











#### **Document Control**

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### **TABLE OF CONTENTS**

GLO	GLOSSARY		
1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 1.10 1.11 1.12 2 2.1 2.2	A2P PROJECT INTRODUCTION  Albury to Parkes (A2P)  Project Scope  Site Description  Objectives  Scopes  Previous Studies  Purpose and Requirements  Information Documents  Inputs  Flood Assessment of IFC Design - 1% AEP  Outputs  Limitations and Assumptions  COMPLIANCE WITH REQUIREMENTS  Project Scope and Requirements  Conditions of Approval – Flooding		
2.3 3.1 3.2 3.3 3.4 3.5	Updated Mitigation Measures - Flooding  CHANGE MANAGEMENT  Concept Design to SDR  SDR to PDR  PDR to DDR  DDR to IFC Rev 0.  IFC Rev 0 to IFC Rev 1		
<b>4</b> 4.1 4.2	MODELLING METHODOLOGY  Hydrology Modelling  Hydraulic Modelling	24	
<b>5</b> 5.1 5.2 5.3 5.4 5.5	FLOOD ASSESSMENT  Existing Condition  Design Condition  Flood Immunity and Scour Protection  Flood Impact Assessment  Sensitivity Test	33 37 39	
6	MITIGATION MEASURES	45	
7 APP	RECOMMENDATIONS AND NEXT STAGE		
	PENDIX A		
	PENDIX B DataHub Data		
ART	C Review Comments	58	
Exter D1 –	PENDIX D	59 59	
	W Review Comments		
APP	ENDIX D2	61	

# A2I | ALBURY TO ILLABO FLOOD DESIGN REPORT – BILLY HUGHES BRIDGE – TRACK LOWERING



Albury City Council Review Request Record	61
APPENDIX E	62
Independent Flood Consultant Review	62
E1 – Review Comments Register	62
E2 – Certificate	62
APPENDIX E1	63
PE Review Comments Register	63
APPENDIX E2	64
PE Certificate	



### **LIST OF TABLES**

Table 0-1: Definitions	6
Table 1-1: Summary of Previous Flood Studies	11
Table 1-2: Available Information	
Table 2-1: Flooding Criteria within PSR Annexure B Technical Requirements	16
Table 2-2: Conditions of Approval Compliance Table – Flooding	17
Table 2-3: Update Mitigation Measures – Water Quality	20
Table 3-1: Design Differences Between Concept and SDR	
Table 3-2: Design Differences Between SDR and PDR	
Table 3-3: Design Differences Between PDR and DDR	
Table 3-4: Design Differences Between DDR and IFC	
Table 3-5: Design Differences Between DDR and IFC	23
Table 4-1: Difference in IFD (%) (ARR2019 versus ARR1987)	25
Table 4-2: Local Flooding - Model Hydrologic Parameters (Non-PMF event)	26
Table 4-3: DDR XP-RAFTS Hydrologic Model Parameters for PMF	28
Table 4-4: Hydrologic Model Comparisons (PMF Event)	28
Table 4-5: Local Flooding - Model Hydrologic Parameters (PMF Event)	28
Table 4-6: TUFLOW Model Setup	
Table 4-7: Summary of Critical Durations for local catchment modelling – Billy Hughes Bridge – Track Lowering	31
Table 5-1: Points of Interest	
Table 5-2: Peak Flood Levels – Existing Conditions	
Table 5-3: Peak Flood Levels (mAHD) at Points of Interest – Existing Conditions	
Table 5-4: Peak Flood Velocity – Existing Conditions	
Table 5-5: Peak Flood Velocity (m/s) at Points of Interest – Existing Conditions	35
Table 5-6: Flood Hazard – Existing Conditions	
Table 5-7: Peak Flood Hazard at Points of Interest – Existing Conditions	
Table 5-8: Peak Flood Levels – Design Conditions	
Table 5-9: Peak Flood Levels (mAHD) at Points of Interest – Design Conditions	
Table 5-10: Peak Flood Velocity – Design Conditions	
Table 5-11: Peak Flood Velocities (m/s) at Points of Interest – Design Conditions	
Table 5-12: Flood Hazard – Design Conditions	
Table 5-13: Peak Flood Hazard at Points of Interest – Design Conditions	
Table 5-14: Flood Level Impact Assessment	
Table 5-15: Changes in Flood Level (m) at Points of Interest	
Table 5-16: Flood Velocity Impact Assessment	
Table 5-17: Flood Hazard Impact Assessment	
Table 5-18: Structure Blockage Percentages	43
Table 5-19: Structure Blockage Parameters based on ARR2019	44



### **LIST OF FIGURES**

Figure 1-1:	Site Locations	10
Figure 1-2:	Afflux around Chainge 635+300km (Left Panel: Changes in Flood Level in 1%AEP - DDR Design vs Existing; Right	ıt
	Panel: Changes in Flood Level in 1%AEP - IFC Design vs Existing)	14
Figure 1-3:	Afflux around Chainge 634+900km (Left Panel : Changes in Flood Level in 1%AEP - DDR Design vs Existing; Right	ıt
	Panel: Changes in Flood Level in 1%AEP - IFC Design vs Existing)	14
Figure 4-1:	Albury Flood Study 2016 Flood Extent – 1% AEP Event (WMA Water, 2016)	25
	Hydrologic Model Setup for PMF	
Figure 4-3:	Model Topography	27
Figure 4-4:	TUFLOW Model Extent	30
Figure 4-5:	DDR Design in Billy Hughes	32
Figure 5-1:	Existing Conditions Flood Extent – 1% AEP event	33
Figure 5-2:	Points of Interest.	34
Figure 5-3:	Hazard Category Classification	36
Figure 5-4:	Design Conditions Flood Extent – 1% AEP event	37
Figure 5-5:	1% AEP Hazard Chainage 635+300km (Left- Changes in Flood Hazard, Right – Existing Hazard)	40
Figure 5-6:	Downstream Reporting Location	41
Figure 5-7:	1% AEP – Water Level vs Time Downstream of the Site	41
	2% AEP – Water Level vs Time Downstream of the Site	
Figure 5-9:	5% AEP – Water Level vs Time Downstream of the Site	42
Figure 5-10	1: 10% AFP – Water Level vs Time Downstream of the Site	43



### **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
CSR	Combined Services Route
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



Term	Definition
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 Mtigiation 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 requires 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-along 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:



- Daroobalgie 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 conducts a flood assessment for Billy Hughes Bridge as shown in Figure 1-1. The background and previous studies for the site are listed below.





Figure 1-1: Site Locations

#### **Background**

The Billy Hughes Bridge package forms part of the Albury to Illabo (A2I) section of works, with the proposed track lowering works located approximately between Chainage 634+640 km to Chainage 635+270 km, to enable the Plate Structure Outlines D, H and F2 to Plate D clearance (Plate F2M). In addition to track lowering, track slewing is also required to provide sufficient clearance for Inland Rail traffic.

Based on the new track alignment, construction of the new formation, earthworks and a drainage network are also required.

### 1.4 Objectives

This report has been prepared to support the delivery of the Billy Hughes Bridge track lowering by providing a flood impact assessment for the Detailed Design Review (DDR) stage and an assessment of 1%AEP of Issued for Construction (IFC) design to confirm that the minor changes between IFC design and DDR design pose negligible impact on flooding. The flood assessment aims to estimate the flood behaviour within the study area and assess the potential flood impacts as a result of the rail and associated drainage design.

This report should be read in conjunction with the Detailed Design Report – Billy Hughes Bridge – Track Lowering – (5-0052-210-PEN-B5-RP-0001.)

### 1.5 Scopes

The scope of this study includes:



- Carrying out the flood assessment for the design in the DDR stage for the design events of 10%, 5%, 2%, 1% AEP, 1% AEP with climate change and PMF.
- Checking flood assessment results against the flood impact and flood immunity criteria.
- Proposing mitigation measures (if required).
- Carrying out the flood assessment for the IFC design for the event of 1% AEP and confirm the differences in flood impact caused by IFC design and DDR design are minor.

#### 1.6 Previous Studies

#### **Flood Studies**

The Albury Floodplain Risk Management Study and Plan (WMA Water, 2016), which covers the Eight Mile Creek catchment, indicated that the Billy Hughes project site is not susceptible to flooding from the Eight Mile Creek and the unnamed tributary located south of the site for events up to and including the 1% Annual Exceedance Probability (AEP) event.

Table 1-1 summarises all the flood studies associated with the Billy Hughes area.

Table 1-1: Summary of Previous Flood Studies

Item No.	Flood Study	Description
1	Albury Floodplain Risk Management Study and Plan (WMA Water, 2016),	Covers the Eight Mile Creek catchment, indicating that the Billy Hughes project site is not susceptible to flooding from the Eight Mile Creek and the unnamed tributary located south of the site for events up to and including the 1% Annual Exceedance Probability (AEP) event.
2	Eight Mile Creek Flood Study (URS,2012)	Covers the Eight Mile Creek catchment and provides some information regarding regional flooding and the hydrologic model

#### Reference Design

A high-level assessment using a drainage model was undertaken for the Billy Hughes Bridge site during Reference Design, as outlined in the following reports:

- Reference Design Report Albury (2-0008-210-PEN-01-RP-0002)
- A2I Technical Paper 11 (2-0008-210-EAP-00-RP-0010)

The Reference Design Report determined that the enhancement site is not affected by regional flooding, however, site infrastructure may cause the redistribution of overland flows. Furthermore, it indicated that lowering the track could increase the rail drainage catchment area by approximately 0.6ha, which would be directed to an existing culvert at Chainage 635+320 km. The design resulted in a minor increase (3.7%) in flows at culvert Chainage 635+320km, about 60m downstream (south) of the proposed drainage design outlet. The flow increase would result in an afflux of 40mm on the downstream creek floodplain.

#### **Environmental Impact Statement**

**Environmental Impact Statement:** 

 Albury to Illabo Environmental Impact Statement (EIS) Technical Paper 11 – Hydrology, flooding and water quality (July 2022) (currently under planning assessment)

The Billy Hughes site was investigated as part of the EIS as discussed in the draft Albury to Illabo EIS Technical Paper 11 – Hydrology, flooding and water quality (July 2022).

On 8th October 2024, the A2I project received Planning Approval. As such, a qualitative assessment has been undertaken to comply with the conditions of approval, and assess the flood conditions of the site based on the Albury Floodplain Risk Management Study and Plan (WMA Water, 2016). It was found that the site is not affected by regional flooding in events up to and including the 1% AEP, however, site infrastructure may cause redistribution of overland flows.



#### 1.7 Purpose and Requirements

The primary purpose of this flood assessment report is to investigate the flood behaviour and its potential flood impact and demonstrate compliance with the CSSI Planning Approval Conditions of Approval, based on the latest DDR & IFC design.

#### 1.8 Information Documents

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

- Albury Floodplain Risk Management Study and Plan Report (WMA Water, 2016)
- Albury to Illabo (A2I) and Stockinbingal to Parkes (S2P) Projects Reference Design Report Albury (WSP, June 2022), 2-0008-210-PEN-01-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 (under assessment)

#### 1.9 Inputs

The inputs to this flood assessment report include:

- Australian Standards and Guidelines: AS 7637 Railway Infrastructure Hydrology and Hydraulics
- Australian Rainfall and Runoff: A Guide to Flood Estimation 2019 v4.1
- Austroads Guide to Bridge Technology Part 8: Hydraulic Design of Waterway Structures
- Inland Rail Climate Change Risk Assessment Framework

#### **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	Туре	Description / Comments
1	Albury Floodplain Risk Management Study and Plan Report (WMA Water, 2016)	PDF	This report provided an indication of the risk posed to the site from regional flooding. In addition, this report provided relevant rainfall losses that were utilised in the DJV TUFLOW hydraulic model.
2	MIKE FLOOD model as part of Albury Floodplain Risk Management Study and Plan report (WMA Water, 2016)	MIKE FLOOD hydraulic model	This MIKE FLOOD model provided the existing drainage details that were utilised in the DJV TUFLOW hydraulic model.
3	Eight Mile Creek Flood Study (URS,2012)	PDF	Covers the Eight Mile Creek catchment and provides some information regarding regional flooding and hydrologic model
4	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	Downloaded from https://elevation.fsdf.org.au/ on 28/09/2023.  The information is in 1m resolution in the GDA2020 projection.
5	LiDAR 2015 and High-Resolution Aerial Imagery. The data derived points have an accuracy of 0.15m (68% confidence interval) ARTC LiDAR	TIF format in 1m resolution in GDA94	The existing 1m LiDAR (provided by ARTC) was received from Martinus on 12/11/2024.  However, the LiDAR2020 (item 4) is newer and in GDA2020. Therefore, only LiDAR 2020 (item 4) is used.
6	A2P BLH EXT Converted GDA20Z55.12da	12da	Received on 1/5/24



Item	Information	Туре	Description / Comments
	A2P BLH EXT GDA20Z55_RAIL.12da A2P BLH EXT GDA20Z55_ROAD.12da		Existing Conditions Survey in the GDA 2020 Projection from Martinus.
7	A2P BLH EXT GDA20Z55 COMBINED_240918.12daz A2P BLH EXT GDA20Z55 COMBINED_240918.dxf	12da and dxf	Received on 19/9/24  Updated Existing Conditions Survey in the GDA 2020 Projection from Martinus.
8	BILLY HUGHES BALLAST DEM dem BILLY HUGHES CAPPING DEM dem BILLY HUGHES B5 CIVIL DEM.dem	dem	Received on 21/10/24  Design civil Surface in the GDA 2020  Projection from DJV Civil Team
9	5-0052-210-CCW-B5-MD-0001- BILLY_HUGHES_BRIDGE_3D_CIVIL _DESIGN_STRINGS_12D.12daz	12da	Received on 12/9/24  Design civil strings in the GDA 2020  Projection from DJV Civil/Rail Team
10	B5-WIP-DDR.12daz B5-WIP-DDR PIT SCHEDULE.xlsx	12da and excel	Received on 10/9/24  Design Pits/Pipes Network from DJV  Drainage Team
11	BILLY HUGHES B5 BALLAST DEM 0.2m grid - IFC.dem BILLY HUGHES B5 CIVIL DEM 0.2m grid - IFC.dem	dem	Received on 10/04/25  Design civil Surface (IFC) in the GDA 2020  Projection from DJV Civil Team.

### 1.10 Flood Assessment of IFC Design - 1% AEP

Modelling of the IFC design (item 11 in Table 1-2) was undertaken for the 1% AEP design as below and it was determined that the changes between DDR and IFC are very minor. The details are as below:

- The cess drain was widened locally to fit the drainage pits from 800mm to 900mm from Chainage 635+050km to Chainage 635+200km. The DDR flood results show the water level is very shallow and well confined within the cessdrain. After widening, the water level is not expected to show a major difference. Figure 1-2 shows a comparison between IFC and DDR flood impact. It can be seen that there are immaterial changes to the flood level impact around the area of the cessdrain discharge point between DDR and IFC.
- The RMAR vertical alignment was adjusted to get additional clearance at Chainage 634+900km. The DDR flood results show that the RMAR area is outside of the flood extent. Therefore, the changes in RMRA would not cause any difference in flooding. Figure 1-3 shows a comparison between IFC and DDR flood impact. It shows that there are no changes to the change in flood levels in this area.



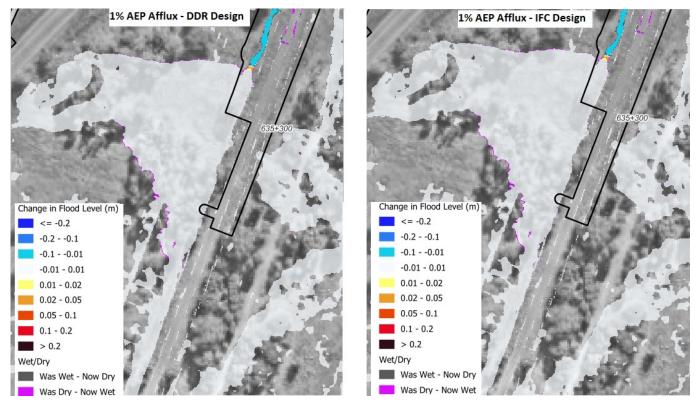


Figure 1-2: Afflux around Chainge 635+300km (Left Panel: Changes in Flood Level in 1%AEP - DDR Design vs Existing; Right Panel: Changes in Flood Level in 1%AEP - IFC Design vs Existing)

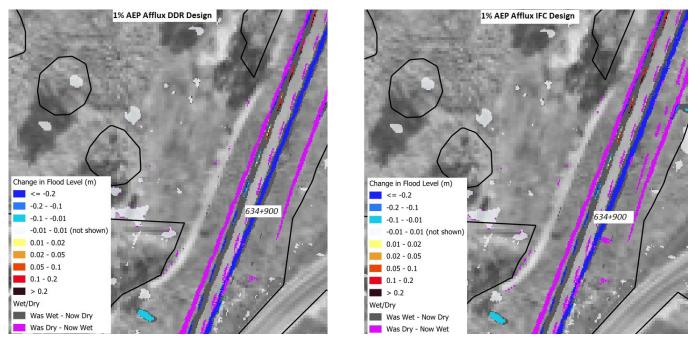


Figure 1-3: Afflux around Chainge 634+900km (Left Panel: Changes in Flood Level in 1%AEP - DDR Design vs Existing; Right Panel: Changes in Flood Level in 1%AEP - IFC Design vs Existing)

Overall, the IFC design does not cause material change to the DDR flooding assessment results. Therefore, the DDR flood assessment results are presented in this report from Section 2 onwards.

### 1.11 Outputs

The list of flood maps, along with the maps are included in Appendix A.



#### 1.12 Limitations and Assumptions

The following limitations and assumptions are applied to the Billy Hughes Bridge site.

- The hydraulic and hydrologic model and results of the previous flood study (Albury Floodplain Risk Management Study, WMA 2016) are currently unavailable.
- Based on the flood maps, it is inferred that the site is not subjected to regional flooding in events up to and including the 1% AEP as per the Albury Floodplain Risk Management Study and Plan (WMA Water, 2016).
- The details of the existing culverts used in the TUFLOW hydraulic model developed for this study were obtained from the MIKE FLOOD hydraulic model used in the Albury Floodplain Risk Management Study and Plan (WMA Water, 2016).
- The TUFLOW Flood depths have been 'filtered' using a map cut-off depth of 0.05 m as per industry practice to eliminate immaterial sheet flow. However, the figures of changes in flood level (Figures A37-A40) are without a depth cut-off to avoid overstating flood impacts.
- The TUFLOW Rainfall-on-Grid hydraulic model has not been calibrated or validated based on historical data.
- An assessment of temporary works and staging has not been undertaken.
- Flood immunity is in accordance with Clause 5.4.2 and Clause 5.4.3 of Annexure B of PSR (see Table 2-1)
- Confirmation of the invert level of the existing culvert has been requested, and will be confirmed and included in the next submission. The latest DDR survey has been incorporated into this assessment and results.
- 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 is adopted for all the other culverts, pits and pipes outside the project boundary.



### 2 COMPLIANCE WITH REQUIREMENTS

### 2.1 Project Scope and Requirements

Assessment of the DDR detailed design, to determine if it meets the Project Scope and Requirements (PSRs), has been undertaken. This is demonstrated throughout the flood assessment with Table 2-1 below summarising the Billy Hughes site Design's Compliance with the PSRs.

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 (structure modifications do not affect waterway flow)
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.	Compliant. See Section 5.3
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.	Compliant. See Section 5.3
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 (existing bridge will not be modified)
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.	Climate Change assessment was carried out by running the 1% AEP + 2090 RCP 8.5.  Refer to Section 0.
A2I Technical Requirements*	IR-SR-A2I- 349	The Corridor System for Enhancement Corridors shall have a flood immunity of no worse than existing.	Compliant. See Section 5.3
A2I Technical Requirements*	IR-SR-A2I- 350	The Corridor System, where the existing track is lowered, shall maintain the existing flood immunity.	Compliant. See Section 5.3
A2I Technical	IR-SR-A2I-	The Corridor System shall prevent damage of	Not assessed in this report.
Requirements*	quirements* 352 the formation due to ponding of water.		Refer Detailed Design Report (5- 0052-210-PEN-B5-RP-0001) for drainage design
A2I Technical Requirements*	IR-SR-A2I- 458	The Corridor System shall prevent ponding in longitudinal open channels.	Not assessed in this report.  Refer Detailed Design Report (5-0052-210-PEN-B5-RP-0001) for drainage design



Requirement	Identifier	A2P Technical Requirements Description	Compliance Evidence Reference
A2I Technical Requirements*	IR-SR-A2I- 459	The Corridor System for Enhancement Corridors shall provide mitigation for flood impacts no worse than existing condition.	There are no non-compliant flood impacts.  Refer to Section 5.4
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.	There are no non-compliant flood impacts.  Refer to Section 5.4
A2I Technical Requirements*	IR-SR-A2I- 465	The Corridor System shall minimise changes to the existing or natural flow patterns.	There are no non-compliant flood impacts and flow behaviour is largely maintained. Refer to Section 5.4
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 underbridges (culverts or under-track encasements) in this scope of work
A2I Technical Requirements*	IR-SR-A2I- 735	The Third-Party System private roads shall have flood immunity no worse than existing.	N/A No third-party private roads are present near the site
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 below.

<sup>\*</sup>A2I Technical requirements are used in A2P as A2P forms part of A2I.

## **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 presented the table below.

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 5.4
E39	The CSSI must be designed with the objective to meet or improve upon the flood performance identified in the documents listed in <b>Condition A1</b> . 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 5.4



Condition #	Condition or Criteria	Compliance Evidence Reference
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 <b>Condition A1</b> . This modelling must include:	Compliant.  The model was evaluated for 10%AEP, 5%AEP, 2%AEP, 1%AEP, 1%AEP + Climate Change and PMF. Aside from those, the model is also evaluated for 1%AEP with blockage assessment.  Refer to Section 5.
E40	a) Hydrologic and hydraulic assessments consistent with Australian Rainfall and Runoff – A Guide to Flood Estimation (GeoScience Australia, 2019);	Compliant. Section 4 and Appendix B shows that ARR2019 guidelines were used for this assessment.
E40	b) Use of modelling software appropriate to the relevant modelling task;	Compliant. Section 4.2 shows that the 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 0 shows that field survey was incorporated into the flood model.
E40	d) Confirmation of predicted afflux at industrial properties adjacent to Railway Street, Wagga Wagga based on field survey.	N/A – Railway Street, Wagga Wagga is not included in this package.
E40	Updated flood modelling must be made publicly available in accordance with <b>Condition B18</b> .	Flood design report and independent review of the flood design report shall be provided 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 <b>Conditions E38 and E40</b> 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 <b>Condition A16,</b> 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 Proof Engineer's specialist contractor, who satisfies and complies with the requirements of A16.  Consultation with the Council and other Stakeholders is being 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 E46 items below
E42	(a) a maximum increase in inundation time of one hour, or 10%, whichever is greater;	Compliant. Refer to Section 0
E42	(b) a maximum increase of 10 mm in above-floor inundation to habitable rooms where floor levels are currently exceeded;	Compliant. No flood level increase of 10mm in above-floor inundation on any properties.  Refer to Section 5.4



Condition	Condition or Criteria	Compliance Evidence Reference
#		·
E42	(c) no above-floor inundation of habitable rooms which are currently not inundated;	Compliant. No increase for above-floor inundation of habitable rooms on any properties.
		Refer to Section 5.4
E42	(d) a maximum increase of 50 mm in inundation of land zoned as residential, industrial or commercial;	Compliant. No flood level increase of more than 50mm in residential, industrial and commercial areas.
		Refer to Section 5.4
E42	(e) a maximum increase of 100 mm in inundation of land zoned as environment zone or public recreation;	Compliant. No flood level increase of more than 100mm in the environment zone or public recreation.
		Refer to Section 5.4
E42	(f) a maximum increase of 200 mm in inundation of land zoned as rural or primary production, environment zone or public recreation;	Compliant. No flood level increase of more than 200mm in rural or primary production, environment zone or public recreation
		Refer to Section 5.4
E42	(g) no increase in the flood hazard category or risk	Compliant.
	to life; and	Refer to Section 0
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 0
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	Compliant.
	of <b>Condition E46</b> ; and	Refer to Section 5
E43	b) the results of consultation with the relevant council in accordance with <b>Condition E50</b>	Refer to E50
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.
E44	The Flood Design Report required by Condition E47 must be approved by the Planning Secretary	This report will be submitted to the Planning Secretary for approval prior to the



Condition #	Condition or Criteria	Compliance Evidence Reference
	prior to works that may impact on flooding or the relevant council's stormwater network.	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 <b>Condition E47</b> .	Local drainage flow regime, catchment area and imperviousness remain the same as per existing condition, there is no additional flow towards existing Council's stormwater network. The design has not worsened the existing flooding condition.  Discharges to Council's stormwater network has been consulted with Albury City Council through staged design submissions and receipt of review comments. Details are documented in 5-0052-210-PEN-B5-RP-0001.

#### **Updated Mitigation Measures - Flooding** 2.3

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 the table below.

Table 2-3: Update Mitigation Measures – Water Quality

Condition #	Condition or Criteria	Compliance Evidence Reference	Comment if non-compliant
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 Council and other relevant authorities will be undertaken through 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 report relates to the Billy Hughes site, and so is not relevant to Wagga Wagga Yard.	



	Condition #	Condition or Criteria	Compliance Evidence Reference	Comment if non-compliant
		This would be informed by topographic and building floor surveys and a review of localised drainage structures (as required).	Compliant. Quantitative assessment has been undertaken. Refer	
	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 impacted by drainage and/or flooding. The outcomes of the assessment are to be provided to DCCEW-BCS	to Section 5.		
	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.	This report relates to the Billy Hughes site, and so 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.

Table 3-1: Design Differences Between Concept and SDR

Item	Difference	Reason for Change
1	DJV created a new TUFLOW hydraulic model to model the area of interest	No TUFLOW hydraulic model was available for Proposal stage.

#### 3.2 SDR to PDR

Flood modelling is not applicable to this stage.

Table 3-2: Design Differences Between SDR and PDR

Item	Difference	Reason for Change
1	Incorporation of the latest existing conditions survey	A new existing conditions survey was undertaken
2	Incorporation of updated rail design (ballast, capping and top of rail)	New rail design
3	Incorporation of design drainage (cess drain + pits + pipes)	New drainage design
4	Incorporation of mitigation measures (widened design channel)	Mitigation option

#### 3.3 PDR to DDR

The received TUFLOW model (item 1 in Table 1-2) was updated to be in line with ARR2019 for this DDR assessment.

Table 3-3: Design Differences Between PDR and DDR

Item	Difference	Reason for Change
1	Incorporation of the latest existing conditions survey	A new existing conditions survey was undertaken for DDR design stage.
2	Incorporation of updated rail design (ballast, capping and top of rail)	New DDR rail design
3	Incorporation of design drainage (cess drain + pits + pipes)	New DDR drainage design
4	Update Hydrology and Hydraulic models to run the Probable Maximum Flood (PMF)	Updated dCoA conditions require PMF to be run
5	Update Hydraulic and Hydrologic models based on Proof Engineering comments	Modified some hydraulic and hydrologic parameters based on Proof Engineering review comments

#### 3.4 DDR to IFC Rev 0

Key changes between the DDR and the IFC Design is listed in Table 3-4.



Table 3-4: Design Differences Between DDR and IFC

Item	Difference	Reason for Change
1	Updating text and methodology section to clearly reflect development of model extent	To address ARTC review comments
2	Carrying out 1% AEP flood assessment for IFC design	To determine the minor changes between IFC design and DDR design will not impact flooding

#### 3.5 IFC Rev 0 to IFC Rev 1

Key changes between the Rev 0 and the Rev 1 report is listed in the table below.

Table 3-5: Design Differences Between DDR and IFC

Item	Difference	Reason for Change
1	Corrected cross-reference to Conditions in Table 2-2 for E41	To address TfNSW review comment
2	Reworded description of consultation with Council and other stakeholders for CoA E41 in Table 2-2	To address a TfNSW review comment made on another package, but equally applicable to this one.



#### 4 MODELLING METHODOLOGY

This flood assessment comprises a TUFLOW hydraulic model, an XP-Rafts Hydrologic model and a desktop analysis based on The Albury Floodplain Risk Management Study and Plan (WMA Water, 2016).

The overall approach for flood modelling is listed below:

- Creation of a new Rainfall-on-Grid TUFLOW hydraulic model, to model local catchment flooding for the area
  of interest around Billy Hughes Bridge to represent the existing pre-development conditions using existing
  conditions survey, LiDAR and drainage information from the MIKE Flood Model as per the Albury Floodplain
  Risk Management Study and Plan report (WMA Water, 2016)
- Creation of a XP-Rafts Hydrologic model to represent regional flooding in the Probable Maximum Flood (PMF) of Eight Mile Creek based on information in the Eight Mile Creek Flood Study (URS,2012). Incorporate Regional Flooding inflow into an additional PMF TUFLOW hydraulic model based on results from XP-Rafts Hydrologic model results.
- The existing ground surface of the catchment used in the hydraulic model was based on the 1m resolution LiDAR data acquired from the Elevation Information System (ELVIS, https://elevation.fsdf.org.au). Feature survey data was used to represent the topography within the project site. The hydraulic model was run using a 1m cell size.
- Manning's roughness coefficients were selected based on land zoning, aerial imagery and the guidance in ARR2019.
- The TUFLOW hydraulic model uses the Australian Rainfall and Runoff (ARR2019) input parameters and the Australian Bureau of Meteorology (BoM) rainfall data.
- Use of the rainfall losses as per ARR2019 Guidelines (Probability Neutral Burst Initial Loss and Continuing Losses). Initial and continuing losses were considered and applied using a rainfall excess approach.
- Three types of boundary conditions were used. The first one is rainfall excess hyetographs for internal catchment inflow boundaries, and the second one is a normal flow boundary condition for the downstream ends of the model. For the PMF case, a further Flow vs Time boundary condition was added to represent the flow from the Eight Mile Creek catchments.
- As per ARR2019 guidelines, running of an ensemble of durations and temporal patterns to determine the critical storm durations for the site area.
- Update the existing condition TUFLOW hydraulic model to the design condition by incorporating the rail and drainage design into the existing condition hydraulic model.
- Undertaking the flood impact assessment for the 1%, 2%, 5% and 10% AEP events (Refer to Section 0 for details)
- Conducting a climate change risk sensitivity assessment for the 1% AEP to inform the potential impact on the railway track flood immunity.
- Conducting a blockage sensitivity assessment for the 1% AEP event as per ARR2019 guidelines.
- Flood depths have been 'filtered' using a map cut-off depth of 0.05 m. However, the figures of changes in flood level (Figures A37-A40) are without a depth cut-off to avoid overstating flood impacts.
- The TUFLOW hydraulic model set-up is summarised in Table 4-6 and the model extent is shown in Figure 4-4.

### 4.1 Hydrology Modelling

The Albury Floodplain Risk Management Study and Plan (WMA Water,2016), covers the Eight Mile Creek catchment, indicates that the Billy Hughes project site is not susceptible to regional flooding for the 1% Annual Exceedance Probability (AEP) event, as shown in Figure 4-1. For the PMF event, this has the potential for the regional flooding from Eight Mile Creek to impact the site area.



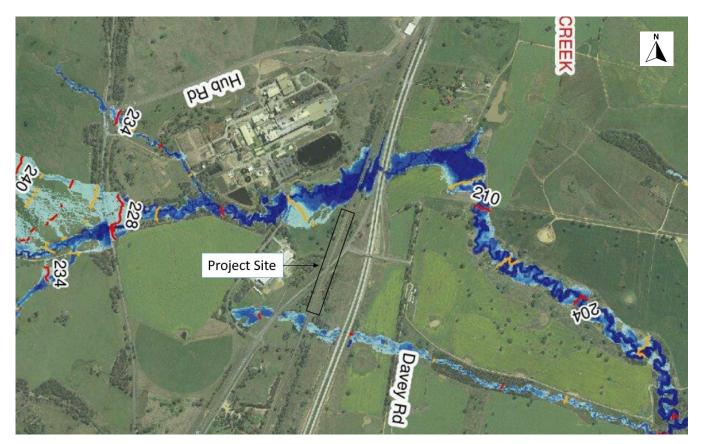


Figure 4-1: Albury Flood Study 2016 Flood Extent - 1% AEP Event (WMA Water, 2016)

For events up to and including the 1% AEP, this previous study which utilised a regional catchment model, the superseded Australia Rainfall and Runoff 1987 (ARR1987) design event rainfall approach was used, to determine the catchment runoff and hence flood levels and inundation extents. A desktop assessment was conducted to assess the potential risk and understand the implications of updating the modelling in accordance with the current ARR2019 methodology. For the PMF event, as discussed below, a hydrologic model was developed to determine the regional flows from Eight Mile Creek.

#### **Methodology (non-PMF events)**

Table 4-1 compares the design rainfall data from ARR2019 to the data from ARR1987 for the area of interest (extracted at Latitude -36.0033 and Longitude 146.9885). Generally, the ARR2019 Intensity-Frequency-Duration (IFD) values are lower than the ARR1987 values, except for the shorter/lower magnitude events. The previous study (WMA Water, 2016) showed that the critical durations for the catchment were two-hour and six-hour events. It should be noted that for the 1% AEP event, the previous study (WMA Water, 2016) indicates that the area around the Billy Hughes site is unaffected by regional flooding. Given that the ARR2019 design rainfall values for the 1% AEP event are lower than those of ARR1987, it is expected that the new ARR methodology will result in lower regional event flow rates, flood inundation extents, and flood levels as compared to the previous study.

Table 4-1: Difference in IFD (%) (ARR2019 versus ARR1987)

Duration	Rainfall Intensity difference between ARR2019 and ARR1987 (%)					
	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
5 mins	9%	7%	7%	3%	-2%	-6%
10 mins	11%	11%	12%	7%	1%	-2%
20 mins	7%	8%	9%	0%	0%	-3%
30 mins	1%	2%	4%	0%	-3%	-6%
1 hour	-6%	-4%	-2%	-6%	-10%	-12%



Duration	Rainfall Intensity difference between ARR2019 and ARR1987 (%)					
	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
2 hours	-10%	-8%	-7%	-10%	-14%	-16%
3 hours	-10%	-10%	-8%	-11%	-14%	-16%
6 hours	-13%	-12%	-10%	-12%	-16%	-17%
24 hours	-20%	-15%	-12%	-14%	-14%	-14%
48 hours	-23%	-18%	-11%	-12%	-5%	-3%

Therefore, as the site will not be affected by regional flooding in events up to and including the 1% AEP event, no hydrologic model was developed for these events. Local catchment hydrology was modelled directly within TUFLOW using a Rainfall-on-Grid method.

As per Table 4-2 the rainfall losses used were as per ARR2019 guidelines with the adoption of Probability Neutral Burst Initial Losses and Continuing Losses. The hydrologic parameters that are described are provided in Appendix B.

Using the TUFLOW hydraulic model, an ensemble of duration and temporal patterns was run for each modelled AEP event, and a critical duration analysis was undertaken for the site area. These durations were then used for the flood assessment.

Table 4-2: Local Flooding - Model Hydrologic Parameters (Non-PMF event)

Parameters	Value	Notes
Initial Loss	Probability Neutral Burst Initial Loss	ARR Datahub (see Appendix B)
Continuing Loss	1.8 mm/hr	ARR Datahub (see Appendix B)
Events	1% + Climate Change, 1%, 2%, 5% and 10% AEP	-
Durations	10min to 720min	-
Temporal Patterns	10 Temporal Patterns for each duration	As per ARR2019 guidelines

#### **Methodology (PMF event)**

An XP-RAFTS Hydrologic model was set up to determine the flows in the PMF event for Eight Mile Creek as the regional flooding has the potential to impact the site. The model set up is shown below Figure 4-2 and the model parameters are shown in Table 4-3. The two reporting locations highlighted in Figure 4-2 represent the two locations that are used as inflows in the TUFLOW model. These inflows and model extents are shown in Figure 4-4.



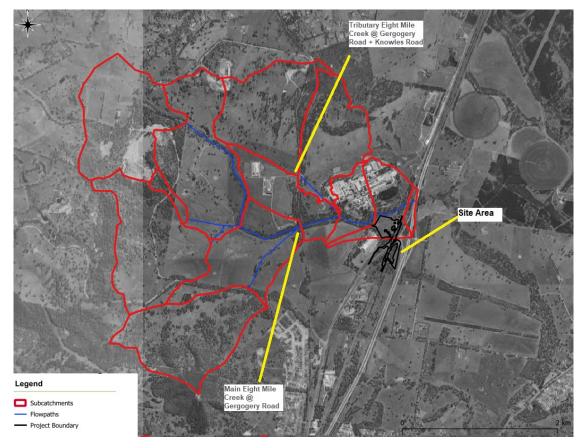


Figure 4-2: Hydrologic Model Setup for PMF

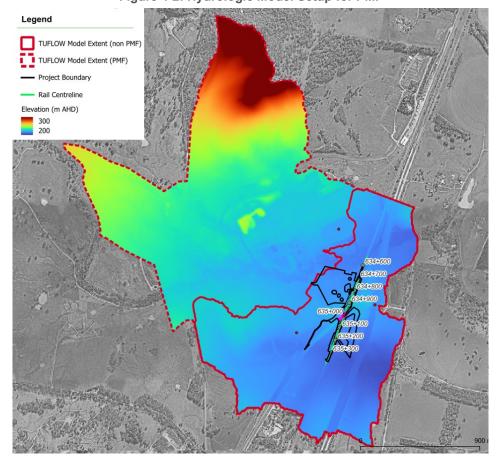


Figure 4-3: Model Topography



Table 4-3: DDR XP-RAFTS Hydrologic Model Parameters for PMF

Parameters	Value	Notes
Hydrology model and version	XP-RAFTS model (Version 2018.1) using Storm injector HL(V 1.3.7.0).	-
Total catchment area	12 km <sup>2</sup>	-
Initial Loss	0 mm	-
Continuing Loss	1 mm/hr	-
Catchment Slope	Vectored slopes based on LiDAR*	*Slopes were varied slightly in the process of comparing and deriving similar flows to flood study values (see below)
Impervious Area	Based on Aerial imagery	-
Mannings Roughness	Various roughness *based on Aerial imagery	*Pervious Mannings roughness was varied slightly in the process of comparing and deriving similar flows to flood study values (see below)
Events	PMF	-
Duration Temporal pattern received/generated	Ensemble 11 temporal patterns for GSDM PMF from 15 minutes to 180 minutes	As per ARR2019 guidelines

The Eight Mile Creek Flood Study (2012) provides peak flows from the XP-Rafts hydrological model used for the study. This was used as a point of comparison between the results generated from the developed DDR XP-Rafts model for the PMF event. Further refinement of the model was then undertaken by varying the Mannings roughness and Catchment slopes which resulted in the flows shown in Table 4-4. As shown below, the resultant flows from the DDR model are within 10% for both key points of interest. For the purposes of an apple-to-apple comparison, only the BOM (2003) Temporal Pattern was used to run and the generate peak flows tabulated in Table 4-4. However, for the existing and design runs, the full ensemble of 11 Temporal Patterns was run as stated in Table 4-5.

**Table 4-4: Hydrologic Model Comparisons (PMF Event)** 

Location	Flood Study Peak Flow (m³/s)	DDR Hydrology Model Peak Flow (m³/s)	Changes in Peak Flow (%)
Main Eight Mile Creek @ Gergogery Road	430	392	-9%
Tributary Eight Mile Creek @ Gergogery Road + Knowles Road	81	76	-6%

In addition to the XP-Rafts modelling for the regional flooding, the local catchment hydrology modelling was also undertaken simultaneously within TUFLOW using a Rainfall-on-Grid model. The parameters are shown in Table 4-5.

Table 4-5: Local Flooding - Model Hydrologic Parameters (PMF Event)

Parameters	Value	Notes
Initial Loss	0 mm	-
Continuing Loss	1 mm/hr	-



Events	1% + Climate Change, 1%, 2%, 5% and 10% AEP	-
Durations	10min to 360min	-
Temporal Patterns	11 Temporal Patterns for each duration	As per ARR2019 guidelines

### 4.2 Hydraulic Modelling

#### **Existing Conditions Model**

The TUFLOW hydraulic model set-up is summarised in Table 4-6 and the model extent is shown in Figure 4-4. The model extent is determined by the terrain and the Albury Floodplain Risk Management Study and Plan (WMA Water, 2016). The model extent captures the entire local catchment upstream of the area of interest for all events. For PMF, the external flow is used.

As shown below, the PMF event has a larger model extent to account for the regional flow from Eight Mile Creek. As per the Albury Floodplain Risk Management Study and Plan (WMA Water, 2016), the site is only affected by regional flooding in events greater than the 0.5% AEP event. Therefore, in all events other than the PMF, the model extent comprises of the local catchment while in the PMF, the model extent is increased to also account for external inflows from Eight Mile Creek.



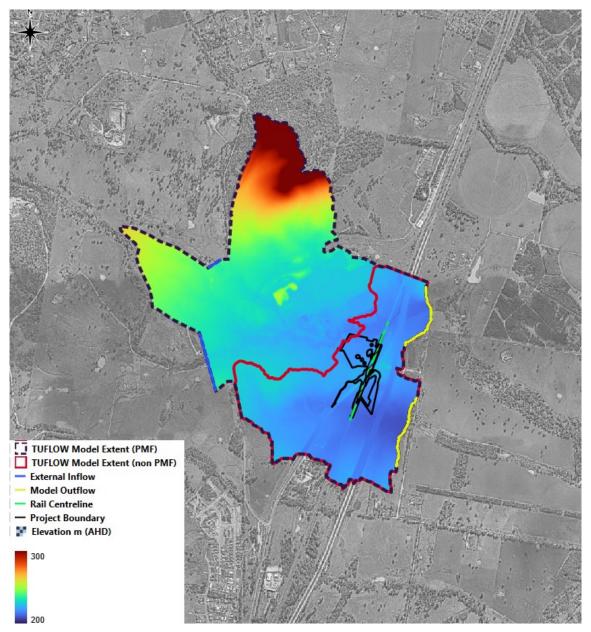


Figure 4-4: TUFLOW Model Extent

Table 4-6: TUFLOW Model Setup

Parameter	Comment
TUFLOW version	TUFLOW.2023-03-AC
Adopted Grid Cell Size	1m
Model Topography	Based on 1m LiDAR from ELVIS. Supplemented by existing conditions survey as well as design tins for design surfaces
Inflows	Rainfall-on-Grid applied with a 2d_rf layer comprising the entire model extent. For the PMF, there are two additional Flow vs Time inflows to represent regional flooding from Eight Mile Creek.
Dams Initial Water Levels	All farm dams were assumed to be full.
Drainage	Culverts, Pipes and Pits were modelled as 1d network elements with connections to the 2d domain via either 1d_nwk pits or 2d_bc lines.



Parameter	Comment
Downstream Boundary Conditions	Set as HQ (head vs flow) boundary with a slope of 0.01 based on the general slope of the area.
Manning's Roughness Values	<ul> <li>Floodplain–0.055</li> <li>RockyTerrain–0.050</li> <li>Basins/Channels/Water–0.015</li> <li>Streets/Roads–0.020</li> <li>Rail – 0.040</li> </ul>

Table 1-2 presents the relevant available information, data and inputs incorporated into the TUFLOW model, along with the dates the data was received.

#### **Drainage Network**

Existing condition drainage elements were used as per the MIKE FLOOD model, as part of the Albury Floodplain Risk Management Study and Plan report (WMA Water, 2016). Some existing culvert levels were updated based on the survey.

#### **Design Events**

The TUFLOW hydraulic model was run for the 10%, 5%, 2%, 1% AEP, 1% AEP + climate change and the PMF. A critical duration analysis was undertaken to confirm the relevant critical duration storms in the area of interest. This involved the running of the entire ensemble of duration events and temporal patterns as per ARR2019 guidelines.

For the design events, all 10 Temporal Patterns were run for the identified critical durations to ensure that any changes in Temporal Patterns between existing and design conditions situations would be reflected in the impact assessment. For the PMF, only the critical duration and temporal patterns combination were run.

Table 4-7: Summary of Critical Durations for local catchment modelling - Billy Hughes Bridge - Track Lowering

Design Events	Critical Durations	Critical temporal pattern ID
10% AEP	20min/30min/180min	All 10 TPs
5% AEP	20min/30min/180min	All 10 TPs
2% AEP	20min/30min/180min	All 10 TPs
1% AEP	20min/30min/180min	All 10 TPs
1% AEP + Climate Change	20min/30min/180min	All 10 TPs
PMF	120min/150min	TP03/TP05

#### **Climate Change**

There are no design criteria to assess for flood impacts in a climate change scenario. Therefore, a sensitivity assessment was conducted to anticipate future climate change flood risk. As per the EIS report (Section 3.3.5 of Albury to Illabo Environmental Impact Statement Technical Paper 11) and the agreement between the Contractor and ARTC for the continued use of the prior version of ARR2019 climate change method (refer to IR2140-RTRFI-000773), the Year 2090 RCP8.5 interim climate change factor sourced from the ARR Data Hub (https://datalegacy.arr-software.org/) was adopted. The use of the 2090 RCP8.5 interim climate change factor is associated with a 20.2% increase in rainfall.

#### **Design Conditions Model**

For the design conditions, the existing conditions model was updated with the following (Figure 4-5):

- DDR Track Design
- DDR Drainage Design



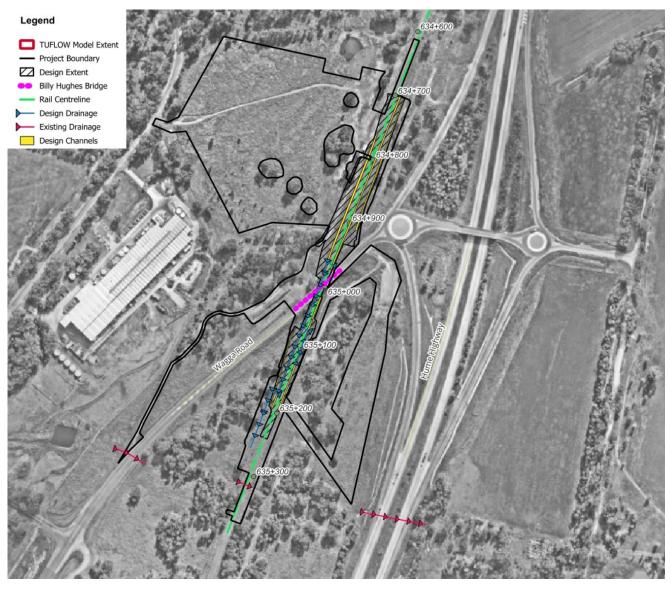


Figure 4-5: DDR Design in Billy Hughes



#### 5 FLOOD ASSESSMENT

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

### **5.1** Existing Condition

In existing conditions, the relatively small catchment area near the bridge results in shallow flows, reaching in a maximum depth of 400 mm north of Wagga Road and up to 1.25m at the existing cross culvert at Chainage 635+200km. This can be seen in Figure 5-1.

Velocities are also relatively low, peaking at 1.0 m/s in the vicinity of the site area near the rail line. The rail line remains unaffected and maintains flood immunity during the 1% AEP event.

Flood hazard is generally small, being H1 Hazard Category for the majority of the site, with small patches of H2 and H3 in areas in the existing channels, north of Wagga Road and on the southern end of the site near the existing cross culvert at Chainage 635+200km.

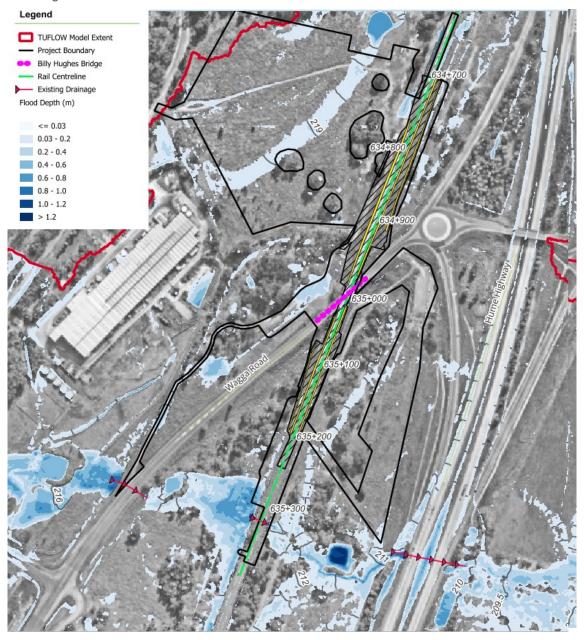


Figure 5-1: Existing Conditions Flood Extent – 1% AEP event



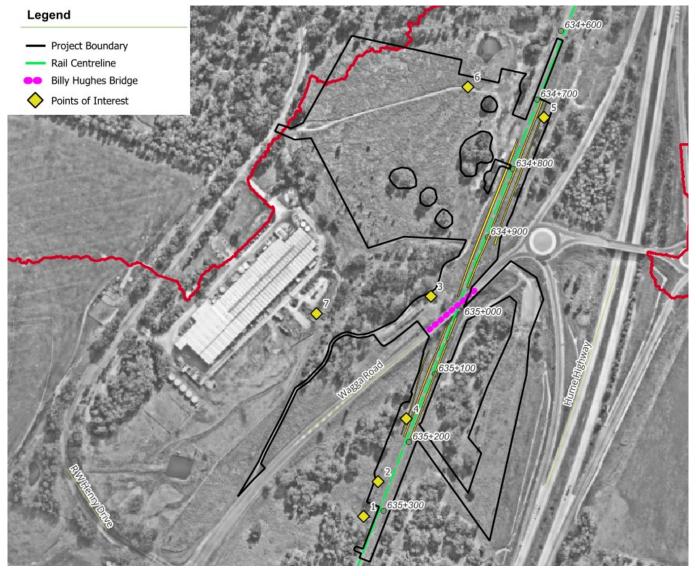


Figure 5-2: Points of Interest

Figure 5-2 shows points of interest 1 to 7 that have been used for the flood impact assessment presented in the following sections and Table 5-1 below describes the location at each point of interest.

Table 5-1: Points of Interest

Point of Interest	Notes
1	Location within the proposed design channel near the inlet to the Cross Culvert (Chainage 635+300km)
2	Location at the outlet of the drainage network (Chainage 635+260km)
3	Location at a large area of ponding immediately upstream of the bridge (Chainage 635+000km)
4	Location within the proposed design channel (Chainage 635+170km)
5	Location within the flow path that flows south-west towards the bridge (Chainage 634+720km)
6	Location on the local access road (Chainage 634+700km)
7	Location near the existing industrial building (Chainage 635+050km)



The existing condition flood behaviour is discussed in Table 5-2 to Table 5-7.

Table 5-2: Peak Flood Levels - Existing Conditions

Design Events	Flood Levels				
PMF event	The floodwaters overtop the rail (by up to 1m)				
All other % AEP events	<ul> <li>The floodwaters do not overtop the rail.</li> <li>Refer to Table 5-3 for flood level comparison based on points of interest.</li> </ul>				

Table 5-3: Peak Flood Levels (mAHD) at Points of Interest – Existing Conditions

Locations	10% AEP	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	213.45	213.55	213.68	213.77	213.91	216.38
Point 2	213.66	213.70	213.70	213.78	213.92	216.38
Point 3	221.81	221.83	221.84	221.85	221.86	220.03
Point 4	217.10	217.12	217.13	217.14	217.15	220.02
Point 5	220.29	220.30	220.31	220.32	220.33	220.47
Point 6	218.03	218.05	218.06	218.06	218.08	220.13
Point 7	220.99	221.03	221.07	221.11	221.16	222.01

Table 5-4: Peak Flood Velocity - Existing Conditions

Design Events	Flood Velocities
PMF	Peak velocities reach a maximum of 2m/s on the site area in the existing channels
All % AEP events	Peak velocities within the site are generally below 1m/s, other than in a few areas near the culvert around Chainage 635+260km and existing channels.  Pefer to Table 5.5 for flood velocity comparison based on points of interest.
	Refer to Table 5-5 for flood velocity comparison based on points of interest.

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

Locations	10% AEP	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	0.8	0.8	0.8	0.8	0.8	0.9
Point 2	0.7	0.7	0.8	0.8	0.8	1.2
Point 3	0.0	0.0	0.0	0.0	0.0	0.1
Point 4	0.5	0.5	0.5	0.6	0.5	1.4
Point 5	0.2	0.2	0.3	0.3	0.3	0.7
Point 6	0.5	0.6	0.6	0.6	0.7	1.4
Point 7	0.1	0.1	0.1	0.1	0.1	0.1

The flood hazard assessment is based on the general flood hazard classification set by the Australian Institute for Disaster Resilience in the Australian Disaster Resilience Handbook Collection - Flood Hazard, 2017. The below figure shows the classification of the Hazard categories as a function of flood depth (m) and velocity (m/s).



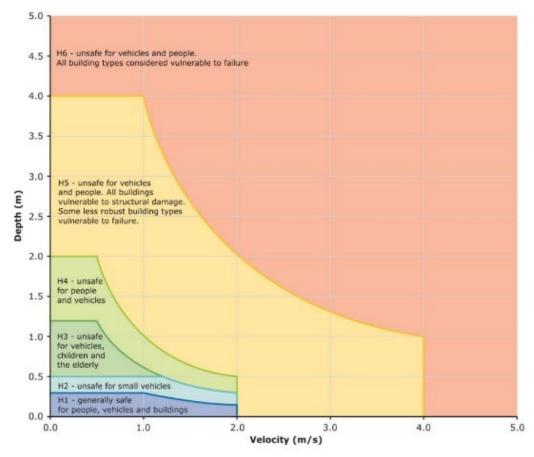


Figure 5-3: Hazard Category Classification

Table 5-6: Flood Hazard – Existing Conditions

Design Events	Flood Hazard
PMF event	<ul> <li>Peak Flood Hazard reaches a maximum of H5 Hazard Category on the site area in the existing channels</li> </ul>
All %AEP events	<ul> <li>Peak Flood Hazard is generally small, being H1 Hazard Category for the majority of the site, with small patches of H2 and H3 in areas in the existing channels, north of Wagga Road and on the southern end of the site near the existing cross culvert at Chainage 635+200km.</li> <li>Refer to Table 5-7 for a comparison of flood hazards based on the points of interest.</li> </ul>

Table 5-7: Peak Flood Hazard at Points of Interest – Existing Conditions

Locations	10% AEP	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	H2	H2	Н3	Н3	Н3	H5
Point 2	H1	H1	H1	H1	H1	H5
Point 3	H1	H1	H1	H1	H1	H2
Point 4	H1	H1	H1	H1	H1	H4
Point 5	H1	H1	H1	H1	H1	H2
Point 6	H1	H1	H1	H1	H1	H5
Point 7	НЗ	НЗ	НЗ	НЗ	НЗ	H4



# 5.2 Design Condition

The design condition hydraulic modelling incorporated the lowering of the rail track in addition to the pits, pipes and channels as per the drainage design.

The design conditions for flood behaviour are similar to those of the existing conditions, with the exception of the introduced pit, pipe, and channel network, which diverts flow to the outlet at Chainage 635+260km.

The design conditions flood depths are similar to the existing conditions, with a maximum depth of approximately 400 mm north of Wagga Road in the 1% AEP event. The design condition velocities are similar to the existing conditions, with the exception of a slight increase in the proposed design channels and the southern area of the site, where the drainage network outlets are located. Flood hazard remains consistent with the existing conditions except for a slight increase in the proposed design channels and patches in the southern area of the site where the drainage network outlets are located. Differences in flooding between design conditions and existing conditions are discussed in detail in Section 5.4.

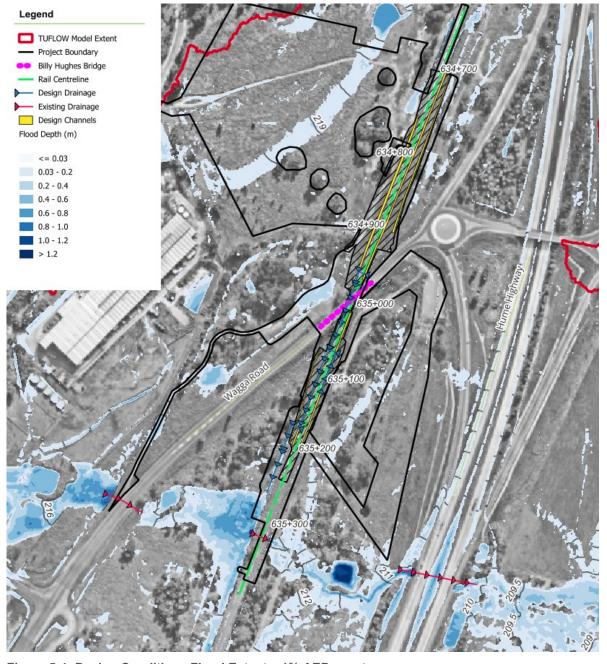


Figure 5-4: Design Conditions Flood Extent – 1% AEP event

The design conditions for flooding behavior are shown in the tables below...



Table 5-8: Peak Flood Levels - Design Conditions

Design Events	Flood Levels
PMF event	The floodwaters overtop the rail (by up to 1m)
All other % AEP events	<ul> <li>The flood waters do not overtop the rail.</li> <li>Refer to Table 5-9 for flood level comparison based on points of interest.</li> </ul>

Table 5-9: Peak Flood Levels (mAHD) at Points of Interest - Design Conditions

Locations	10% AEP	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	213.46	213.55	213.69	213.78	213.92	216.38
Point 2	213.70	213.73	213.74	213.79	213.93	216.38
Point 3	221.81	221.83	221.84	221.85	221.86	222.02
Point 4	216.80	216.92	216.93	216.93	216.94	217.52
Point 5	220.30	220.32	220.33	220.34	220.35	220.47
Point 6	218.03	218.04	218.06	218.06	218.07	220.12
Point 7	220.99	221.03	221.07	221.11	221.16	222.01

### Table 5-10: Peak Flood Velocity - Design Conditions

Design Events	Flood Velocities					
PMF Event	Peak velocities reach a maximum of 2.3m/s on the site area near the bridge					
All % AEP events	<ul> <li>Peak velocities within the site are generally below 1m/s, other than in a few areas near the existing channels.</li> </ul>					
	Refer to Table 5-11 for velocity comparison based on points of interest.					

Table 5-11: Peak Flood Velocities (m/s) at Points of Interest – Design Conditions

Locations	10% AEP	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	0.8	0.8	0.8	0.8	0.8	0.9
Point 2	0.8	0.9	0.9	0.9	0.9	1.2
Point 3	0.0	0.0	0.0	0.0	0.0	0.1
Point 4	0.3	0.3	0.3	0.3	0.3	1.5
Point 5	0.2	0.2	0.3	0.3	0.3	0.7
Point 6	0.5	0.6	0.6	0.6	0.7	1.3
Point 7	0.1	0.1	0.1	0.1	0.1	0.1

### Table 5-12: Flood Hazard - Design Conditions

Design Events	Flood Hazard
PMF event	Peak Flood Hazard reaches a maximum of H5 Hazard Category on the site area



Design Events	Flood Hazard
All %AEP events	<ul> <li>Peak Flood Hazard is generally small, being H1 Hazard Category for the majority of the site, with small patches of H2 and H3 in areas in the existing channels, north of Wagga Road and on the southern end of the site near the existing cross culvert at Chainage 635+200km.</li> <li>Refer to Table 5-13 for velocity comparison based on points of interest.</li> </ul>

Table 5-13: Peak Flood Hazard at Points of Interest - Design Conditions

Locations	10% AEP	5% AEP	2% AEP	1% AEP	1% AEP + Climate Change	PMF
Point 1	H2	H2	Н3	Н3	Н3	H5
Point 2	H1	H1	H1	H1	H2	H5
Point 3	H1	H1	H1	H1	H1	H2
Point 4	H1	H1	H1	H1	H1	H4
Point 5	H1	H1	H1	H1	H1	H2
Point 6	H1	H1	H1	H1	H1	H5
Point 7	НЗ	НЗ	НЗ	НЗ	НЗ	H4

# 5.3 Flood Immunity and Scour Protection

The flood immunity was assessed, and the railway maintained flood immunity in both existing and design conditions up to the 1% AEP event. This results in compliance with Technical Requirements IR-SR-A2I-349.

As discussed in Section 0, no areas have material increases in velocity, so no investigation into scour protection is warranted.

# 5.4 Flood Impact Assessment

The flood impact assessment was conducted, and results are summarised below for events up to and including the 1% AEP event. The following sections present the flood impact assessment outcomes.

# **Changes in Peak Flood Levels**

The impacts presented below are due to the implementation of the design surface for the rail line and the design drainage.

Table 5-14: Flood Level Impact Assessment

Design Events	Changes in Peak Flood Levels (afflux)
All %AEP events	<ul> <li>Minor localised increases are present within the rail corridor, design channels and slightly outside the project boundary, however these are all within acceptable limits. (See discussion below)</li> </ul>

Table 5-15: Changes in Flood Level (m) at Points of Interest

Locations	10% AEP	5% AEP	2% AEP	1% AEP
Point 1	No Change	0.01	0.01	0.01
Point 2	0.04	0.04	0.02	0.01
Point 3	No Change	No Change	No Change	No Change
Point 4	-0.22	-0.23	-0.23	-0.24
Point 5	0.02	0.02	0.02	0.02
Point 6	No Change	No Change	No Change	No Change



Point 7	No Change	No Change	No Change	No Change
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## **Changes in Peak Flood Velocity**

Table 5-16: Flood Velocity Impact Assessment

Design Events	Changes in Peak Flood Velocity
All %AEP events	<ul> <li>There are minor areas of velocity increases, however they all result in a change of velocity that is less than 0.5m/s and so are deemed to be compliant.</li> </ul>

# **Changes in Peak Flood Hazard**

**Table 5-17: Flood Hazard Impact Assessment** 

Design Events	Changes in Peak Flood Hazard
All %AEP events	<ul> <li>There are minor areas of increase in Hazard Category on the southern end of the site and extend outside the project boundary. However, this is unlikely to pose a risk to life (see below)</li> </ul>

As described above, the main area of concern regarding flood hazard increases in the vicinity of the outlet of the proposed drainage network around Chainage 635+260km. Within the area shown in Figure 5-5, there are patches of increase in Flood Hazard Category which are located at the transition zones between the Flood Hazard Categories. As such, these increases are most likely due to the slight variations in flood depth in the area and are likely due to model noise due to limitations of the terrain model. In addition, these slight increases are in an area where there are no roads, buildings or likely human interaction. Therefore, these are unlikely to cause a material risk to life and hence deemed compliant.

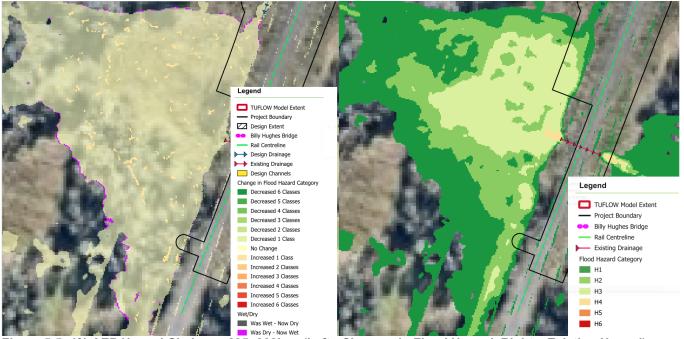


Figure 5-5: 1% AEP Hazard Chainage 635+300km (Left- Changes in Flood Hazard, Right – Existing Hazard)

### **Changes in Duration of Inundation**

Analysis of changes in duration of inundation was undertaken by the comparison of water level vs time graphs between design and existing conditions at a downstream location. As shown in the below figures, there is no material changes to the water level vs time graphs or flood behaviour as a result of the design works.



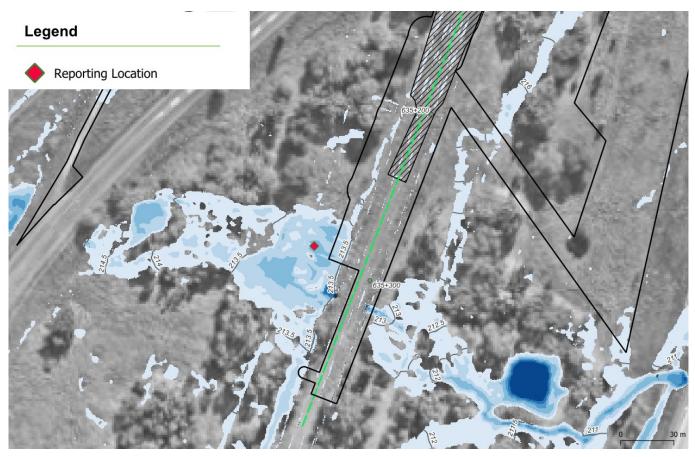


Figure 5-6: Downstream Reporting Location

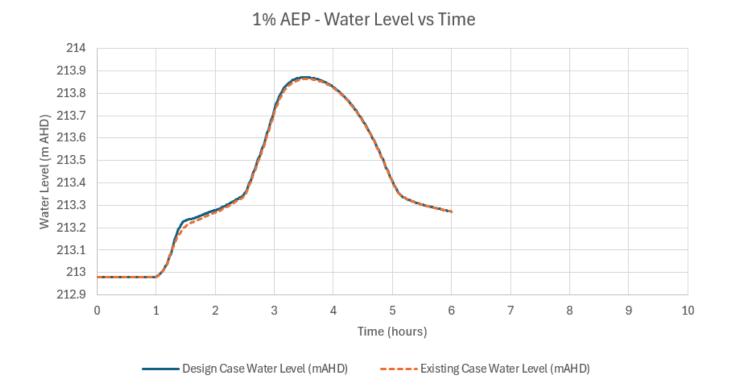


Figure 5-7: 1% AEP – Water Level vs Time Downstream of the Site



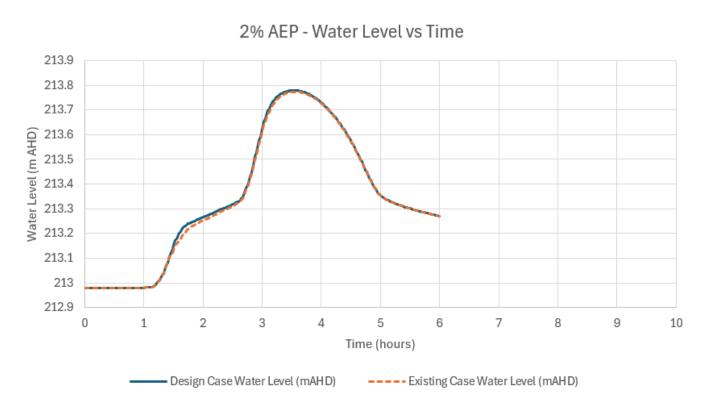


Figure 5-8: 2% AEP - Water Level vs Time Downstream of the Site

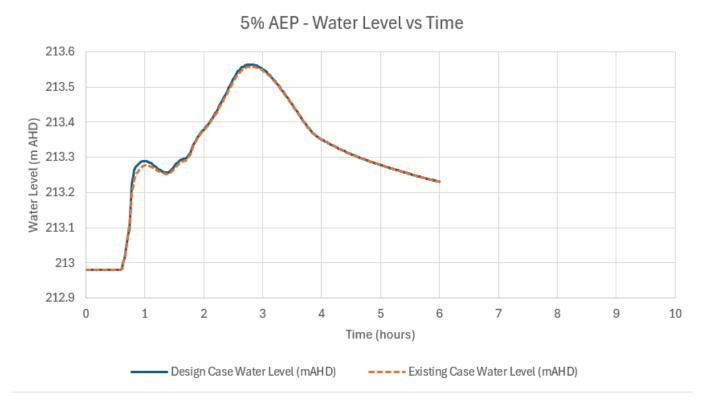
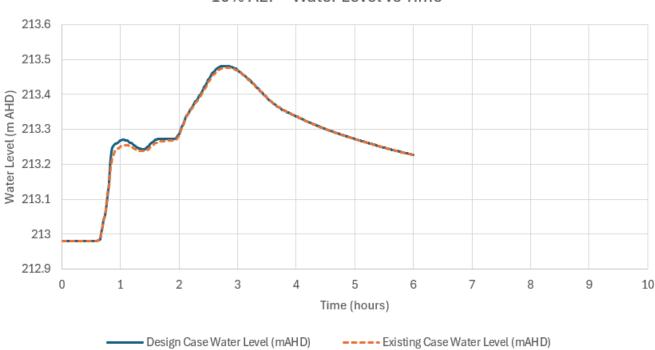


Figure 5-9: 5% AEP - Water Level vs Time Downstream of the Site





10% AEP - Water Level vs Time

Figure 5-10: 10% AEP - Water Level vs Time Downstream of the Site

# 5.5 Sensitivity Test

## **Blockage Assessment**

A hydraulic blockage assessment was carried out for the 1% AEP design scenario as per the guidance set out in ARR2019. The assessment involved assessing the site area for debris availability, mobility and transportability (Table 5-19) in conjunction with structure dimensions, which were used to determine the relevant blockage factors shown in Table 5-18. All culverts, pits and pipes outside the project boundary were all assumed to have a 20% blockage.

Figures are provided in Appendix A.

The assessment is summarised as below:

 Within the study area, the railway track is not overtopped in either existing or design conditions in the 1% AEP event + blockage.

Table 5-18: Structure Blockage Percentages

Structure	Blockage Percentage (1% AEP)	Comments	
All on-site design pipes	50%	Within the project boundary	
All on-site design pits	20%	Within the project boundary	
Existing culvert under Wagga Road (Chainage 635+300km)	50%	Within the project boundary	
Existing culvert under Rail (Chainage 635+300km)	10%	Within the project boundary	
Culvert, pit and pipe (All others)	20%	Outside of the project boundary	



Table 5-19: Structure Blockage Parameters based on ARR2019

Structure	Debris Availability	Debris Mobility	Debris Transportability	AEP Adjusted Debris Potential
All on-site design pipes	High	Low	Low	Medium
Existing culvert under Wagga Road	Medium	Low	Low	Medium
Existing culvert under the Rail	Medium	Low	Low	Medium

# **Climate Change Risk Assessment**

Climate change risk assessment was carried out by running the 1% AEP with 2090 RCP8.5 interim climate change factor (refer to Section 0 for details of the approach), and the results of flood depth, flood velocity and flood hazard can be found in Section 5.1 and Section 5.2 The corresponding flood maps can be found in Appendix A. The assessment is summarised as below:

 Within the study area, the railway track is not overtopped in either existing or design conditions in the 1% AEP event + Climate Change.



#### 6 **MITIGATION MEASURES**

Since the impact of the project does not extend outside the project boundary and no instances of non-compliance in terms of flood impact were identified, no mitigation measures are necessary at this stage.

# A2I | ALBURY TO ILLABO FLOOD DESIGN REPORT – BILLY HUGHES BRIDGE – TRACK LOWERING



#### 7 RECOMMENDATIONS AND NEXT STAGE

This is the final 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 C, D and E)

Consequently, there are no further recommendations.



# **APPENDICES**





# **APPENDIX A**

# Flood Maps





# Table A-1: List of Maps in Appendix A

Existing Conditions Maps
Figure A1: 10% AEP Flood Depth (m) - Existing Conditions
Figure A2: 5% AEP Flood Depth (m) - Existing Conditions
Figure A3: 2% AEP Flood Depth (m) - Existing Conditions
Figure A4: 1% AEP Flood Depth (m) - Existing Conditions
Figure A5: 1% AEP + Climate Change Flood Depth (m) - Existing Conditions
Figure A6: Probable Maximum Flood (PMF) Flood Depth (m) - Existing Conditions
Figure A7: 10% AEP Velocity (m/s) - Existing Conditions
Figure A8: 5% AEP Velocity (m/s) - Existing Conditions
Figure A9: 2% AEP Velocity (m/s) - Existing Conditions
Figure A10: 1% AEP Velocity (m/s) - Existing Conditions
Figure A11: 1% AEP + Climate Change Velocity (m/s) - Existing Conditions
Figure A12: Probable Maximum Flood (PMF) Velocity (m/s) - Existing Conditions
Figure A13: 10% AEP Flood Hazard - Existing Conditions
Figure A14: 5% AEP Flood Hazard - Existing Conditions
Figure A15: 2% AEP Flood Hazard - Existing Conditions
Figure A16: 1% AEP Flood Hazard - Existing Conditions
Figure A17: 1% AEP + Climate Change Flood Hazard - Existing Conditions
Figure A18: Probable Maximum Flood (PMF) Flood Hazard - Existing Conditions
Developed Conditions Maps
Figure A19: 10% AEP Flood Depth (m) - Developed Conditions
Figure A20: 5% AEP Flood Depth (m) - Developed Conditions
Figure A21: 2% AEP Flood Depth (m) - Developed Conditions
Figure A22: 1% AEP Flood Depth (m) - Developed Conditions
Figure A23: 1% AEP + Climate Change Flood Depth (m) - Developed Conditions
Figure A24: Probable Maximum Flood (PMF) Flood Depth (m) - Developed Conditions
Figure A25: 10% AEP Velocity (m/s) - Developed Conditions
Figure A26: 5% AEP Velocity (m/s) - Developed Conditions
Figure A27: 2% AEP Velocity (m/s) - Developed Conditions
Figure A28: 1% AEP Velocity (m/s) - Developed Conditions



Figure A29: 1% AEP + Climate Change Velocity (m/s) - Developed Conditions

Figure A30: Probable Maximum Flood (PMF) Velocity (m/s) - Developed Conditions

Figure A31: 10% AEP Flood Hazard - Developed Conditions

Figure A32: 5% AEP Flood Hazard - Developed Conditions

Figure A33: 2% AEP Flood Hazard - Developed Conditions

Figure A34: 1% AEP Flood Hazard - Developed Conditions

Figure A35: 1% AEP + Climate Change Flood Hazard - Developed Conditions

Figure A36: Probable Maximum Flood (PMF) Flood Hazard - Developed Conditions

### Flood Level Impact Maps

Figure A37: 10% AEP - Change in Flood Level (m)

Figure A38: 5% AEP - Change in Flood Level (m)

Figure A39: 2% AEP - Change in Flood Level (m)

Figure A40: 1% AEP - Change in Flood Level (m)

### Flood Velocity Change Maps

Figure A41: 10% AEP - Change in Flood Velocity (%)

Figure A42: 5% AEP - Change in Flood Velocity (%)

Figure A43: 2% AEP - Change in Flood Velocity (%)

Figure A44: 1% AEP - Change in Flood Velocity (%)

### Flood Hazard Change Maps

Figure A45: 10% AEP - Change in Flood Hazard

Figure A46: 5% AEP - Change in Flood Hazard

Figure A47: 2% AEP - Change in Flood Hazard

Figure A48: 1% AEP - Change in Flood Hazard

### **Blockage Assessment**

Figure A49: 1% AEP + Blockage Flood Depth (m) - Design Conditions

Figure A50: 1% AEP + Blockage Velocity (m/s) - Design Conditions

Figure A51: 1% AEP + Blockage Flood Hazard - Design Conditions

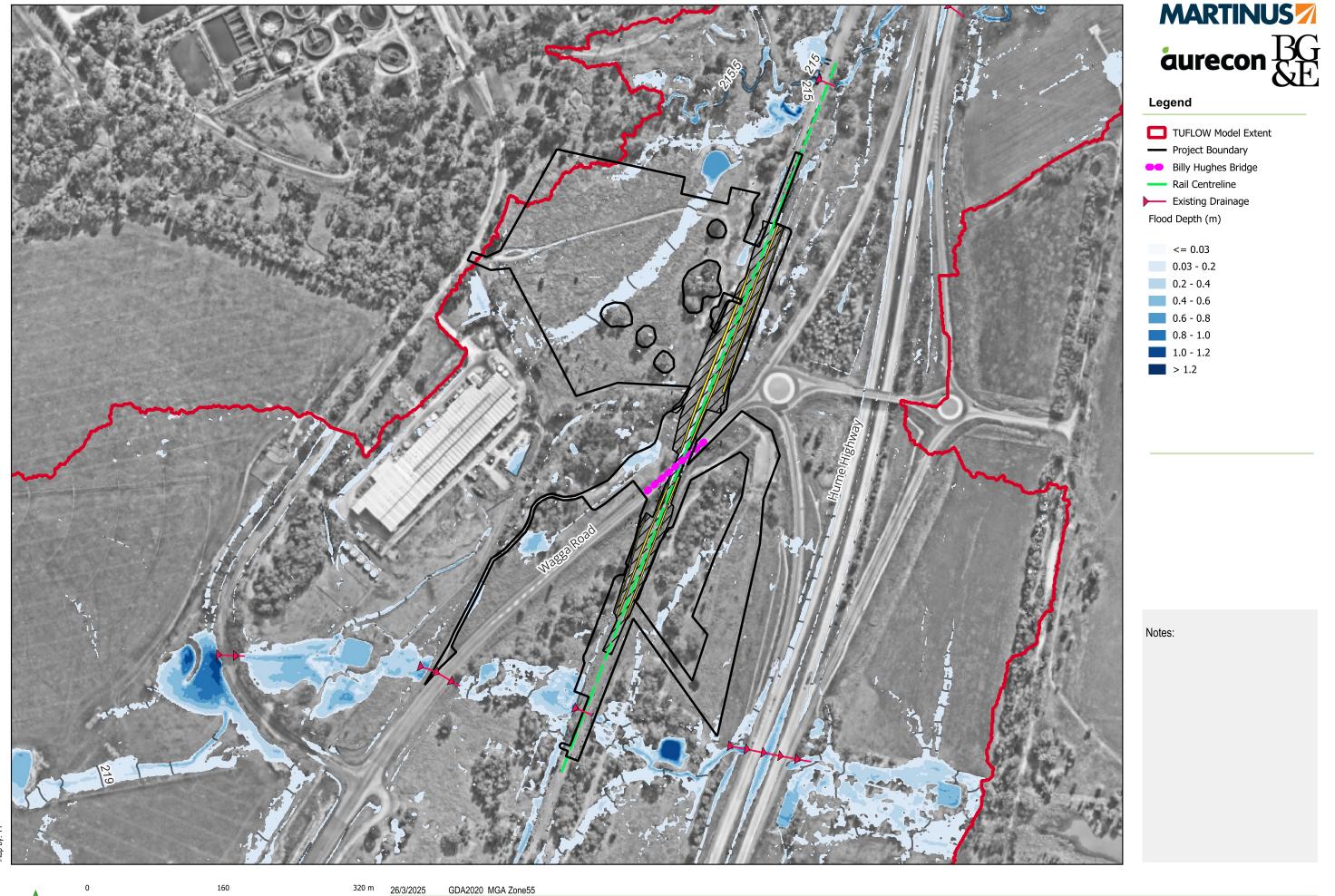




Figure A1: Billy Hughes - Inland Rail (A2P) - IFC Stage 10% AEP Flood Depth (m) - Existing Conditions

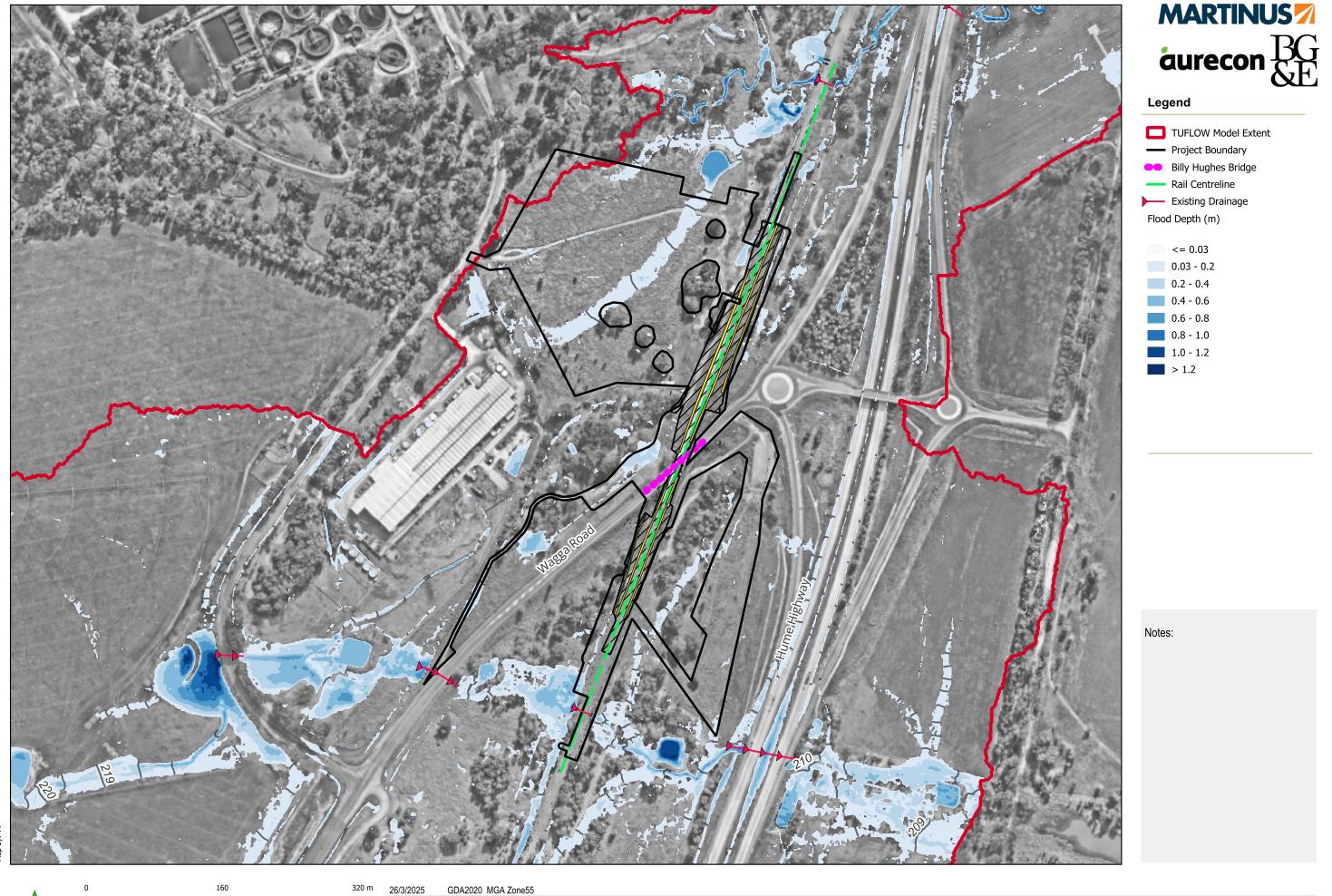




Figure A2: Billy Hughes - Inland Rail (A2P) - IFC Stage 5% AEP Flood Depth (m) - Existing Conditions

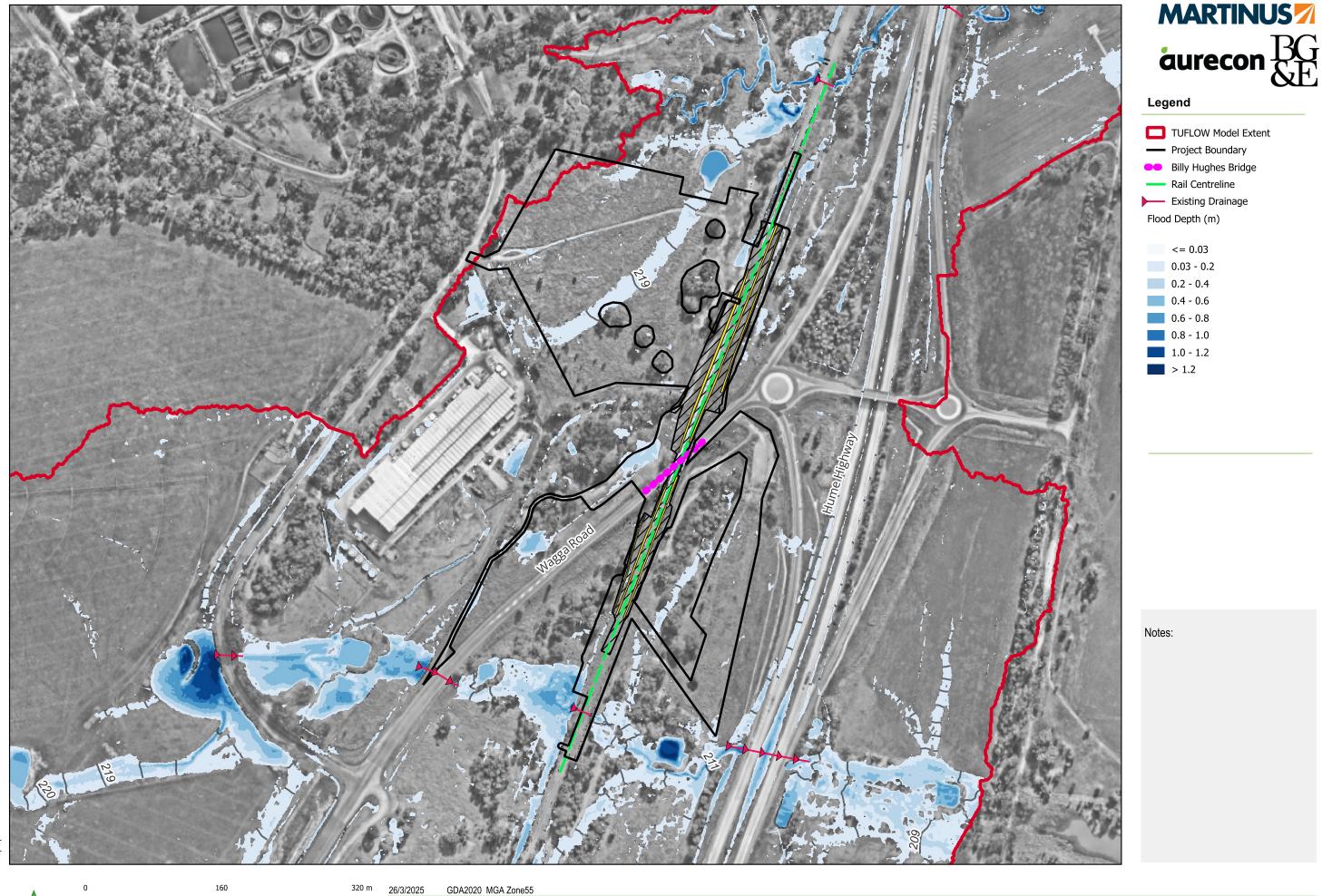




Figure A3: Billy Hughes - Inland Rail (A2P) - IFC Stage 2% AEP Flood Depth (m) - Existing Conditions

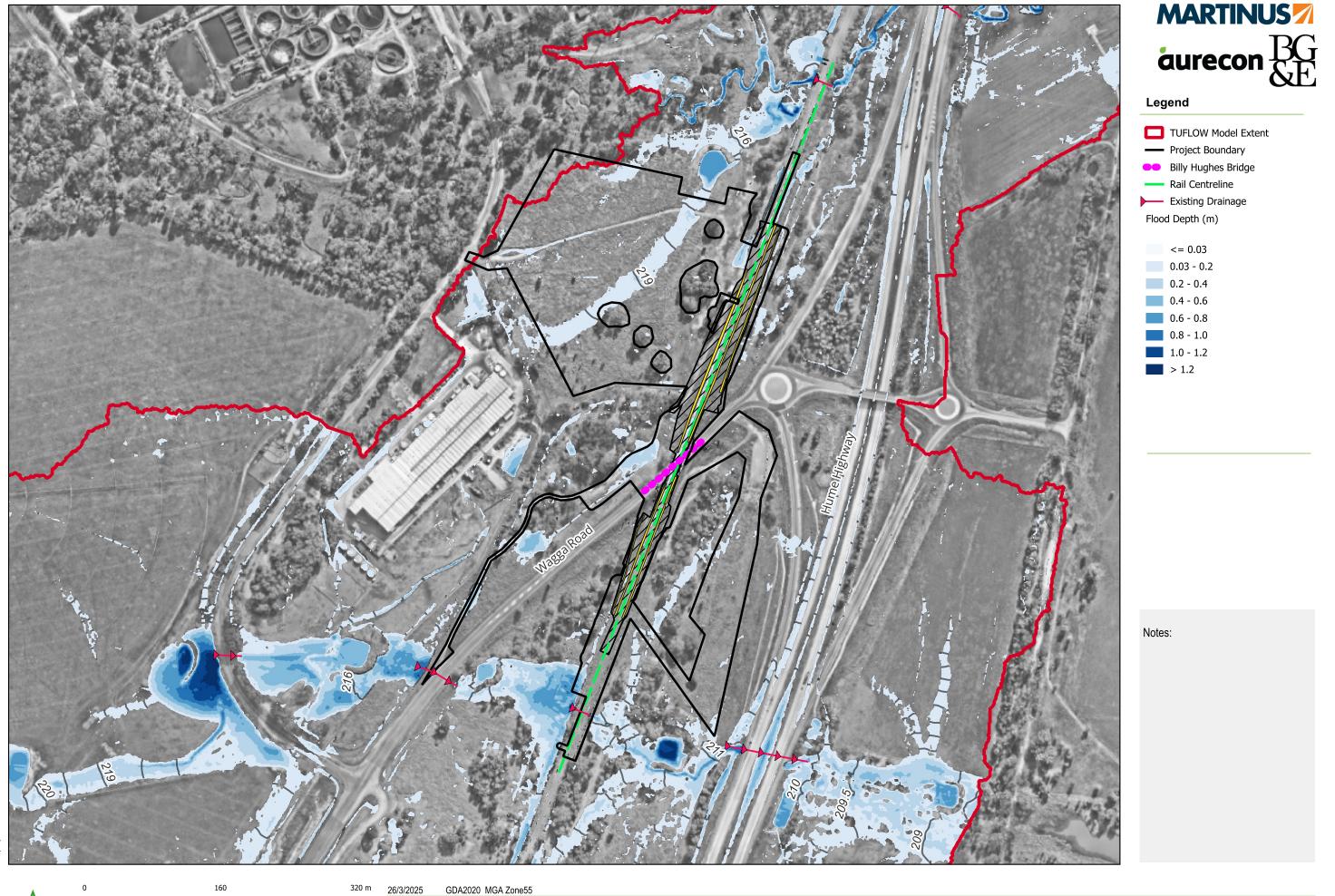




Figure A4: Billy Hughes - Inland Rail (A2P) - IFC Stage 1% AEP Flood Depth (m) - Existing Conditions

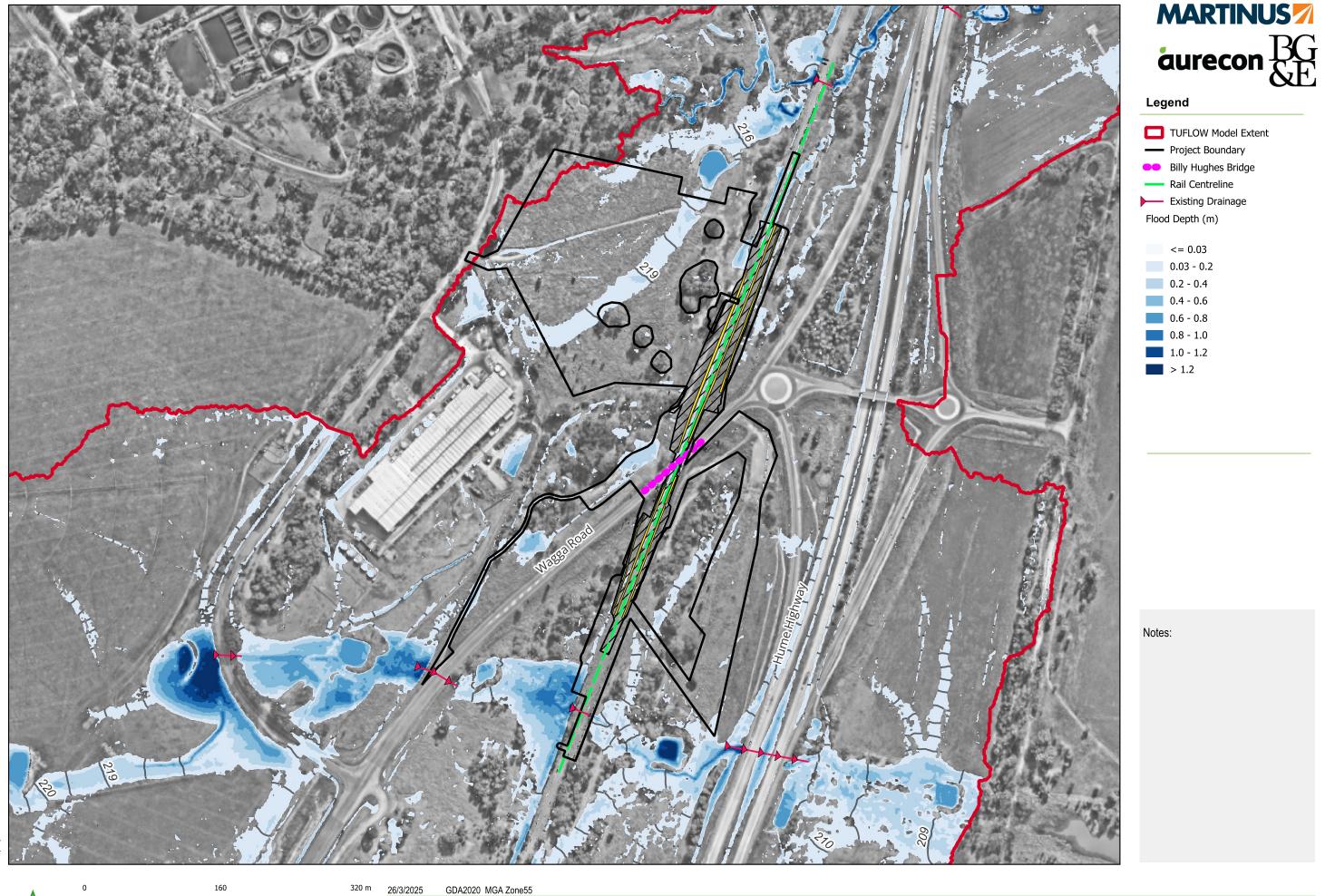
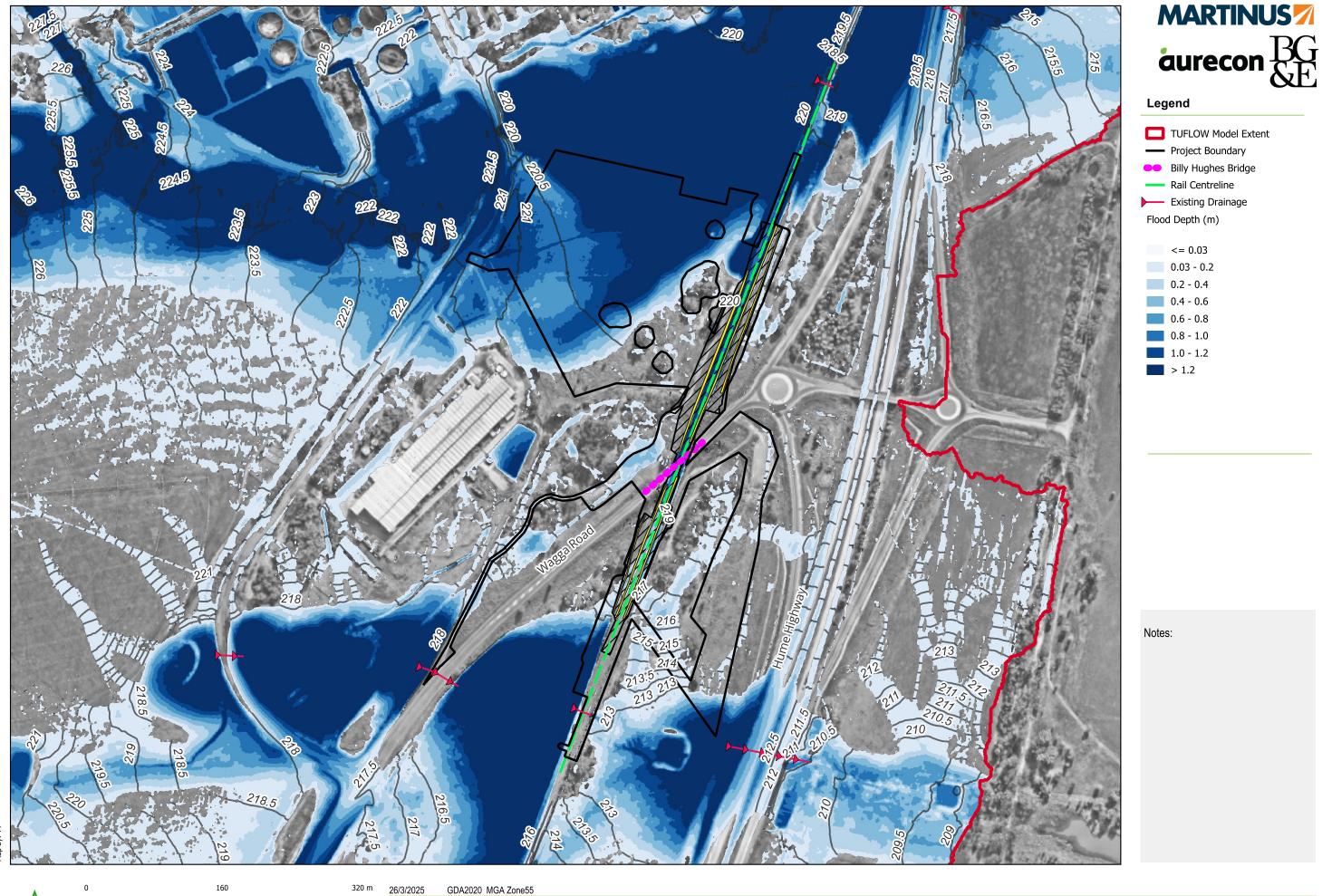




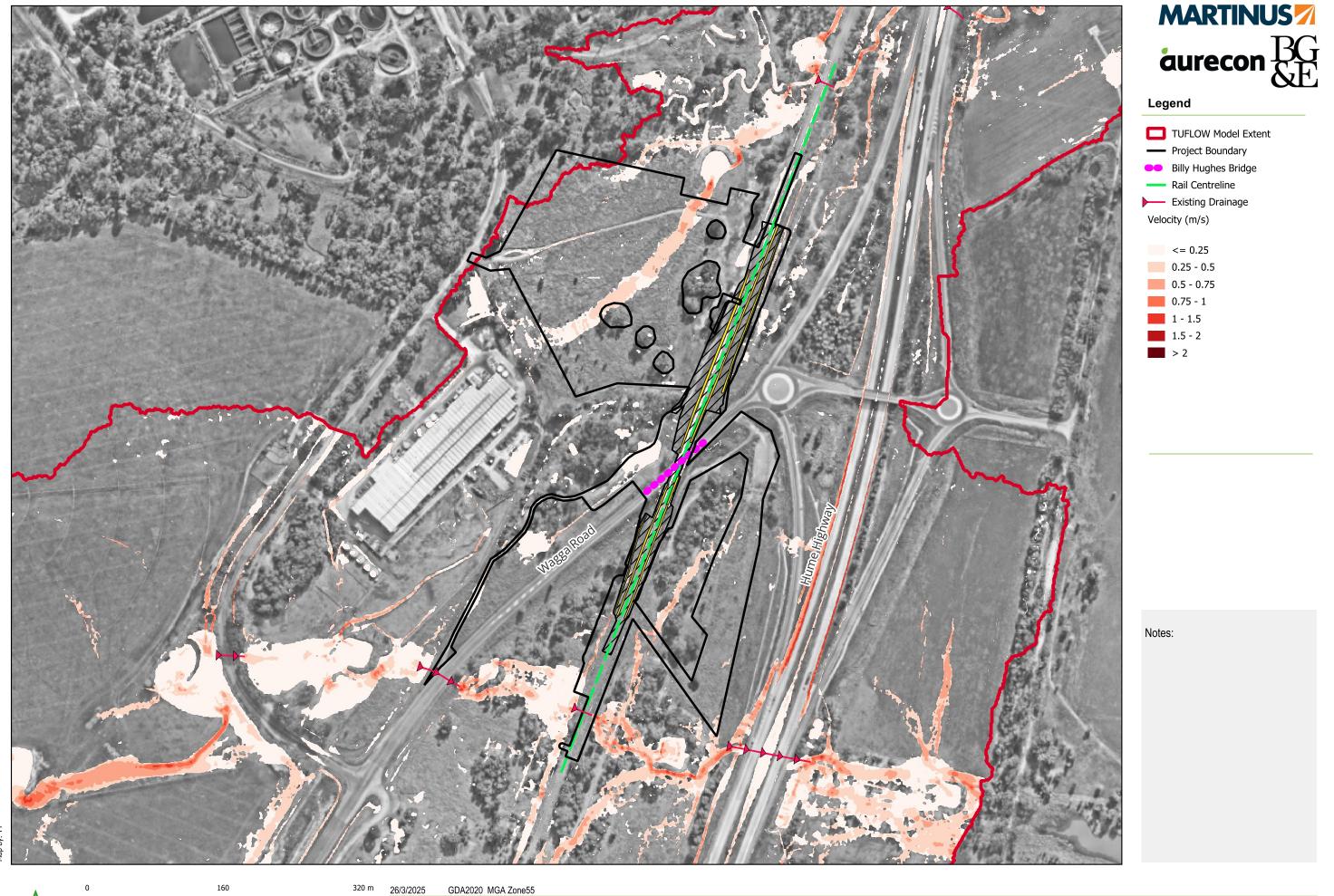
Figure A5: Billy Hughes - Inland Rail (A2P) - IFC Stage 1% AEP Flood Depth (m) - Existing Conditions



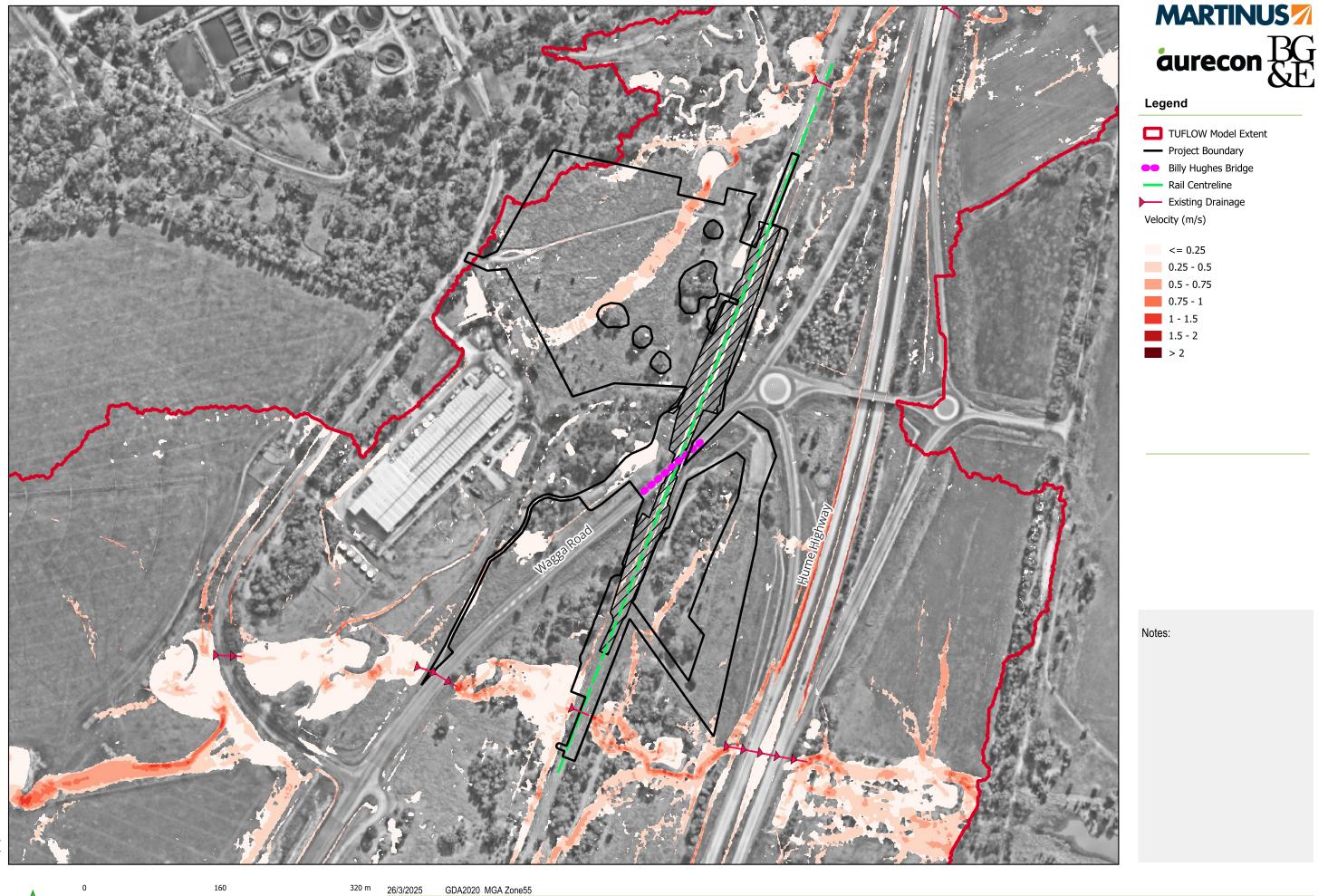




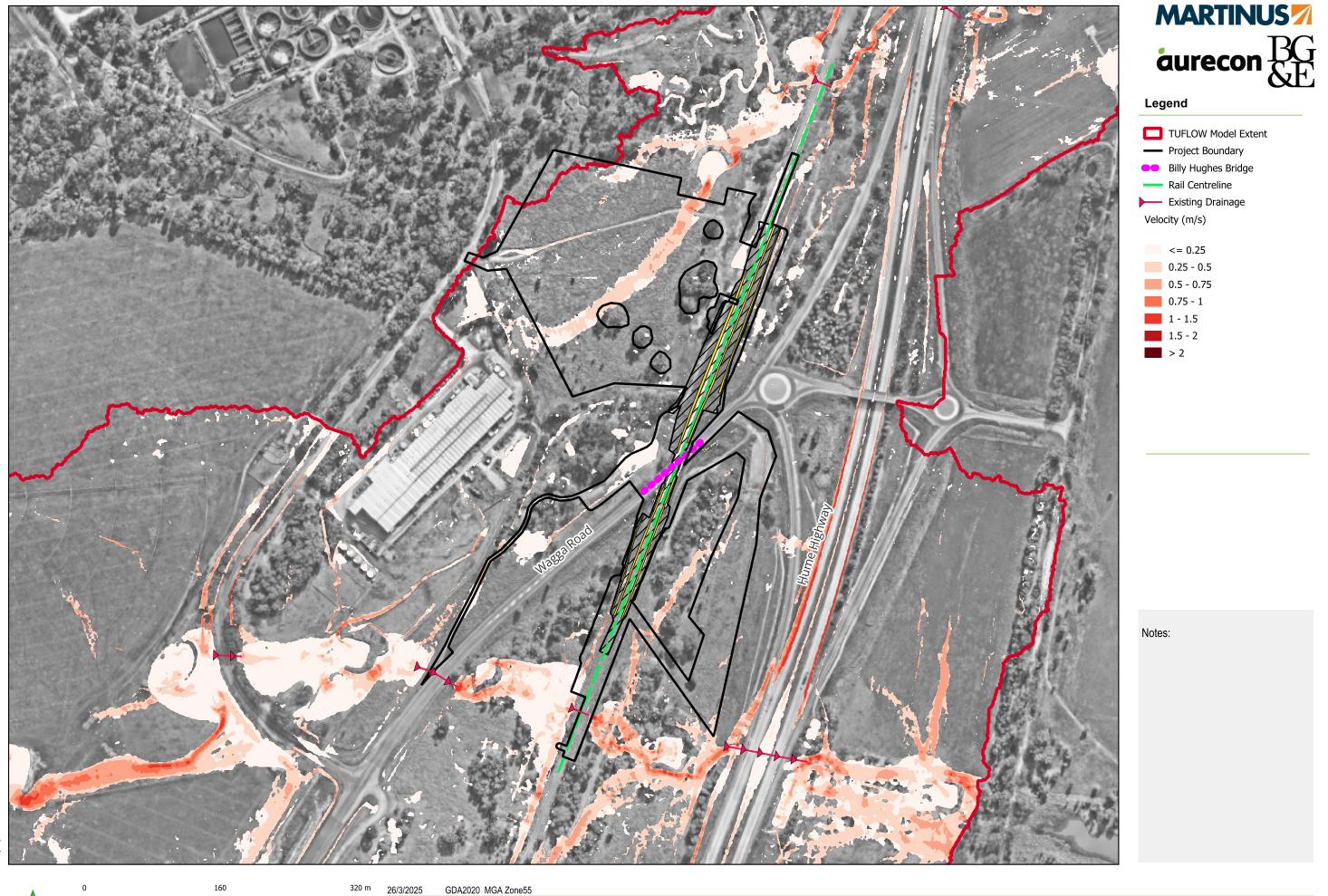




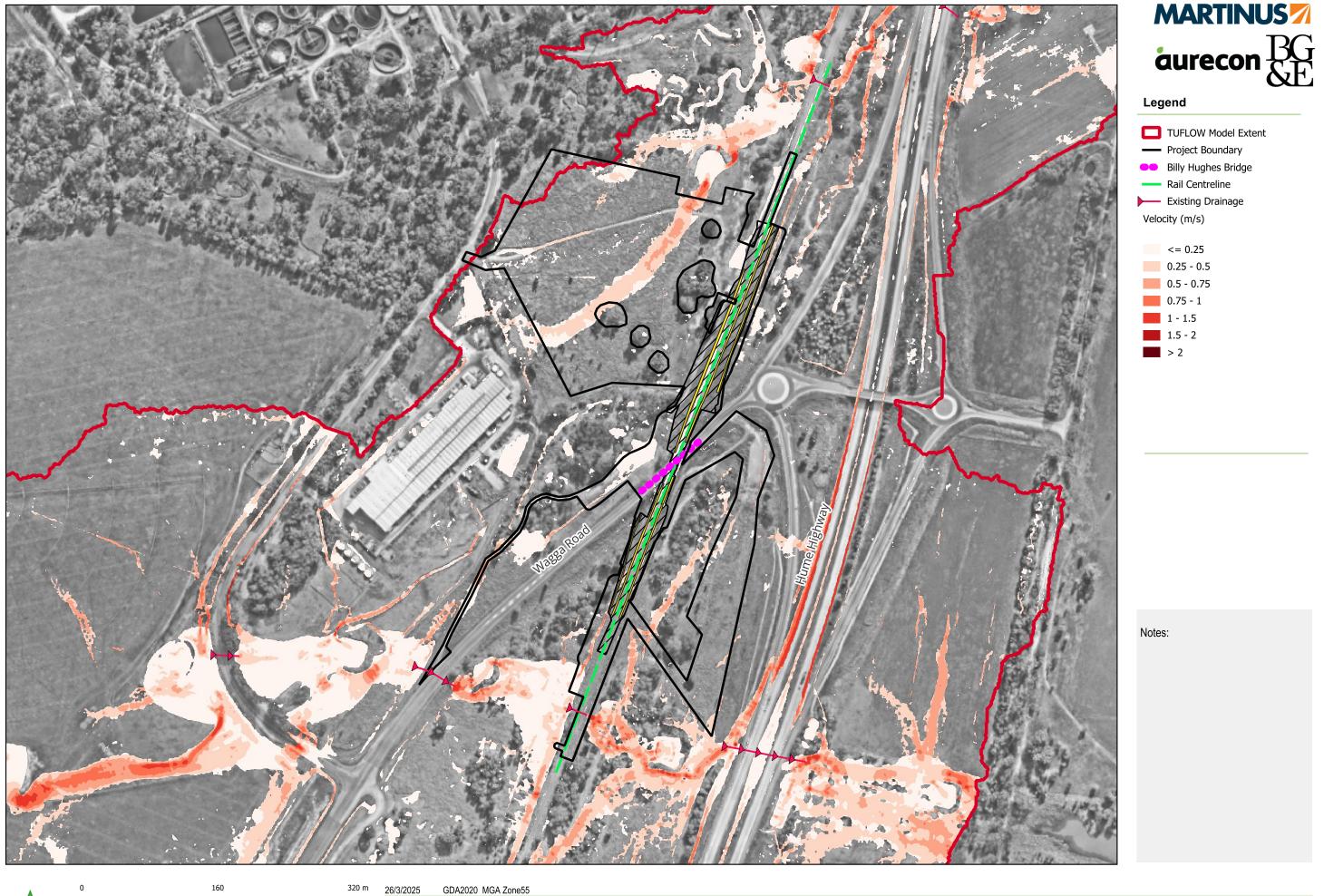




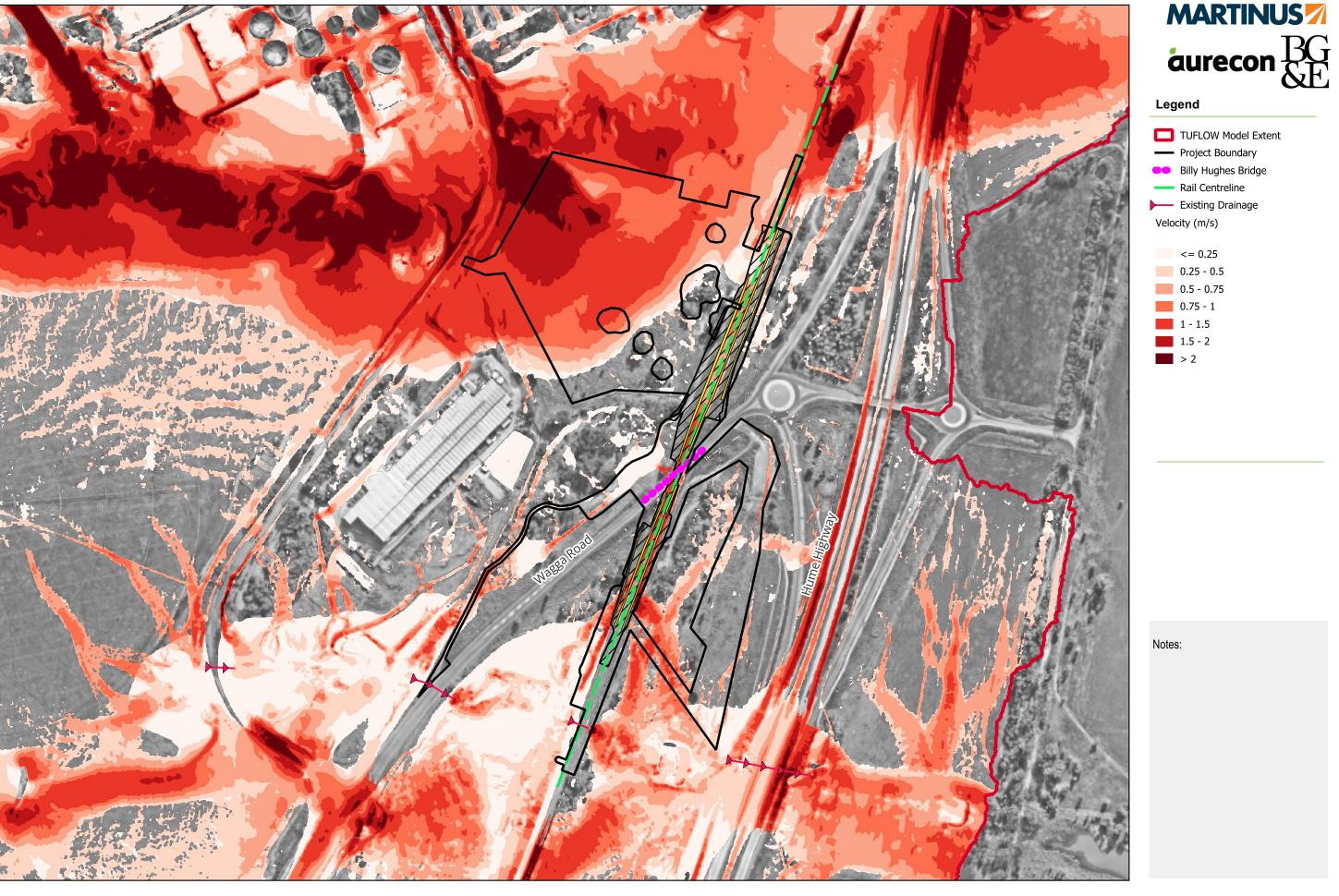














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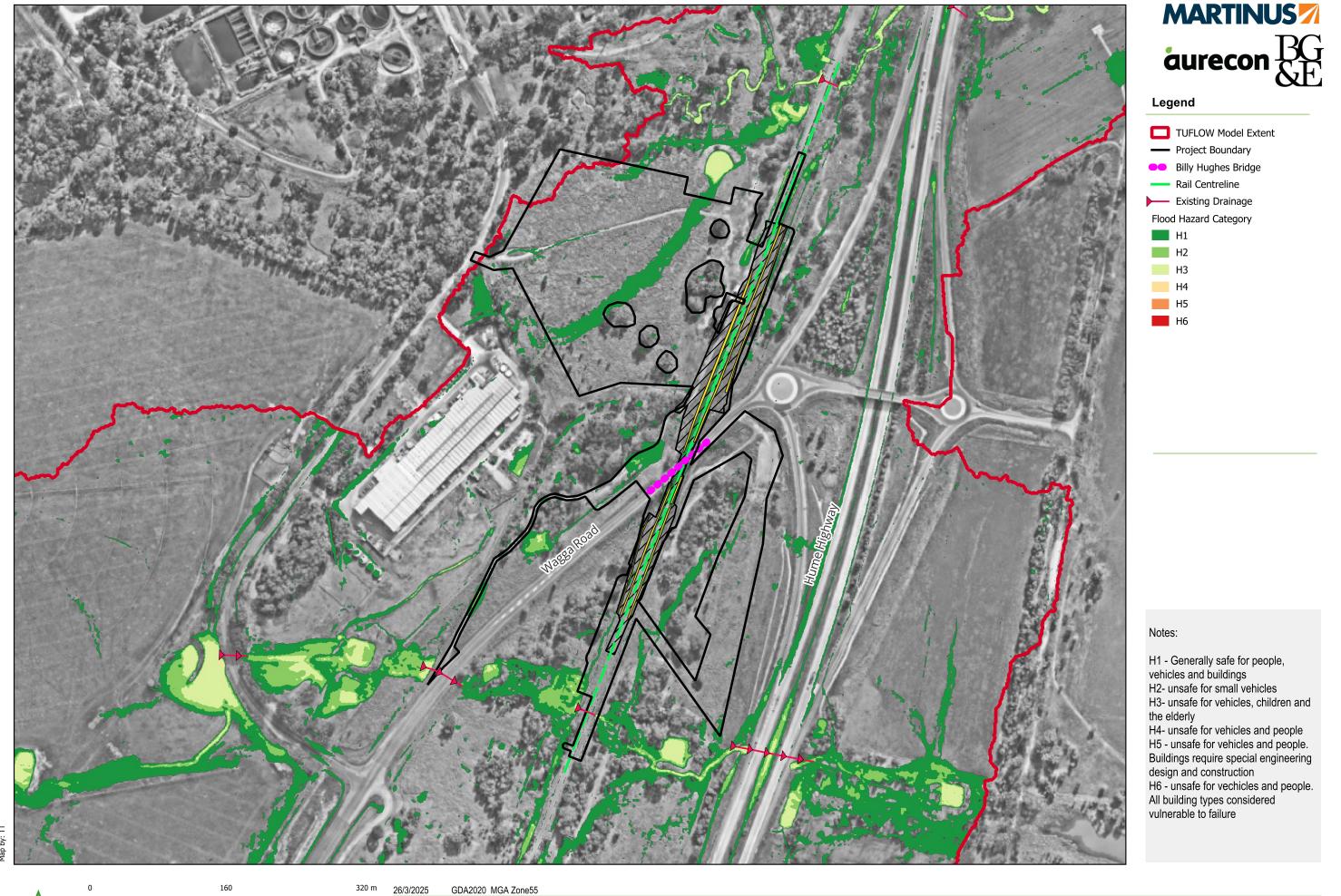




Figure A13: Billy Hughes - Inland Rail (A2P) - IFC Stage 10% AEP Flood Hazard - Existing Conditions

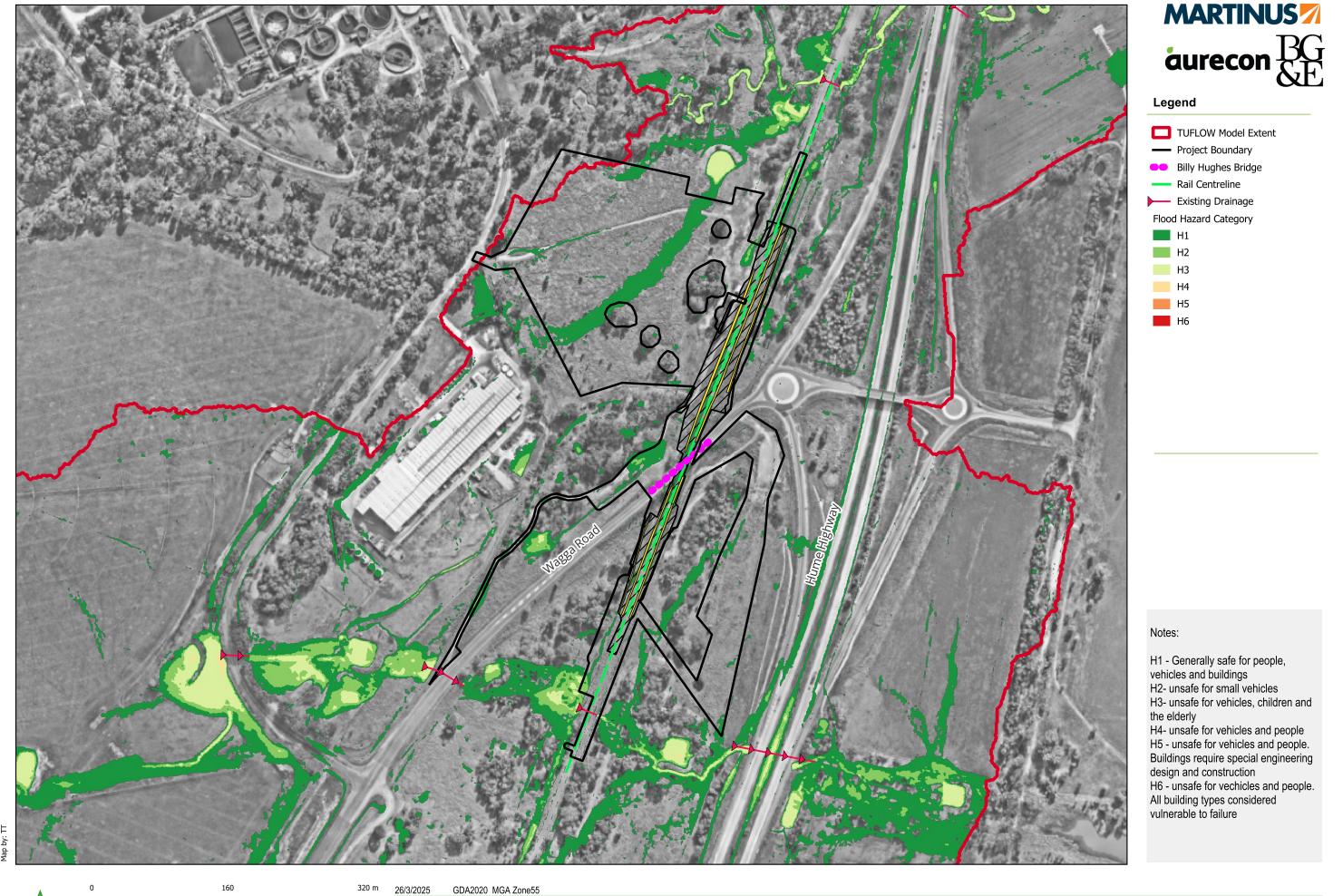




Figure A14: Billy Hughes - Inland Rail (A2P) - IFC Stage 5% AEP Flood Hazard - Existing Conditions

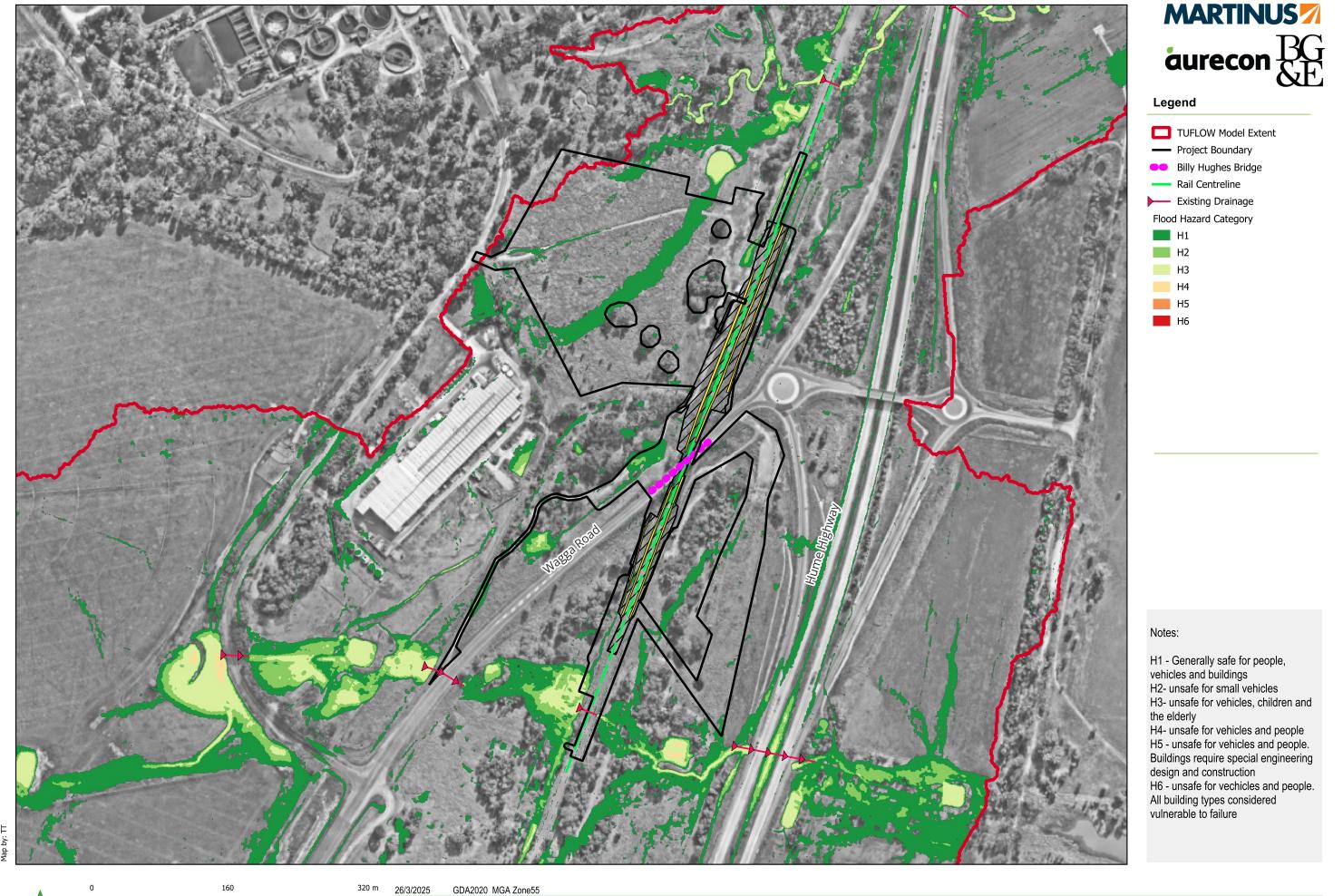




Figure A15: Billy Hughes - Inland Rail (A2P) - IFC Stage 2% AEP Flood Hazard - Existing Conditions





Figure A16: Billy Hughes - Inland Rail (A2P) - IFC Stage 1% AEP Flood Hazard - Existing Conditions





Figure A17: Billy Hughes - Inland Rail (A2P) - IFC Stage 1% AEP + Climate Change Flood Hazard - Existing Conditions

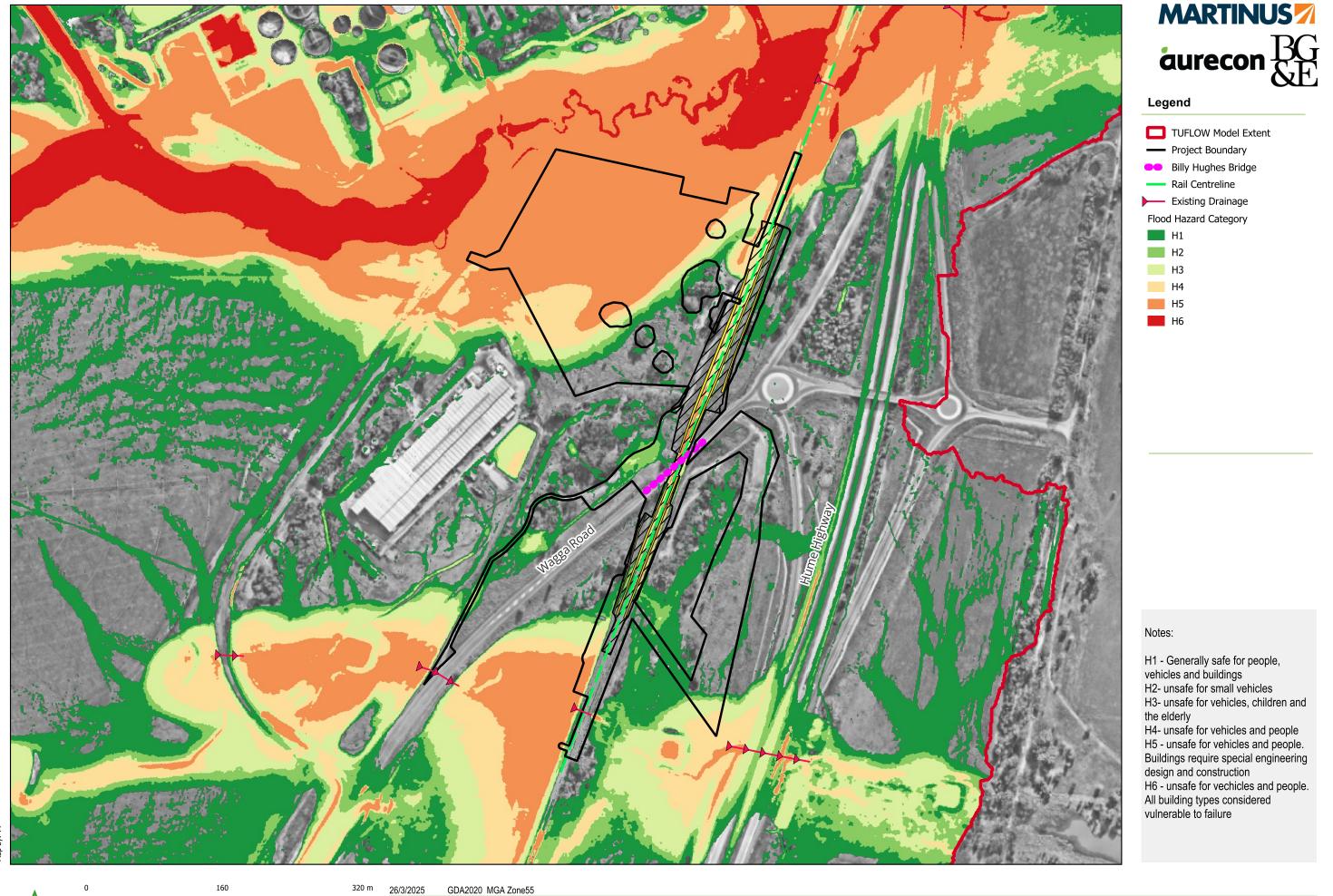
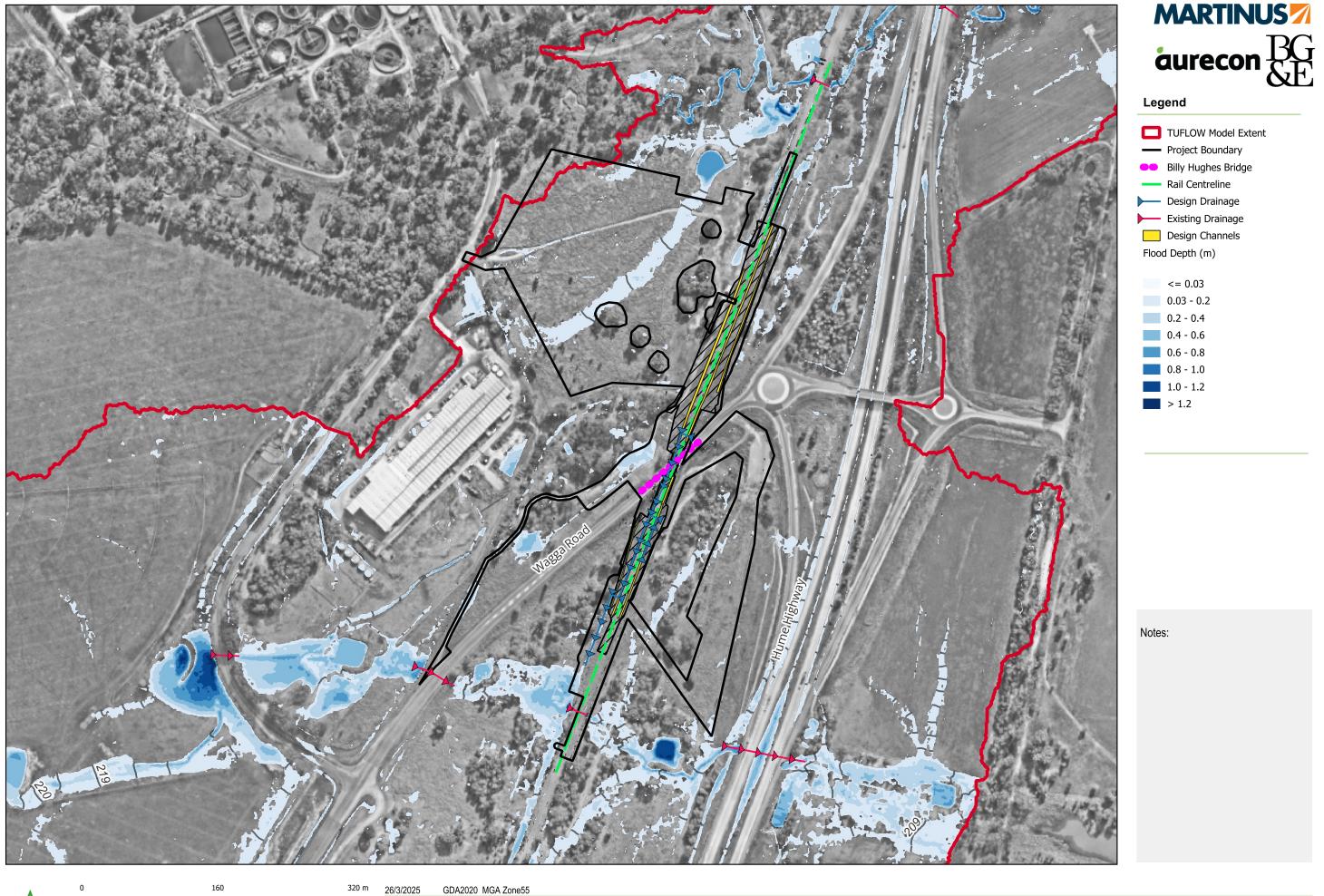




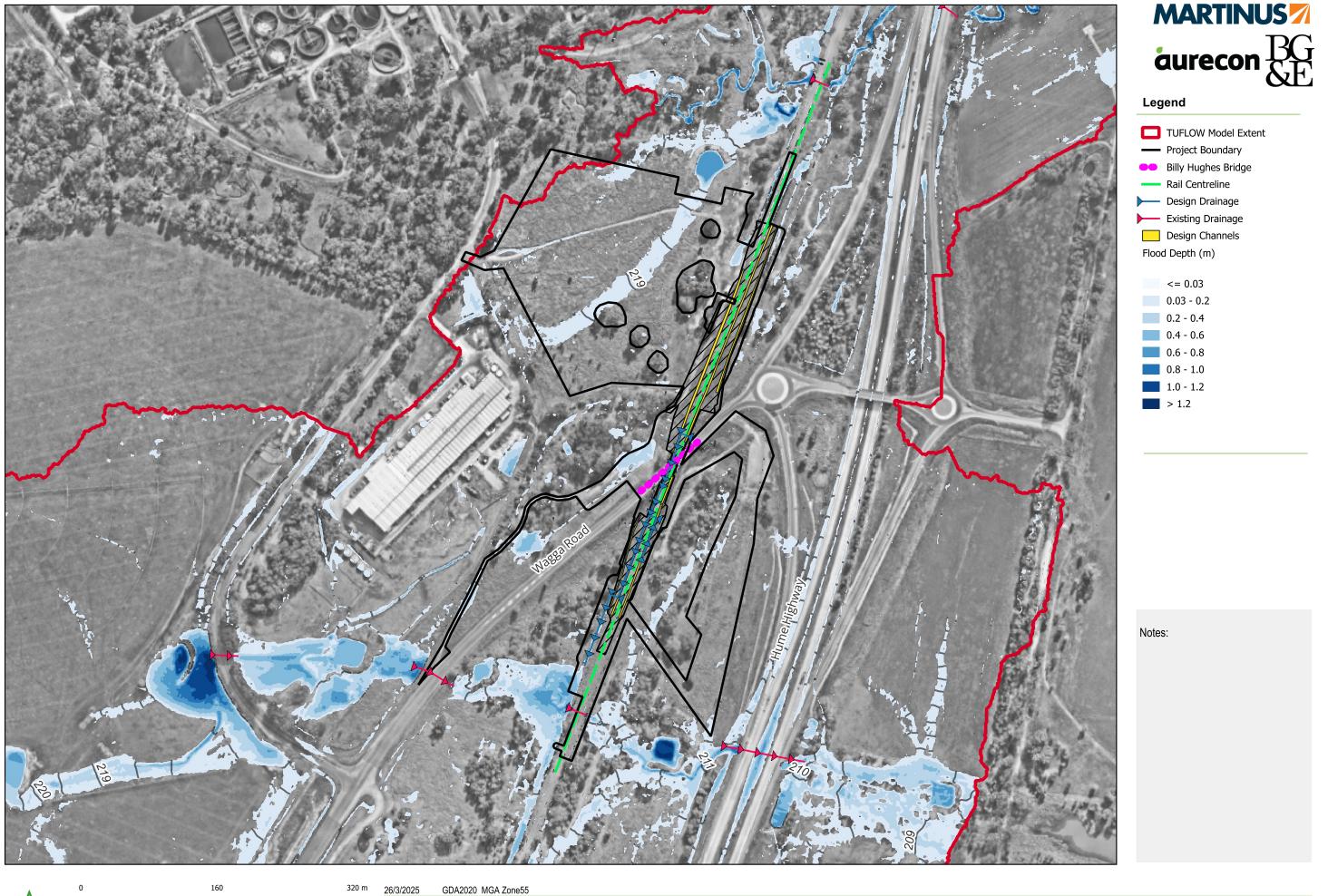
Figure A18: Billy Hughes - Inland Rail (A2P) - IFC Stage Probable Maximum Flood (PMF) Flood Hazard - Existing Conditions



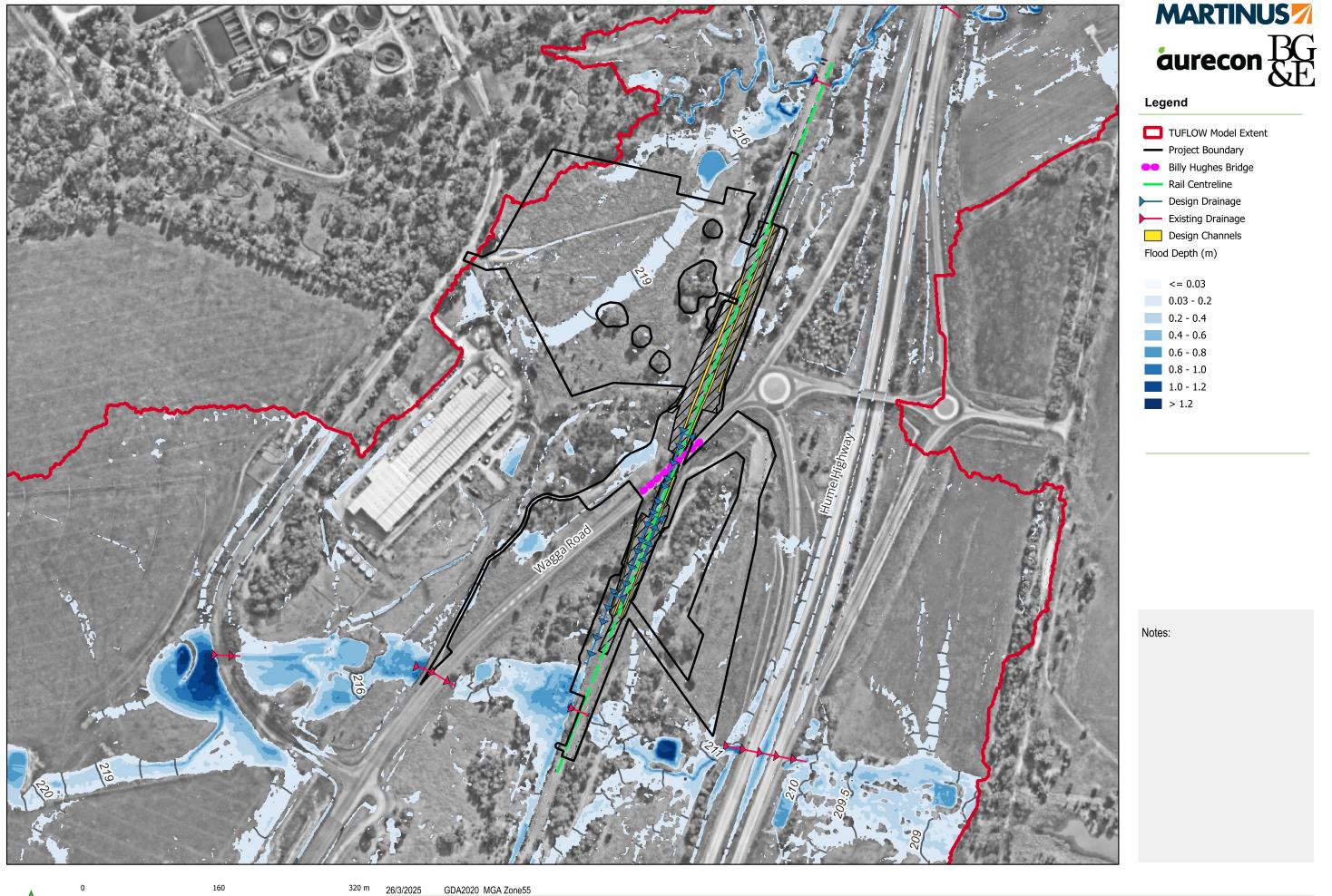




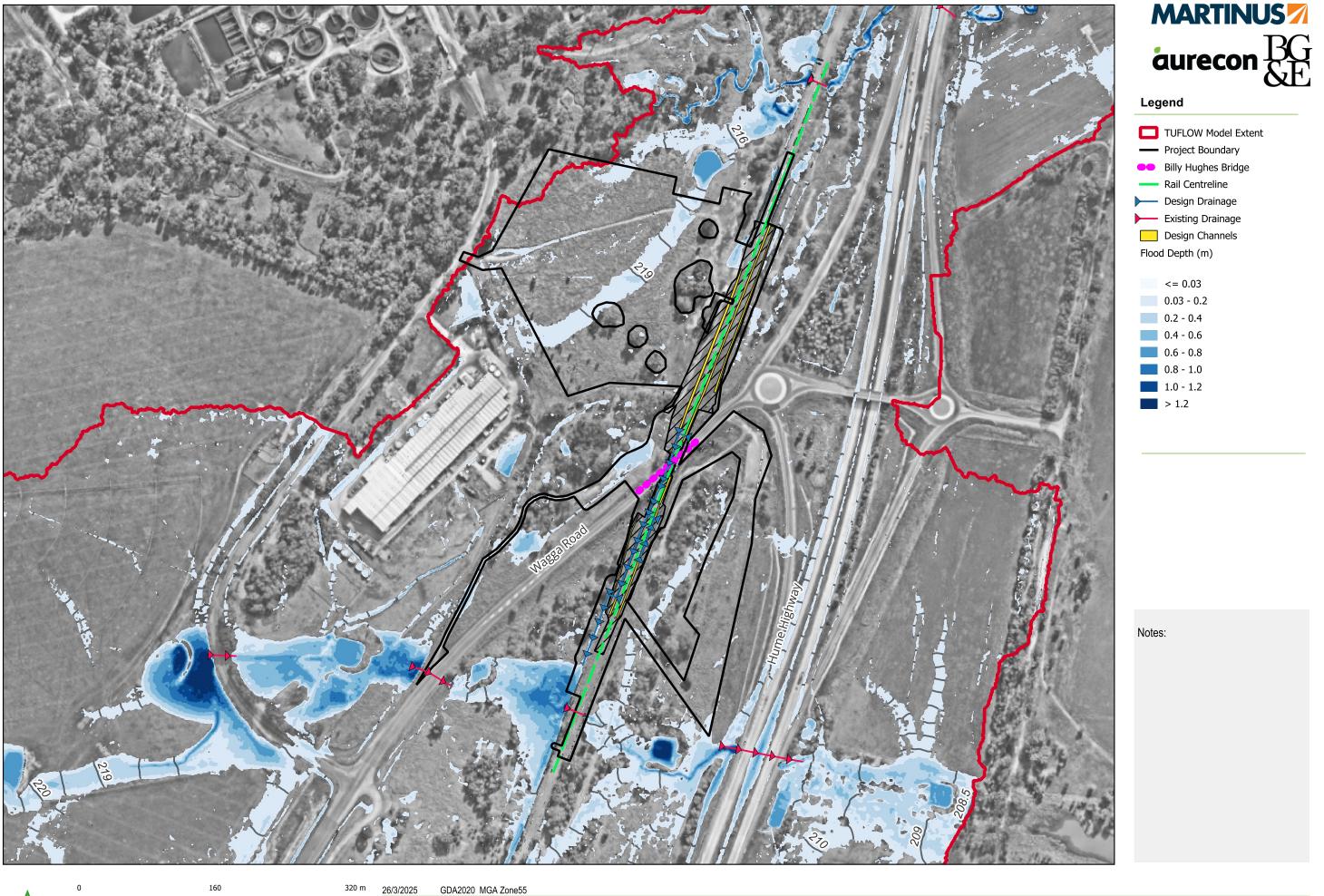




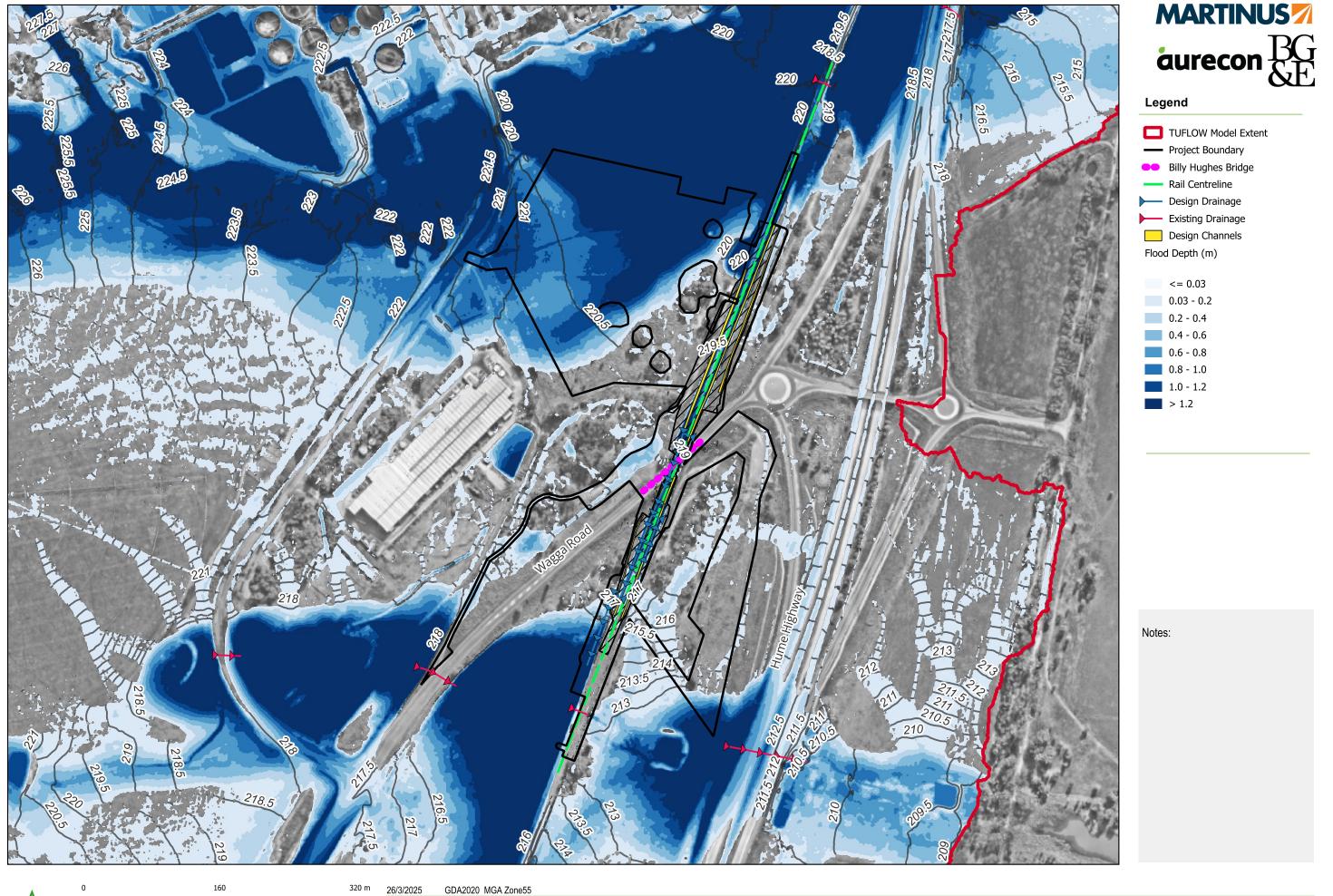








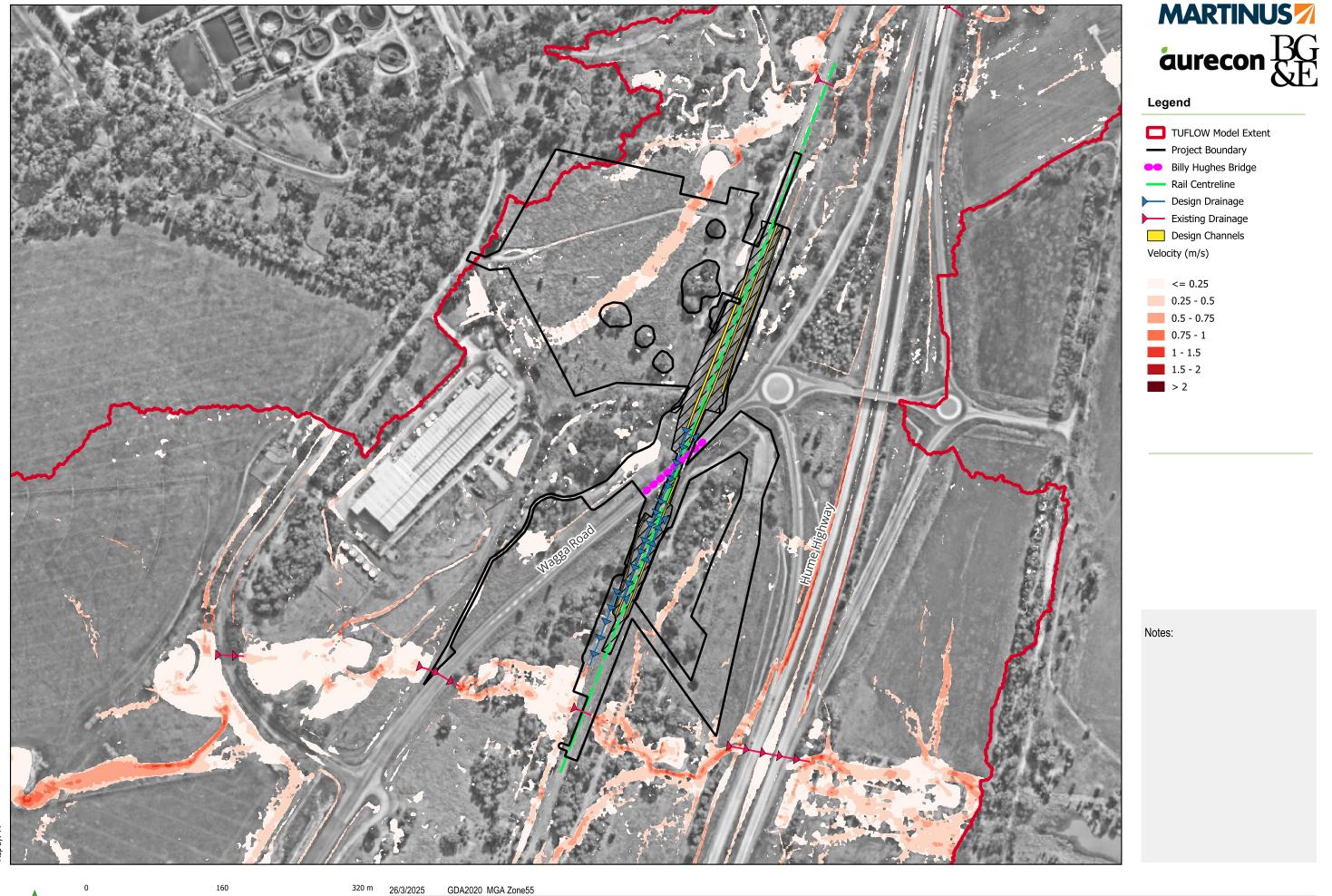




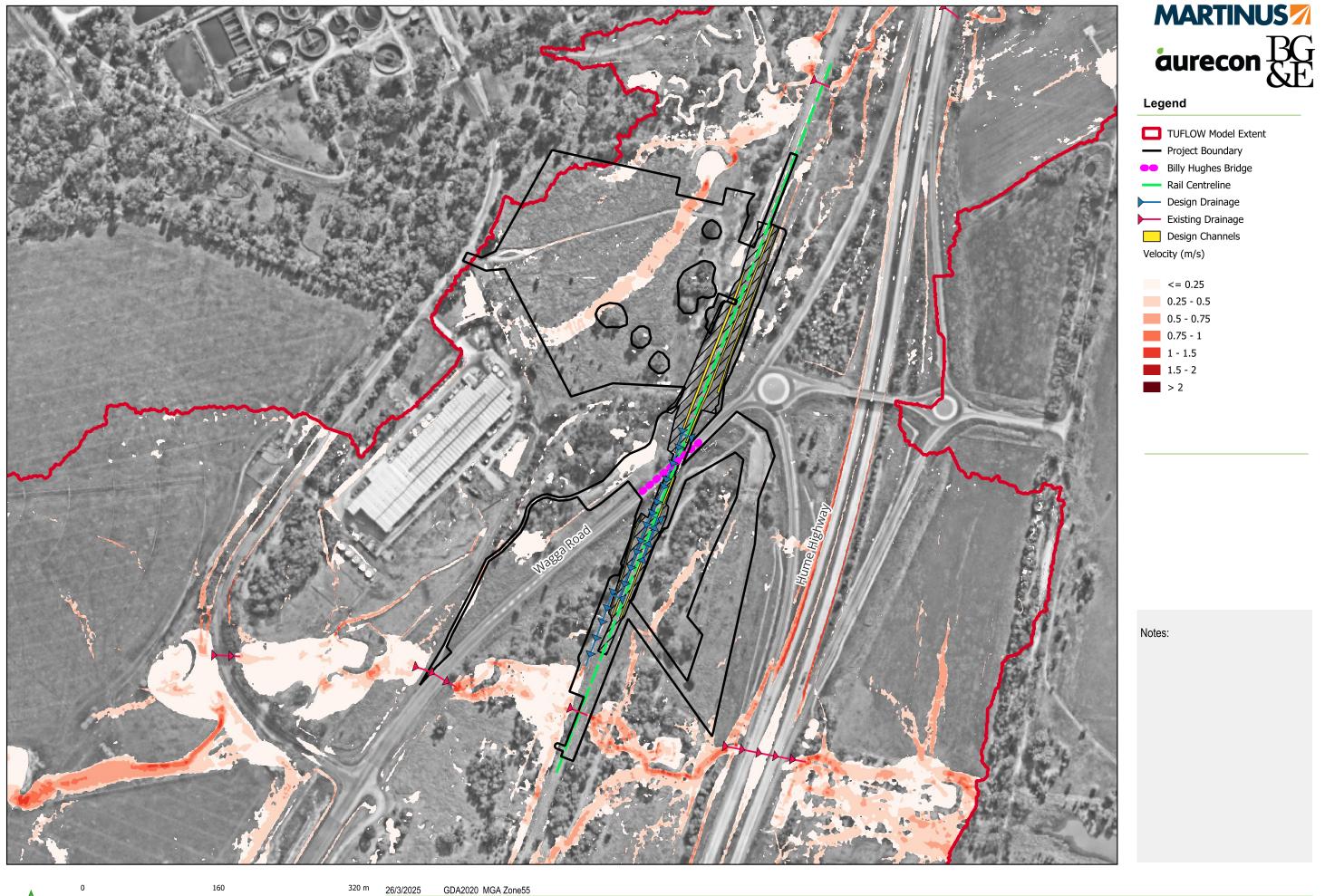




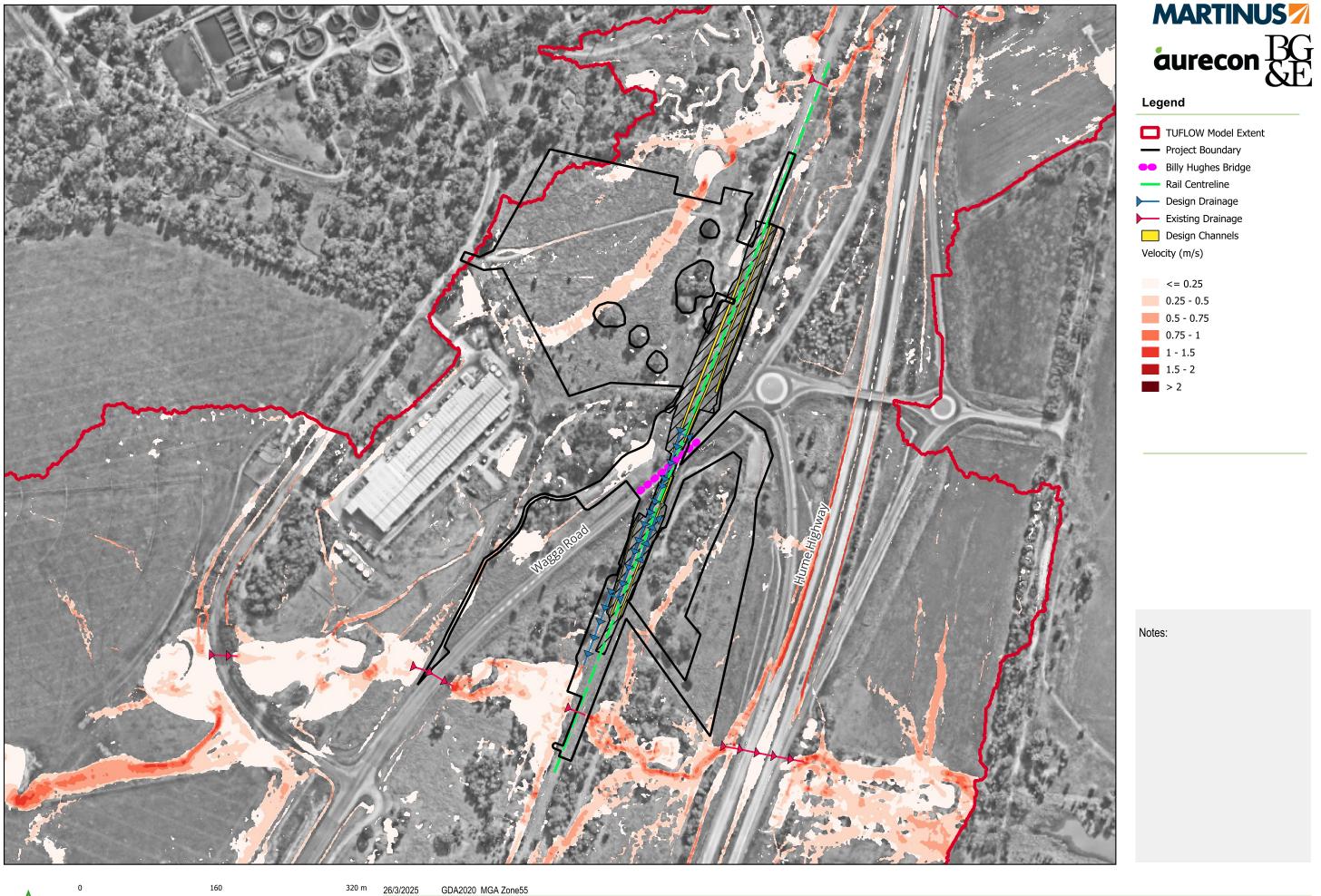




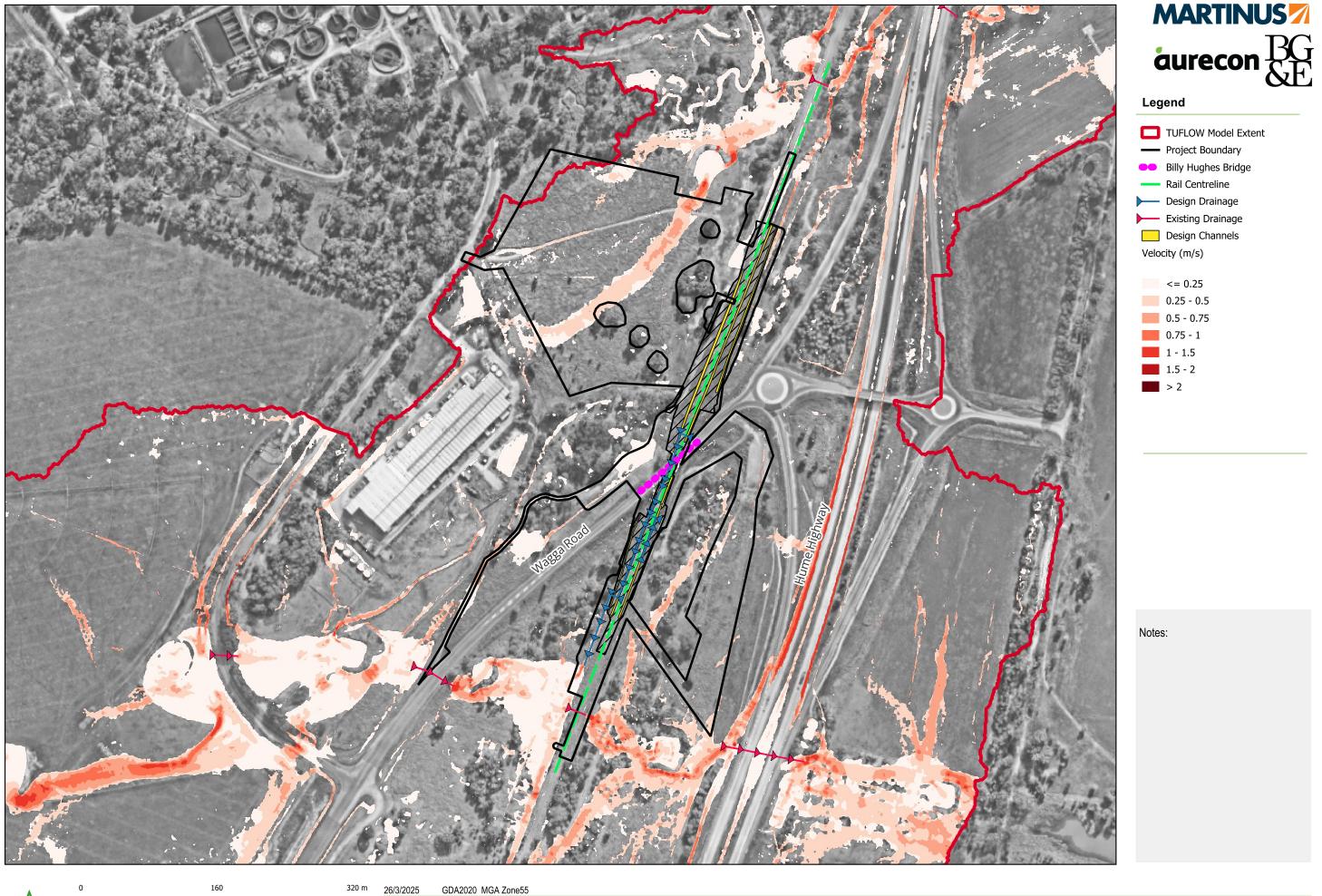














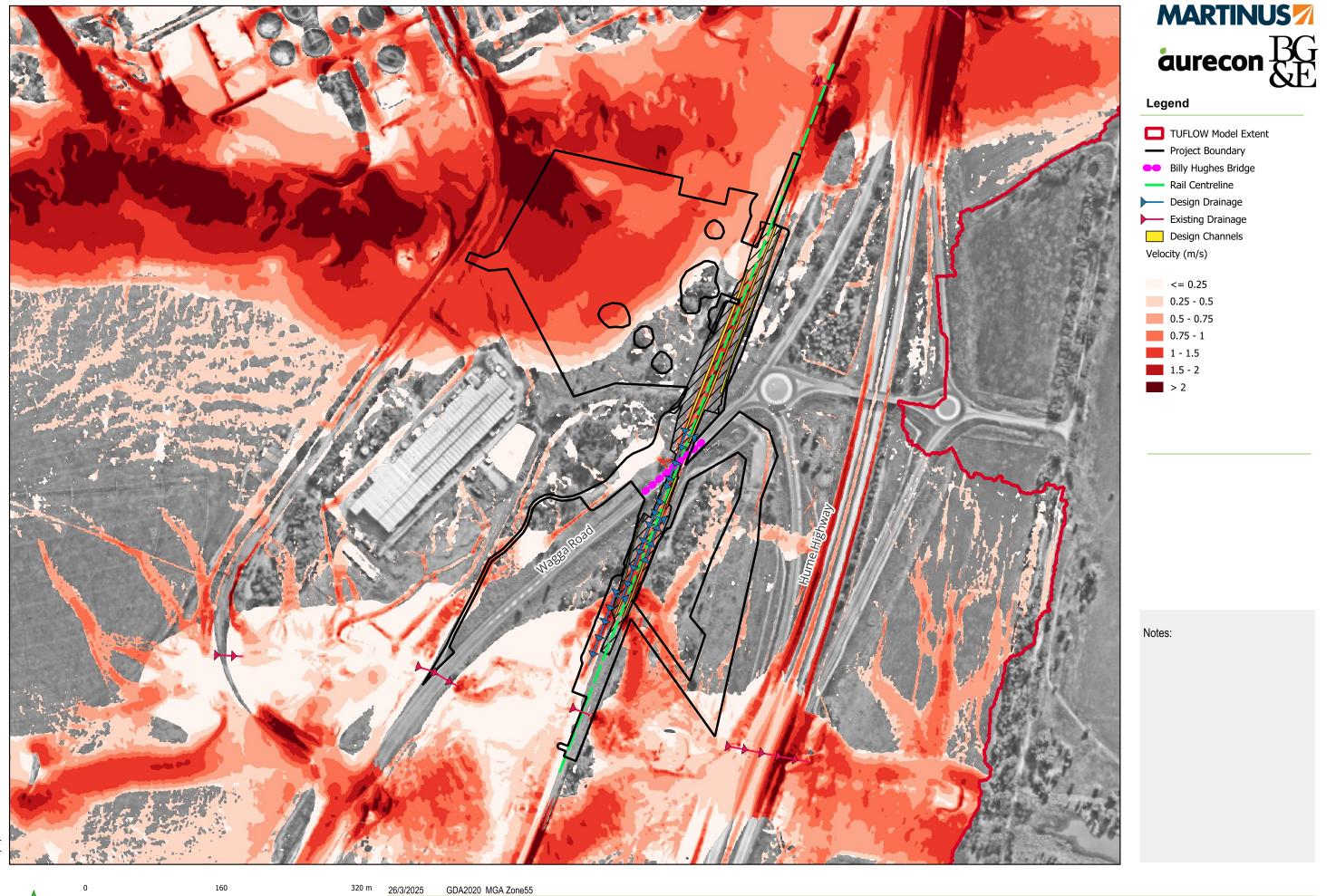




Figure A30: Billy Hughes - Inland Rail (A2P) - IFC Stage Probable Maximum Flood (PMF) Velocity (m/s) - Developed Conditions

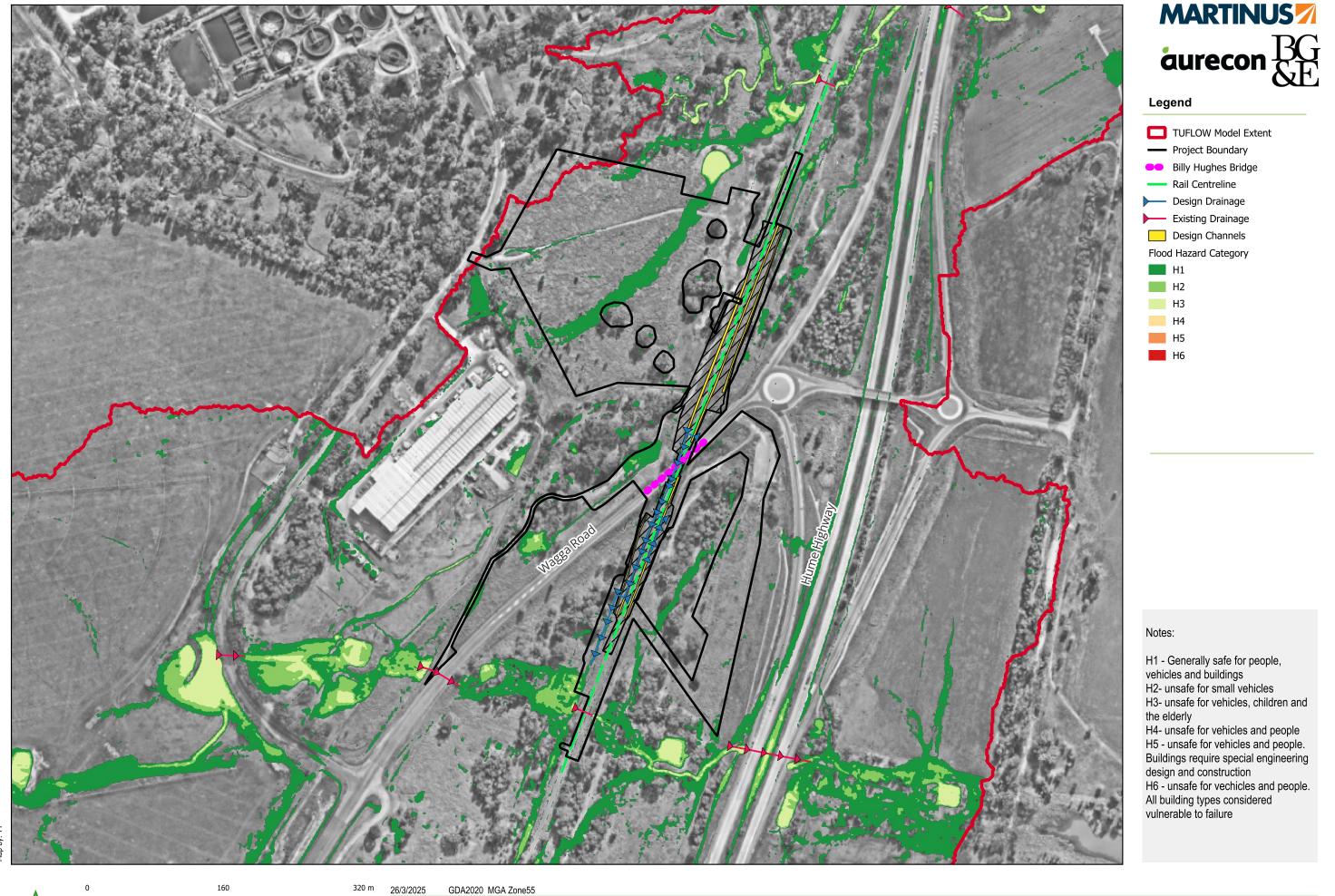




Figure A31: Billy Hughes - Inland Rail (A2P) - IFC Stage 10% AEP Flood Hazard - Developed Conditions

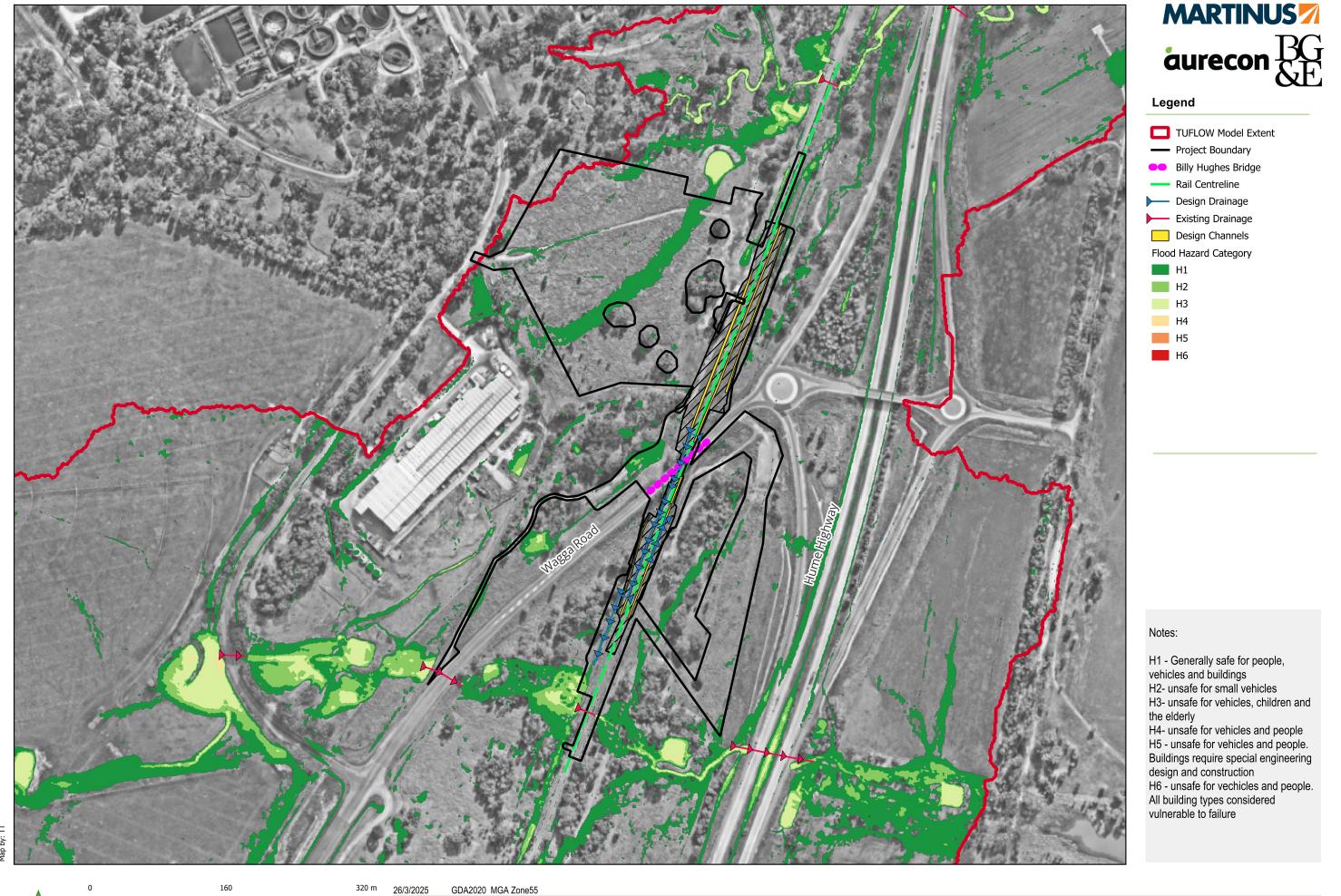




Figure A32: Billy Hughes - Inland Rail (A2P) - IFC Stage 5% AEP Flood Hazard - Developed Conditions

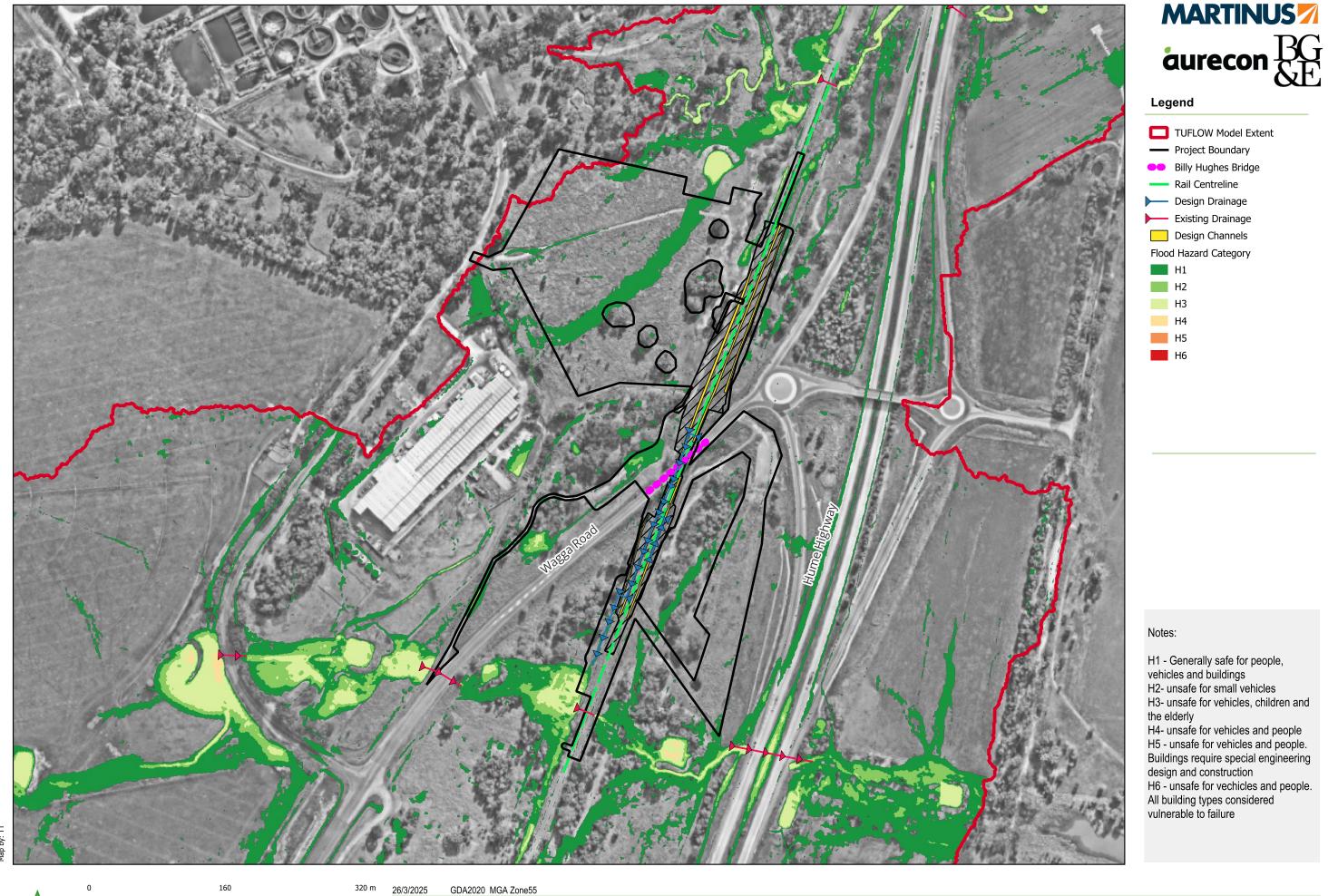




Figure A33: Billy Hughes - Inland Rail (A2P) - IFC Stage 2% AEP Flood Hazard - Developed Conditions





Figure A34: Billy Hughes - Inland Rail (A2P) - IFC Stage 1% AEP Flood Hazard - Developed Conditions

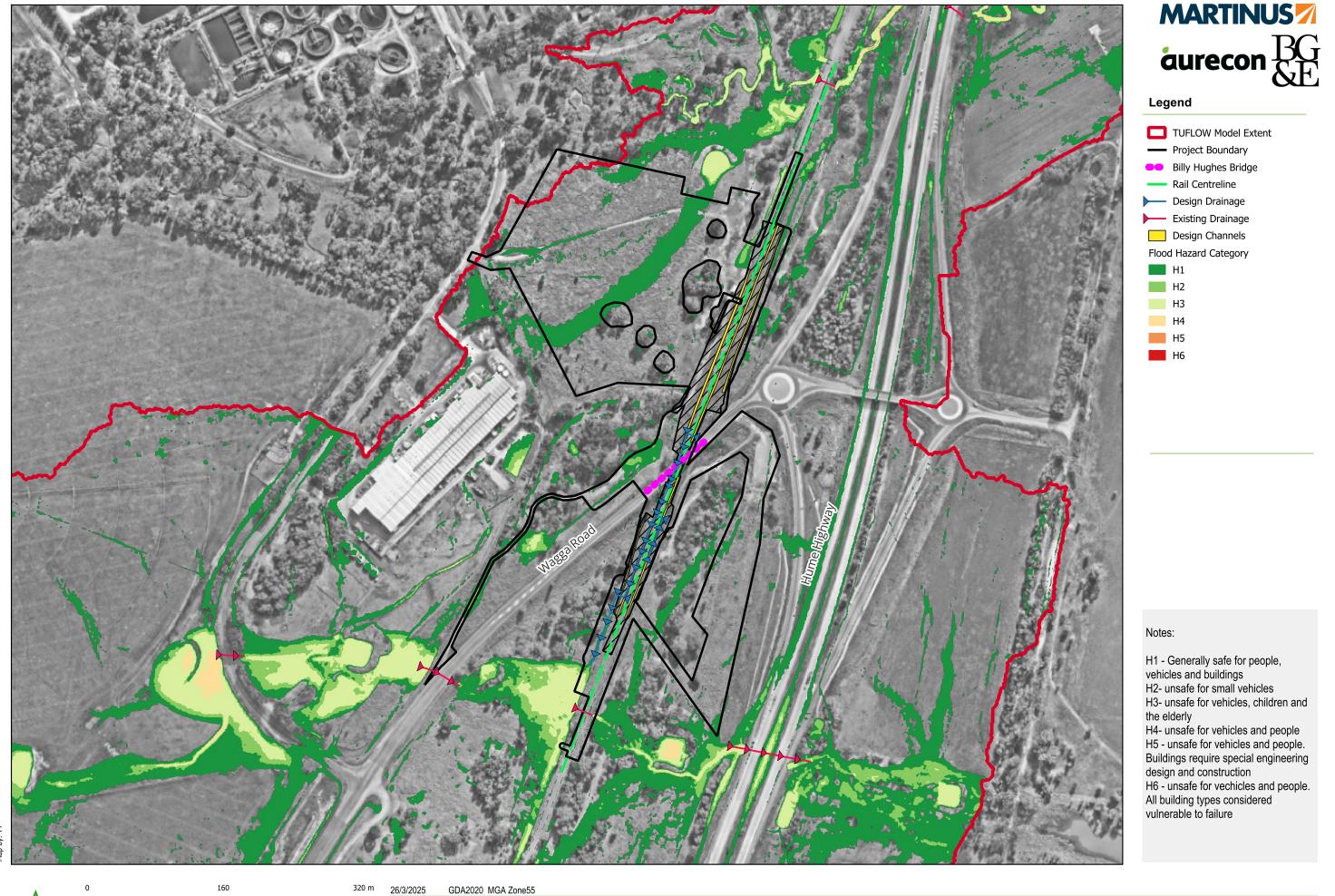




Figure A35: Billy Hughes - Inland Rail (A2P) - IFC Stage 1% AEP + Climate Change Flood Hazard - Developed Conditions

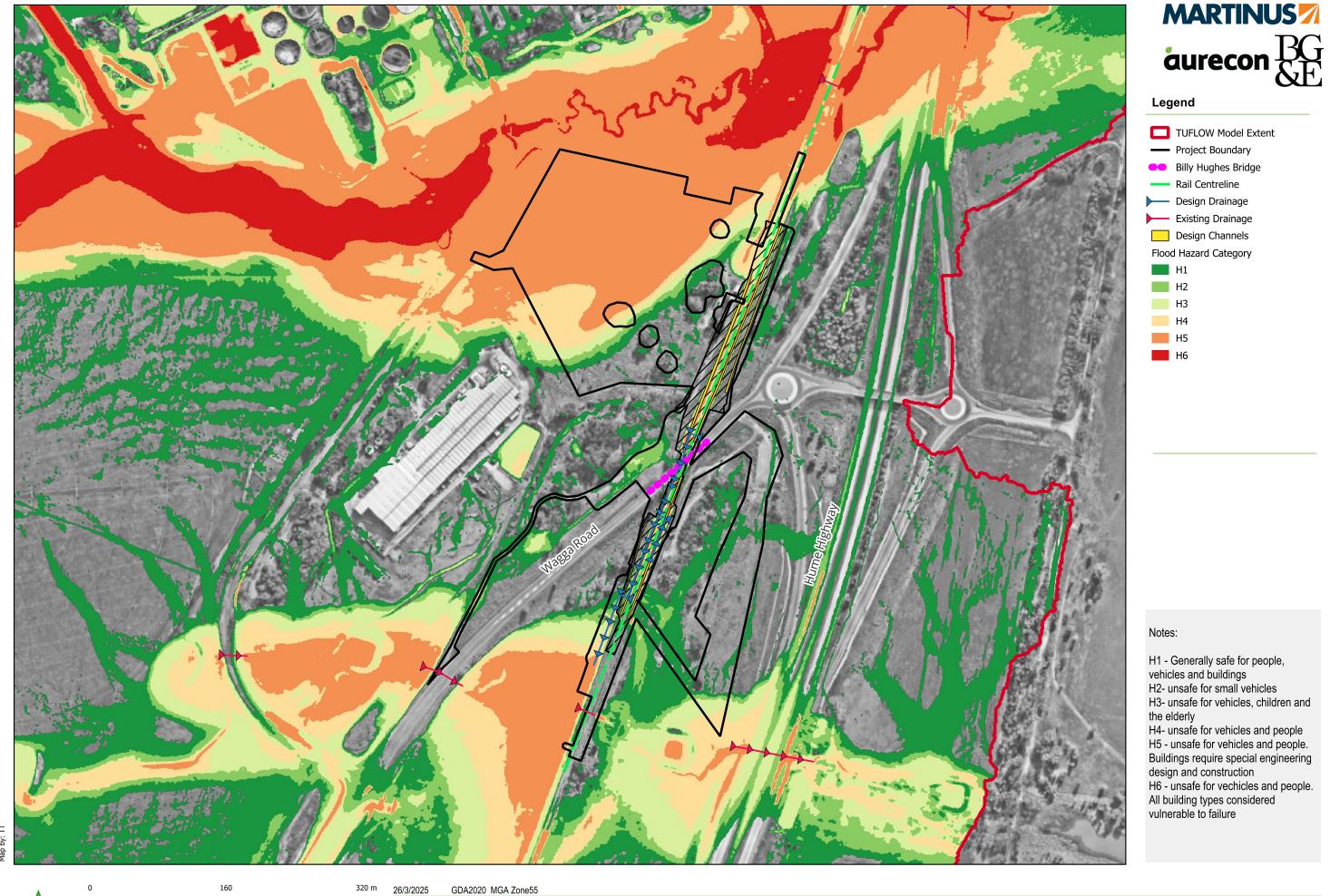
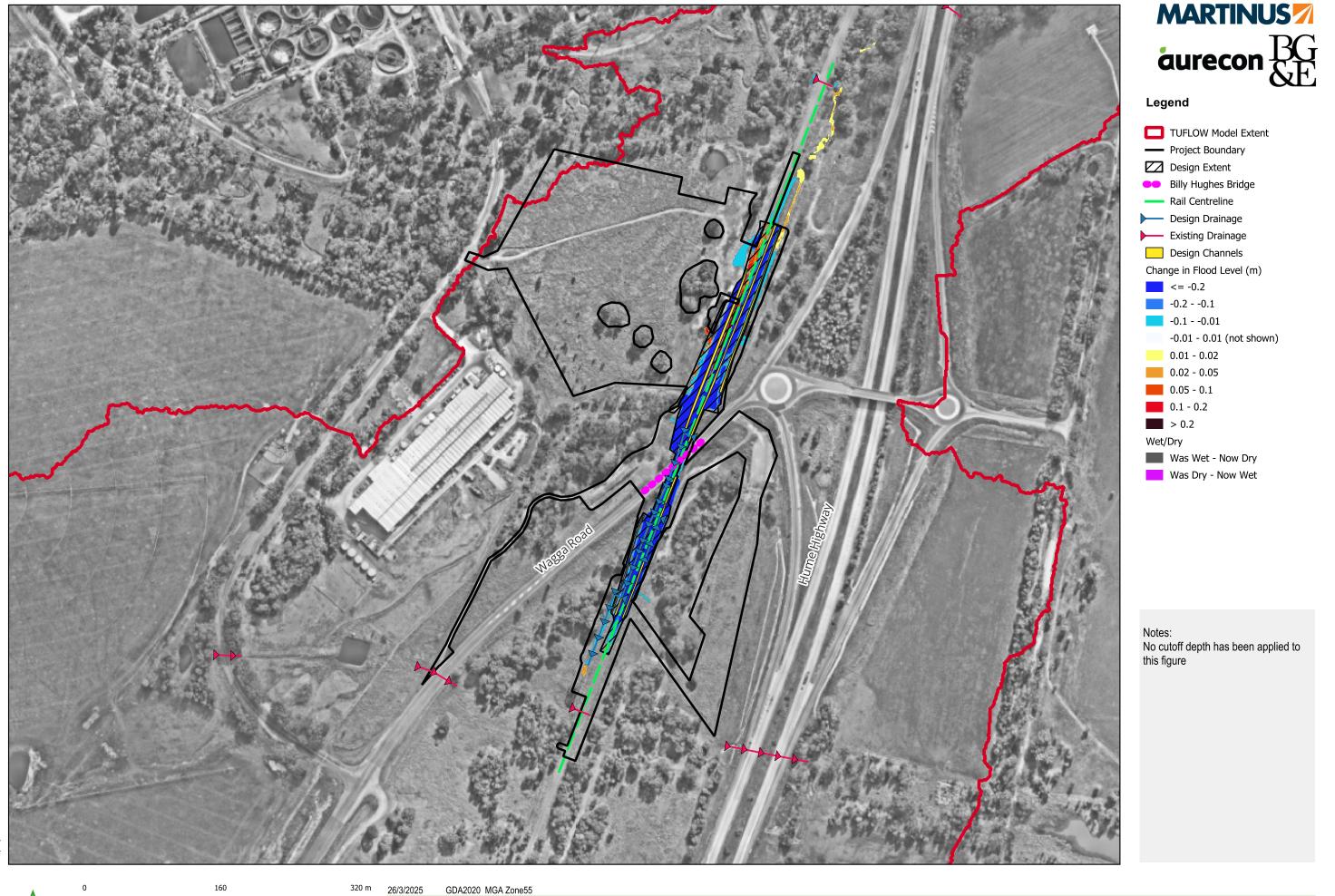
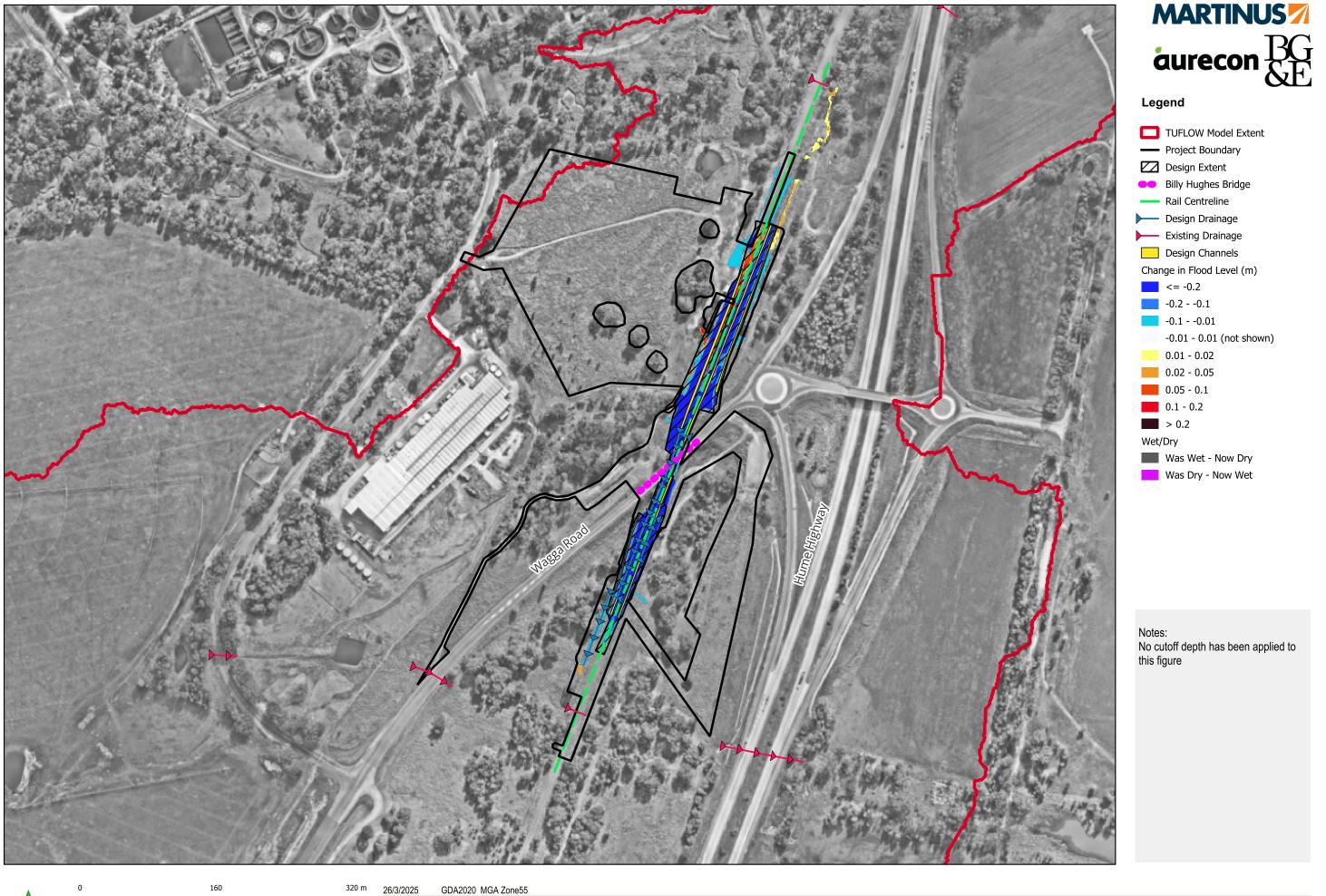




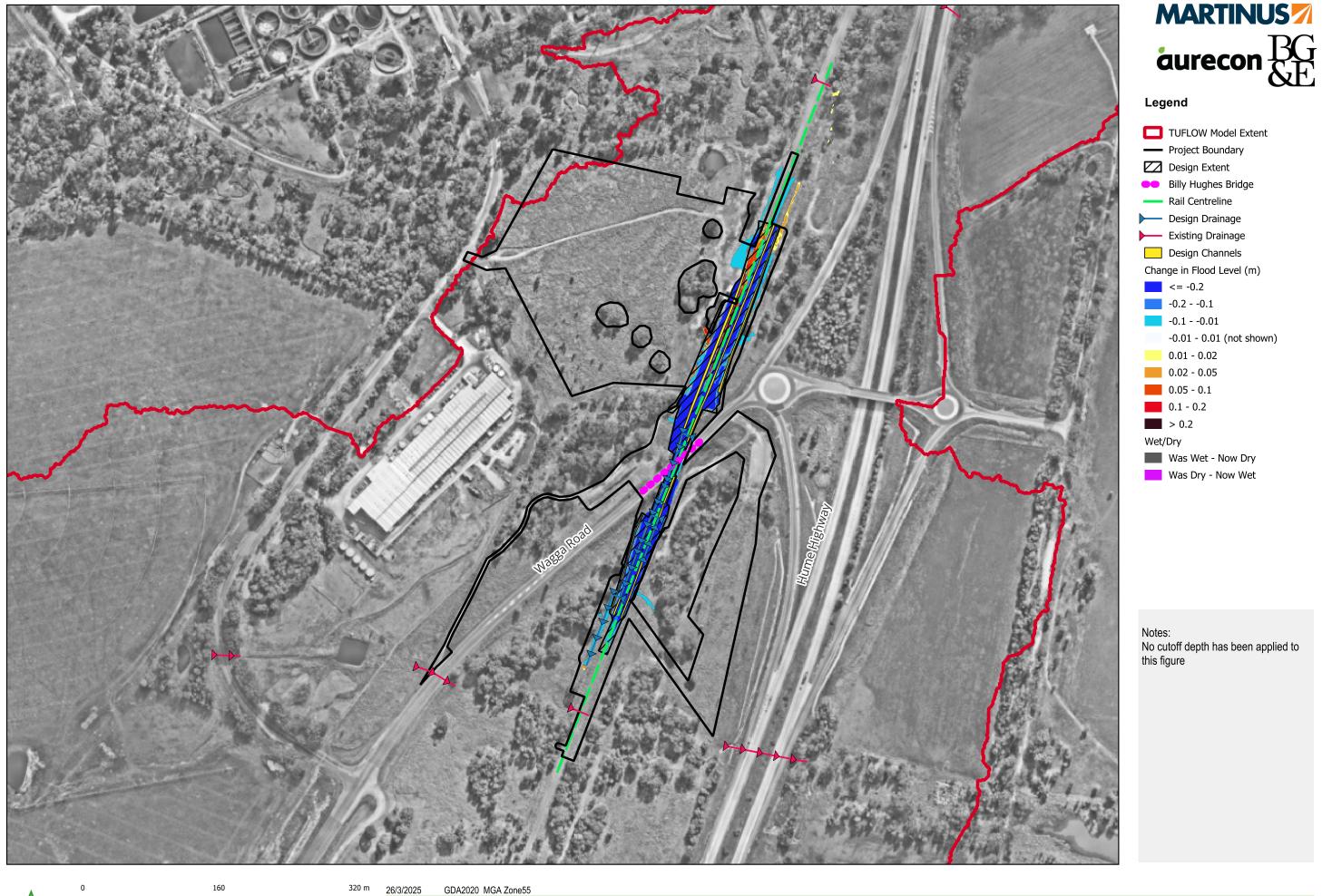
Figure A36: Billy Hughes - Inland Rail (A2P) - IFC Stage Probable Maximum Flood (PMF) Flood Hazard - Developed Conditions



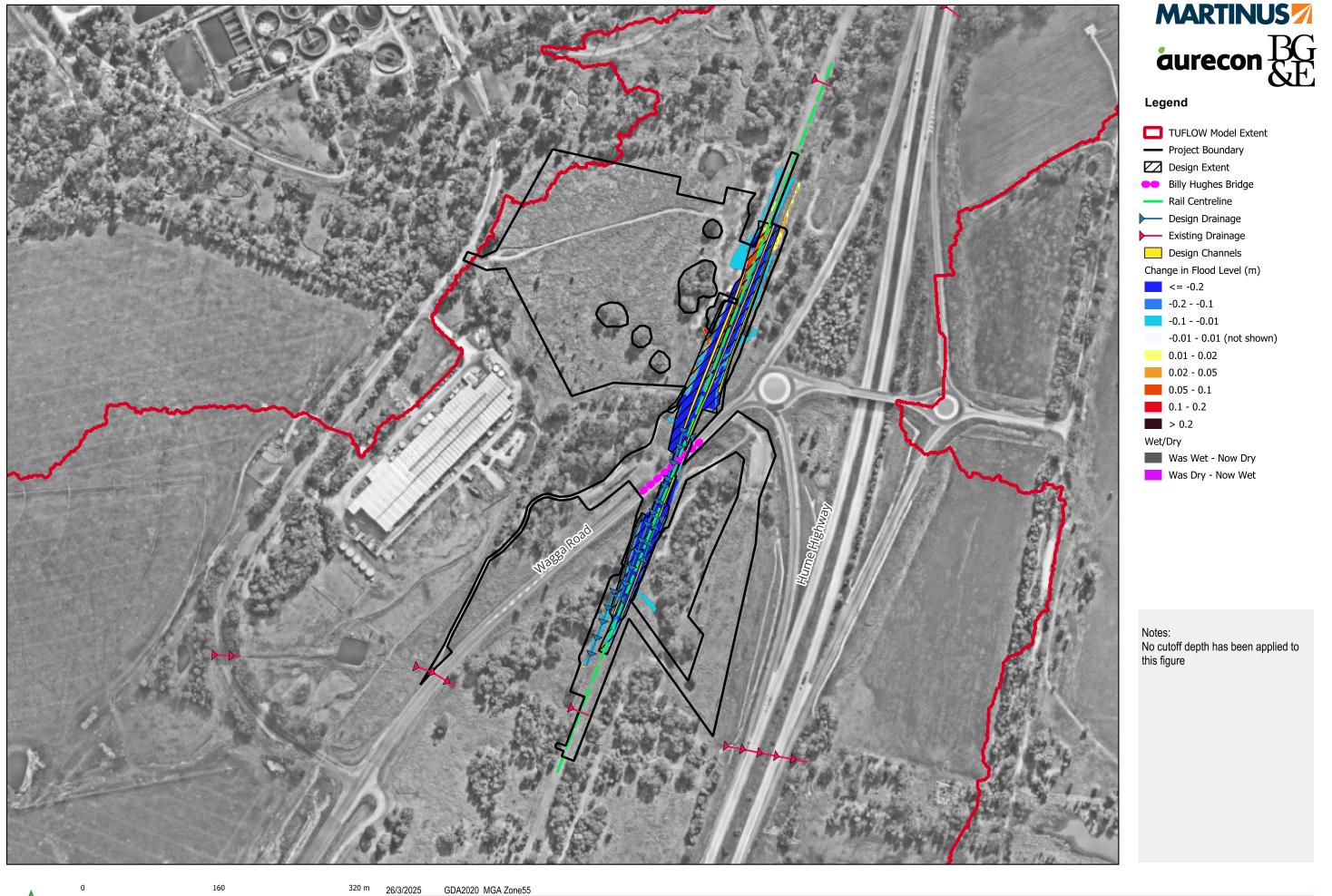












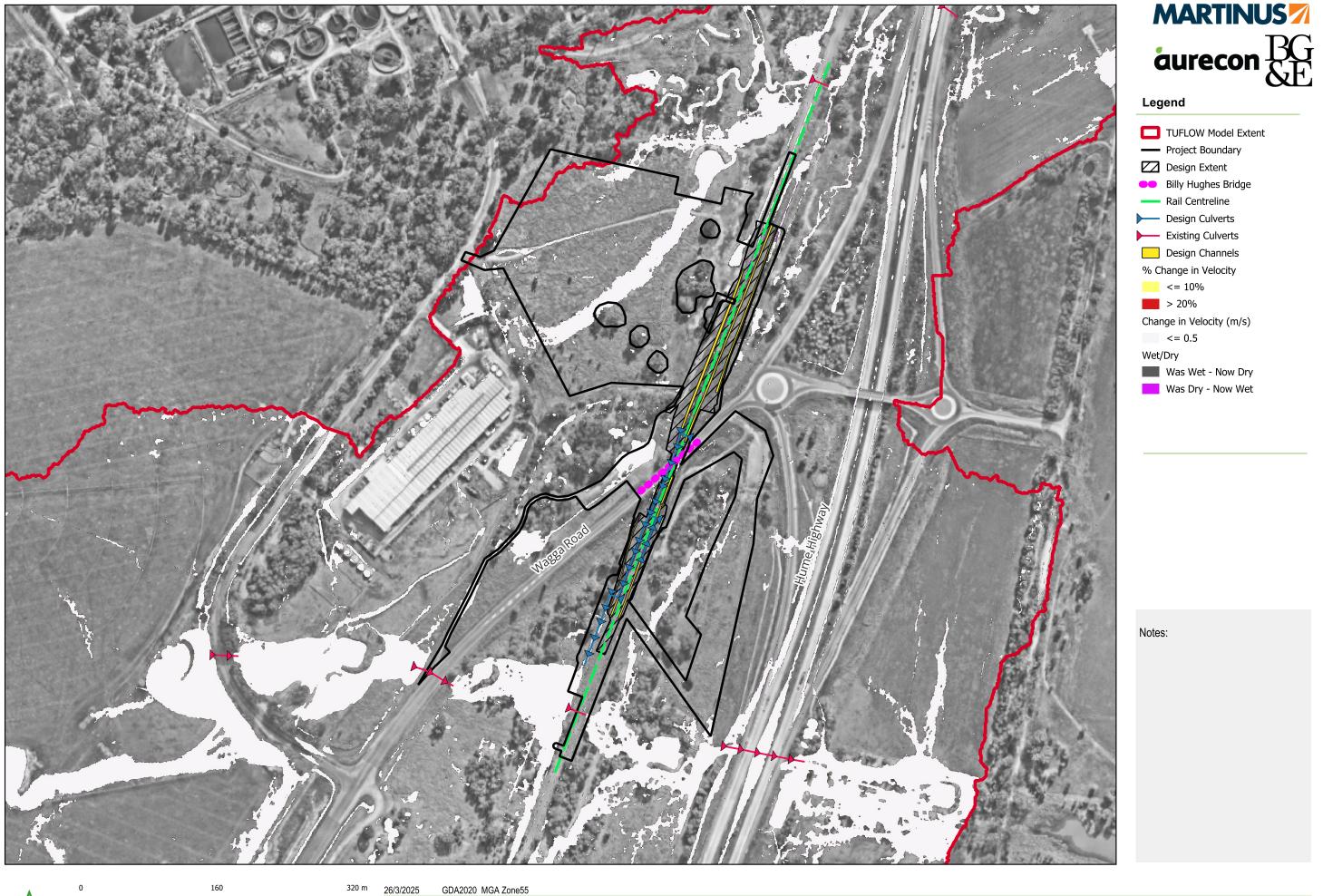




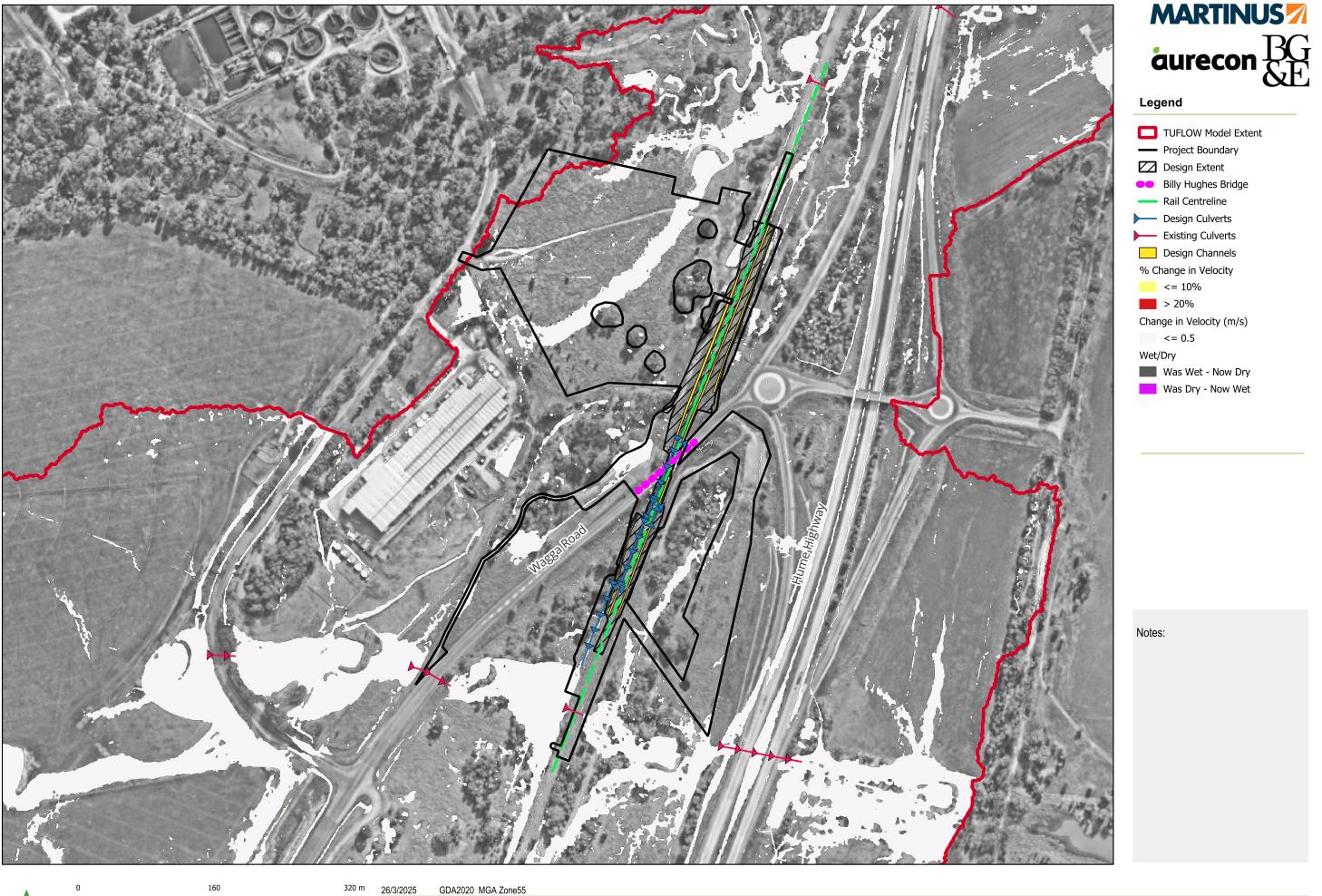














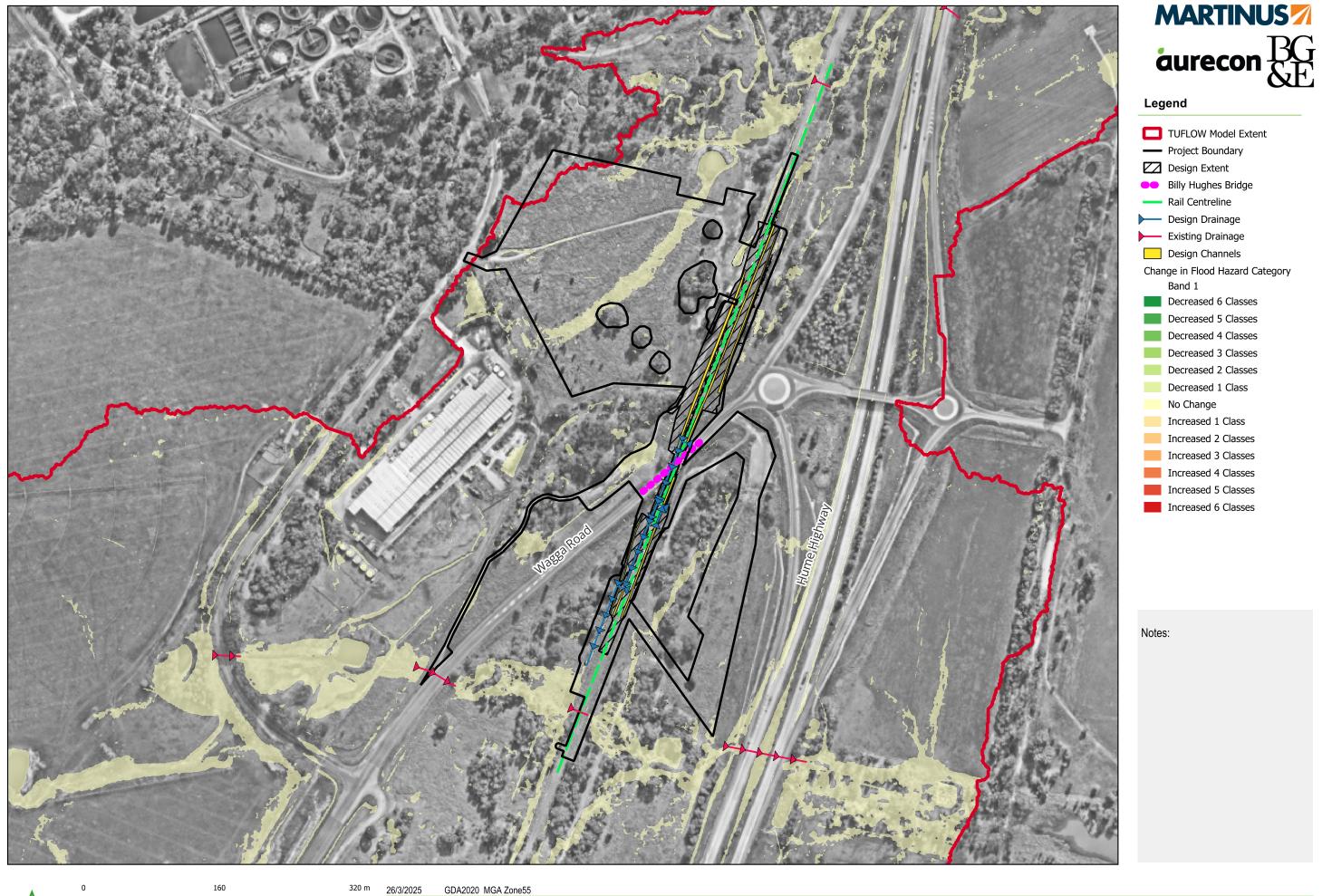




Figure A45: Billy Hughes - Inland Rail (A2P) - IFC Stage 10% AEP - Change in Peak Flood Hazard (Design Condition vs Existing Condition)

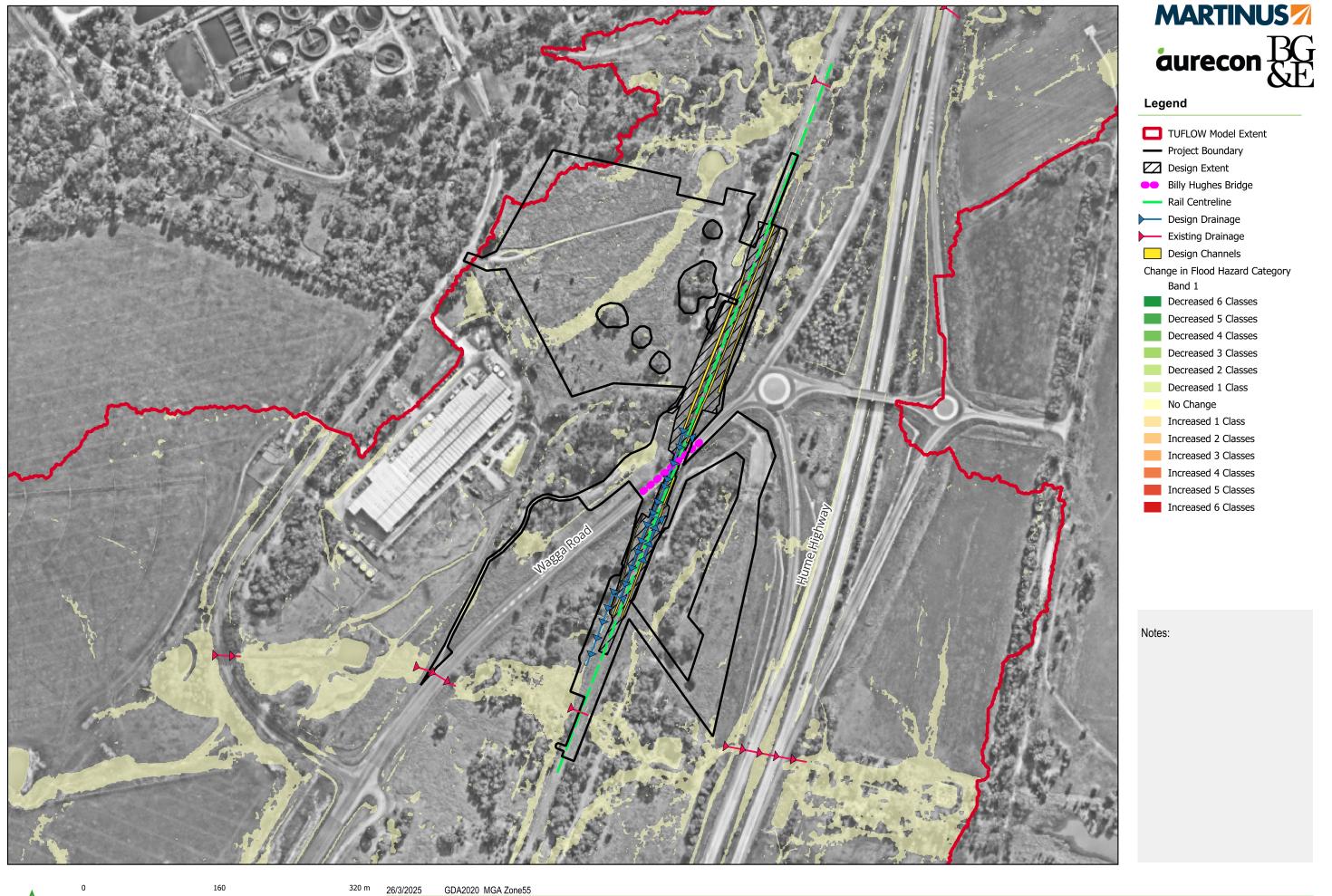
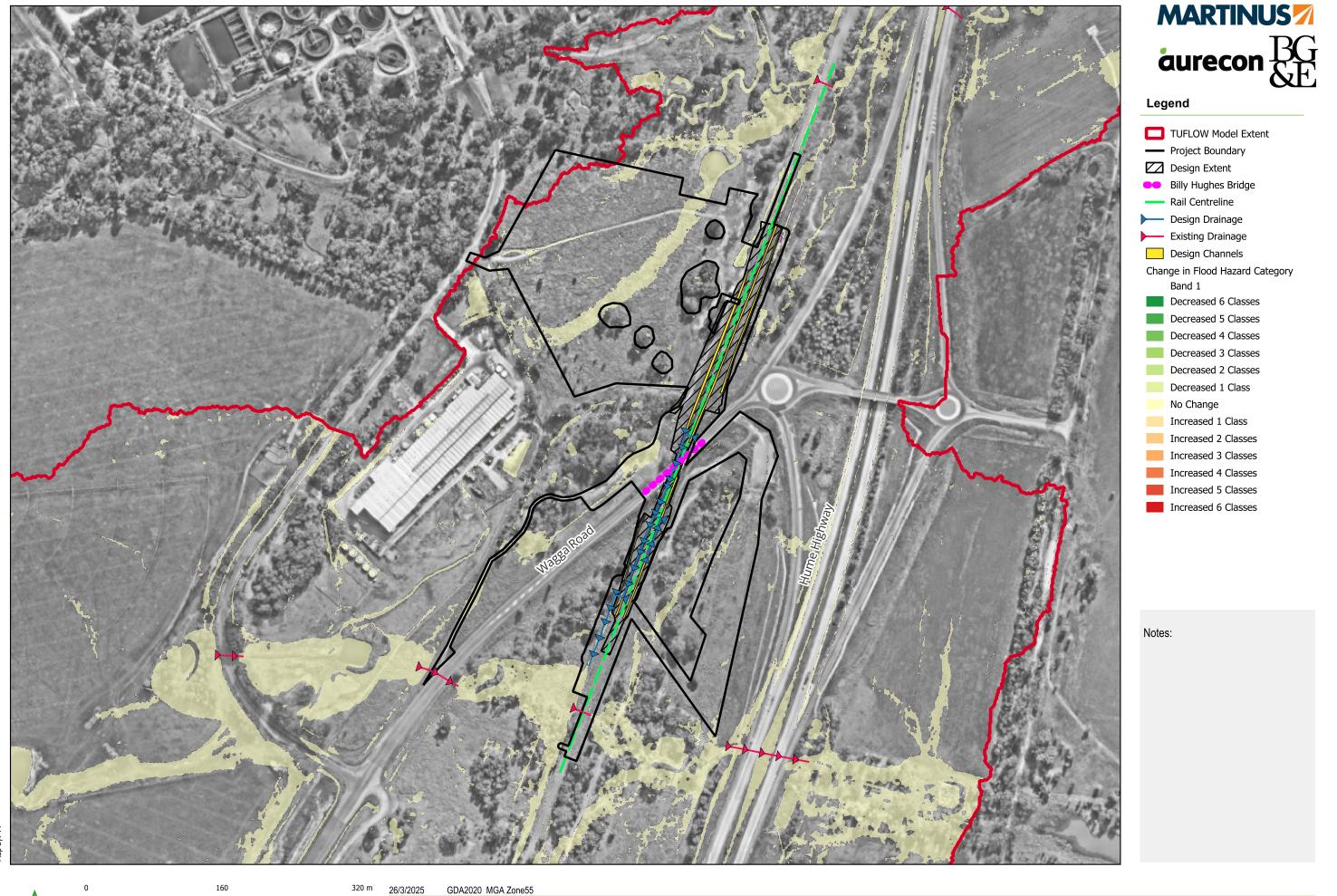




Figure A46: Billy Hughes - Inland Rail (A2P) - IFC Stage 5% AEP - Change in Peak Flood Hazard (Design Condition vs Existing Condition)





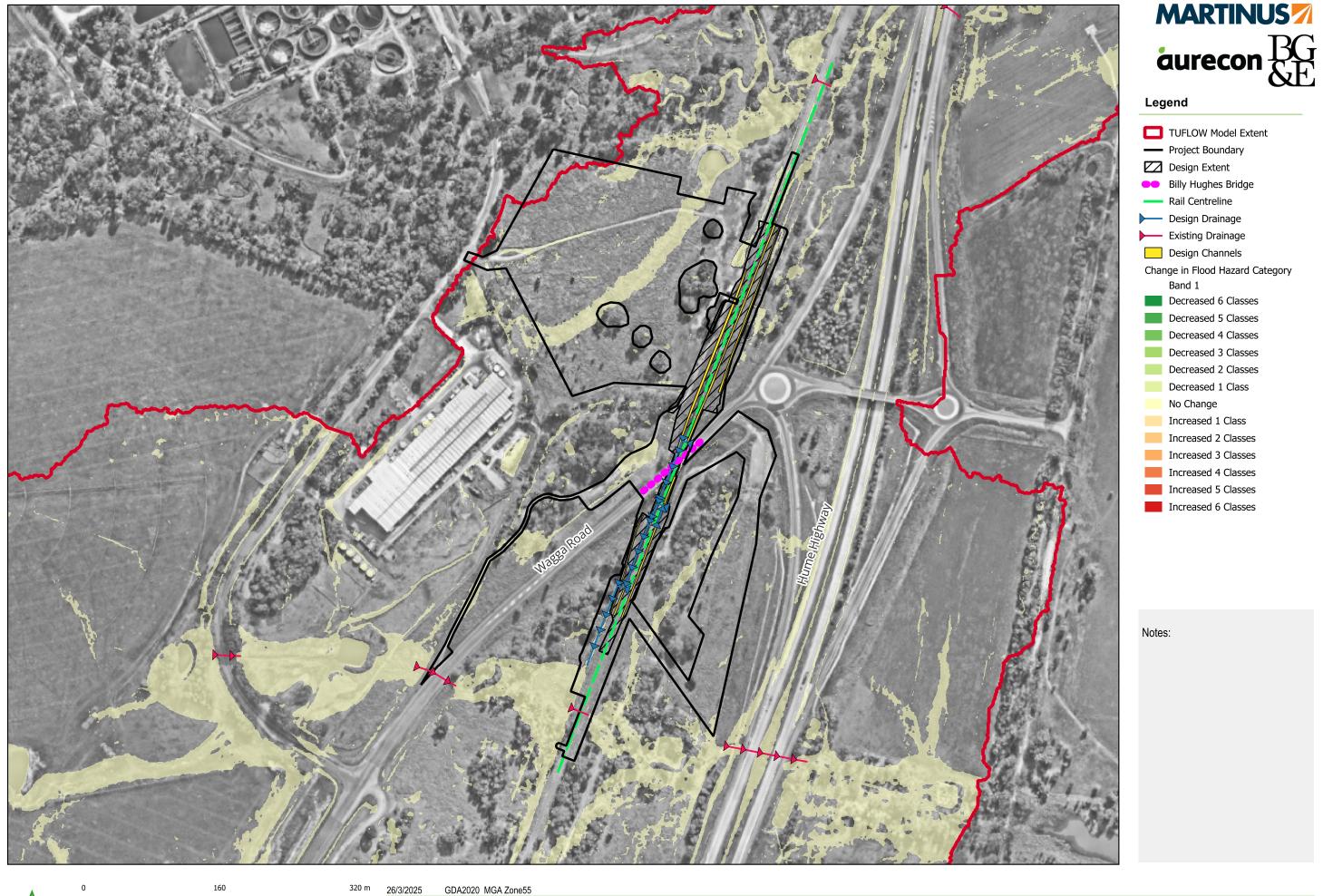
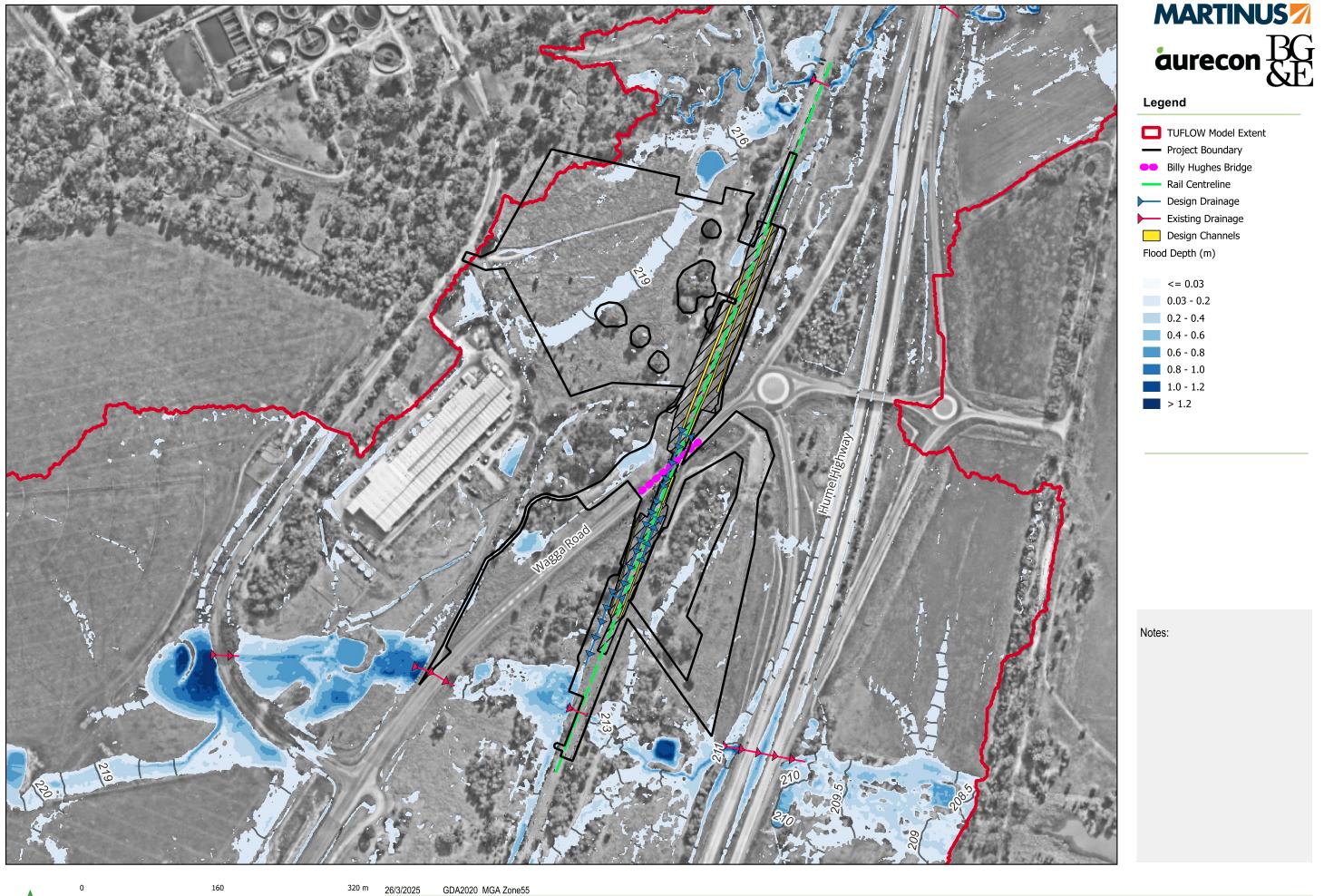




Figure A48: Billy Hughes - Inland Rail (A2P) - IFC Stage 1% AEP - Change in Peak Flood Hazard (Design Condition vs Existing Condition)





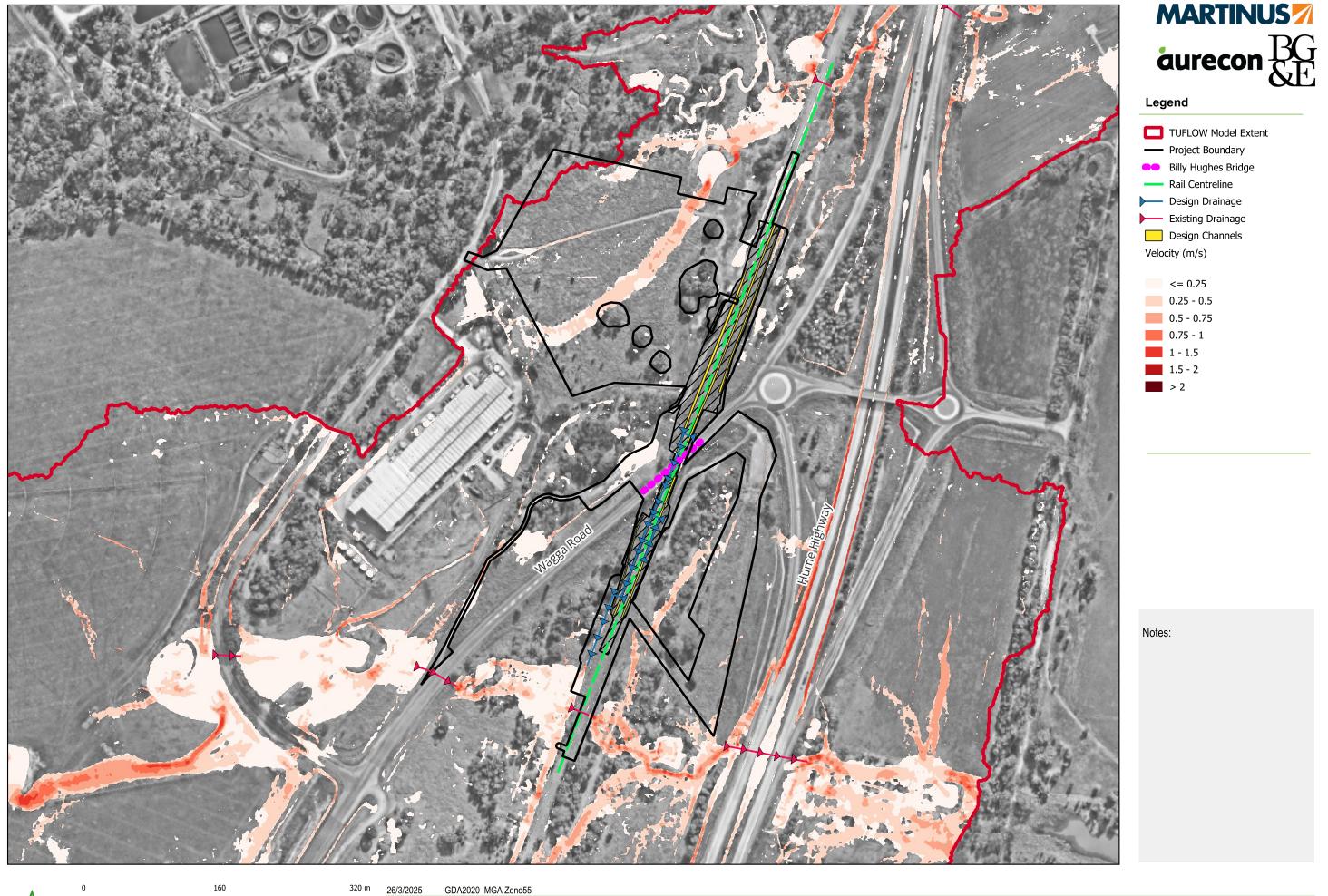








Figure A51: Billy Hughes - Inland Rail (A2P) - IFC Stage 1% AEP + Blockage - Flood Hazard - Developed Conditions



# **APPENDIX B**

# ARR DataHub Data





Results - ARR Data Hub

[STARTTXT]

Input Data Information

[INPUTDATA]

Latitude, -36.003300

Longitude, 146.988500

[END\_INPUTDATA]

River Region

[RIVREG]

Division, Murray-Darling Basin

River Number, 10

River Name, Murray Riverina

[RIVREG\_META]

Time Accessed,28 September 2023 05:54PM

Version,2016\_v1

[END\_RIVREG]

**ARF** Parameters

[LONGARF]

Zone, Southern Temperate

a,0.158

b,0.276

c,0.372

d,0.315

e,0.000141

f,0.41

g,0.15

h,0.01

i,-0.0027

[LONGARF\_META]

Time Accessed,28 September 2023 05:54PM

Version,2016\_v1

[END\_LONGARF]

Storm Losses

[LOSSES]

ID,25723.0

Storm Initial Losses (mm),27.0



Storm Continuing Losses (mm/h),4.5

[LOSSES META]

Time Accessed,28 September 2023 05:54PM

Version,2016 v1

[END LOSSES]

**Temporal Patterns** 

[TP]

code,MB

Label, Murray Basin

[TP META]

Time Accessed, 28 September 2023 05:54PM

Version,2016\_v2

[END TP]

**Areal Temporal Patterns** 

[ATP]

code,MB

arealabel, Murray Basin

[ATP\_META]

Time Accessed,28 September 2023 05:54PM

Version,2016 v2

[END\_ATP]

Median Preburst Depths and Ratios

[PREBURST]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),2.5 (0.129),1.7 (0.065),1.2 (0.038),0.7 (0.019),0.9 (0.020),1.0 (0.021)

90 (1.5),1.9 (0.084),1.6 (0.053),1.4 (0.040),1.2 (0.030),0.7 (0.016),0.4 (0.007)

120 (2.0),5.1 (0.211),3.1 (0.099),1.9 (0.050),0.6 (0.015),0.4 (0.008),0.2 (0.004)

180 (3.0),2.0 (0.073),2.6 (0.072),2.9 (0.071),3.3 (0.071),1.5 (0.028),0.2 (0.003)

360 (6.0), 3.2 (0.098), 2.7 (0.062), 2.3 (0.046), 1.9 (0.035), 3.8 (0.059), 5.2 (0.073)

720 (12.0),0.1 (0.004),0.5 (0.009),0.7 (0.012),0.9 (0.014),2.1 (0.026),2.9 (0.033)

1080 (18.0),0.0 (0.000),0.3 (0.005),0.5 (0.008),0.7 (0.009),1.6 (0.017),2.2 (0.022)

1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.8 (0.008),1.4 (0.013)

 $2160\ (36.0), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000)$ 

 $2880\ (48.0), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000)$ 

 $4320\ (72.0), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000)$ 

[PREBURST\_META]

Time Accessed, 28 September 2023 05:54PM



Version,2018\_v1

Note, Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END\_PREBURST]From preburst class

10% Preburst Depths

[PREBURST10]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0), 0.0 (0.000), 0.0 (0.000), 0.0 (0.000), 0.0 (0.000), 0.0 (0.000), 0.0 (0.000)

90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

120 (2.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

180 (3.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

 $360\ (6.0), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000)$ 

720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

 $1080\ (18.0), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000)$ 

1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

[PREBURST10\_META]

Time Accessed, 28 September 2023 05:54PM

Version,2018 v1

Note, Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END PREBURST10]From preburst class

25% Preburst Depths

[PREBURST25]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0), 0.1 (0.004), 0.0 (0.002), 0.0 (0.001), 0.0 (0.000), 0.0 (0.000), 0.0 (0.000)

90 (1.5),0.1 (0.003),0.0 (0.001),0.0 (0.001),0.0 (0.000),0.0 (0.000),0.0 (0.000)

120 (2.0),0.1 (0.004),0.1 (0.002),0.0 (0.001),0.0 (0.000),0.0 (0.000),0.0 (0.000)

180 (3.0),0.0 (0.001),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

360 (6.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

 $4320\ (72.0), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000), 0.0\ (0.000)$ 

[PREBURST25 META]



Time Accessed, 28 September 2023 05:54PM

Version,2018 v1

Note, Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END\_PREBURST25]From preburst class

#### 75% Preburst Depths

#### [PREBURST75]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),17.8 (0.908),16.9 (0.642),16.4 (0.527),15.8 (0.443),14.1 (0.337),12.8 (0.276)

90 (1.5), 16.9 (0.767), 17.1 (0.581), 17.3 (0.499), 17.4 (0.439), 13.3 (0.286), 10.2 (0.197)

 $120\ (2.0), 18.3\ (0.766), 17.9\ (0.562), 17.6\ (0.473), 17.4\ (0.407), 14.9\ (0.301), 13.1\ (0.238)$ 

180 (3.0),14.1 (0.525),15.6 (0.439),16.5 (0.400),17.4 (0.371),14.5 (0.266),12.3 (0.204)

 $360\ (6.0), 14.0\ (0.427), 14.6\ (0.342), 15.0\ (0.303), 15.3\ (0.273), 17.9\ (0.276), 19.9\ (0.277)$ 

720 (12.0),5.7 (0.139),7.9 (0.151),9.4 (0.156),10.9 (0.159),15.1 (0.190),18.2 (0.207)

1080 (18.0),2.3 (0.050),5.0 (0.084),6.8 (0.100),8.6 (0.110),10.7 (0.118),12.3 (0.123)

1440 (24.0),0.9 (0.018),4.2 (0.064),6.4 (0.085),8.4 (0.099),10.1 (0.101),11.3 (0.101)

2160 (36.0),0.0 (0.000),0.6 (0.008),1.0 (0.012),1.4 (0.014),3.1 (0.027),4.4 (0.034)

2880 (48.0),0.0 (0.000),0.2 (0.002),0.3 (0.003),0.4 (0.004),0.5 (0.004),0.6 (0.004)

4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.1 (0.001)

#### [PREBURST75 META]

Time Accessed, 28 September 2023 05:54PM

Version,2018\_v1

Note, Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END\_PREBURST75]From preburst class

# 90% Preburst Depths

### [PREBURST90]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),42.6 (2.174),35.9 (1.360),31.4 (1.012),27.2 (0.761),26.8 (0.641),26.6 (0.570)

90 (1.5),37.2 (1.687),37.5 (1.270),37.6 (1.086),37.8 (0.952),30.4 (0.656),24.9 (0.483)

120 (2.0),34.2 (1.427),35.8 (1.123),36.8 (0.987),37.8 (0.887),41.5 (0.836),44.3 (0.805)

180 (3.0),26.2 (0.976),33.7 (0.951),38.6 (0.935),43.3 (0.921),36.5 (0.669),31.4 (0.520)

360 (6.0),32.6 (0.991),30.3 (0.709),28.7 (0.582),27.3 (0.487),35.9 (0.553),42.3 (0.590)

720 (12.0),14.1 (0.348),20.1 (0.384),24.1 (0.399),27.9 (0.408),29.6 (0.373),30.9 (0.351)

 $1080\ (18.0), 14.6\ (0.317), 20.2\ (0.340), 23.9\ (0.349), 27.5\ (0.354), 27.3\ (0.301), 27.2\ (0.270)$ 

 $1440\ (24.0), 12.6\ (0.251), 20.4\ (0.313), 25.5\ (0.339), 30.4\ (0.357), 26.0\ (0.261), 22.7\ (0.204)$ 

2160 (36.0), 3.0 (0.052), 7.3 (0.098), 10.1 (0.118), 12.8 (0.132), 12.8 (0.112), 12.9 (0.100)

2880 (48.0),1.7 (0.027),5.0 (0.062),7.2 (0.077),9.3 (0.087),19.9 (0.159),27.9 (0.198)

4320 (72.0),0.0 (0.000),1.5 (0.017),2.5 (0.024),3.5 (0.030),10.8 (0.077),16.2 (0.103)



### [PREBURST90\_META]

Time Accessed, 28 September 2023 05:54PM

Version,2018\_v1

Note, Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END PREBURST90]From preburst class

### Interim Climate Change Factors

### [CCF]

,RCP 4.5,RCP6,RCP 8.5

2030,0.816 (4.1%),0.726 (3.6%),0.934 (4.7%)

2040,1.046 (5.2%),1.015 (5.1%),1.305 (6.6%)

2050,1.260 (6.3%),1.277 (6.4%),1.737 (8.8%)

2060,1.450 (7.3%),1.520 (7.7%),2.214 (11.4%)

2070,1.609 (8.2%),1.753 (8.9%),2.722 (14.2%)

2080, 1.728 (8.8%), 1.985 (10.2%), 3.246 (17.2%)

2090,1.798 (9.2%),2.226 (11.5%),3.772 (20.2%)

### [CCF\_META]

Time Accessed, 28 September 2023 05:54PM

Version,2019 v1

Note,ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

[END CCF]

### Probability Neutral Burst Initial Loss

## [BURSTIL]

min (h)\AEP(%),50.0,20.0,10.0,5.0,2.0,1.0

60 (1.0),17.0,9.0,8.4,9.2,9.5,8.5

90 (1.5),17.4,9.7,8.8,9.2,9.2,9.0

120 (2.0),16.4,9.7,9.0,9.4,9.0,7.7

180 (3.0),18.1,11.1,9.6,9.6,9.0,8.1

360 (6.0),17.5,11.6,10.6,11.4,9.7,6.2

720 (12.0),21.5,15.6,14.1,14.2,12.3,7.6

1080 (18.0),22.3,16.7,15.5,15.6,14.0,10.1

1440 (24.0),23.1,17.4,16.2,16.3,15.6,11.6

2160 (36.0),25.4,20.7,20.7,21.2,19.6,15.1

2880 (48.0),25.9,21.6,21.9,22.0,21.0,12.9

4320 (72.0),26.6,22.5,23.4,23.9,23.1,17.5

[BURSTIL\_META]

Time Accessed, 28 September 2023 05:54PM



Version,2018\_v1

Note, As this point is in NSW the advice provided on losses and pre-burst on the <a href="./nsw\_specific">NSW Specific Tab of the ARR Data Hub</a> is to be considered. In NSW losses are derived considering a hierarchy of approaches depending on the available loss information. Probability neutral burst initial loss values for NSW are to be used in place of the standard initial loss and pre-burst as per the losses hierarchy.

#### [END\_BURSTIL]

Transformational Pre-burst Rainfall

[PREBURST\_TRANS]

min (h)\AEP(%),50.0,20.0,10.0,5.0,2.0,1.0

60 (1.0), 9.9, 17.9, 18.5, 17.7, 17.4, 18.4

90 (1.5), 9.5, 17.2, 18.1, 17.7, 17.7, 17.9

120 (2.0), 10.5, 17.2, 17.9, 17.5, 17.9, 19.2

180 (3.0),8.8,15.8,17.3,17.3,17.9,18.8

360 (6.0),9.4,15.3,16.3,15.5,17.2,20.7

720 (12.0),5.4,11.3,12.8,12.7,14.6,19.3

1080 (18.0),4.6,10.2,11.4,11.3,12.9,16.8

1440 (24.0),3.8,9.5,10.7,10.6,11.3,15.3

2160 (36.0), 1.5, 6.2, 6.2, 5.7, 7.3, 11.8

2880 (48.0), 1.0, 5.3, 5.0, 4.9, 5.9, 14.0

4320 (72.0),0.3,4.4,3.5,3.0,3.8,9.4

[PREBURST\_TRANS\_META]

The tranformational pre-burst is intended for software suppliers in the NSW area and is simply the Initial Loss - Burst Initial Loss. It is not appropriate to use these values if considering a calibrated initial loss.

[END\_PREBURST\_TRANS]



## **APPENDIX C**

## **ARTC Review Comments**



ARTC INLAND

Contractor DC to update for re-submission Submitted Document No. or Transmittal No.: Martinus-PTRAN-001212 2100 - A2I Date Submission Received: 22/04/2025 nment Sheet Number\_Revision: 5-0052-210-IHY-B5-CS-0001\_E Comment Sheet Title: External Comment Sheet - A2I | Flood Design Report - Billy Hughes Bridge - Track Lowering

		<b>Revision Date:</b> 30/04/2025			Documents related in Aconex (by IR DC)													
			Revi	ew Comments (Rev	riewer)						Responses (Do		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 <b>or</b> 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	Clarification	5-0052-210-IHY-B5-RP-0001_A.pdf	Page 12, Table 2-1	PDR	incorrect section reference. There is no Section 0.	Opportunity	Hartley Bulcock	6/06/2024	Michal Plesko / Zoe Cruice	DJV DC	1/07/2024	This reference will be corrected		Ayub Ali	4/12/2024	CLOSED	Section references corrected.	
2	Opportunity	5-0052-210-IHY-B5-RP-0001_A.pdf	Page 19, 5-0052-210- IHY-B5-RP-0001_A, Section 4.1.3 (Page 18)	PDR	Appears to be a duplication of the dot point above. Hence, correction is required.	Opportunity	Ayub Ali	4/06/2024	Michal Plesko / Zoe Cruice	DJV DC	1/07/2024	This will be corrected		Ayub Ali	4/12/2024	CLOSED	Duplication deleted.	
3	PSR Annexure B Technical Requirements (sections 5.4.1 and 5.4.4)	5-0052-210-IHY-B5-RP-0001_A.pdf	Page 20, 5-0052-210- IHY-B5-RP-0001_A, Section 4.1.3 (Page 19)	PDR	No information has been provided how the model extent was determined. A statement is required confirming the entire local catchment upstream of the area of interest has been captured. Alternatively, external flow boundaries were used. A topographic map is also required in support of the claim.	Non-Compliant	Ayub Ali	4/06/2024	Jasmine Lee / Zoe Cruice	DJV/MR	1/07/2024		Section 4.1.2 and Section 4.2.1 of 5-0052-210-IHY-B5_RP-0001	Ayub Ali	22/04/2025	CLOSED	This item is closed based on the submitted screenshot extracted from the report.	
4	Condition E40	5-0052-210-IHY-B5-RP-0001_B.pdf	Page 19, 5-0052-210- IHY-B5-RP-0001_B, Section 4	DDR	Mention here that a sensitivity assessment of potential blockage has been carried out in accordance with ARR 2019 Guidelines.	Opportunity	Ayub Ali	4/12/2024	Jasmine Lee/Malinda Gunasekera	DJV	14/01/2025	section as shown in Screenshot 2 below.	Section 4 of 5-0052-210-IHY- B5_RP-0001	Ayub Ali	22/04/2025	CLOSED	This item is closed based on the submitted screenshot extracted from the report.	
5	PSR Annexure B Technical Requirements (sections 5.4.1 and 5.4.4)	5-0052-210-IHY-B5-RP-0001_B.pdf	Page 24, 5-0052-210- IHY-B5-RP-0001_B, Section 4.2	DDR	No information has been provided how TUFLOW model extent has been determined/decided. A statement is required either confirming that the model domain has been extended up to the upstream catchment boundary or external upstream flow boundaries have been used for local flood modelling.	Opportunity	Ayub Ali	4/12/2024	Jasmine Lee/Malinda Gunasekera	DJV	14/01/2025		Section 4.1.2 and Section 4.2.1 of 5-0052-210-IHY-B5_RP-0001	Ayub Ali	22/04/2025	CLOSED	This item is closed based on the submitted screenshot extracted from the report.	
				Non Compliant	Non-compliance which requires correction before further	design development	000150	<b>X</b>	(X)		OPEN	Comment has not been addressed.	<u> </u>		Name and Associated and Associated Associate	<u> </u>		
				•	· · ·													
				Opportunity	Comment which identifies an opportunity to save capex,	achieve increased qu	ality or operational outo	ome. Not a non-o	compliance.		CLOSED:	Comment is closed. No further action.						
											NEXT PHASE:	: Comment response has been accepted. Resulting actions have been deferred to the next Phase of the Project (for Doc Control purposes the comment is considered OPEN)						
											TRANSFERRED:	Response is not acceptable or review has been split a	and the comment has been transfe	erred to another com	ment sheet. (for	Doc Control purposes or	mment is considered CLOSED)	

#### Screenshot 1

#### Screenshot 2 4 MODELLING METHODOLOGY

- This food assessment comprises a TUFLOW hydraulic model, an XP-Ralts Hydrologic model and a desktop analysis based on The Albury Floodplain Risk Management Study and Plan (VMA Water, 2016).

  The overall approach for flood modelling is listed below.

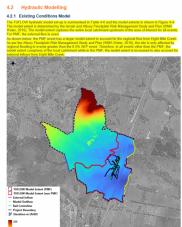
  Creation of a new Rainfall-on-Grid TUFLOW hydraulic model, to model local catchment flooding for the area of Intreast around Billy Hydrologs Bridge to prespece the existing per-development conditions using existing Risk Management Study and Plan report (VMA Water, 2016).

  Creation of a NP-Ralts Plythologic model to represent regional Risk Management Study and Plan report (VMA Water, 2016).

  Creation of a XP-Ralts Plythologic model to represent regional Risk Management Study and Plan report (VMA Water, 2016).

  Creation of a XP-Ralts Plythologic model to represent regional Rodoling in the Problach Manimum Flood (PMF) of Eight Mile Creek hased on information in the Eight Mile Creek Flood Study (URS, 2012). Incorporate Regional Plan Regional Plan Regional Plan Regional Regional Plan Regional Regiona

### Screenshot 3





### **APPENDIX D**

## **External Consultation Review**

D1 – TfNSW review comments

D2 - Albury City Council review request record





## **APPENDIX D1**

## **TfNSW Review Comments**



A2I Flood Design Report CONSULTATION - COMMENTS REGISTER
Title: A2I | Transport for NSW - Flood Design Report - Billy Hughes Bridge - Track Lowering - Comment Register
Doc No: 5-000-12-01-HT-85-65-0001 Revision 3 Revision Date: 2/07/2025

Stakeholder Category Name	Flood Design Report name	Document reference	Date raised	Topic that comment relates to	Comments	Full Name	Company	Date	Response (must be specific on how the comment has been addressed. Agreed approach for re- submission)	Stakeholder Name	Date	Comment Status	Close-Out Comment
State Government	S-0052-210-IHY-BS-RP-0001_B Flood Design Report - Billy Hughes Bridge	Whole document	21/02/2025	Climate Change Assumptions	The climate change assumptions are not aligned with the latest guidance in ARR2019 (Version 4.2). Therefore, the reports do not fully comply with the Post Conditions of Approval – Flooding. Spec Officially: E80 hydrologic and hydrauk assessments consistent with Australian Rainfal and Runoff – A Guide to Flood Estimation (Geoscience Australia, 2019). Any instances of non-compliance must be justified.	Malinda Gunasekera	DJV Flood Modeller	17/03/2025	The Contractor queried the post-contract-award change to the ARR2019 Climate Change approach (changed in Sep 202A), and IR confirmed (post CSI approval on 8 Dct) the continued use of the prior version of ARR2019 Climate change method (refer to IR2140-RRF-00073). It was determined that the prior version should be used to ensure consistency (and thus parity) with the methods used through the EB Technical assessments.	TfNSW	18/06/2025	Closed	Noted.
State Government TfNSW	S-0052-210-IHY-B5-RP-0001_B Flood Design Report - Billy Hughes Bridge	4.2.2 Design Conditions Model	21/02/2025	Drainage design	Drainage design details including long sections and HGLs should be provided. This could be included as an appendix.	Malinda Gunasekera	DJV Flood Modeller	17/03/2025	The drainage details have been provided in the main design report (5.0052-210-PEN-85- R8-0001).  Please refer to Section 4.5 of the Detailed Design Report (5.0052-210-PEN-85-R9-0001) for drainage design details and refer to Drainage Drawings (5-0052-210-PEN-85-DR-0201) for long sections including HGLs and other details.  27/6/252C. The Contractor has requested that IRPL provide the Detailed Design Report to Thissy.	TfNSW	18/06/2025	Open	TfNSW has not received the Detailed Design Report (5-0052-210-PEN-BS- RP-0001), Induding Drainage Drawings (5-0052-210-CDR-BS-DR- 0201) - please provide for TfNSW review.
State Government			18/06/2025		In Table 2-2 for Condition of Approval E41 this should read "The Proponent's response to the requirements of Conditions E38 and E80" please correct.	Malinda Gunasekera	DJV Flood Modeller	27/06/2025	This has been corrected in the report.  Let 1 the "proceeding of prompting to the recoluments of the processing of the p				

OFFICIAL

A1-1



### **APPENDIX D2**

## Albury City Council Review Request Record





### Re: Albury to Illabo - Flood Design Report Tranche 2 for Consultation

From Simon Fisher <simon.fisher@martinus.com.au>

Date Mon 2025-03-03 3:56 PM

To Steven Millett <Steven.Millett@alburycity.nsw.gov.au>; Communications <Communications@alburycity.nsw.gov.au>; info@alburycity.nsw.gov.au <info@alburycity.nsw.gov.au>

**Cc** Chris Standing <a href="mailto:com.au">chris.standing@martinus.com.au</a>; Constance Georgiou <a href="mailto:com.au">constance.georgiou@bdinfrastructure.com</a>

#### Good afternoon,

Following a review of our consultation records we note we have not heard from you or your team members on the Flood Design Reports issued for consultation on 3 February 2025. The consultation period closed on the 21 February 2025. However if you are interested in providing feedback, please kindly **contact us urgently** as the review will be closing tomorrow afternoon.

Alternatively if you do not intend to provide comment then please advise us in writing also.

#### Regards,

### Simon Fisher

Design and Approvals Support Inland Rail - A2P



+61 402 103 704

simon.fisher@martinus.com.au

martinus.com.au

Australia | New Zealand | Chile | USA

◎ in

SAVE CONTACT

From: Simon Fisher <simon.fisher@martinus.com.au>

Sent: Monday, 24 February 2025 2:51 PM

To: Steven Millett <Steven.Millett@alburycity.nsw.gov.au>; Communications

<Communications@alburycity.nsw.gov.au>; info@alburycity.nsw.gov.au <info@alburycity.nsw.gov.au>

Cc: Chris Standing <chris.standing@martinus.com.au>; Constance Georgiou

<constance.georgiou@bdinfrastructure.com>

Subject: Re: Albury to Illabo - Flood Design Report Tranche 2 for Consultation

#### Good afternoon,

Following a review of our consultation records we note we have not heard from you or your team members on the Flood Design Reports issued for consultation on 3 February 2025. The consultation period closed on the 21 February 2025. However if you are interested in providing feedback, please kindly contact

us urgently and review the document(s) in the folder below and fill out the spreadsheet provided **by COB** today.

Alternatively if you do not intend to provide comment then please advise us in writing also.

#### Regards,

## Simon Fisher

Design and Approvals Support Inland Rail - A2P



- +61 402 103 704
- simon.fisher@martinus.com.au
- martinus.com.au
- Australia | New Zealand | Chile | USA

in

SAVE CONTACT

From: Simon Fisher <simon.fisher@martinus.com.au>

Sent: Tuesday, 4 February 2025 8:52 AM

To: Steven Millett <Steven.Millett@alburycity.nsw.gov.au>; Communications

<Communications@alburycity.nsw.gov.au>

Cc: Chris Standing <chris.standing@martinus.com.au>; Constance Georgiou

<constance.georgiou@bdinfrastructure.com>

Subject: Re: Albury to Illabo - Flood Design Report Tranche 2 for Consultation

Hi Steven,

Not a problem, I have added that email address to our stakeholder contact list going forward. Should I reissue the email sent yesterday to that email address also?

#### Regards,

## Simon Fisher

Design and Approvals Support Inland Rail - A2P



- +61 402 103 704
- simon.fisher@martinus.com.au
- martinus.com.au
- Australia | New Zealand | Chile | USA

⊚ in

SAVE CONTACT

From: Steven Millett <Steven.Millett@alburycity.nsw.gov.au>

Sent: Monday, 3 February 2025 6:25 PM

To: Simon Fisher <simon.fisher@martinus.com.au>; Communications <Communications@alburycity.nsw.gov.au>

Cc: Chris Standing <chris.standing@martinus.com.au>; Constance Georgiou

<constance.georgiou@bdinfrastructure.com>

Subject: RE: Albury to Illabo - Flood Design Report Tranche 2 for Consultation

G'day Simon,

Thanks for your email regarding review of the Flood Designs for Murray River bridge and Billy Hughes bridge.

If you would be able to send future correspondence to <a href="info@alburycity.nsw.gov.au">info@alburycity.nsw.gov.au</a> that would be appreciated. This will ensure your correspondence is registered in our Record Management System and allocated to the most relevant staff member for action.

Thanks heaps.

Cheers, Steve.

#### **Steven Millett**

Service Leader Assets, Sustainability and Environment

553 Kiewa Street Albury NSW 2640 T <u>02 6023 8194</u> | M <u>0429 022 981</u> <u>alburycity.nsw.gov.au</u>





AlburyCity acknowledges the Wiradjuri people as the traditional custodians of the land in which we live and work and we pay our respects to Elders past, present and future for they hold the memories, culture, tradition and hopes of Aboriginal and Torres Strait Islander people that contribute to our community.





From: Simon Fisher <simon.fisher@martinus.com.au>

Sent: Monday, 3 February 2025 2:39 PM

To: Steven Millett <Steven.Millett@alburycity.nsw.gov.au>; .Communications

<Communications@alburycity.nsw.gov.au>

Cc: Chris Standing <chris.standing@martinus.com.au>; Constance Georgiou

<constance.georgiou@bdinfrastructure.com>

Subject: Albury to Illabo - Flood Design Report Tranche 2 for Consultation

Dear Albury City Council,

Martinus Rail has been engaged by Inland Rail Pty Ltd (IRPL) to design and construct the Albury to Illabo (the project) section of the Inland Rail Program.

We would like to thank you for your participation so far in the project's design and assessment, through the Environmental Impact Statement (EIS) and Preferred Infrastructure Report (PIR) processes that were run by ARTC and IRPL. Your feedback has helped ARTC and IRPL to identify key risks and opportunities, as well as to highlight management and mitigation processes during construction. You can find the EIS and the PIR on the Major Projects

website: <a href="https://www.planningportal.nsw.gov.au/major-projects/projects/inland-rail-albury-illabo">https://www.planningportal.nsw.gov.au/major-projects/projects/inland-rail-albury-illabo</a>

Martinus Rail is in the process of detailed design finalisation and we are seeking your feedback on the Flood Design Reports that have been developed for Murray River bridge and Billy Hughes bridge. Please note that additional reports for the remaining sites are currently under development and will be issued subsequently when they become available.

These reports have been drafted to meet the requirements of the Conditions of Approval (CoA) issued to the project by the Department of Planning, Housing and Infrastructure.

The purpose of these reports is to demonstrate the impacts, if any, of the project's detailed design for the full range of flood events.

In the link below you can find the relevant draft Flood Design Reports for your review.

02. Albury City Council

We are aware that the list of people we have sent this email may not be the most appropriate people to review. Please kindly download the relevant documents and the comments spreadsheet and send onto them.

If you are interested in providing your feedback, please kindly review the document(s) in the folder above and fill out the spreadsheet provided. Alternatively, if you are not interested in providing feedback on these documents, please let us know in writing.

Consultation will close on Friday, 21 February 2025.

Please reach out if you have any questions or need any support with this process.

#### Regards,

## Simon Fisher

Design and Approvals Support Inland Rail - A2P



- +61 402 103 704
- simon.fisher@martinus.com.au
- martinus.com.au
- Australia | New Zealand | Chile | USA

⊚ in

SAVE CONTACT

This email is confidential. If you are not the nominated recipient, please immediately delete this email, destroy all copies and inform the sender. Martinus prohibits the unauthorised copying or distribution of this email. This email does not necessarily express the views of Martinus. Martinus does not warrant nor guarantee that this email communication is free from errors, virus, interception or interference.



### **APPENDIX E**

# Independent Flood Consultant Review

E1 – Review Comments Register

E2 - Certificate





## **APPENDIX E1**

# PE Review Comments Register



Project: 2100 Deliverable: Billy Hughes Bridge Track Lowering

Comment Sheet Reference: 5-0052-210-IHY-B5-CS-0001-PE\_E

					Review Comments (Rev	iewer)				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)	Comment Type	Full Name	Role	le Date	Response (must be specific on how the comment has been addressed	Where addressed (Section # / Figure #)	Full Name	Company	Date	Comment Outcome	Close-Out Comment			
1	5-0052-210-IHY-B5-RP-0001_A	Section 4.1.2.2	Hatch	Dan Williams	Flood Assessment	10/09/2024	PDR	Losses reference ARR 2019 preference for adoption of those derived through previous investigations. However, this is specifically for calibrated loss rates, whereas the referenced losses appear to be standard design loss rates from ARR 1987 (as appropriate for the referenced studies). Preference should be for ARR Data Hub PNBIL and NSW-specific IL**O4.	Minor	Jasmine Lee	DJV Flo Lea		This will be updated in the DDR stage by using the PNBIL an NSW CL*0.4 losses from ARR Datahub	1	Darren Lyons	Hatch	14/01/2025	CLOSED				
2	5-0052-210-IHY-B5-RP-0001_A	Table 4-3	Hatch	Dan Williams	Flood Assessment	10/09/2024	PDR	Hydraulic roughness specifies that an 'n' value of 0.04 has been adopted for the floodplain, whereas review of the TUFLOW model files found that a value of 0.03 has been adopted, which is too low. Given the predominant floodplain vegetation and shallow flow depths, a value of 0.05-0.06 is appropriate. With the rain-on-grid hydrology, higher values should also be considered for representing sheet flow.	Minor	Jasmine Lee	DJV Flo Lea		24 This will be updated in DDR stage.		Darren Lyons	Hatch	14/01/2025	CLOSED				
3	5-0052-210-IHY-B5-RP-0001_A	Table 4-5	Hatch	Dan Williams	Flood Assessment	10/09/2024	PDR	Initial loss given as being 25 mm, which contradicts the 15 mm specified in Table 4-2. The TUFLOW model files indicate that 15 mm has been used but with the subtraction of the median pre-burst depth from the ARR Data Hub. The content of the Flood Assessment Report should reflect what has been undertaken.	Minor	Jasmine Lee	DJV Flo Lea		This will be corrected in the flood assessment report in the DDR design stage		Darren Lyons	Hatch	14/01/2025	CLOSED				
4	5-0052-210-IHY-B5-RP-0001_A	Section 5.4.1	Hatch	Dan Williams	Flood Assessment	10/09/2024	PDR	The 13 mm increase in peak flood level at the 1% AEP event in the SP4 land seems to incorrectly reference a 10 mm afflux limit associated with above floor flooding from the QDL criteria. Reference to Table 2-2 states that the allowable afflux is 100 mm for the "Surrounds of residential building, other urban, open space and recreational land and infrastructure", which is applicable to the impacted area in this case.	Major	Jasmine Lee	DJV Flo Lea		10mm afflux limit was applied based on the combined assessment of land use and land planning. Although the land planning shows it is SP4, the land falls into an industrial land use where buildings may be built in the future anywhere with the land. As such, 10mm afflux criteria (habitable floor) was considered for the land. However, the limits associated with the QDL criteria have now been superseded by the dCoA. The afflux will be checked against the dCoA in the DDR stage.		Darren Lyons	Hatch	14/01/2025	CLOSED				
5	5-0052-210-IHY-B5-RP-0001_A	Section 5.4.1	Hatch	Dan Williams	Flood Assessment	10/09/2024	PDR	The impact mapping for modelled velocity and hazard conditions identifies the on-site impacts related to the increased flow being discharged from the drainage design. However, it also identifies off-site impacts as being non-compliant with the QDL criteria, which is not necessarily the case. Most of the off-site impact is a function of modelling artefacts associated with poor underlying DEM quality and limitations of the relatively coarse model resolution in comparison to what is being represented. Further, the allowable limits in the QDL criteria appear to have been established for broader scale impacts across the floodplain (hence the 30 m reference in Table 2-2 note 10) and not for highly localised impacts such as these.	Major	Jasmine Lee	DJV Flo Lea		The DEM used in the flood model is the survey data provided by Martinus, which is deemed as suitable for flood modelling. It should be noted that a new verified topo survey will be available for the DDR stage and it will replace the current survey DEM. The new topo survey will be checked and if necessary, limitations will be retained in the flood report.  The flood impact was assessed based on the relative value between the design and the existing. As such, any impact beyond the QDL limits was reported as non-compliance. However, the limits associated with the QDL criteria have no been superseded by the dCoA. The flood impact will be examined against dCoA in the DDR stage.		Darren Lyons	Hatch	14/01/2025	CLOSED				
6	5-0052-210-IHY-B5-RP-0001_A	Section 6	Hatch	Dan Williams	Flood Assessment	10/09/2024	PDR	Mitigation measures have been recommended for further investigation, but this is not required	Major	Jasmine Lee	DJV Flo Lea		The same afflux assessment approach (considering both lan planning and land use) but based on the dCoA will be applied to the DDR stage. Mitigation measures will be provided base on the afflux assessment if required.		Darren Lyons	Hatch	14/01/2025	CLOSED				
7	5-0052-210-IHY-B5-RP-0001_A	Section 7	Hatch	Dan Williams	Flood Assessment	10/09/20244	PDR	The identification of non-compliance issues appears to be incorrect and so the recommendation for further investigation and mitigation would not be required.	Major	Jasmine Lee	DJV Flo Lea		The same afflux assessment approach (considering both lan planning and land use) but based on the dCoA will be applied to the DDR stage. Mitigation measures will be provided base on the afflux assessment if required. Any non-compliance will be resolved as part of the design from DDR.		Darren Lyons	Hatch	14/01/2025	CLOSED				
00	5-0052-210-IHY-B5-RP-0001_A	TUFLOW files	Hatch	Dan Williams	Flood Assessment	10/09/2024	PDR	***NOTE: No further TUFLOW modelling is required and all comments relating to the TUFLOW model files are for information only.*** Recommended that a Maximum Velocity Cutoff Depth such as 0.1 m is specified in the tcf to remove noise from the modelled peak flood velocity result that can often occur during the initial stages of cell wetting.	Minor	Jasmine Lee	DJV Flo Lea		24 Noted.		Darren Lyons	Hatch	14/01/2025	CLOSED				
9	5-0052-210-IHY-B5-RP-0001_A	TUFLOW files	Hatch	Dan Williams	Flood Assessment	10/09/2024	PDR	There are significant data quality issues in the underlying DEM data used in the TUFLOW model. The LiDAR DEM has not filtered the rank floodplain vegetation between Wagga Road and the rail corridor, resulting in elevations in the middle of the floodplain vegetation over 0.5 m higher than the expected ground surface elevation. The 80 m wide DEM centred on the rail corridor exhibits significant artefacts in the vegetated areas beyond the rail formation. The 30 m wide DEM appears to be of a high quality but the reading of three successive DEMs (LiDAR, 80 m corridor, 30 m corridor) creates lines of elevation discontinuity along these interfaces. The 80 m corridor data shouldn't be used, as it reduces the quality of the LiDAR representation. Treatment of the TUFLOW model geometry should also have been undertaken to remove vegetative artefacts and/or blend the transition from one DEM to another.	Minor	Jasmine Lee	DJV Flo Lea		Noted. The design from the DDR stage will rely on the topo survey, which shows an accuracy of ±50mm.		Darren Lyons	Hatch	14/01/2025	CLOSED				
10	5-0052-210-IHY-B5-RP-0001_A	TUFLOW files	Hatch	Dan Williams	Flood Assessment	10/09/2024	PDR	Some of the pit and pipe locations of the design drainage network were not aligned with the overlying surface drainage alignments.	Minor	Jasmine Lee	DJV Flo Lea		This will be checked and updated in the DDR stage.		Darren Lyons	Hatch	14/01/2025	CLOSED				

Project: 2100 Deliverable: Billy Hughes Bridge Track Lowering

Comment Sheet Reference: 5-0052-210-IHY-B5-CS-0001-PE\_E

	Review Comments (Reviewer)												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)	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 Comment						
11	5-0052-210-IHY-B5-RP-0001_A	TUFLOW files	Hatch	Dan Williams	Flood Assessment	11/09/2024	PDR	The above recommended changes were implemented in TUFLOW for Proof Engineering purposes and the 1% AEP flood events were re-simulated. This found relatively consistent impacts to those of the Flood Assessment Report. The main difference was that the location of off-site velocity and hazard impacts changed. PO points were placed in some of the areas of mapped impact and the PO output frequency was increased to a 6-second interval. Comparison of this data for the EXG002 and DES002 scenarios produced zero increase in the resultant peak velocities. This confirms that the flood impact mapping has captured model result artefacts, which appear to be instantaneous spikes (i.e. instability). The baseline velocities in these locations were all the instantaneous peak mapping output will return significant percentage changes. The "noisey" DEM data, rain-on-grid methodology and gridded representation of sub-grid scale drainage works are key contributors to the hypersensitivity of the modelled peak velocity conditions.	Minor	Jasmine Lee	DJV Flooding Lead	3/10/2024	Noted. The comments regarding identifying immaterial impacts associated with modelling noise/artefacts will be taken into account for the DDR stage by updating the above recommended changes.		Darren Lyons	Hatch	14/01/2025	CLOSED							
			Hatch	Dan Williams	Flood Assessment	14/01/2025	DDR	No further comments.		Zoe Cruice	Eng Martinus	14/01/2025	Noted. No further changes or actions.	N/A	Darren Lvons	Hatch	14/01/2025	CLOSED							



## **APPENDIX E2**

## PE Certificate





## **Schedule 12 Consultant Certificate**

### Part A - Consultant's Statement of Conformance for Services

(clause 5.3 (b))

Date:	02 May 2025
Project:	Albury to Parkes Enhancement Project (A2P) (the Project) B5 - Billy Hughes Flood Design Report (IFC)
Consultant:	Hatch Pty Ltd ABN 59 008 630 500
In relation to:	The contract between the Consultant and Martinus Rail Pty Ltd (MR) dated18 March 2024with respect to the Project

- 1. This Statement of Conformance is given in relation to the Agreement.
- 2. The Consultant hereby certifies to MR that:
  - a. the design calculations and drawings are agreed with the Designer; and
  - b. it has provided a full and independent assessment of all factors influencing the final integrity of the specified components of the Works,
  - c. it has reviewed the design calculations, models and drawings, and undertaken separate calculations for critical aspects of the Works,
  - d. it has undertaken an independent detailed check of the Design Documentation,
  - e. it has provided all advice and comment, including calculations, in writing.

Statement 2 above applies to the extent clarified in Section 3 and 4 on the following page.

H	Doniel Willim
Signature of Authorised Person	Signature of Witness
Darren Lyons	Daniel Williams
Name of Authorised Person	Name of Witness

Consultancy Services Agreement - Hatch Revision No.: V1.0

Issue Date: 28/08/2023



## **Schedule 12 Consultant Certificate**

Part A - Consultant's Statement of Conformance for Services

(clause 5.3 (b))

- 3. This statement of conformance applies to the following work packages only:
  - a. B5 Billy Hughes Flood Design Report (IFC)
- 4. Statement 2 is limited to the degree at which the design and review has progressed at the relevant phase (SDR, PDR, DDR & IFC) and the information provided by Martinus.

All proof engineering comments identified as part of our IFC review have been closed.

Issue Date: 28/08/2023

#### **Zoe Cruice**

From: Daniel Williams <dan@torrentconsulting.com.au>

Sent: Thursday, 3 July 2025 2:06 PM

**To:** Zoe Cruice; Mullard, John; Matthews, Walter

**Cc:** Simon Fisher; Nichole Darke

**Subject:** RE: Billy Hughes IFC Flood Design Report

Hi Zoe,

Yes. I can confirm that there is no change to the prior Rev 0 certification.

Thanks, Dan

## Dan Williams Director

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From: Zoe Cruice <zoe.cruice@martinus.com.au>

Sent: Thursday, 3 July 2025 12:56 PM

**To:** Daniel Williams <dan@torrentconsulting.com.au>; Mullard, John <john.mullard@hatch.com>; Matthews, Walter <walter.matthews@hatch.com>

Cc: Simon Fisher <simon.fisher@martinus.com.au>; Nichole Darke <Nichole.Darke@martinus.com.au>

Subject: RE: Billy Hughes IFC Flood Design Report

Hi Dan,

The update to the referencing was purely to account for the re-numbering that occurred between the issuance of the Draft conditions of June 2024 (when the template Flood Report was put together), and the final of Oct 2024 – refer snip below. The numbering has changed:

#### FLOODING

- E42 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 river banks or watercourses.
- E43 The CSSI must be designed with the objective to meet or improve upon the flood performance identified in the documents listed in Condition A1.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.
- E44 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:
  - a)(a) Hydrologic and hydraulic assessments consistent with Australian Rainfall and Runoff A
     Guide to Flood Estimation (GeoScience Australia, 2019);
  - b)(b) Use of modelling software appropriate to the relevant modelling task;
  - e)(c) Field survey of the existing rail formation and rail <u>levels</u>, should be included within the models; and
  - d)(d) Confirmation of predicted afflux at industrial properties adjacent to Railway Street, Wagga Wagga based on field survey.

Updated flood modelling must be made publicly available in accordance with Condition B48.B18.

- E45 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 A46,A16, in consultation with directly affected landowners, DCCEEW Water Group, TfNSW, DPI Fisheries, BCS, NSW State Emergency Service (SES), and relevant Councils.
- E46 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:
  - a)(a) a maximum increase in inundation time of one hour, or 10%, whichever is greater;

NSW Government 48

Department of Planning, Housing and Infrastructure Conditions of Approval for Inland Rail – Albury to Illabo (SSI-10055)

- a maximum increase of 10 mm in above-floor inundation to habitable rooms where floor levels are currently exceeded;
- e)(c) no above-floor inundation of habitable rooms which are currently not inundated;
- d)(d) a maximum increase of 50 mm in inundation of land zoned as residential, industrial or commercial;
- a maximum increase of 100 mm in inundation of land zoned as environment zone or public recreation;
- a maximum increase of 200 mm in inundation of land zoned as rural or primary production, environment zone or public recreation;
- g)(g) no increase in the flood hazard category or risk to life; and
- h)(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.

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.

Can you please confirm on this basis there is no change to your prior Rev 0 certification?



