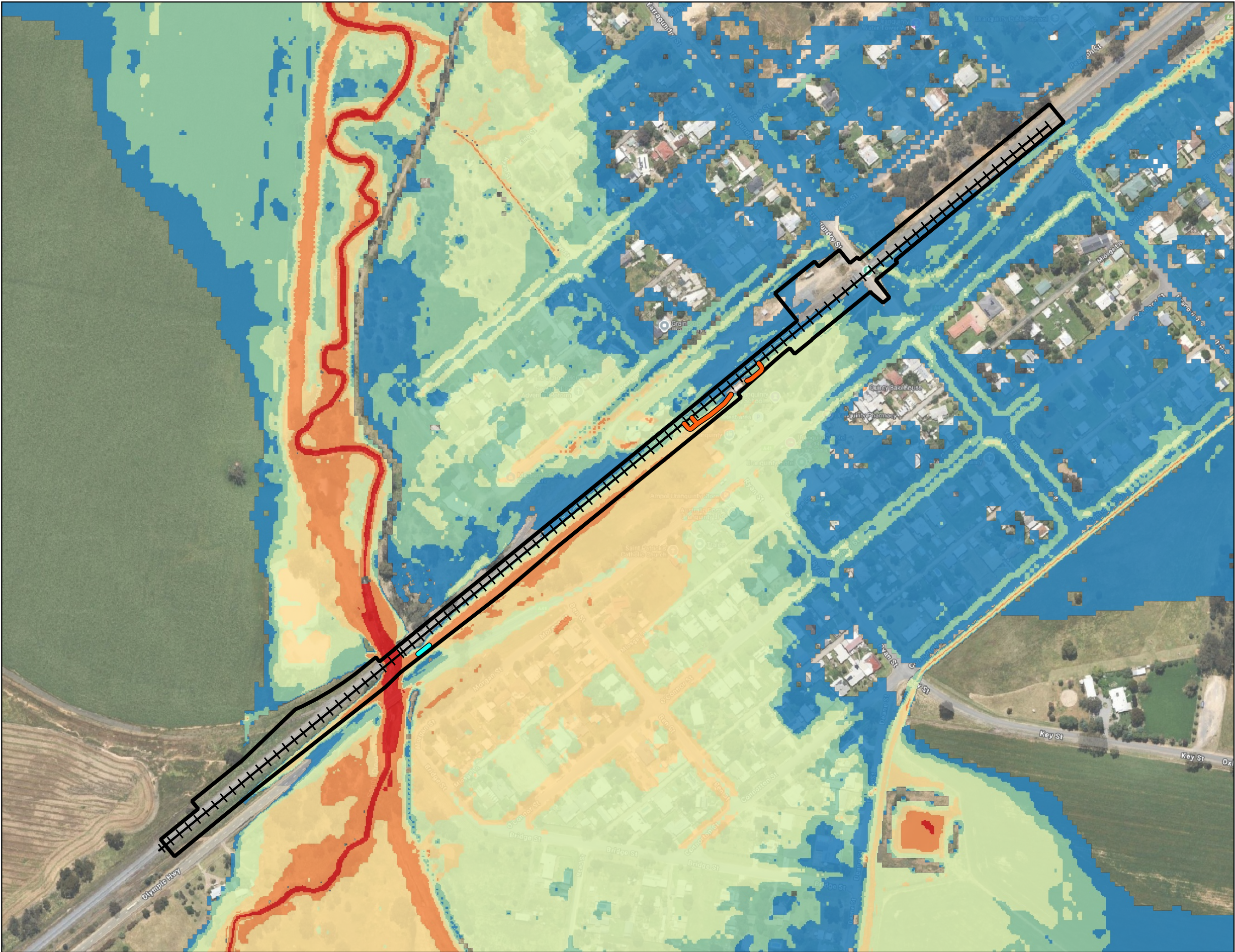
Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A34 : 0.5% AEP (Climate Change Scenario 1) Peak Flood Hazard - Design Condition

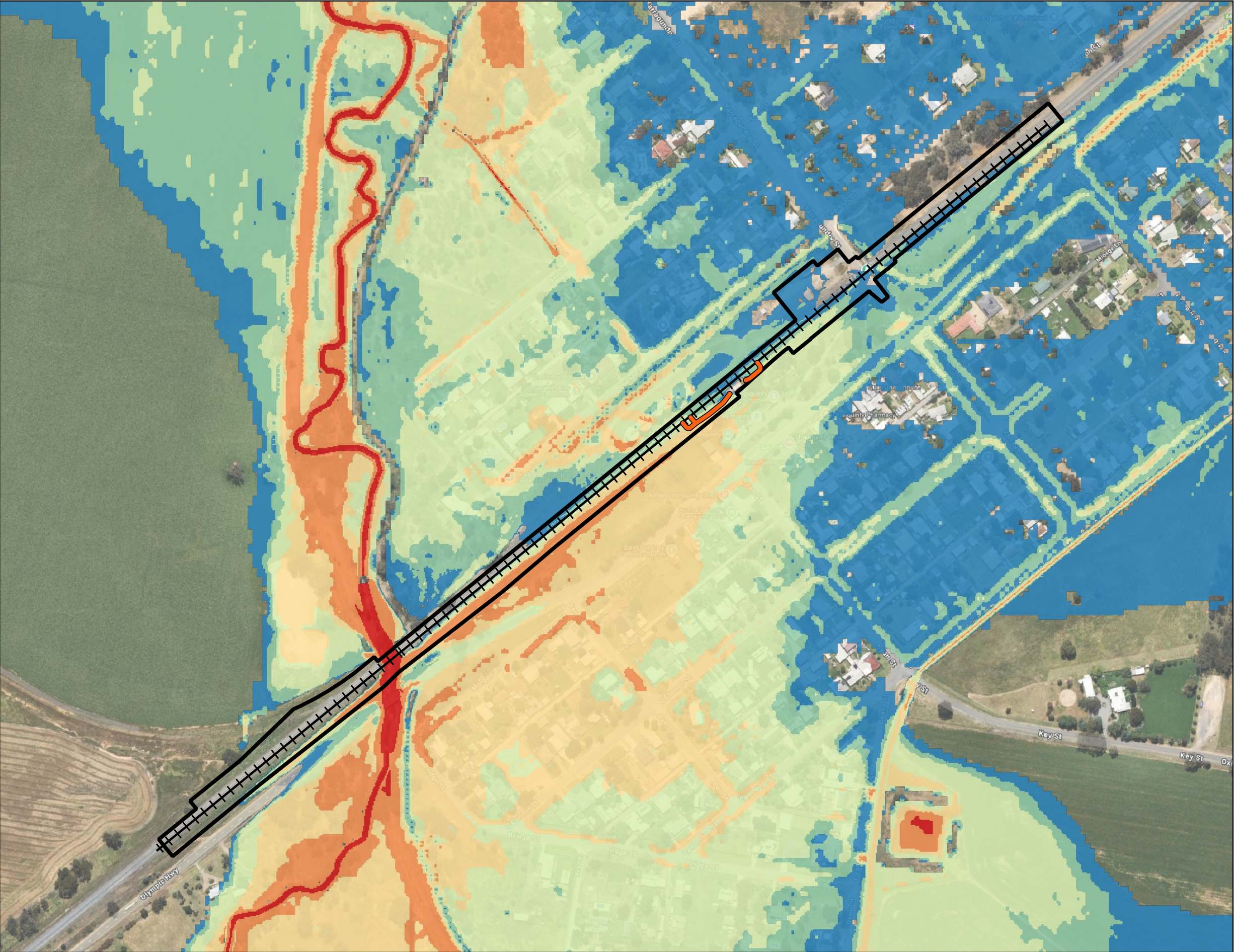
Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:

Map by: TT

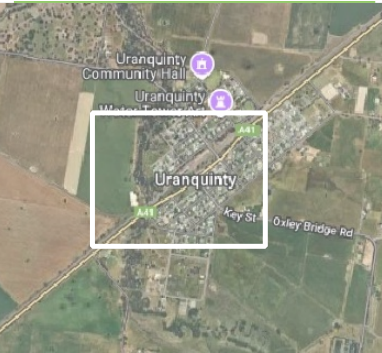


0 160 320 m
7/8/2025 MGA 55
A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage
Figure A35 : 0.2% AEP (Climate Change Scenario 2) Peak Flood Hazard - Design Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A36 : PMF Peak Flood Hazard - Design Condition

Legend

— Project Boundary

— Proposed Bund

+ Design Railway

Changes in Flood Level (m)

≤ -0.2

-0.2 - -0.1

-0.1 - -0.01

-0.01 - 0.01

0.01 - 0.02

0.02 - 0.05

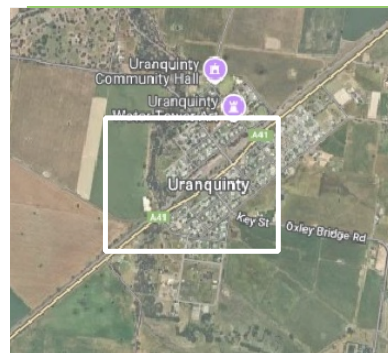
0.05 - 0.1

0.1 - 0.2

> 0.2

Was Wet Now Dry

Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m

7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A37 : 5% AEP Changes in Peak Flood Levels - Design Condition vs Existing Condition

Legend

— Project Boundary

— Proposed Bund

+ Design Railway

Changes in Flood Level (m)

≤ -0.2

-0.2 - -0.1

-0.1 - -0.01

-0.01 - 0.01

0.01 - 0.02

0.02 - 0.05

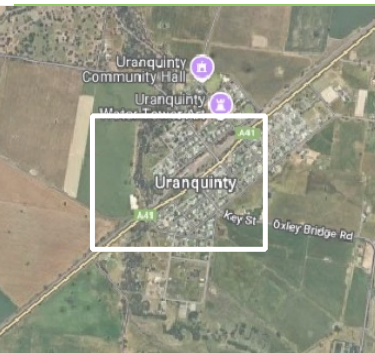
0.05 - 0.1

0.1 - 0.2

> 0.2

Was Wet Now Dry

Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m

7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A38 : 2% AEP Changes in Peak Flood Levels - Design Condition vs Existing Condition

Legend

— Project Boundary

— Proposed Bund

+ Design Railway

Changes in Flood Level (m)

≤ -0.2

-0.2 - -0.1

-0.1 - -0.01

-0.01 - 0.01

0.01 - 0.02

0.02 - 0.05

0.05 - 0.1

0.1 - 0.2

> 0.2

Was Wet Now Dry

Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m

7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A39 : 1% AEP Changes in Peak Flood Levels - Design Condition vs Existing Condition

Legend

— Project Boundary

— Proposed Bund

+ Design Railway

Changes in Flood Level (m)

<= -0.2

-0.2 - -0.1

-0.1 - -0.01

-0.01 - 0.01

0.01 - 0.02

0.02 - 0.05

0.05 - 0.1

0.1 - 0.2

> 0.2

Was Wet Now Dry

Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m

7/8/2025

MGA 55

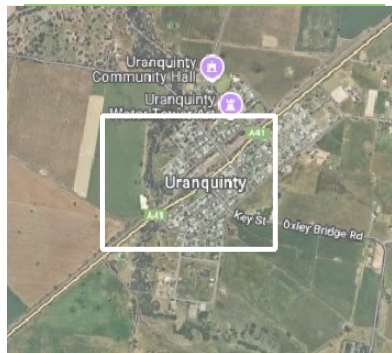
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A40 : 0.5% AEP (Climate Change Scenario 1) Changes in Peak Flood Levels - Design Condition vs Existing Condition

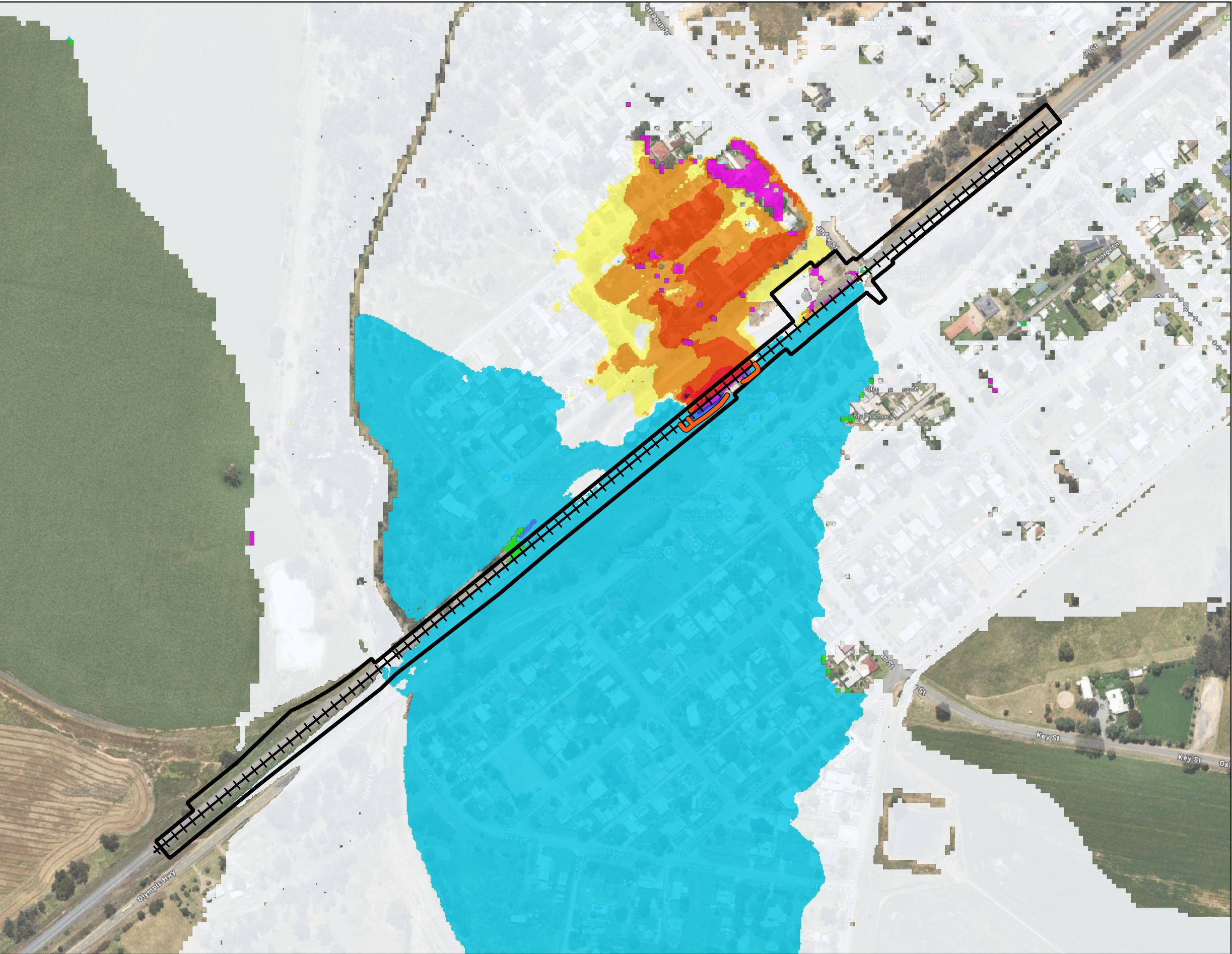
Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Changes in Flood Level (m)
 - ≤ -0.2
 - 0.2 - -0.1
 - 0.1 - -0.01
 - 0.01 - 0.01
 - 0.01 - 0.02
 - 0.02 - 0.05
 - 0.05 - 0.1
 - 0.1 - 0.2
 - > 0.2
- Was Wet Now Dry
- Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m

A3 Scale: 1:4,000,000004

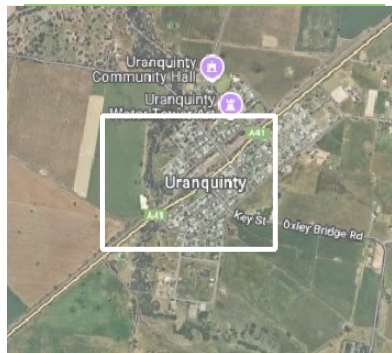
7/8/2025 MGA 55

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A41 : 0.2% AEP (Climate Change Scenario 2) Changes in Peak Flood Levels - Design Condition vs Existing Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Change in Velocity (m/s)
 - ≤ 0.50
- % Change in Velocity
 - $\leq 10\%$
 - 10% - 20%
 - $> 20\%$
- Was Wet Now Dry
- Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A42 : 5% AEP Changes in Peak Flood Velocity - Design Condition vs Existing Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Change in Velocity (m/s)
 - ≤ 0.50
- % Change in Velocity
 - $\leq 10\%$
 - 10% - 20%
 - $> 20\%$
- Was Wet Now Dry
- Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A43 : 2% AEP Changes in Peak Flood Velocity - Design Condition vs Existing Condition

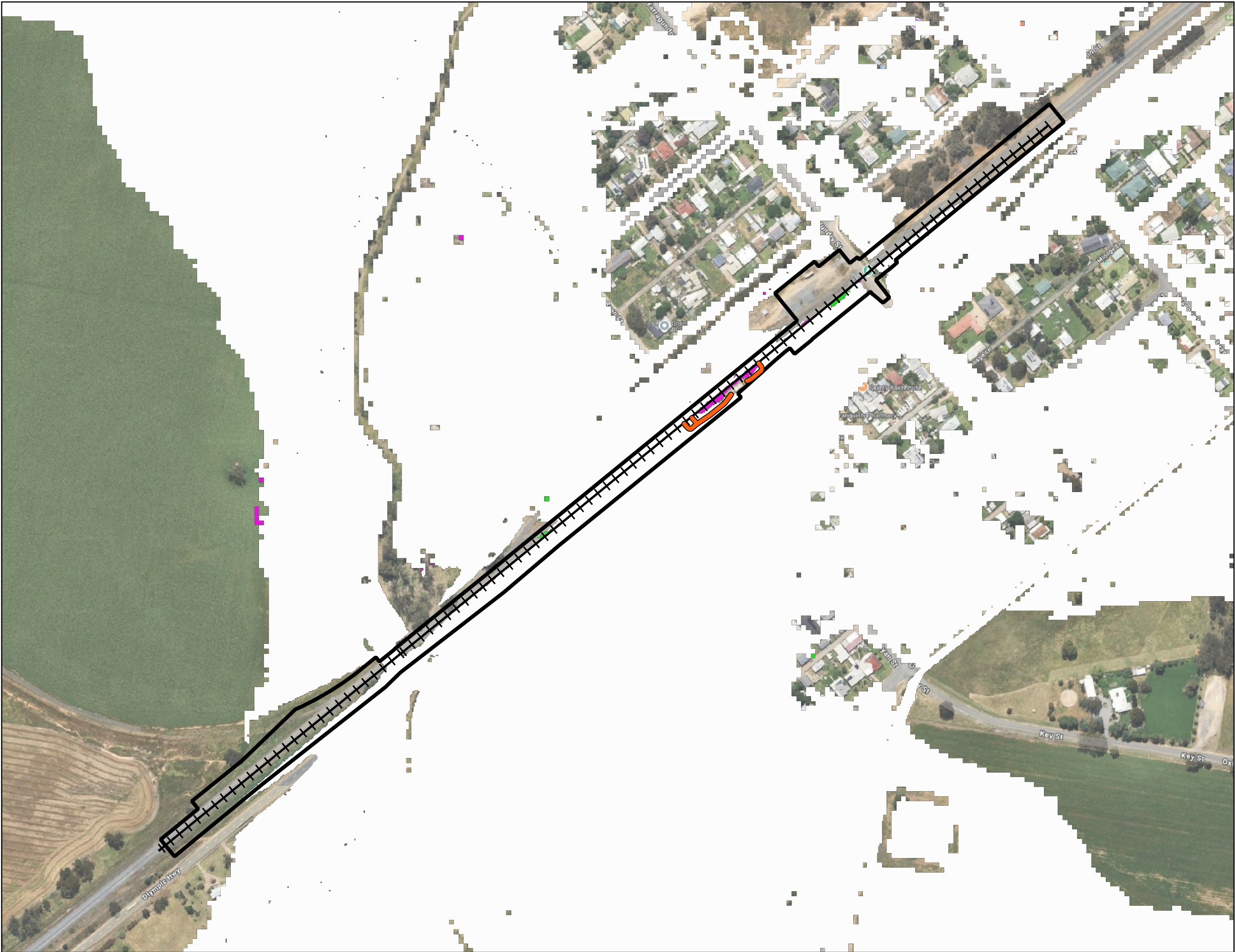
Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Change in Velocity (m/s)
 - ≤ 0.50
- % Change in Velocity
 - $\leq 10\%$
 - 10% - 20%
 - $> 20\%$
- Was Wet Now Dry
- Was Dry Now Wet



Notes:

Map by: TT



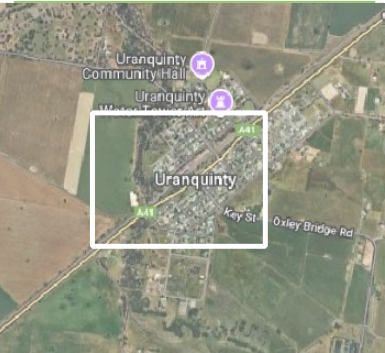
0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A44 : 1% AEP Changes in Peak Flood Velocity - Design Condition vs Existing Condition

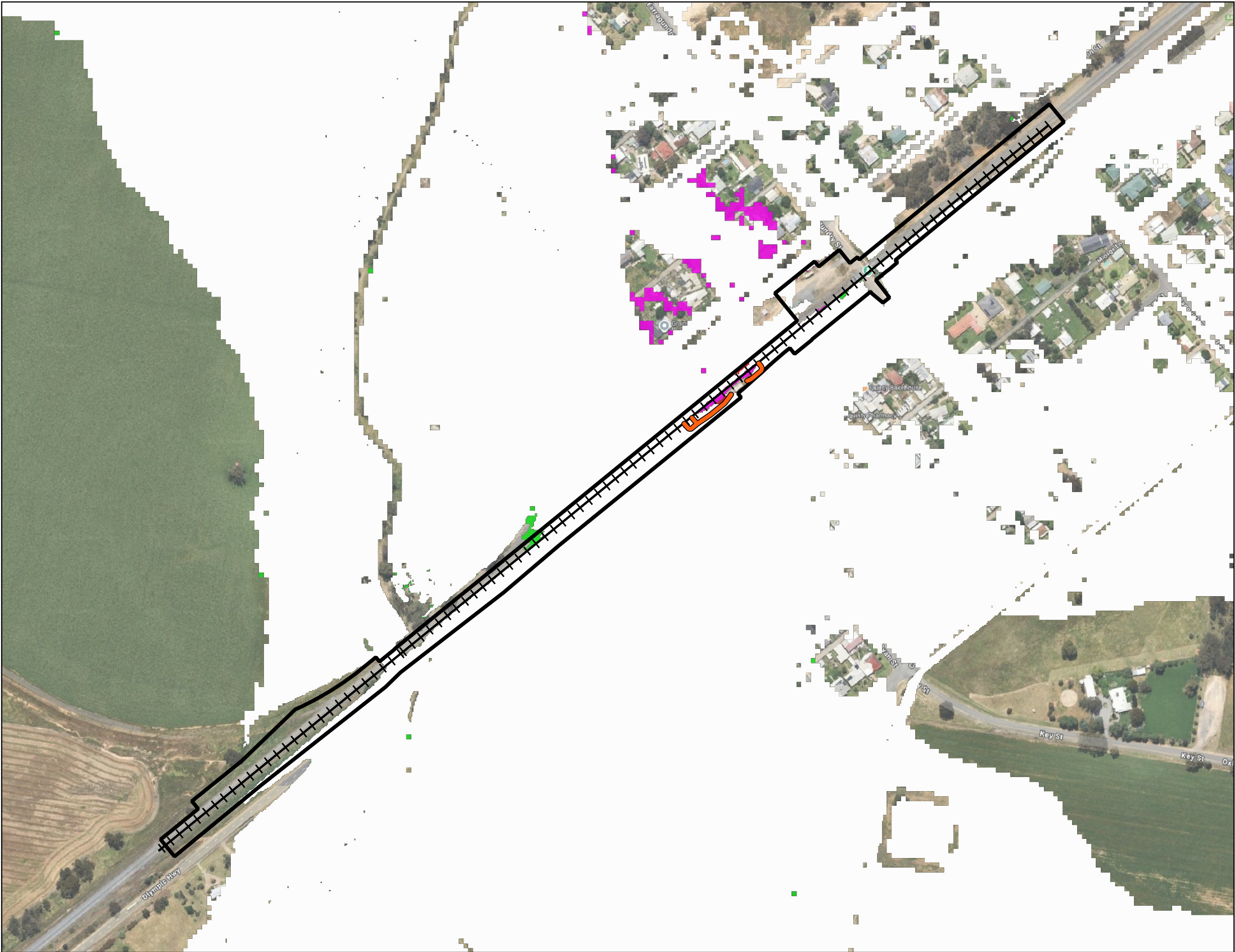
Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Change in Velocity (m/s)
 - ≤ 0.50
- % Change in Velocity
 - $\leq 10\%$
 - 10% - 20%
 - $> 20\%$
- Was Wet Now Dry
- Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55
 A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A45 : 0.5% AEP (Climate Change Scenario 1) Changes in Peak Flood Velocity - Design Condition vs Existing Condition

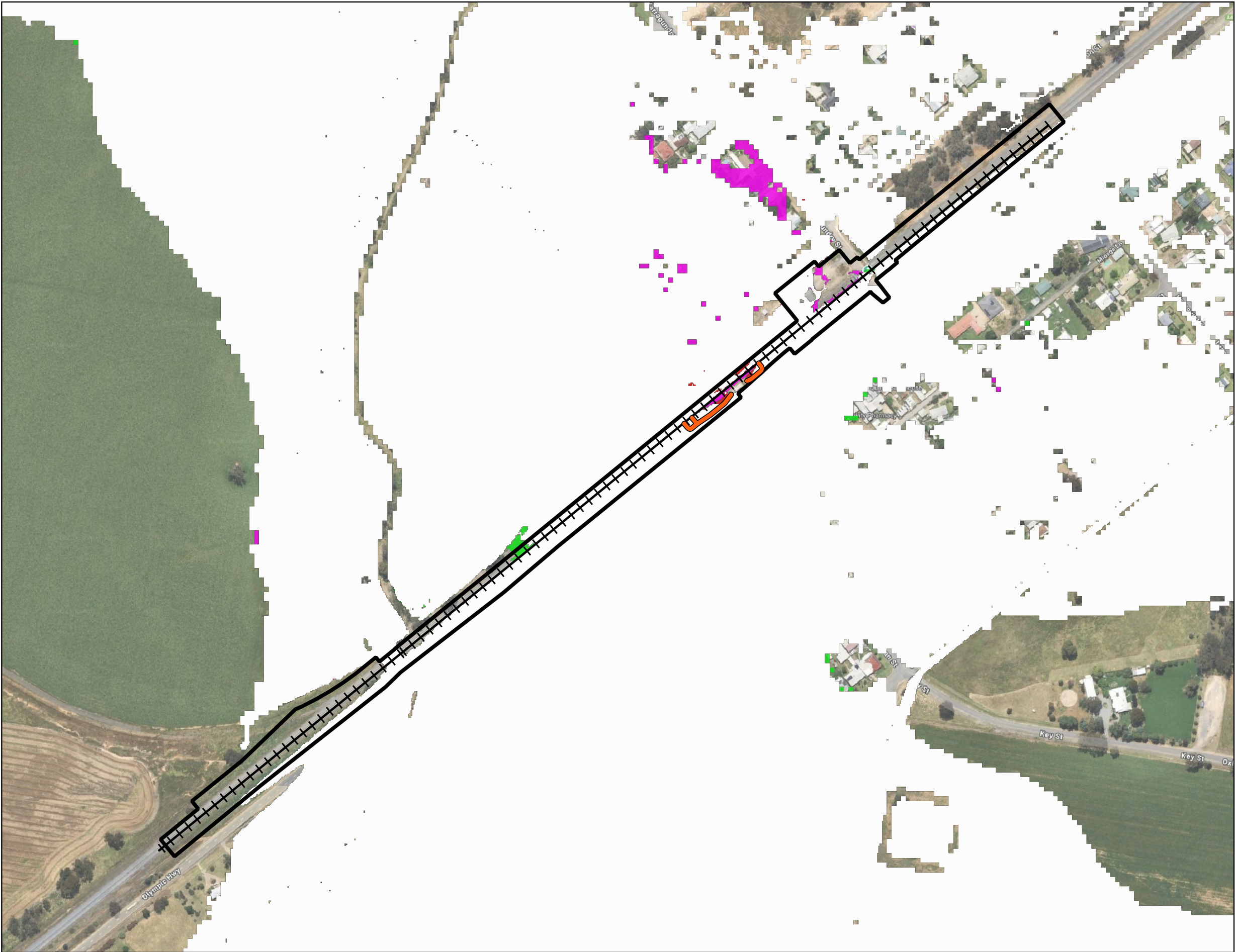
Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Change in Velocity (m/s)
 - ≤ 0.50
- % Change in Velocity
 - $\leq 10\%$
 - 10% - 20%
 - $> 20\%$
- Was Wet Now Dry
- Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m

A3 Scale: 1:4,000,000,000

7/8/2025 MGA 55

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A46 : 0.2% AEP (Climate Change Scenario 2) Changes in Peak Flood Velocity - Design Condition vs Existing Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Change in Flood Hazard
 - Decreased 5 Classes
 - Decreased 4 Classes
 - Decreased 3 Classes
 - Decreased 2 Classes
 - Decreased 1 Class
 - No Change
 - Increased 1 Class
 - Increased 2 Classes
 - Increased 3 Classes
 - Increased 4 Classes
 - Increased 5 Classes
 - Was Wet Now Dry
 - Was Dry Now Wet



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A47 : 5% AEP Changes in Peak Flood Hazard - Design Condition vs Existing Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Change in Flood Hazard
 - Decreased 5 Classes
 - Decreased 4 Classes
 - Decreased 3 Classes
 - Decreased 2 Classes
 - Decreased 1 Class
 - No Change
 - Increased 1 Class
 - Increased 2 Classes
 - Increased 3 Classes
 - Increased 4 Classes
 - Increased 5 Classes
 - Was Wet Now Dry
 - Was Dry Now Wet



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A48 : 2% AEP Changes in Peak Flood Hazard - Design Condition vs Existing Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Change in Flood Hazard
 - Decreased 5 Classes
 - Decreased 4 Classes
 - Decreased 3 Classes
 - Decreased 2 Classes
 - Decreased 1 Class
 - No Change
 - Increased 1 Class
 - Increased 2 Classes
 - Increased 3 Classes
 - Increased 4 Classes
 - Increased 5 Classes
 - Was Wet Now Dry
 - Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A49 : 1% AEP Changes in Peak Flood Hazard - Design Condition vs Existing Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Change in Flood Hazard
 - Decreased 5 Classes
 - Decreased 4 Classes
 - Decreased 3 Classes
 - Decreased 2 Classes
 - Decreased 1 Class
 - No Change
 - Increased 1 Class
 - Increased 2 Classes
 - Increased 3 Classes
 - Increased 4 Classes
 - Increased 5 Classes
 - Was Wet Now Dry
 - Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A50 : 0.5% AEP (Climate Change Scenario 1) Changes in Peak Flood Hazard - Design Condition vs Existing Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Change in Flood Hazard
 - Decreased 5 Classes
 - Decreased 4 Classes
 - Decreased 3 Classes
 - Decreased 2 Classes
 - Decreased 1 Class
 - No Change
 - Increased 1 Class
 - Increased 2 Classes
 - Increased 3 Classes
 - Increased 4 Classes
 - Increased 5 Classes
 - Was Wet Now Dry
 - Was Dry Now Wet



Notes:

Map by: TT



0 160 320 m

7/8/2025

MGA 55

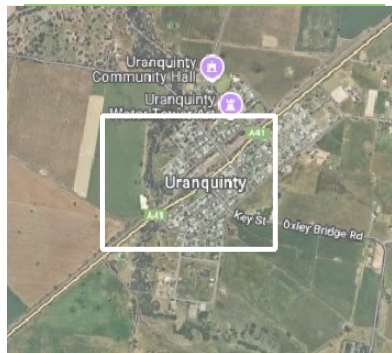
A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

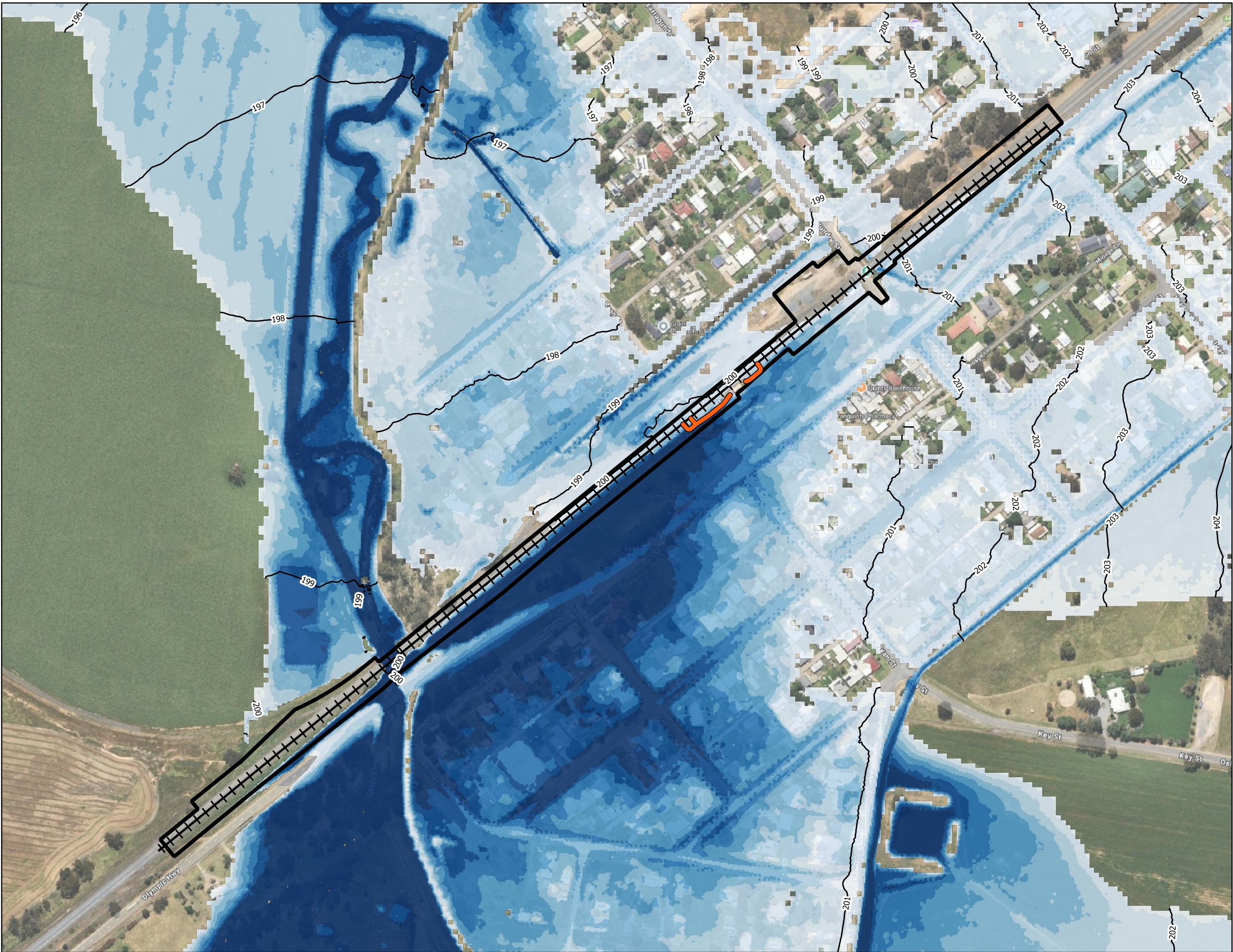
Figure A51 : 0.2% AEP (Climate Change Scenario 2) Changes in Peak Flood Hazard - Design Condition vs Existing Condition

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Level (mAHD)
- Peak Flood Depth (m)
 - <= 0.03
 - 0.03 - 0.20
 - 0.20 - 0.40
 - 0.40 - 0.60
 - 0.60 - 0.80
 - 0.80 - 1.00
 - 1.00 - 1.20
 - > 1.20



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000,000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A52 : 1% AEP Peak Flood Depth and Levels - Blockage Assessment

Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Velocity
 - ≤ 0.25
 - 0.25 - 0.50
 - 0.50 - 0.75
 - 0.75 - 1.00
 - 1.00 - 1.50
 - 1.50 - 2.00
 - 2.00 - 2.50
 - 2.50 - 3.00
 - > 3.00



Notes:



Map by: TT



0 160 320 m 7/8/2025 MGA 55

A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A53 : 1% AEP Peak Flood Velocity - Blockage Assessment

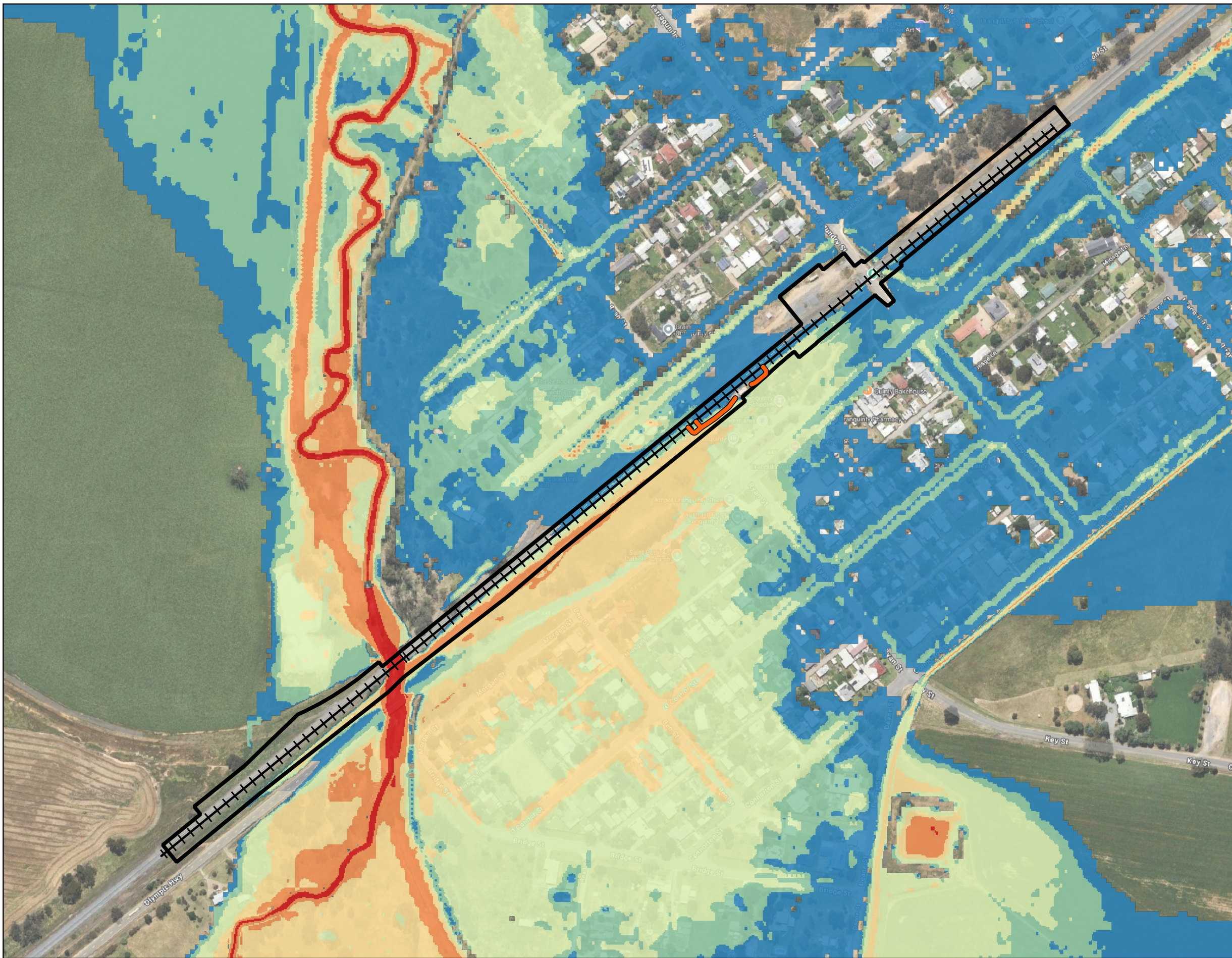
Legend

- Project Boundary
- Proposed Bund
- Design Railway
- Peak Flood Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6



Notes:

Map by: TT



0 160 320 m 7/8/2025 MGA 55
A3 Scale: 1:4,000.000004

Uranquinty Yard - Inland Rail (A2P) - IFC Stage

Figure A54 : 1% AEP Peak Flood Hazard - Blockage Assessment

APPENDIX B

ARTC Review



ARTC INLAND RAIL		Document Control Information			
		Contractor DC to update for re-submission	Submitted Document No. or Transmittal No.:		Martinus-PTTRAN-001281
Project:		2100 - A2I	Date Submission Received:		8/05/2025
Comment Sheet Number_Revision:		5-0052-210-IHY-W1-CS-0001_G	Comment Sheet Title:		External Comment Sheet - A2I Flood Design Report - Uranquinty Yard
Revision Date:		4/09/2025	Documents related in Aconex (by IR DC)		Yes

Review Comments (Reviewer)										Responses (Document Owner)										Close-Out																																																																																			
#	PSR ID No. or Compliance Reference Document (State the fully qualified reference the deliverable is non-compliant with)	Document / drawing number - Revision Number	Section # / page #	Engineering Assurance Stage	Comment (for example must be specific on non compliance. Reference mark-ups, if required)	Comment Type	Full Name	Date	Full Name	Company	Date	Response (must be specific on how the comment has been addressed. Agreed approach for re-submission)	Documentation Section # / Figure #	Full Name	Date	Comment Status	Close-Out Comment																																																																																						
Example	IR-SR-A2I-517 or 01-3500-PD-P00-DE-0008-A	0-0000-900-PEN-00-TE-0020_A		CRR	Is there sufficient space for a 10m maintenance vehicle to turn around at the end of the RMAR?	Non-Compliant	Joe Bloggs	15/02/2023	Fred Bloggs	Designer	15/03/2023	The area has been increased - now possible to turn 12.5m vehicle. The drawings are updated.	01-3500-PD-P00-DE-0008-A 01-3500-PD-P00-DE-0015-C	Jane Doe	27/09/2023	CLOSED																																																																																							
1	PSR Annexure B: Technical Requirements (Item IR-SR-A2I-116)	5-0052-210-IHY-W1-RP-0001_A.pdf	Page 9, 5-0052-210-IHY-W1-RP-0001_A, Section 1.5	PDR	It appears that 0.5% and 0.2% AEP design rainfall events have been simulated for climate change scenarios, whereas IR generally requires 1% AEP design rainfall with an increase for Year 2090 RCP 8.5 climate change factor. Therefore, a clarification is required about it.	Non-Compliant	Ayub Ali	19/09/2024	Yucen Lu	DJV Flood Modeller	13/11/2024	The flood model (hydrology in ARR2019) provided by IR did not include a hydrology model or the inflow of 1%AEP + Climate change (RCP8.5 Year 2090) in TUFLOW. Therefore, the 1%AEP + Climate change (RCP8.5 Year 2090) event could not be run directly. Alternatively, the comparisons of design rainfall depth among the events of 1%AEP + Climate change (RCP8.5 Year 2090), 0.5% AEP and 0.2% AEP were made, indicating that the rainfall depth of 1%AEP + Climate change (RCP8.5 Year 2090) is between 0.5% AEP and 0.2% AEP. As such, the events of 0.5% AEP and 0.2% AEP were used to represent the climate change scenario. The above clarification is included in the Section 6.5.2.		Ayub Ali	8/01/2025	CLOSED	It is understood that two scenarios have been simulated for sensitivity test of climate change which covers the projected increase of rainfall depth. Considering the climate change scenario as a sensitivity test, adopted two scenarios may be supported.																																																																																						
2	PSR Annexure B: Technical Requirements (Item IR-SR-A2I-458)	5-0052-210-IHY-W1-RP-0001_A.pdf	Page 14, 5-0052-210-IHY-W1-RP-0001_A, Table 2-1	PDR	Existing ponding to be mitigated to comply with this requirement.	Non-Compliant	Ayub Ali	19/09/2024	Yucen Lu	DJV Flood Modeller	13/11/2024	The site area is subjected to regional flooding from Sandy Creek. The location of the cess drain channel is flooded in the existing condition instead of ponding. The wording will be updated in the next design phase report. In addition, the design of the cess drain maintains the slope so that the water within the cess drain will flow freely instead of ponding. The details of the cess drain design can be referred to Section 4.5 of 5-0052-210-PEN-W1-RP-0001. Therefore, this requirement is complied with.		Ayub Ali	8/01/2025	CLOSED	DDR Issue of Report 5-0052-210-PEN-W1-RP-0001 has confirmed no ponding.																																																																																						
3	PSR Annexure B: Technical Requirements (Item IR-SR-A2I-116)	5-0052-210-IHY-W1-RP-0001_A.pdf	Page 24, 5-0052-210-IHY-W1-RP-0001_A, Section 4.2.6	PDR	It appears that 0.5% and 0.2% AEP design rainfall events have been simulated for climate change scenarios, whereas IR generally requires 1% AEP design rainfall with an increase for Year 2090 RCP 8.5 climate change factor. Therefore, a clarification is required about it.	Non-Compliant	Ayub Ali	19/09/2024	Yucen Lu	DJV Flood Modeller	13/11/2024	The flood model (hydrology in ARR2019) provided by IR did not include a hydrology model or the inflow of 1%AEP + Climate change (RCP8.5 Year 2090) in TUFLOW. Therefore, the 1%AEP + Climate change (RCP8.5 Year 2090) event could not be run directly. Alternatively, the comparisons of design rainfall depth among the events of 1%AEP + Climate change (RCP8.5 Year 2090), 0.5% AEP and 0.2% AEP were made, indicating that the rainfall depth of 1%AEP + Climate change (RCP8.5 Year 2090) is between 0.5% AEP and 0.2% AEP. As such, the events of 0.5% AEP and 0.2% AEP were used to represent the climate change scenario. The above clarification is included in the Section 6.5.2.		Ayub Ali	8/01/2025	CLOSED	It is understood that two scenarios have been simulated for sensitivity test of climate change which covers the projected increase of rainfall depth. Considering the climate change scenario as a sensitivity test, adopted two scenarios may be supported.																																																																																						
4	PSR Annexure B: Technical Requirements (Item IR-SR-A2I-458)	5-0052-210-IHY-W1-RP-0001_A.pdf	Page 42, 5-0052-210-IHY-W1-RP-0001_A, Section 6.5.2	PDR	Simulating a single scenario (1% AEP + Year 2090 RCP 8.5 Climate Change Factor) could have been better than simulating two scenarios (0.5% and 0.2% AEPs). It would be consistent with other packages as well.	Non-Compliant	Ayub Ali	19/09/2024	Yucen Lu	DJV Flood Modeller	13/11/2024	It is understood that running a single scenario (1%AEP + Climate change (RCP8.5 Year 2090)) will be consistent with other packages. However, due to the limitation of without a hydrology model and 1%AEP + Climate change (RCP8.5 Year 2090) inflow in TUFLOW model. The single scenario (1%AEP + Climate change (RCP8.5 Year 2090)) could not be run. Therefore, 0.5 AEP and 0.2% AEP were used to represent the climate change scenario. The rainfall depth comparison among those three events was made and the clarification was included in Section 6.5.2 of Flood Design Report.		Ayub Ali	8/01/2025	CLOSED	It is understood that two scenarios have been simulated for sensitivity test of climate change which covers the projected increase of rainfall depth. Considering the climate change scenario as a sensitivity test, adopted two scenarios may be supported.																																																																																						
5	Conditions of Approval	5-0052-210-IHY-W1-RP-0001_A.pdf	Page 47, 5-0052-210-IHY-W1-RP-0001_A, Appendix A	PDR	Flood Maps are missing.	Non-Compliant	Ayub Ali	19/09/2024	Yucen Lu	DJV Flood Modeller	13/11/2024	Flood maps have been provided.		Ayub Ali	8/01/2025	CLOSED	Flood maps have been submitted separately at a later date.																																																																																						
6	Clarification IR-SR-A2I-350	5-0052-210-IHY-W1-RP-0001_B.pdf	Page 15, 5-0052-210-IHY-W1-RP-0001_B, Section 2.0 Table 2.1	DDR	PSR ID IR-SR-A2I-350 'shall have a flood immunity of no worse than existing'. Can I confirm, that although Figure A41 drawing in the Appendix is showing an increase (ORANGE colour) of up to 50mm flood levels worse than existing on the Uranquinty township side, that this requirement is achieved because this is for flood immunity of 0.2% not 1%?	Non-Compliant	Stephen Brierley	25/03/2025	Yucen Lu	DJV Flood Modeller	28/04/2025	As per PSR 5.4.2 and 5.4.3, the highest flood immunity that should be adopted is 1% AEP. The railway flood immunity is maintained in existing and design scenarios. Therefore, this PSR is compliant according to Section 6.3. Figure A41 shows the flood impact map for 0.2% AEP, and afflux should be checked against CoA E42. CoA E42 stipulates the afflux to be compliant with the events up to 1% AEP, which is complied with in this assessment.		Stephen Brierley	21/07/2025	CLOSED	Has the flood modelling been completed for Uranquinty ? I note Martinus-RFI-000995 - once resolved this comments sheet can be closed. If the silos and siding can be confirmed as ARTC land then the flood design can be confirmed and boundary ownership approved by ARTC then this comment can close. RFI-000995 Resolved and Martinus have confirmed ARTC boundary requirements are not necessary. Comment closed.																																																																																						
7	Clarification	5-0052-210-IHY-W1-RP-0001_B.pdf	Page 36, 5-0052-210-IHY-W1-RP-0001_B, Section 6.3	DDR	While flood immunity is improved in the design condition, why overtopping depth is greater in the design condition for greater than 1% AEP flood events? A discussion and reference to tabulated data is necessary for clarity and better understanding.	Non-Compliant	Ayub Ali	14/03/2025	Yucen Lu	DJV Flood Modeller	28/04/2025	The overtopping depth in design is 1-2 mm higher than the existing in the events greater than 1%AEP. The text is re-worded, and another table that includes events greater than 1% AEP is included. 6.3 Flood Immunity and Scour Protection The flood immunity of the railway corridor improves from existing (5% AEP) to design (2% AEP) which complies with the criteria in PSR for a no-warping impact. The design is compliant with the CoA Condition E42 for up to the 1% AEP event with the proposed development having minimal impacts on areas outside of the site. A comparison between top of rail, top of formation and overtopping flood depths for each flood event for the design and existing conditions at Chaiway 525+780m (deepest overtopping location in 1% AEP) is presented in Table 6-15. The flood immunity achieved for 1% AEP in design is 100mm greater than existing design. 100mm overtopping depth is 100mm less than existing design for 1% AEP in design, which is due to the regional flooding. Table 6-15: Comparison of Flood Level at Chaiway 525+780m (up to 1% AEP) <table><tr><th rowspan="2">Change</th><th colspan="2">Top of the Rail Level (mASD)</th><th colspan="2">Top of the Formation Level (mASD) ¹</th><th colspan="2">0.5% AEP Flood Level (mASD)</th><th colspan="2">2% AEP Flood Level (mASD)</th><th colspan="2">1% AEP Flood Level (mASD)</th></tr><tr><th>Existing</th><th>Design</th><th>Existing</th><th>Design</th><th>Existing</th><th>Design</th><th>Existing</th><th>Design</th><th>Existing</th><th>Design</th></tr><tr><td>0.5% AEP</td><td>200.09</td><td>200.14</td><td>199.42</td><td>199.47</td><td>Not overtopped</td><td></td><td>200.15</td><td>200.29</td><td>200.29</td><td>200.30</td></tr><tr><td>2% AEP</td><td>200.09</td><td>200.14</td><td>199.42</td><td>199.47</td><td>200.35</td><td>200.41</td><td>200.50</td><td>200.52</td><td>202.47</td><td>202.48</td></tr></table> ¹ Note that the top of the formation level has been assumed to be 800mm below the top of the rail level. Table 6-16: Comparison of Flood Level at Chaiway 525+780m (0.5% AEP, 0.2% AEP and 1% AEP) <table><tr><th rowspan="2">Change</th><th colspan="2">Top of the Rail Level (mASD)</th><th colspan="2">Top of the Formation Level (mASD) ¹</th><th colspan="2">0.5% AEP Flood Level (mASD)</th><th colspan="2">2% AEP Flood Level (mASD)</th><th colspan="2">1% AEP Flood Level (mASD)</th></tr><tr><th>Existing</th><th>Design</th><th>Existing</th><th>Design</th><th>Existing</th><th>Design</th><th>Existing</th><th>Design</th><th>Existing</th><th>Design</th></tr><tr><td>0.5% AEP</td><td>200.09</td><td>200.14</td><td>199.42</td><td>199.47</td><td>200.35</td><td>200.41</td><td>200.50</td><td>200.52</td><td>202.47</td><td>202.48</td></tr><tr><td>2% AEP</td><td>200.09</td><td>200.14</td><td>199.42</td><td>199.47</td><td>200.35</td><td>200.41</td><td>200.50</td><td>200.52</td><td>202.47</td><td>202.48</td></tr></table> ¹ Note that the top of the formation level has been assumed to be 800mm below the top of the rail level.	Change	Top of the Rail Level (mASD)		Top of the Formation Level (mASD) ¹		0.5% AEP Flood Level (mASD)		2% AEP Flood Level (mASD)		1% AEP Flood Level (mASD)		Existing	Design	Existing	Design	Existing	Design	Existing	Design	Existing	Design	0.5% AEP	200.09	200.14	199.42	199.47	Not overtopped		200.15	200.29	200.29	200.30	2% AEP	200.09	200.14	199.42	199.47	200.35	200.41	200.50	200.52	202.47	202.48	Change	Top of the Rail Level (mASD)		Top of the Formation Level (mASD) ¹		0.5% AEP Flood Level (mASD)		2% AEP Flood Level (mASD)		1% AEP Flood Level (mASD)		Existing	Design	Existing	Design	Existing	Design	Existing	Design	Existing	Design	0.5% AEP	200.09	200.14	199.42	199.47	200.35	200.41	200.50	200.52	202.47	202.48	2% AEP	200.09	200.14	199.42	199.47	200.35	200.41	200.50	200.52	202.47	202.48		Ayub Ali	2/06/2025	CLOSED	This item is closed based on the response and its screenshot evidence.
Change	Top of the Rail Level (mASD)		Top of the Formation Level (mASD) ¹		0.5% AEP Flood Level (mASD)		2% AEP Flood Level (mASD)		1% AEP Flood Level (mASD)																																																																																														
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2% AEP	200.09	200.14	199.42	199.47	200.35	200.41	200.50	200.52	202.47	202.48																																																																																													
8	CoA E42	5-0052-210-IHY-W1-RP-0001_B.pdf	Page 37, 5-0052-210-IHY-W1-RP-0001_B, Section 5.4.4	DDR	Flow rate vs time is not an appropriate parameter for estimating duration of inundation. Rather flood level vs time should be used at all locations for estimating the change in duration of inundation.	Non-Compliant	Ayub Ali	14/03/2025	Yucen Lu	DJV Flood Modeller	28/04/2025	The flow rate has been removed, and Section 6.4.4 has been updated. 6.4.4 Changes in Duration of Inundation The analysis of the change in duration of inundation was undertaken by comparing flood level vs time upstream and downstream of the site in the existing and design conditions. As shown in the below figures, for the 2% AEP event, there is negligible change between the existing and design conditions. However, for the 2% AEP and the 1% AEP events, it can be seen that there is a reduction in the flood level, mainly due to the incorporation of the track and bunds that reduce the flow travelling to this downstream location, but the durations are almost similar. Overall, there is no increase in duration of inundation as a result of the project works and this complies with CoA E42a).		Ayub Ali	2/06/2025	CLOSED	This item is closed based on the response and its screenshot evidence.																																																																																						
9	Clarification	5-0052-210-IHY-W1-RP-0001_B.pdf	Page 42, 5-0052-210-IHY-W1-RP-0001_B, Figures 6-11 to 6-16	DDR	The term "Level vs Time" should be replaced with "Flood level vs Time" for better clarity	Opportunity	Ayub Ali	14/03/2025	Yucen Lu	DJV Flood Modeller	28/04/2025	Updated the words. The snips are attached below. 		Ayub Ali	2/06/2025	CLOSED	This item is closed based on the response and its screenshot evidence.																																																																																						
					Non-Compliant:	Non-compliance which requires correction before further design development occurs.																																																																																																	
					Opportunity:	Comment which identifies an opportunity to save capex, achieve increased quality or operational outcome. Not a non-compliance.																																																																																																	
																NEXT PHASE:																																																																																							
																Comment response has been accepted. Resulting actions have been deferred to the next Phase of the Project (for Doc Control purposes comment is considered OPEN)																																																																																							
																TRANSFERRED:																																																																																							
																Response is not acceptable or review has been split and the comment has been transferred to another comment sheet. (for Doc Control purposes comment is considered CLOSED)																																																																																							

APPENDIX C

Independent Flood Consultant Review



Project: 2100 Deliverable: Uranquinty Yard Comment Sheet Reference: 5-0052-210-HY-W1-CS-0001-PE 1										Responses (Document Owner)										Close-Out		
#	Document number / drawing number - Revision Number	Section # / page #	Company	Full Name	Functional Area	Date	Design Gate	Comment (for example must be specific on non-compliance. Reference mark-ups, if required)	Compliance Reference Document (State the fully qualified reference the deliverable is non-compliant with)	Comment Type	Full Name	Role	Date	Response (must be specific on how the comment has been addressed)	Where addressed (Section # / Figure #)	Full Name	Company	Date	Comment Outcome	Close-Out	Close-Out Comment	
1	5-0052-210-HY-W1-RP-0001_A	TUFLOW files	Hatch	Sam Drysdale	Flood Assessment	30/09/2024	PDR	updates reporting to reflect adopted critical durations.		Minor	Yuen Lu	DJV Flood Modeler	12/11/2024	The adopted critical durations will be updated in the next design stage phase report.	Table 4.1 in 5-0052-210-HY-W1-RP-0001	Darren Lyons	Hatch	20/11/2024	CLOSED	Noted		
2	5-0052-210-HY-W1-RP-0001_A	TUFLOW files	Hatch	Sam Drysdale	Flood Assessment	30/09/2024	PDR	It is recommended that the effect of the surveyed rail levels and reduced model cell size of the existing scenario model should be communicated to Council to inform their flood planning, i.e. the improved detail of the rail infrastructure results in a higher flood level to the east of the rail corridor.		Minor	Yuen Lu	DJV Flood Modeler	12/11/2024	The Flood Design Report and independent review of flood design report shall be provided to IR through this submission, for IR to upload on the IR website, as per C&A B18 responsibility allocation. The above words will be updated in E49 in Section 2 of Flood Design Report in the next design phase.	E49 in Section 2	Darren Lyons	Hatch	20/11/2024	CLOSED	Noted		
3	5-0052-210-HY-W1-RP-0001_B	TUFLOW files	Hatch	Sam Williams	Flood Assessment	31/03/2025	DDR	Changes have been made to the Sandy Creek channel cross-sections between PDR and DDR, with two additional cross-sections added between the Olympic Hwy and the railway. The cross-section geometry of these two additional sections is different in the Design scenario than it is in the Existing scenario. This is artificially changing the hydraulics of the downstream bridge structure, resulting in an increased conveyance through the rail embankment. This is evident within the flood impact mapping and hydrographs presented in the Flood Design Report. The design does not provide additional cross-drainage and should not be resulting in a reduction in flood levels upstream of the railway. When the Design scenario is simulated with channel cross-sections that are consistent with the Existing scenario, the results show that the Design is increasing the peak flood levels within the residential area upstream of the railway by around 25 mm, which is to be expected given the Design is reducing the water that is overtopping the railway.			Yuen Lu	DJV Flood Modeler	11/04/2025	The addition of the two cross-sections is to reflect the changes due to the design. At the downstream of the proposed culvert towards Sandy Creek, there is a design leftbank to smooth the channel sloping down to the Sandy Creek and this slope encroaches into the TUFLOW 1D domain, resulting in the cross-section changes. Therefore, the two cross-sections were used to reflect such changes. However, it was found such design changes were not recorded in the flood design report (5-0052-210-HY-W1-RP-0001). The information will be added to Section 4.2.2 of 5-0052-210-HY-W1-RP-0001 (refer to the snips below) 22/09/2025 (YL): The representations of Sandy Creek Railway Bridge and Olympic Highway Bridge over Sandy Creek were converted from 1D to 2D. The model were re-run and assessed the latest IFC design. The results show the full compliance. The results and description were included in 5-0052-210-HY-W1-RP-0001_A.	Section 4.2.2 of 5-0052-210-HY-W1-RP-0001	Daniel Williams	Hatch	16/04/2025	CLOSED	The addition of the two extra cross-sections is not required to represent the impact of the design. However, if these are retained in the model then the 1D channel representation is incorrect as it is changing the upstream section used to calculate the bridge hydraulics, which shouldn't be changing. Therefore, another cross section needs to be added between section SC_014a_Add1 and Rail_Brg_002. However, based on the PE modelling, it is expected that this will result in non-compliant impacts. Further, when comparing the existing 1D model representation in this area to the LQAR data, the 1D cross sections do not adequately capture the channel geometry through the highway and railway bridges. If retaining a 1D model representation of the channel it would be recommended to use the available data to improve the model representation through this reach of the creek. However, given the significant spatial variation in channel section and associated contraction and expansion losses, it is recommended that the model representation be converted fully to 2D for the channel reach containing the road and rail bridge structures. This will remove any uncertainty associated with the modeller's selection of representative 1D cross sections and the 1D model calculations in resolving the local flood hydraulics. If the conversion of the model representation from 1D to 2D improves the efficiency of flood flow conveyance through the rail embankment then it could potentially reduce the modelled upstream existing 1% AEP flood level below the level of the design site works, removing the potential for impacts. *** It is requested that this 2D model conversion be undertaken to ensure that the potential impacts and mitigation measures associated with the design works can be assessed with a reasonable degree of certainty ***		
4	5-0052-210-HY-W1-RP-0001_B	TUFLOW files	Hatch	Sam Williams	Flood Assessment	31/03/2025	DDR	In reviewing the modifications made to the Sandy Creek channel it has become apparent that the 1D representation of the channel hydraulics in the vicinity of the railway is poor. The channel cross-section upstream of the railway (which has also been replicated in the additional two sections) provides an artificial contraction, having a much smaller cross-sectional geometry than the bridge opening. This is why the bridge conveyance is improved when the channel sections have been modified for the Design scenario. It is recommended that the representation of the channel and structure hydraulics through the Olympic Highway and railway is reviewed and updated to ensure that the cross-damper capacity is being represented accurately. Ideally this would be undertaken through conversion to a fully-2D representation. The outcome of this is likely to be an increased conveyance of flood waters through the rail bridge and a reduction in upstream flood levels. If the upstream flood levels can be sufficiently reduced in the Existing scenario then mitigation might not be required to resolve the 25 mm impact, i.e. if there is no overtopping of the railway then the Design will not impact the flood behaviour.		Opportunity	Yuen Lu	DJV Flood Modeler	02/12/25	The TUFLOW model was adapted from the received model of Yarralua, Ladywinb and Uranquinty Floodplain Risk Management Studies and Plans (GRC, 2021), in which the bridge structures and Sandy Creek were modelled as 1D. Since the model was calibrated, the methodology of representations of the river channel and bridge structures was retained as the same. 22/09/2025 (YL): As per the response to E3, the representations of Sandy Creek Railway Bridge and Olympic Highway Bridge over Sandy Creek were converted from 1D to 2D. The full compliance were achieved for IFC design. The results and description were included in 5-0052-210-HY-W1-RP-0001_A.		Daniel Williams	Hatch	16/04/2025	CLOSED	It would be OK if the 1D model representation wasn't integral to the simulation of the design works and the resultant modelled impacts. However, as discussed above, the 1D representation of the creek in the vicinity of the rail embankment is inadequate to assess the potential flood impacts associated with the design works with a sufficient degree of certainty. *** It is requested that the recommended model changes be implemented, as discussed above ***		
5	5-0052-210-HY-W1-RP-0001_G	TUFLOW files	Hatch	Sam Drysdale	Flood Assessment	11/09/2025	IFC	In response to Comments #3 and #4, the model representation of Sandy Creek was totally converted to 2D. Large changes in velocity and level were noted at the end of the 1D representation upstream of the rail corridor. A fully 2D representation has been undertaken as a sensitivity within the proof engineering which demonstrated comparable flood flows being simulated through the rail bridge structure to those in the 1D/2D model. On the basis Comments #3 and #4 have been closed.			Yuen Lu	DJV Flood Modeler	03/02/25	Block: However, according to TUFLOW recommendations, the pier form loss coefficients in Hydraulics of Bridge Waterways are calculated based on the cross-sectional averaged velocity through the bridge opening without piers present. Therefore, specifying a blockage value is not required when using a pier form loss coefficient derived by this method. Sensitivity testing based on proof engineering indicates that the design continues to satisfy the criteria, and thus no further action will be taken.		Darren Lyons	Hatch	23/09/2025	NO CHANGES	Noted that the TUFLOW user states it is not necessary. However, by not introducing a blockage, the simulated velocity through the structure is lower than it should be. It is a better approach to retain the blockage and reduce the applied form loss accordingly. However, in this instance the impact to the outcome of the assessment has been confirmed to be negligible.		
6	5-0052-210-HY-W1-RP-0001_G	TUFLOW files	Hatch	Sam Drysdale	Flood Assessment	11/09/2025	IFC	The rates of blockage and form loss factors for the Sandy Creek rail bridge (no blockage and 0.04 form loss) could not be confirmed. A sensitivity assessment within the proof engineering was undertaken using the provided 1D/2D model, with form losses derived by the proof engineers (15% blockage and 0.2 form loss based on a 10 degree skew during peak flood flow conditions). This sensitivity produced a slight increase in modelled peak flood level impacts but these still satisfy the GDI, return.		Minor	Yuen Lu	DJV Flood Modeler	03/02/25	A model validation has been demonstrated throughout the design iterations, its formal inclusion and justification in the final report may be prudent to ensure transparency and support the credibility of the modelling outcomes. However, it is understood that Wagga Wagga City Council is in the process of adopting updated flood studies across the LGA, which may explain the reason behind removing the model validation references if the models are now deemed to be superseded.	Section 5	Darren Lyons	Hatch	23/09/2025	NO CHANGES	Noted		
7	5-0052-210-HY-W1-RP-0001_G	TUFLOW files	Hatch	Sam Drysdale	Flood Assessment	11/09/2025	IFC	It is noted that previous submissions included a model validation section within the reporting. While validation has been demonstrated throughout the design iterations, its formal inclusion and justification in the final report may be prudent to ensure transparency and support the credibility of the modelling outcomes. However, it is understood that Wagga Wagga City Council is in the process of adopting updated flood studies across the LGA, which may explain the reason behind removing the model validation references if the models are now deemed to be superseded.		Opportunity	Yuen Lu	DJV Flood Modeler	03/02/25	A model validation has been demonstrated throughout the design iterations, its formal inclusion and justification in the final report may be prudent to ensure transparency and support the credibility of the modelling outcomes. However, it is understood that Wagga Wagga City Council is in the process of adopting updated flood studies across the LGA, which may explain the reason behind removing the model validation references if the models are now deemed to be superseded.	Section 5	Darren Lyons	Hatch	23/09/2025	NO CHANGES	Noted		
			Hatch	Daniel Williams	Flood Assessment	23/09/2025	IFC	No further comments.			Steve Croxall	Engineering Manager	03/02/25	Noted. No action. Closed.					NO CHANGES			

APPENDIX D

External Consultant Review



Attachment 1: A2I Flood Design Report CONSULTATION - COMMENTS REGISTER

Stakeholder Category	Stakeholder Name	Flood Design Report name	Document reference (e.g.	Date raised	Topic that comment	Comments	Full Name	Company & Role	Date	Response	Documentation Section # / Figure #
State Government Agency	TfNSW	5-0052-210-IHY-G1-RP-0001_A.1 Flood Design Report - Culcairn Yard - For Consultation 5-0052-210-IHY-G2-RP-0001_A.1 Flood Design Report - Henty Yard - For Consultation 5-0052-210-IHY-G4-RP-0001_A.1 The Rock Yard - Flood Design Report - For Consultation 5-0052-210-IHY-W1-RP-0001_A.1 Flood Design Report - Uranquinty Yard - For Consultation 5-0052-210-IHY-W9-RP-0001_A.1 Bomen Yard Flood Design Report - For Consultation	Whole document	14/11/2024	Administrative	Multiple cross-referencing links are broken in the reports. TfNSW assumes administrative errors such as these will be corrected.	Zoe Cruice	Martinus - Engineering Manager	29/11/2024	Noted. Apologies. These will be fixed to hyperlink and reference correctly.	Rev 0 Report
State Government Agency	TfNSW	5-0052-210-IHY-G1-RP-0001_A.1 Flood Design Report - Culcairn Yard - For Consultation 5-0052-210-IHY-G2-RP-0001_A.1 Flood Design Report - Henty Yard - For Consultation 5-0052-210-IHY-G4-RP-0001_A.1 The Rock Yard - Flood Design Report - For Consultation 5-0052-210-IHY-W1-RP-0001_A.1 Flood Design Report - Uranquinty Yard - For Consultation 5-0052-210-IHY-W9-RP-0001_A.1 Bomen Yard Flood Design Report - For Consultation	Blockage Assessment section of each report	14/11/2024	Blockage assumptions	All assessments adopted a site-specific blockage, but a consistent 20% blockage for all culverts outside of the project area. What informed this assumption? If the purpose was to assess ARR2019 blockage guidelines, TfNSW suggests that the blockage rates for all culverts should be informed by this guidance as even off-site culverts have the potential to influence flows within the sites.	Yucen Lu	DJV Flood Modeller	3/12/2024	A technical memo has been provided to provide explanation and justification of the proposed approach. Please review this memo (5-0052-210-IHY-99-ME-0001) and advise if the blockage assessment and assumptions are acceptable.	Technical Memo
State Government Agency	TfNSW	5-0052-210-IHY-G1-RP-0001_A.1 Flood Design Report - Culcairn Yard - For Consultation 5-0052-210-IHY-G2-RP-0001_A.1 Flood Design Report - Henty Yard - For Consultation 5-0052-210-IHY-G4-RP-0001_A.1 The Rock Yard - Flood Design Report - For Consultation 5-0052-210-IHY-W1-RP-0001_A.1 Flood Design Report - Uranquinty Yard - For Consultation 5-0052-210-IHY-W9-RP-0001_A.1 Bomen Yard Flood Design Report - For Consultation	Blockage Assessment section of each report	14/11/2024	Blockage assumptions	Why was the ARR2019 blockage guidance not included in the design runs? One of the compliance requirements is that all modelling be undertaken in line with this guidance. The design runs have not been undertaken with this blockage guidance incorporated. A typical blockage sensitivity test would have been to include the ARR2019 blockage guidance in the design runs, and then to assess higher and/or lower rates of blockage as necessary.	Yucen Lu	DJV Flood Modeller	3/12/2024	A technical memo has been provided to provide explanation and justification of the proposed approach. Please review this memo (5-0052-210-IHY-99-ME-0001) and advise if the blockage assessment and assumptions are acceptable.	Technical Memo
State Government Agency	TfNSW	5-0052-210-IHY-W1-RP-0001_A.1 Flood Design Report - Uranquinty Yard - For Consultation	Appendix A - Mapping	14/11/2024	Climate change impact assessment	TfNSW notes that the Conditions of Approval require impacts to be managed up to and including the 1% AEP. However, the climate change assessment shows that the works are likely to have an adverse impact on future 1% AEP floods. It also shows the activation of a new flowpath that results in newly flooded areas and properties. The intention of the climate change impact assessment is unclear - was it simply a sensitivity check or was the purpose to confirm that the design is compatible with future climate change? If the later, and IRPL has considered climate change in the assessment to identify measures that may need to be taken in the future to address increased impacts due to climate change, then the design appears to warrant further refinement to address identified increased impacts due to climate change.	Yucen Lu	DJV Flood Modeller	3/12/2024	As per the Conditions of Approval E42, flood impact assessment is only up to 1% AEP design event. So 1% AEP climate change is for sensitivity test only. This will be clearly stated in the Section 6.5.2 in the next design stage report.	Rev B report



MARTINUS 

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