Technical Memo

HOBSONVILLE GROVE PRIVATE PLAN CHANGE

Stormwater Modelling and Flood Risk Assessment Report – RFI Response 2

Austino Property Group

TO:	Auckland Council	**HG PROJECT NO:**	A2212330.03
FROM:	Saeed Ghavidelfar, Fatemeh Mohammadi	**DATE:**	21 November 2024

1.0 INTRODUCTION

This technical memo presents responses to items #HW21 and #HW23 of RFI (2) for the Private Plan Change at 84 and 100 Hobsonville Road.

This memo must be read in conjunction with the Stormwater Modelling and Flood Risk Assessment Report submitted to Auckland Council on 12/09/2024.

#	Specific Request	Reasons for request	Clause 23(1) further information Request Satisfied or Not Satisfied	Clause 23(2) Additional Information required
				area, how will this be implemented. Please provide details in the SMP. Are GPTs (such as downstream defenders or approved alternatives) provided upstream of the communal bioretention devices? Please discuss. Additionally, Te Kawerau ā Maki noted that treatment devices are GD01 compliant devices, please confirm if this is the case, and clarify in the SMP.
HW21	Schedule 2 of the NDC requires that new urban development and intensification avoids the increase of existing flooding or creation of new flooding of habitable floors. How is this being addressed? Please comment for the 10% and 1% AEP event. In the SMP Table 4 Requirements for Schedule 4 of the NDC, under the column Design approach, attenuation is proposed attenuation, however this is not reflected in Table 7 Summary of Stormwater Principles Options and Design Guides or Section 7.2 Preferred stormwater management approach, please ensure the information is consistent in the SMP.	To better understand how flooding is managed for the plan change area.	Clause 23(1) not satisfied. Additional information required.	Regarding Appendix 6: Stormwater Modelling Flood Assessment. • Please discuss why an increased 2D mesh size at the culvert inlet and outlet is used? It would be expected that there would be a higher resolution near culverts, not a lower resolution . This approach may have been used for model stability purposes (which is fine). However, such modifications are not "real" and it may cause some issues. Has the culvert performance been checked using manual checks or HY8 (for example) to make sure that the culvert flows are reasonable? • The flood depth maps (Figure 13 and 14) show flat, "dug out" sections near the culverts. It is recommended that the mesh size near the culvert is close to the culvert dimension and represents the channel near the culvert as best as possible (conveyance and storage). The current representation could be misrepresenting water levels upstream and downstream of the culvert, please clarify. As per the previous comment this approach may have been used for model stability reasons. Please confirm. • The model results show that the culvert doesn't overtop, however there is some ponding on the road, likely caused by the overland flow paths along the road (see Figure 14), please clarify. • Why was the Brigham Creek road bridge not modelled?

15

Hobsonville Grove PPC – Additional information requested under Clause 23(2)

HW23	Please provide further information on the stormwater and flooding effects on the culverts under Upper Harbour Motorway, and how these effects will be mitigated. Modelling carried out by the applicant indicates that the culverts under Upper Harbour Motorway do not have capacity in the 1% AEP event including 3.8 degrees of climate change. What are the effects of this lack of capacity?	It is important to understand what the effects of live zoning the land will be and how the effects are proposed to be mitigated, in particular for potential increased water levels adjacent to the culverts.	Clause 23(1) not satisfied. Additional information required.	Please discuss why blockage scenarios do not seem to have been considered as part of the culvert capacity analyses, and what would be the effects of this on upstream properties and the motorway?

Figure 1. RFIs #HW21 and #HW23.

2.0 RESPONSES TO RFI #HW21

Regarding Appendix 6: Stormwater Modelling Flood Assessment.

Please discuss why an increased 2D mesh size at the culvert inlet and outlet is used? It would be expected that there would be a higher resolution near culverts, not a lower resolution. This approach may have been used for model stability purposes (which is fine). However, such modifications are not "real" and it may cause some issues. Has the culvert performance been checked using manual checks or HY8 (for example) to make sure that the culvert flows are reasonable?

The flood depth maps (Figure 13 and14) show flat, "dug out" sections near the culverts. It is recommended that the mesh size near the culvert is close to the culvert dimension and represents the channel near the culvert as best as possible (conveyance and storage). The current representation could be misrepresenting water levels upstream and downstream of the culvert, please clarify. As per the previous comment this approach may have been used for model stability reasons. Please confirm.

A higher mesh size (6-18m2) was assigned to the 2D Zone upstream and downstream of motorway culverts to avoid culvert 1D nodes having their flow limited from the 2d zone. Using large mesh sizes around the 1D culvert inlets/outlets along with increasing the number of 2D mesh connecting to the culvert nodes by increasing the “2D element area factor” is a standard modelling approach in InfoWorks ICM to produce accurate and stable results for the large culverts.

Due to high vegetation cover, the LiDAR levels around the culvert motorway's inlets and outlets are slightly higher than those in the survey data extracted from the URS model. Thus, Mesh Level Zones were added upstream and downstream of culverts to drop the ground levels to match the culvert invert levels. Modifying LiDAR was essential for a smooth flow transition between the 1D culvert and 2D surface, ensuring the model's stability and accuracy.

A HY-8 model was also built for the motorway culverts to verify the accuracy of modelled culverts. Figure 4 presents the HY-8 model configuration and result for the motorway Twin culvert (C2 and C3). The HY-8 model closely replicated the ICM results with the estimated post-development 100-year 3.8ºCC peak water level of 19.95 mRL at the motorway culvert upstream.

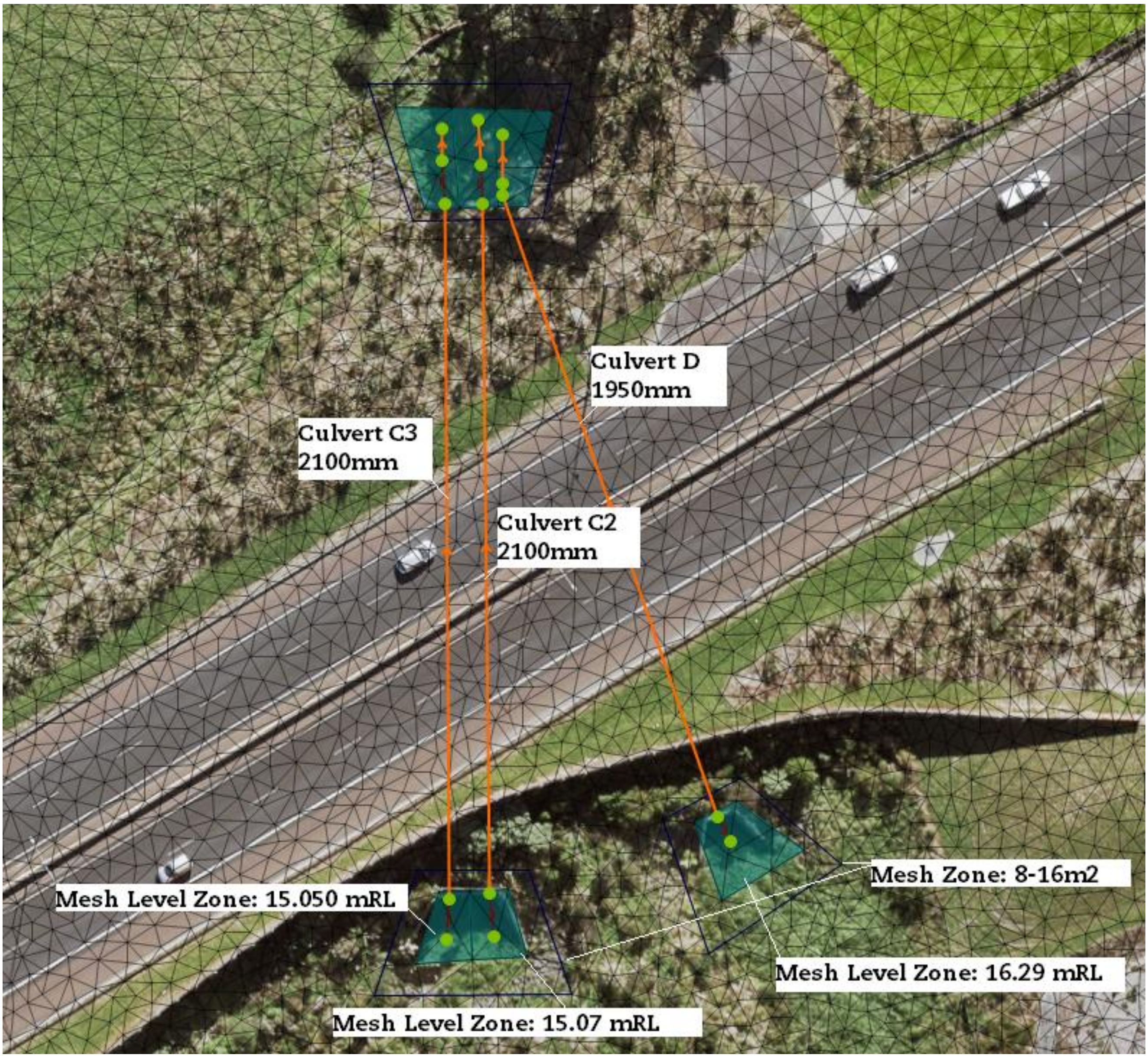

Figure 2. Culverts set up and 2D mesh configuration in InfoWorks ICM model.

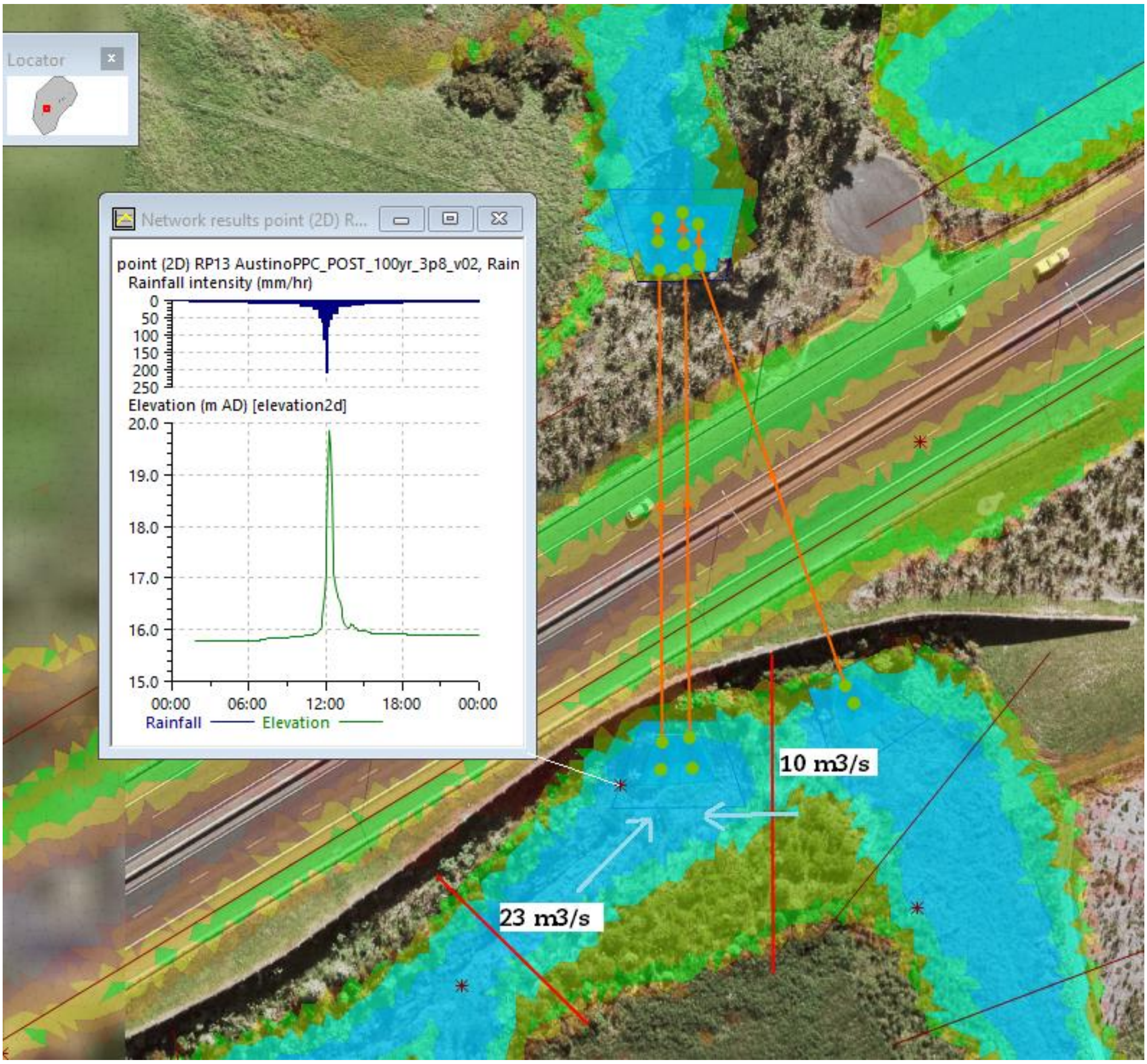

Figure 3. Estimated water level upstream of the motorway culvert – InfoWorks ICM

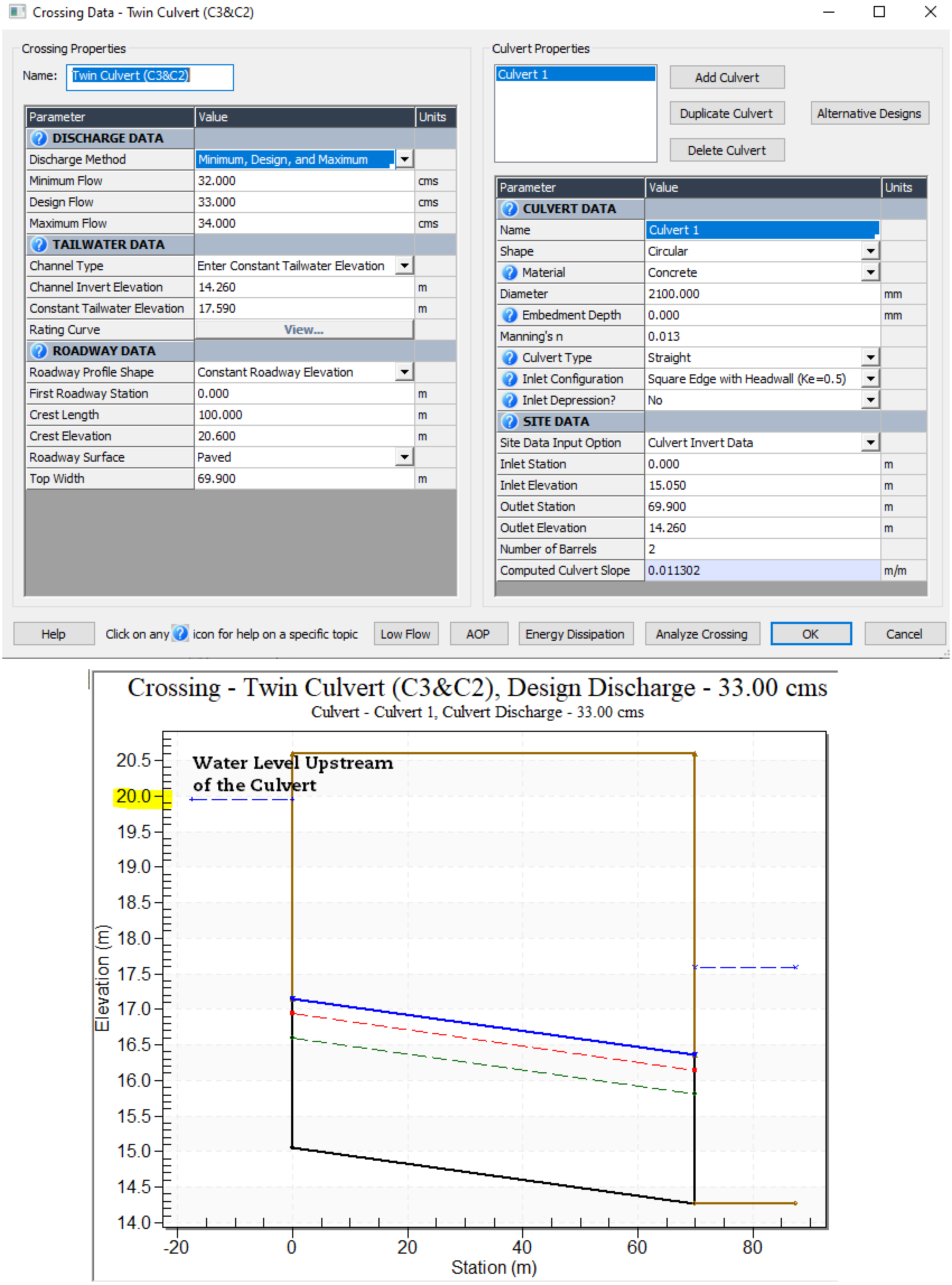

Figure 4. Estimated water level upstream of the motorway culvert – HY-8 model.

The model results show that the culvert doesn't overtop, however there is some ponding on the road, likely caused by the overland flow paths along the road (see Figure 14), please clarify.

Figure 5 shows the flow directions around the culvert's motorway for the post-development 100yr 3.8° storm event. The flood ponding on the motorway is generated by the local overland flow paths. The motorway flood discharges into the stream since its level is higher than the maximum flood level in the stream, as shown in the cross-section below.

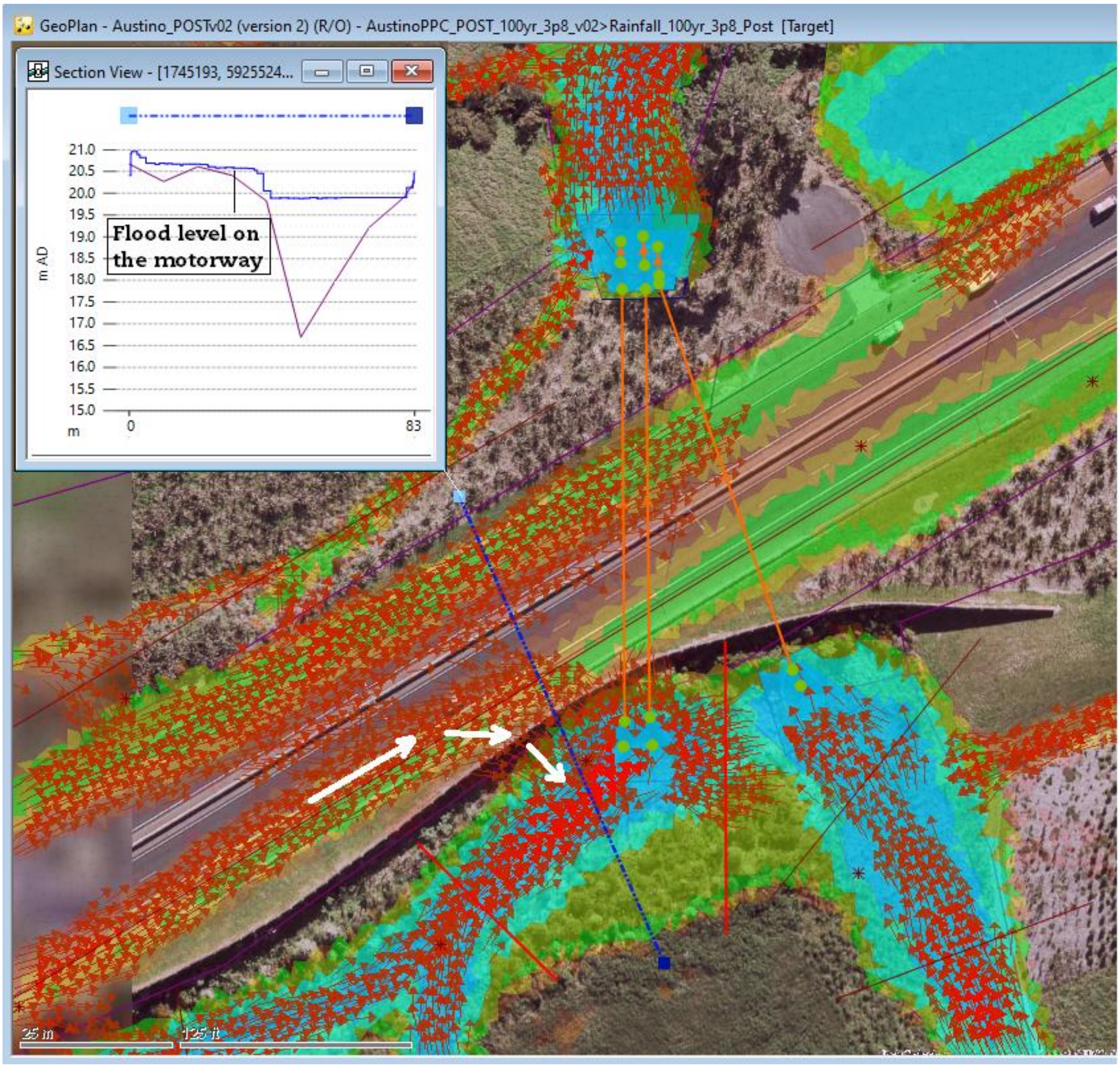

Figure 5. Flow directions around motorway culvert.

Why was the Brigham Creek road bridge not modelled?

The Brigham Creek Road bridge has a wide span, so it is unlikely to impact the stream's conveyance capacity. Thus, the Waiarohia Stream channel was opened at this location as outlined in the Stormwater Modelling Methodology sent to Council on the 24/07/2024.

Figure 6. Google Street View for Brigham Creek Road Bridge.

3.0 RESPONSES TO RFI #HW23

Please discuss why blockage scenarios do not seem to have been considered as part of the culvert capacity analyses, and what would be the effects of this on upstream properties and the motorway?

To ensure the proposed plan change does not adversely affect the motorway and upstream property under the blockage scenario, all the motorway culverts are blocked by 50%, and the model was re-run for the 100-year event under 3.8° Climate Change (CC) and no-CC for pre-development and post-development scenarios. The 50% blockage was considered in this assessment according to the Auckland Council Stormwater Code of Practice Version 4, as recommended for culverts larger than 1500mm (The Auckland Code of Practice for Land Development and Subdivision: Chapter 4: Stormwater, Version 4.0, March 2024).

The impact of blockage on the flooding of the motorway and three properties, discussed in the Flood Assessment report, was assessed.

3.1 FLOOD IMPACT ON THE MOTORWAY

Figures 7 and 8 show the water level difference between post-development and pre-development for the 100-year 3.8°CC and no CC with a 50% culvert blockage scenario, respectively.

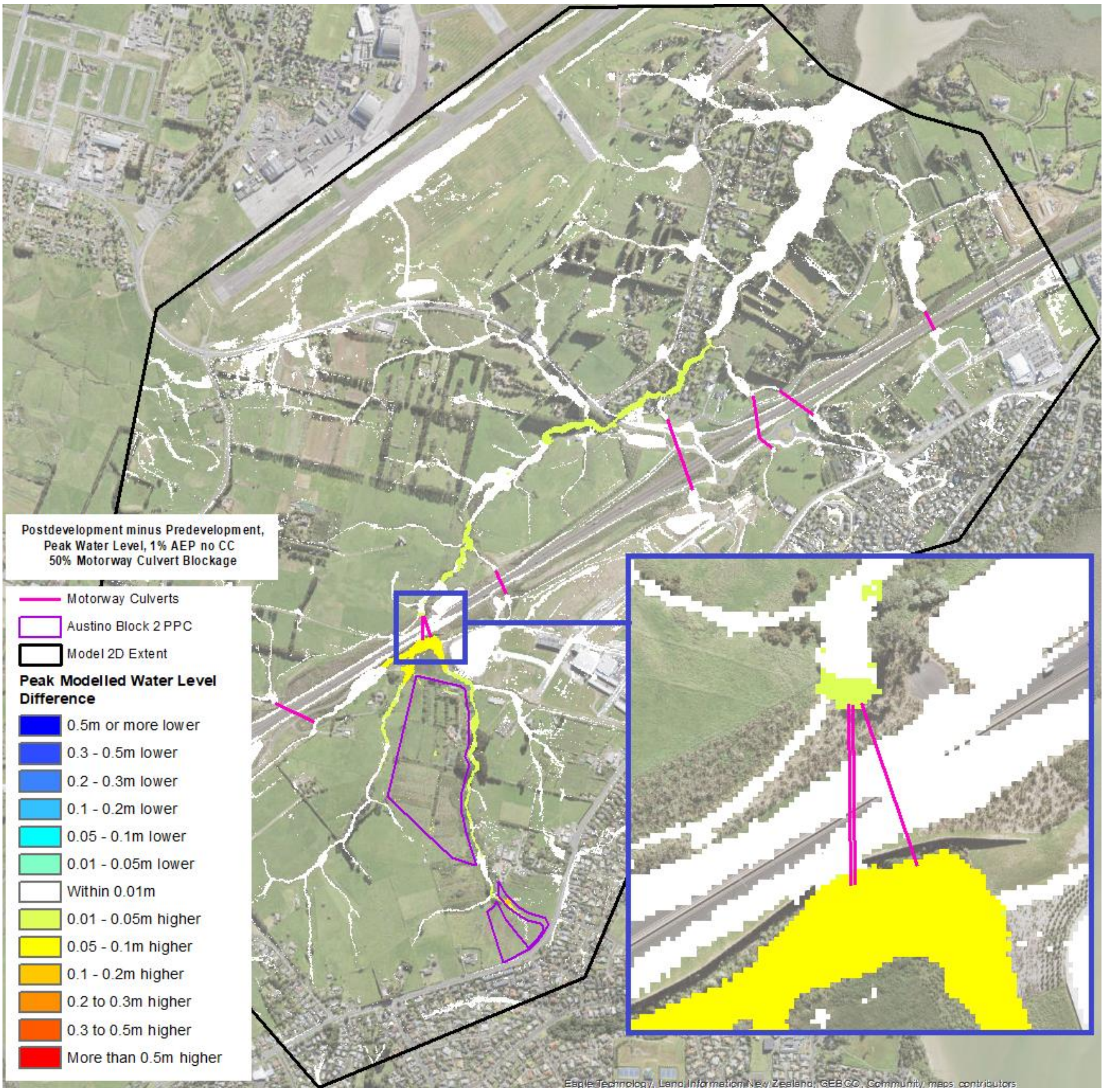

Figure 7. Peak modelled water level difference, post minus pre 100yr no CC, 50% blockage of motorway culverts

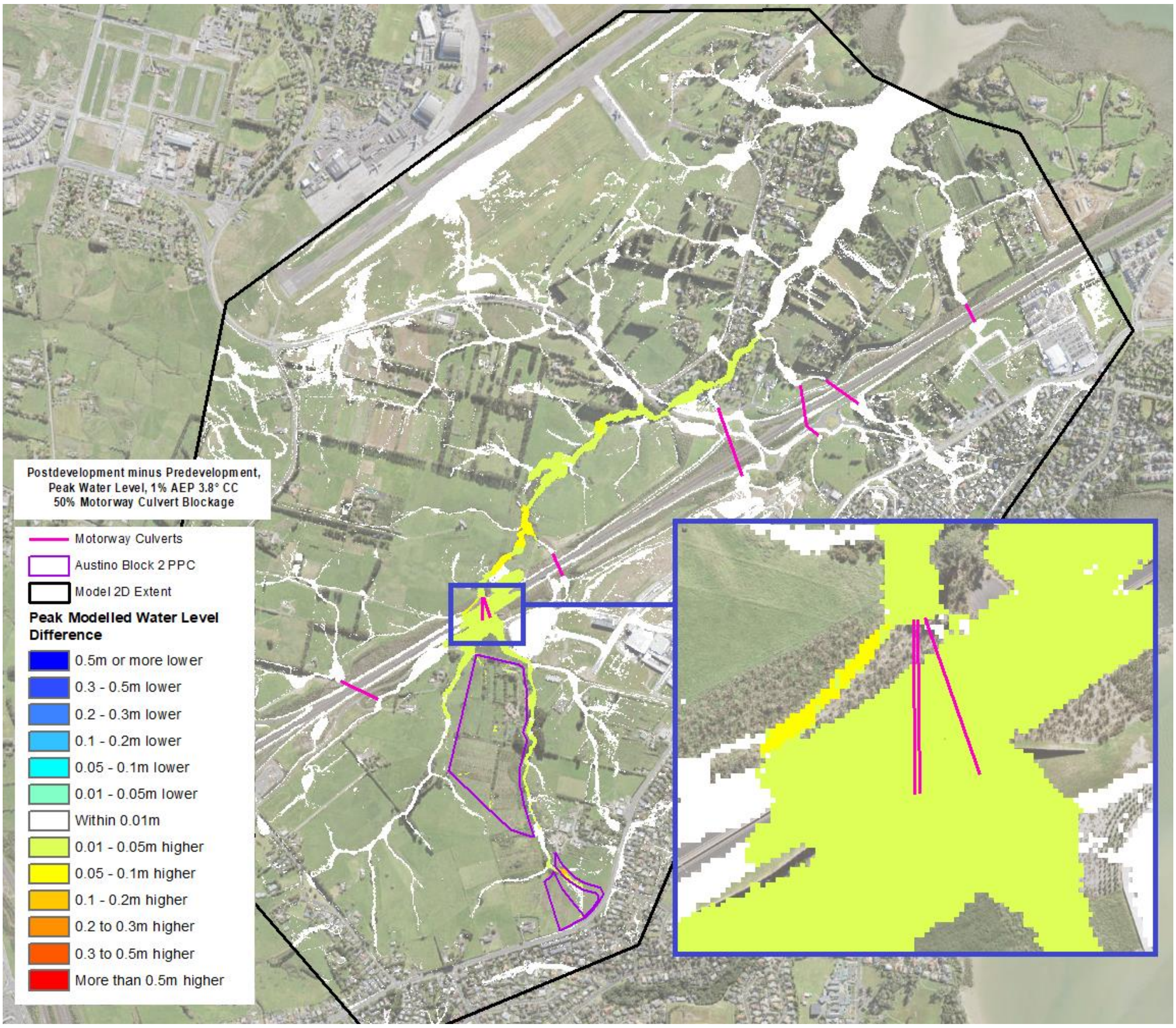

Figure 8. Peak modelled water level difference, post minus pre 100yr 3.8° CC, 50% blockage of motorway culverts.

Under no climate change and with 50% blockage, the proposed development has no impact on the motorway since the flood does not overtop it (Figure 7 and Table 1). The motorway crest level is around 20.6 mRL.

TABLE 1: FLOOD LEVEL DIFFERENCE UPSTREAM OF CULVERTS – 50% Blockage

CULVERT	RAINFALL EVENT AND CLIMATE CHANGE (CC)	PRE-DEVELOPMENT FLOOD LEVEL UPSTREAM (M RL)	POST-DEVELOPMENT FLOOD LEVEL UPSTREAM (M RL)	DIFFERENCE (M)
Twin Culvert (C2 and C3)	100-year (No CC)	19.64	19.73	0.09
	100-year (3.8°CC)	20.88	20.90	0.02

Under 3.8° climate change and with 50% blockage, both the pre-development and post-development floods overtopped the motorway. As a result of the proposed development, the flood depth over the motorway increased by 20mm. Flood hazard and ponding duration assessments were undertaken to ensure this marginal increase does not adversely impact motorway safety/functionality.

The Australian Rainfall and Runoff (ARR): A Guide to Flood Estimation (2019) provides a hazard classification of flooding effects on people based on a number of factors (Figure 9). ARR classifies a flood depth less than 300mm with a velocity less than 2 m/s and depth (d) x velocity (v) product equal to or less than 0.3 m^2/s as H1, which is assessed as "generally safe" for vehicles and people to traverse. All other categories may impose risks to people, vehicles or buildings.

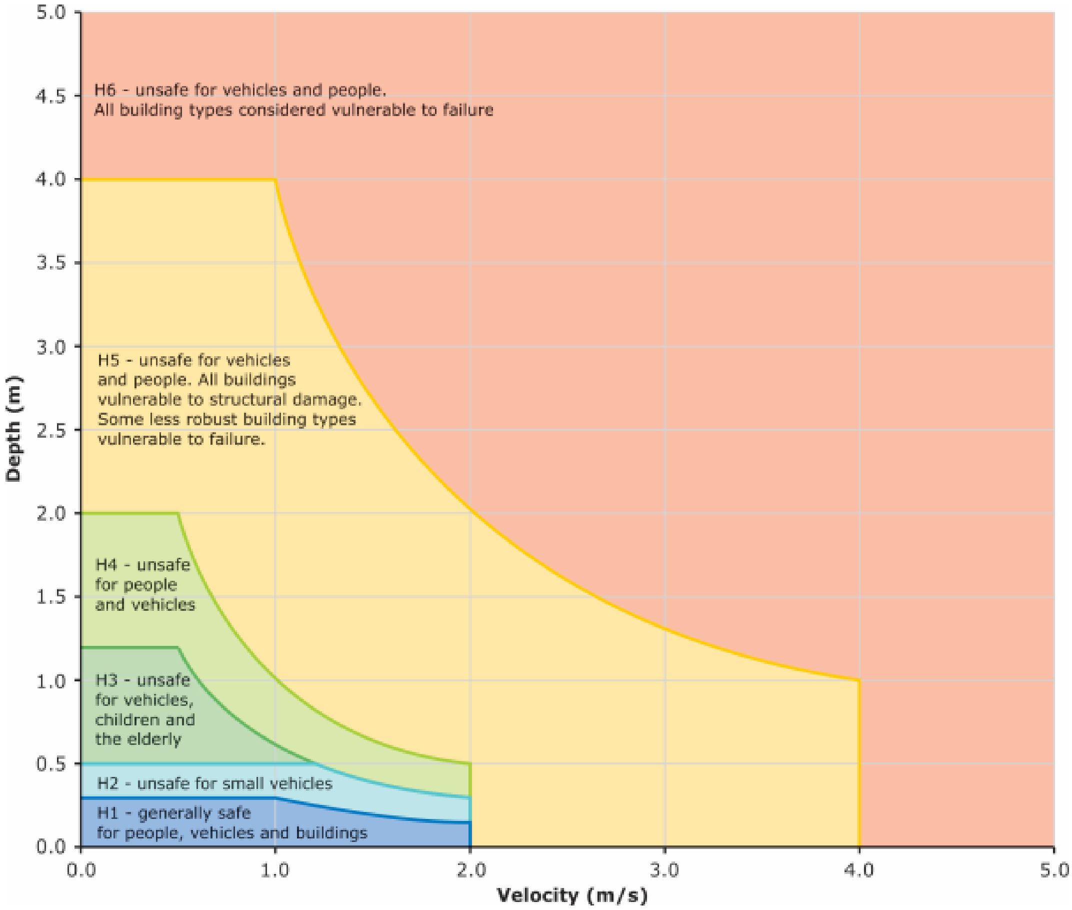

Figure 9. Combined flood hazard curves (Smith et al., 2014, Flood hazard UNSW Australia water research laboratory technical report 2014/07 30 September 2014).

Figures 10 and 11 show the flood hazard classification for pre-development and post-development scenarios under 1% AEP 3.8° CC and 50% culvert blockage, according to the Australian Rainfall and Runoff (ARR).

The maps indicate that the motorway lanes mainly fall in the H1 and H2 categories, and there is no substantial change in the hazard classifications resulting from a 20mm flood depth increase due to the proposed development.

A flood duration assessment was also carried out to evaluate the changes in ponding time on the motorway.

Figure 12 shows the post-development flood duration for 1% AEP 3.8° CC with 50% culvert blockage. The Flood duration is defined as the time period in which the flood depth remains higher than 300mm. This depth is associated with the highest depth in the H1 hazard categories which is considered safe for people and vehicles.

The motorway lanes' ponding time (flood duration) is around 20-30 minutes. There is no substantial change in the ponding time between the post-development and pre-development scenarios (Figure 13), indicating that the development does not impact the motorway functionality under the blockage scenario.

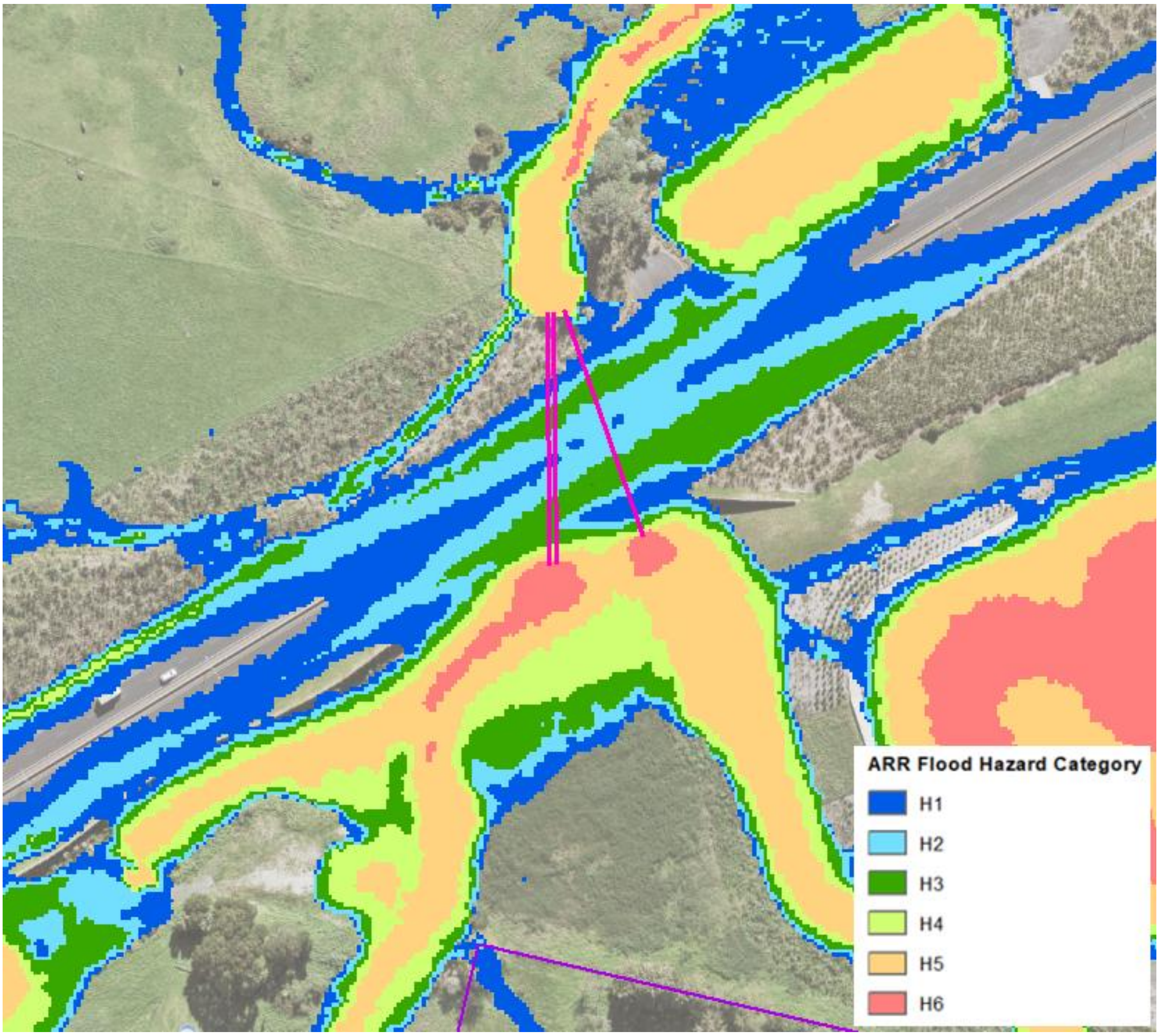

Figure 10. ARR flood hazard classification for pre-development 1% AEP 3.8° CC, 50% culvert blockage.

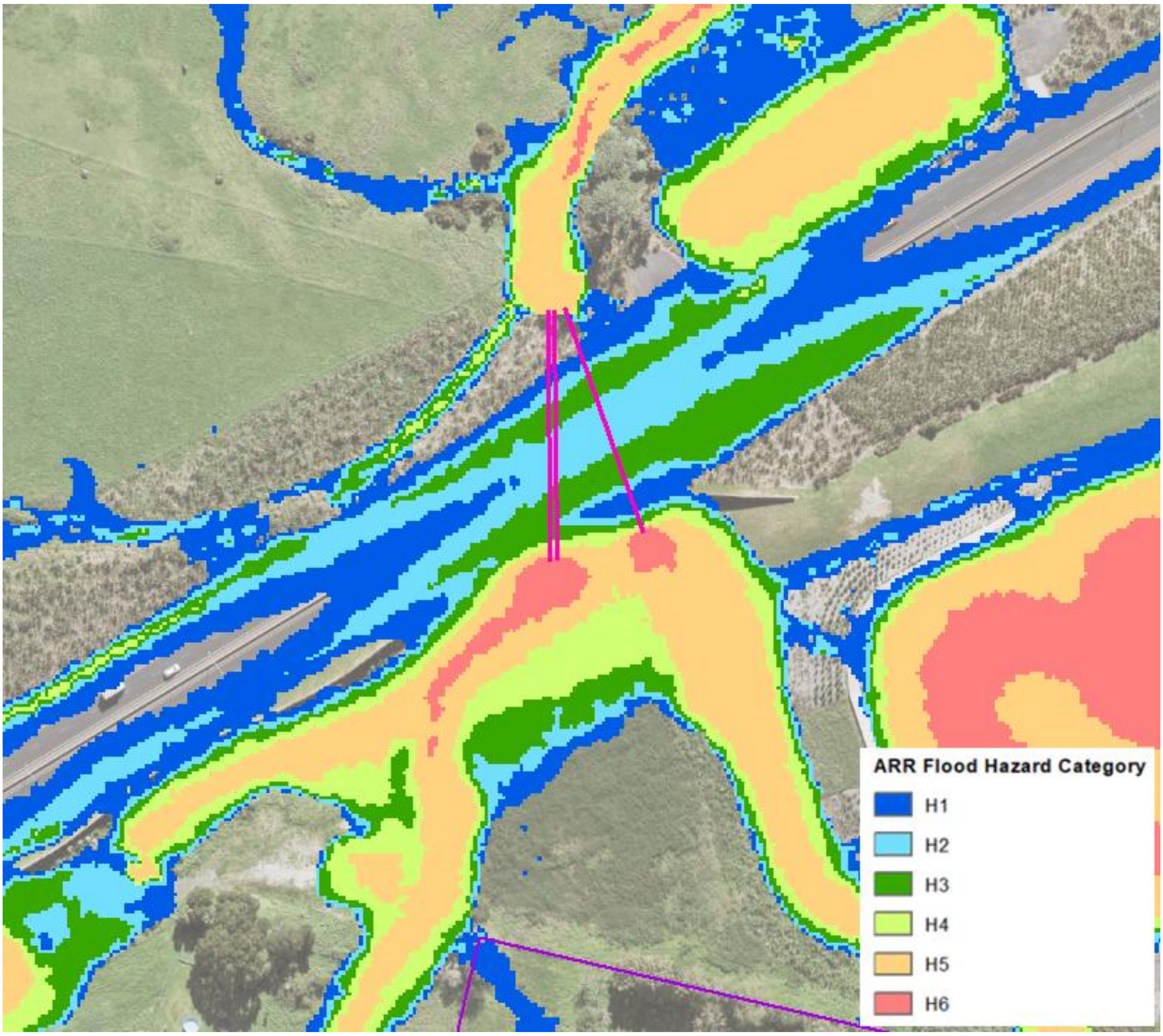

Figure 10. ARR flood hazard classification for post-development 1% AEP 3.8° CC, 50% culvert blockage.

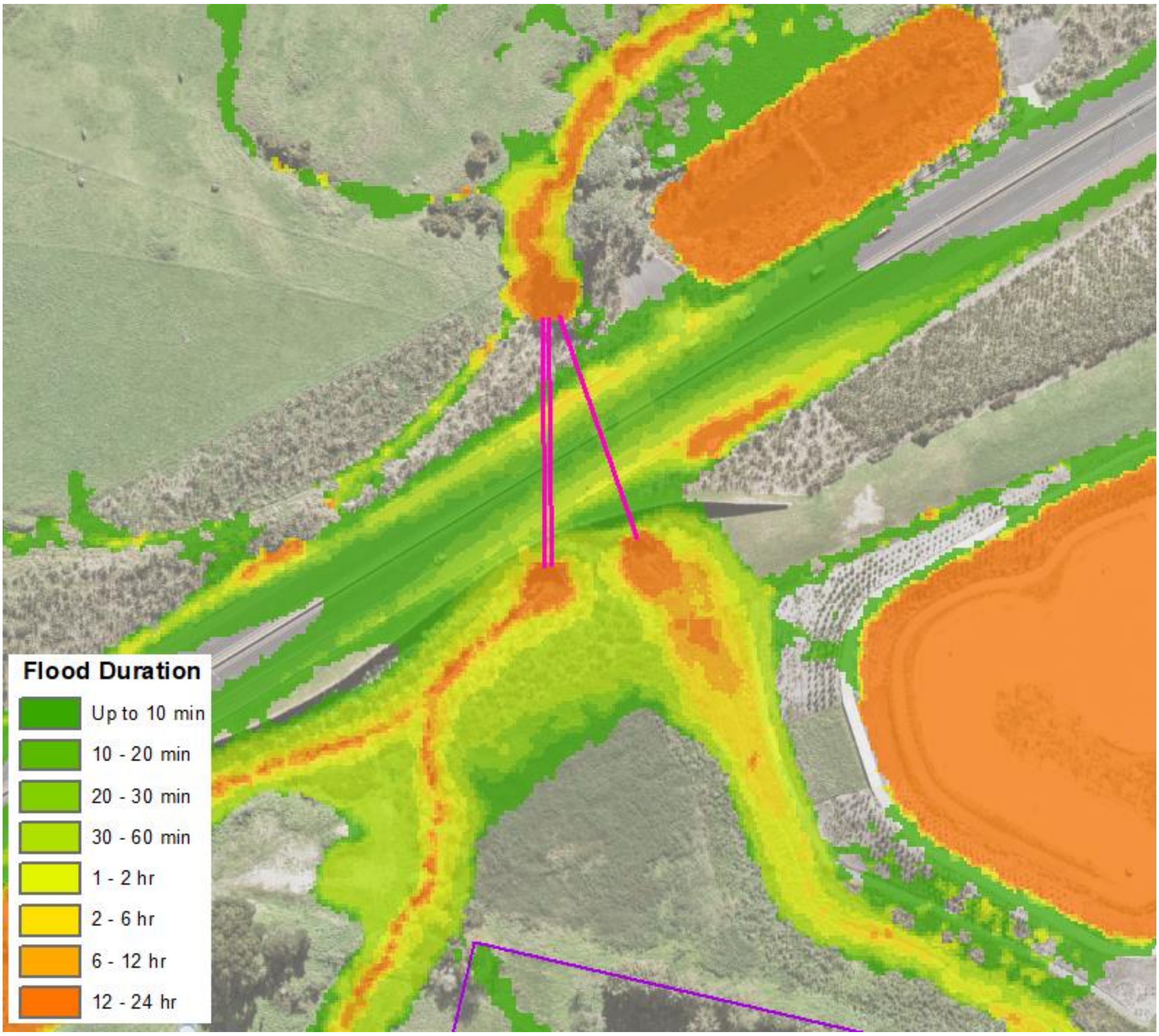

Figure 12. Post-development flood duration for 1% AEP 3.8° CC, 50% culvert blockage (Flood duration shows the time period the flood depth is higher than 300mm).

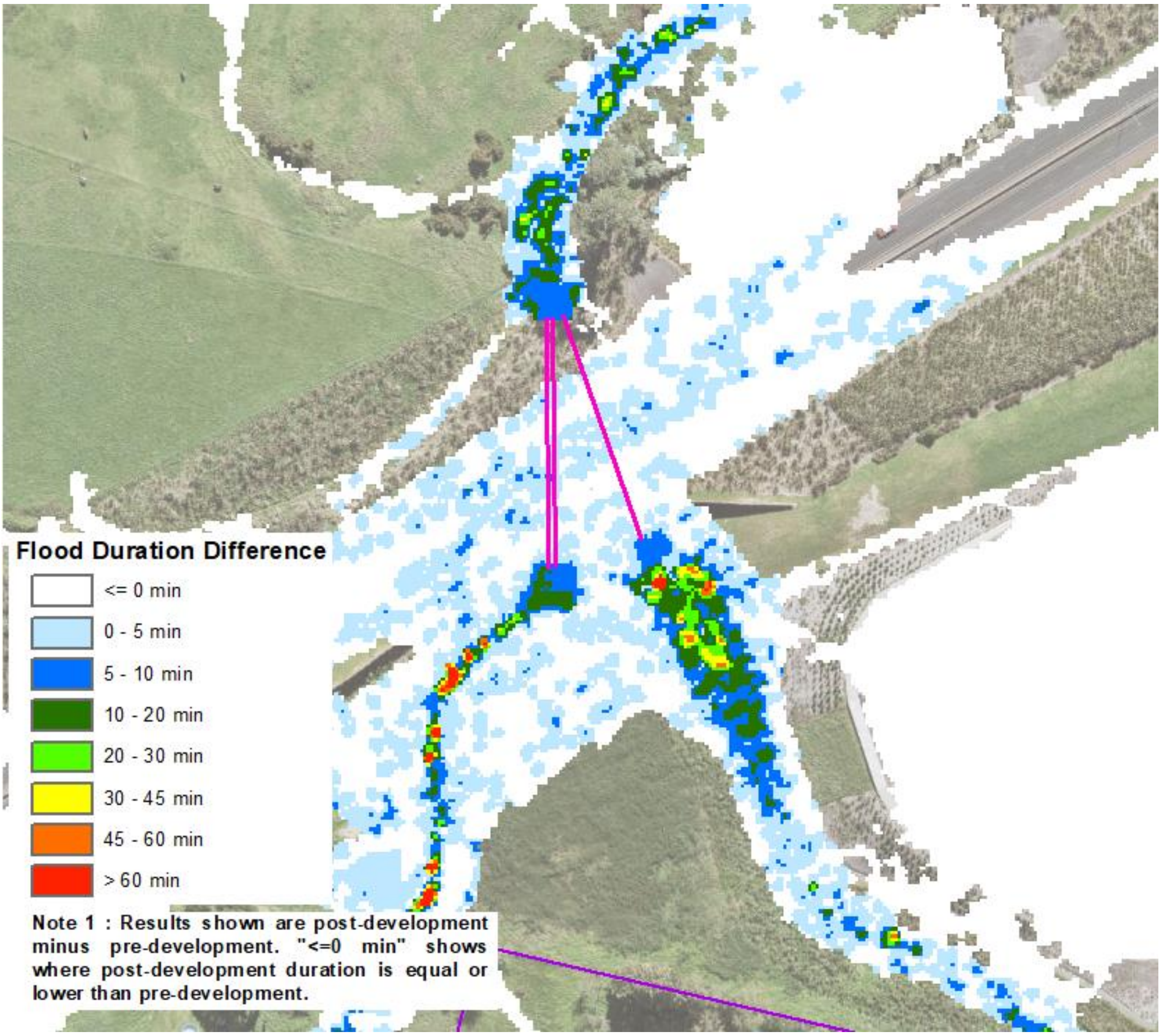

Figure 13. Flood duration difference between post and post-development for 1% AEP 3.8° CC with 50% culvert blockage.

3.2 FLOOD IMPACT ON THE PROPERTIES

Table 2 presents the results of the flood assessment on three properties under the culvert blockage scenario. As expected, the flood level increased on 27 Trig Road (south of the motorway) due to the culvert blockage. However, the difference between the post- and pre-development scenarios remained minor, under 3.8° and no climate change scenarios.

The two properties north of the motorway are almost unimpacted with the culvert blockage.

TABLE 2: MODEL RESULTS WITHIN THREE SPECIFIED PROPERTIES – 50% Culvert Blocked						
ADDRESS	**RAINFALL EVENT AND CLIMATE CHANGE (CC)**	**FLOOD DEPTH PREDEVELOPMENT(M)**	**FLOOD DEPTH POSTDEVELOPMENT(M)**	**FLOOD DEPTH DIFFERENCE(M)**	**PEAK MODELLED WATER LEVEL PREDEVELOPMENT(MRL)**	**PEAK MODELLED WATER LEVEL POSTDEVELOPMENT(MRL)**
27 Trig Road	100-year (No CC)	2.53	2.62	0.09	19.67	19.76
	100-year (3.8°CC)	3.75	3.77	0.02	20.90	20.92
161 Brigham Creek Road (pump station)	100-year (No CC)	0.00	0.00	0.00	N/A	N/A
	100-year (3.8°CC)	0.10	0.10	0.00	9.97	9.97
162 Brigham Creek Road	100-year (No CC)	0.20	0.20	0.00	8.87	8.87
	100-year (3.8°CC)	0.21	0.24	0.03	8.78	8.81