Flood Risk Assessment

Cove Road & Mangawhai Heads Road, Mangawhai
The Rise Private Plan Change – PPC83

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Revision History

Revision No	Description/comments	Prepared By	Date
0	Plan Change	D. Teh	22 January 2024

Document Control

Action	Name	Signed	Date
Prepared by	D. Teh Civil Engineer		22 January 2024
Reviewed by	S. Rankin Director BE (Env) CPEng (NZ & Fiji) CMEngNZ IntPE(NZ) MFIE(Fiji)		22 January 2024

Distribution

Business/company	Attention	Role
The Rise Limited		Client

Table of Contents

Table of Figures

List of Tables

1 Introduction

Chester Consultants Ltd (Chester) has been engaged by The Rise Limited to provide a Flood Risk Assessment with respect to the proposed Private Plan Change (PPC83) for the rural area to the east of Cove Road, Mangawhai and to the north of Mangawhai Heads Road (West), Mangawhai, referred to herein as 'the PPC'.

This report has been prepared solely for the benefit of this specific project, and the Kaipara District Council (KDC). Chester accepts no liability for inaccuracies in third party information used as part of this report. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

This report is based on development data provided by third party contributors to the private plan change application as well as data obtained from the KDC and Northland Regional Council (NRC) maps current to the site at the time of this document's production. All vertical levels stated in this report are in New Zealand's One Tree Point 1964 vertical datum unless otherwise stated. Should alterations be made which impact upon the development not otherwise authorised by this report then the design / comments / recommendations contained within this report may no longer be valid.

In the event of the above, the property owner should immediately notify Chester Consultants Ltd to enable the impact to be assessed and, if required, the design and or recommendations shall be amended accordingly and as necessary.

2 Site Description

The PPC Area is comprised of multiple lots and is approximately 56.9ha in size. Refer to Appendix 1 of Barker & Associates Limited's Assessment of Effects and Section 32 Evaluation Report for a list of the legal descriptions, title references and property address of each parcel that making up the PPC Area.

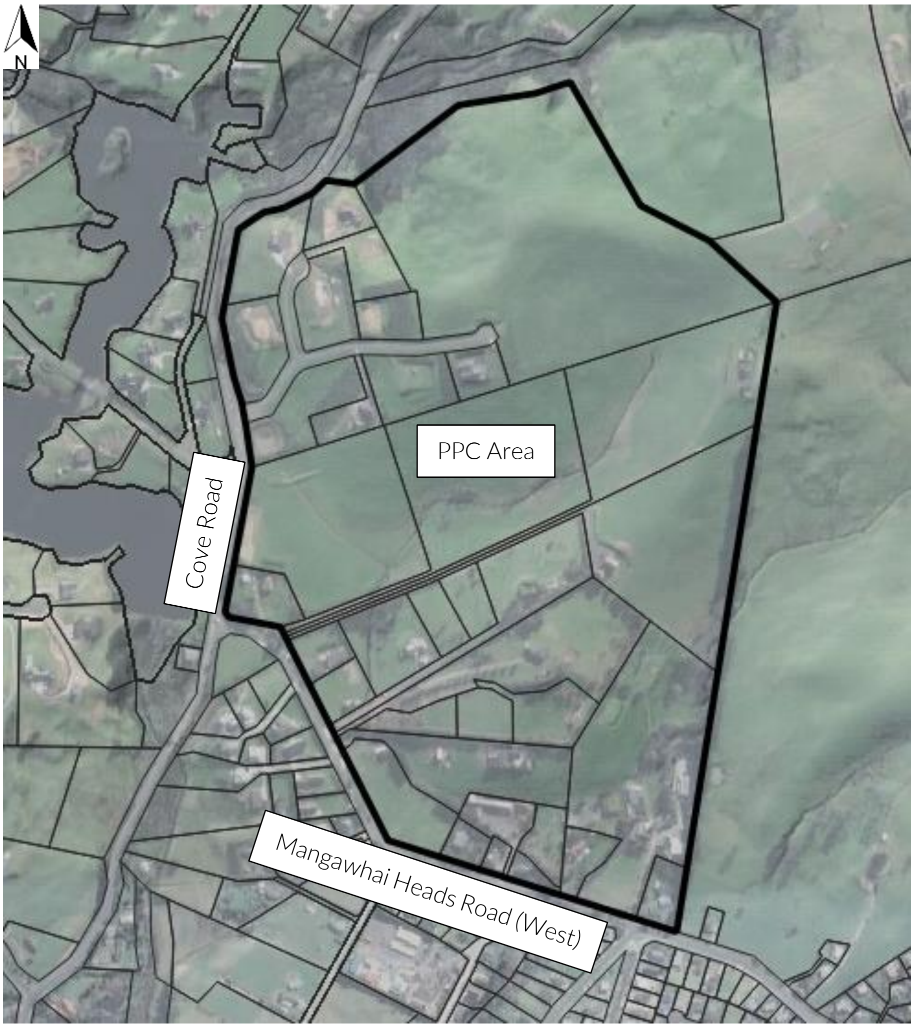

Figure 2-1: Private Plan Change Area.

3 Purpose

This report is intended to inform the Proposed Private Plan Change by assessing the impact the PPC could potentially have on the downstream environment, and to inform the Stormwater Management Plan which has also been prepared by Chester for the PPC.

This report and the flood modelling undertaken is limited to only assessing downstream effects. This report and results are not meant to be used as a detailed assessment of the flooding hazard within the PPC Area. It is assumed that flooding within the PPC area would be assessed at resource consent stage when the development scheme is being prepared and assessed as per the normal process.

4 Flood Risk Assessment

This section of the report describes the natural and physical characteristics that make up the PPC Area to provide context for the stormwater management requirements.

4.1 Flood Hazard Description

Currently, the majority of the PPC Area drains to the south towards the residential areas before draining in to the Mangawhai Estuary. The Northland Regional Council (NCR) Hazard webpage indicates that these areas are identified to be overlaid with the 100 Year ARI floodplain, refer to Figure 4-1 below.

Two other areas of interest include the area to the west towards Robert Hastie Drive (private road) where water flows from the north-western corner of the PPC Area flow towards Robert Hastie Drive, and the area in the north towards Tangaroa Road (private road) where the flows form the northern area of the PPC Area flow towards Tangaroa Road. Refer to Figure 4-1 below.

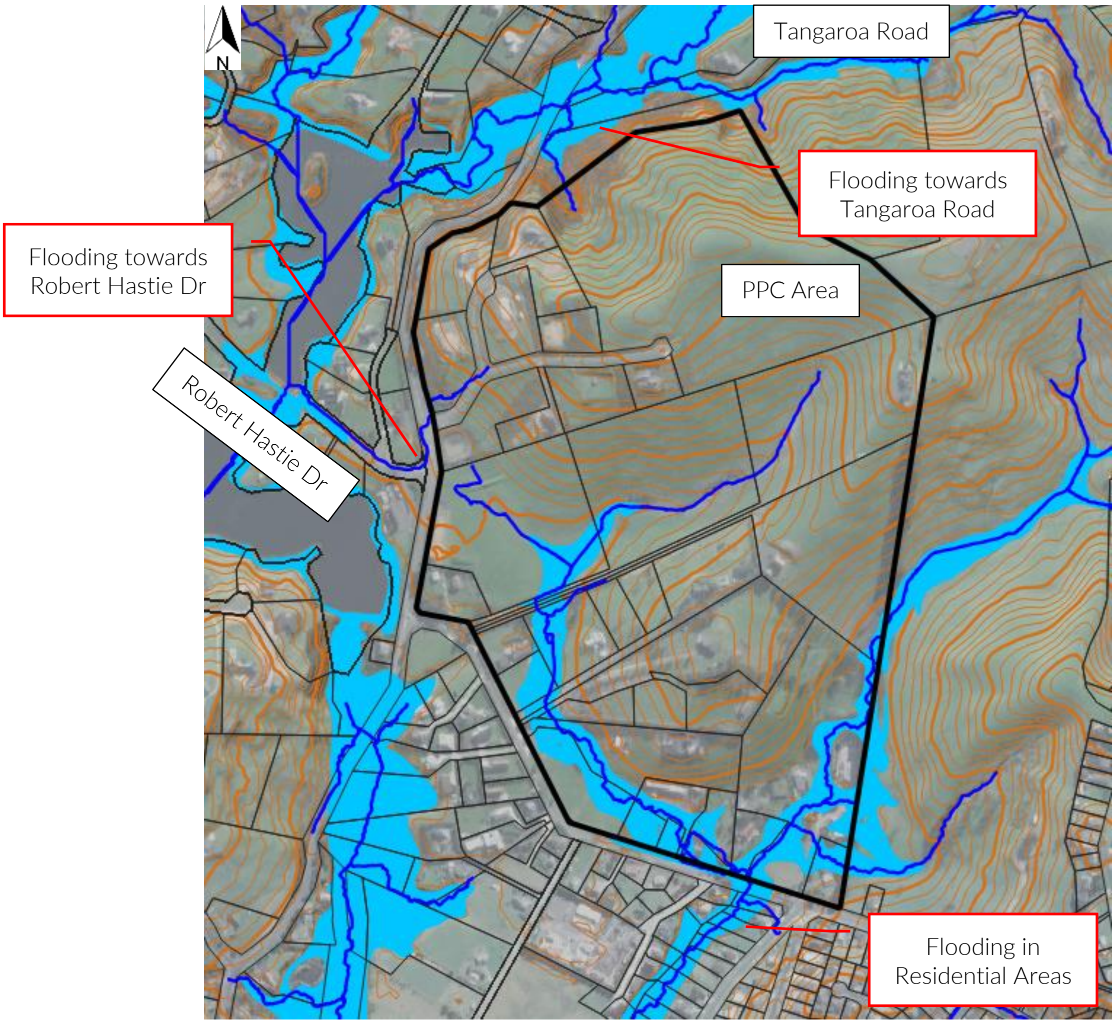

Figure 4-1: KDC 100 Year ARI Regionwide floodplains within the PPC Area.

4.2 Catchment Delineation

Using Land Information New Zealand's (LINZ) Northland 2018-2020 LiDAR data, three catchments were identified, West Catchment, North Catchment, and the PC Catchment.

The West and North Catchments represent the two relatively smaller areas of the PPC Area which drain to the west to Robert Hastie Drive and north towards Tangaroa Road, respectively.

The PC Catchment represents the majority of the land within the PPC Area, this area drains to the south towards the existing residential properties past Mangawhai Heads Road (West). In order to assess the southern flows the assessment has been taken wider that the PPC boundary as the entire catchment needs to be considered; this wider catchment has then been broken down into eight sub-catchments.

Table 4-1 below list the catchment and sub-catchments that were assessed alongside their respective areas, and Figure 4-2 below shows the locations of the catchments and sub-catchments.

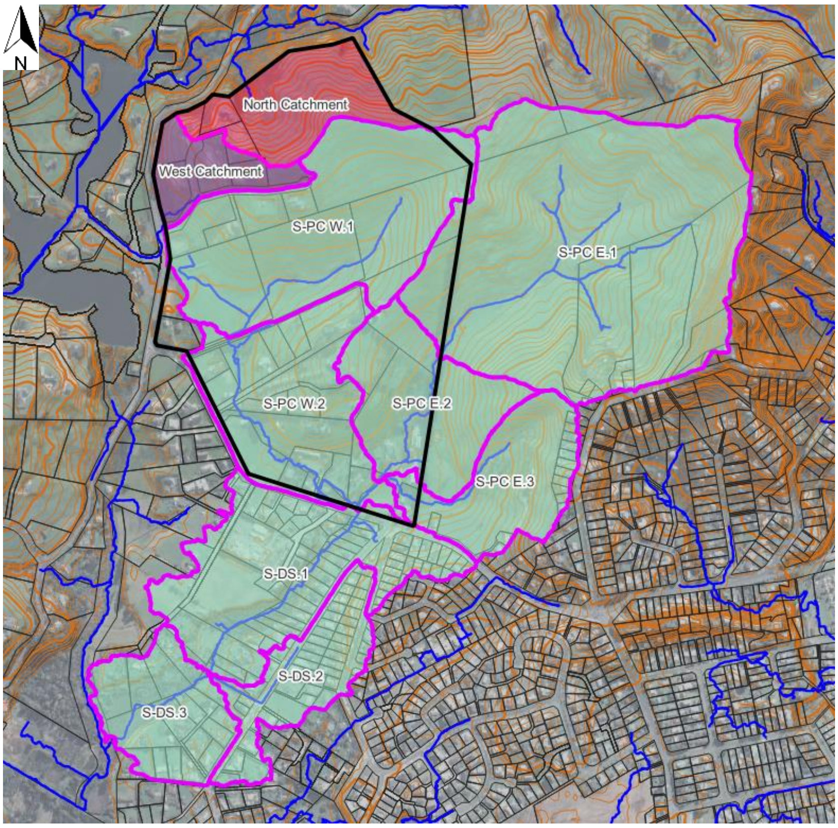

Figure 4-2: Delineated catchments and sub-catchments

Table 4-1: Catchment Areas

Catchment	Area (km²)
North Catchment	0.0738
West Catchment	0.0394
PPC Catchment - Sub-catchment PC W.1	0.2048
PPC Catchment - Sub-catchment PC W.2	0.1349
PPC Catchment - Sub-catchment PC E.1	0.3872
PPC Catchment - Sub-catchment PC E.2	0.1030
PPC Catchment - Sub-catchment PC E.3	0.0823
PPC Catchment - Sub-catchment PC DS.1	0.1597
PPC Catchment - Sub-catchment PC DS.2	0.0701
PPC Catchment - Sub-catchment PC DS.3	0.0747

4.3 Flowrate Analysis – Hydrology Methodology

Using HEC-HMS in accordance with the TP108 methodology but using the Type SCS Type 1A 24-hour storm pattern, we have estimated the peak runoff from the delineated catchment areas for the 1% AEP and 10% AEP storm events.

4.3.1 Rainfall Depths

Rainfall data was obtained from Table 6.7 of the Kaipara District Engineering Standards (2011) and have been adjusted with a 17% allowance for climate change (2.1-degree Celsius increase in temperature). The table below represents the rainfall depths used to calculate the peak runoffs:

Table 4-2: Rainfall Depths

AEP (%)	Rainfall Depth with Climate Change allowance (mm)
10%	193
1%	324

4.3.2 Scenarios

Two scenarios were assessed, Current Scenario and Proposed Scenario.

Current Scenario is based on the existing rural zoning within the PPC Area while the Proposed Scenario is based on the proposed residential zoning within the PPC Area without any form of stormwater mitigation. This is to assess how much effect the proposed PPC has on the flooding hazard, without including any form of mitigation, and compare that to the Current Scenario when both scenarios are at Maximum Probable Development.

4.3.3 Impervious Percentages

Impervious coverages were obtained from the relevant zoning text in the KDC District Plan. Refer to the table below for the summarised impervious and pervious coverages. The proposed residential zoning for the PPC Area within the Proposed Scenario was modelled with an impervious coverage of 60% to reflect the proposed increase in the permitted impervious coverage as part of the private plan change application.

Table 4-3: Impervious and pervious coverages for different land zones in the Current Flood Model Scenario

Land Zone	Impervious Coverage (%)	Pervious Coverage (%)
Rural Zones	10	90
Urban Zones	40	60
Business: Industrial Zones	100	0
Road Parcels	85	15

Table 4-4: Impervious and pervious coverages for different land zones in the Proposed Flood Model Scenario

Land Zone	Impervious Coverage (%)	Pervious Coverage (%)
Rural Zones	10	90
Urban Zones	40	60
Urban Zones in the PPC Area	60	40
Business: Industrial Zones	100	0
Road Parcels	85	15

4.3.4 Time of Concentration & CN & Initial Abstraction

Time of concentration for the delineated catchments were calculated using 10-85 slopes and 10-85 lengths obtained using HECHMS and using the TP108 methodology. Reaches were required to connect the sub-catchments within the PPC Catchment within the HECHMS model. These reaches were assigned a lag routing method with the lag duration calculated using the TP108 methodology with length and slope values obtained using HECHMS with a CN of 98 and a channelisation factor of 0.8. A CN of 98 was used as these reaches represent watercourses which is already inundated with water and so soils will be highly saturated and will have characteristics like impervious areas. Refer to Appendix A for time of concentration calculations.

CN numbers for the catchment were obtained by using the impervious and pervious coverages seen in Table 4-3 above, where the impervious areas were assigned a CN of 98 and pervious areas were assigned a CN of 74. Weighted CNs were obtained for each of the delineated catchments and sub-catchments based off the area. A CN of 98 was assigned for impervious areas as is typical while a CN of 74 was used for pervious areas as the soil type within the

PPC area was predominantly underlain with sandstone and siltstone as per the 1:250k geological maps by GNS Science.

Initial abstraction for each catchment and sub-catchment were obtained using the process outlined in TP108. Specifically, initial abstraction was calculated using equation 3.5 of TP108 whereby the pervious area is divided by the total area and then multiplied by five.

Refer to Appendix A for the time of concentration, area-weighted CN and initial abstraction values for both model scenarios, Current Scenario and Proposed Scenario.

4.3.5 HECHMS Model

The HECHMS software and the hydrology parameters above were used to estimate the peak flowrates for the 1% and 10% AEP 24-hour rainfall events.

Refer to Figure 4-3 below for a plan overview of the HEC-HMS model. Basin models were used to represent the delineated sub-catchments and catchments seen in Figure 4-2 and reaches were used to connect the relevant sub-catchments. Junction components were used to connect the reaches and sub-basins, and lastly, sink components were used to model the endpoints.

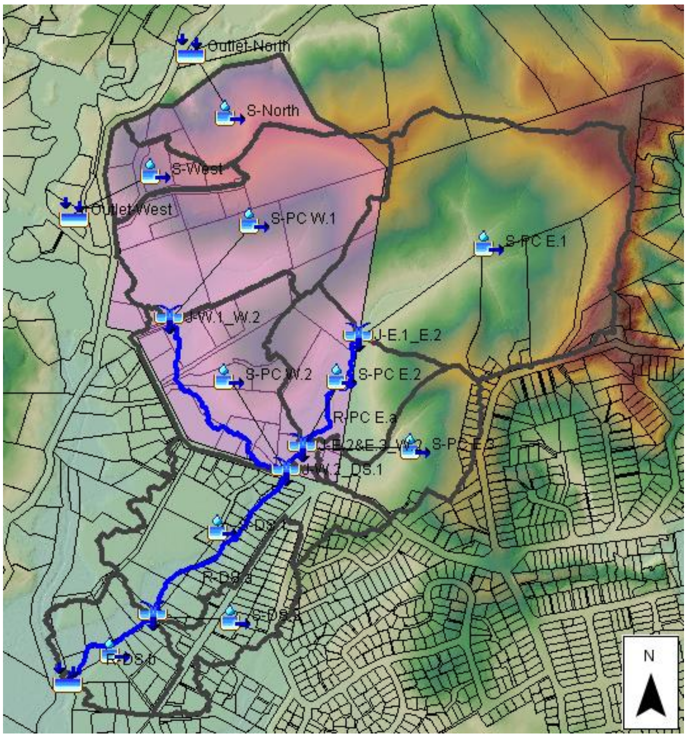

Figure 4-3: HECHMS basin overview for both Current and Proposed Scenarios

Using the above, the flowrates from the HECHMS model are summarised in the tables below. Refer to the Appendix B for HECHMS summary outputs.

Table 4-5: HECHMS modelled flowrates for the Current Scenario

Current Scenario - Catchments	10% AEP Peak Flowrates (m^3/s)	1% AEP Peak Flowrates (m^3/s)
North Catchment	0.67	1.32
West Catchment	0.36	0.70
PPC Catchment - Sub-catchment PC W.1	1.76	3.47
PPC Catchment - Sub-catchment PC W.2	1.05	2.06
PPC Catchment - Sub-catchment PC E.1	3.69	6.94
PPC Catchment - Sub-catchment PC E.2	0.96	1.84
PPC Catchment - Sub-catchment PC E.3	0.84	1.56
PPC Catchment - Sub-catchment PC DS.1	1.55	2.83
PPC Catchment - Sub-catchment PC DS.2	0.67	1.23
PPC Catchment - Sub-catchment PC DS.3	0.72	1.33

Table 4-6: HECHMS modelled flowrates for the Proposed Scenario

Proposed Scenario - Catchments	10% AEP Peak Flowrates (m^3/s)	1% AEP Peak Flowrates (m^3/s)
North Catchment	0.84	1.50
West Catchment	0.45	0.80
PPC Catchment - Sub-catchment PC W.1	2.24	3.99
PPC Catchment - Sub-catchment PC W.2	1.35	2.41
PPC Catchment - Sub-catchment PC E.1	3.74	7.00
PPC Catchment - Sub-catchment PC E.2	1.10	2.00
PPC Catchment - Sub-catchment PC E.3	0.85	1.57
PPC Catchment - Sub-catchment PC DS.1	1.56	2.84
PPC Catchment - Sub-catchment PC DS.2	0.67	1.23
PPC Catchment - Sub-catchment PC DS.3	0.72	1.33

4.4 Flood Analysis – HECRAS

A 2D model was created using the HECRAS software. The majority of the 2D flow area uses an average cell dimension of 5m wide by 5m long. Figure 4-4 below shows an overview of the HECRAS 2D flood model.

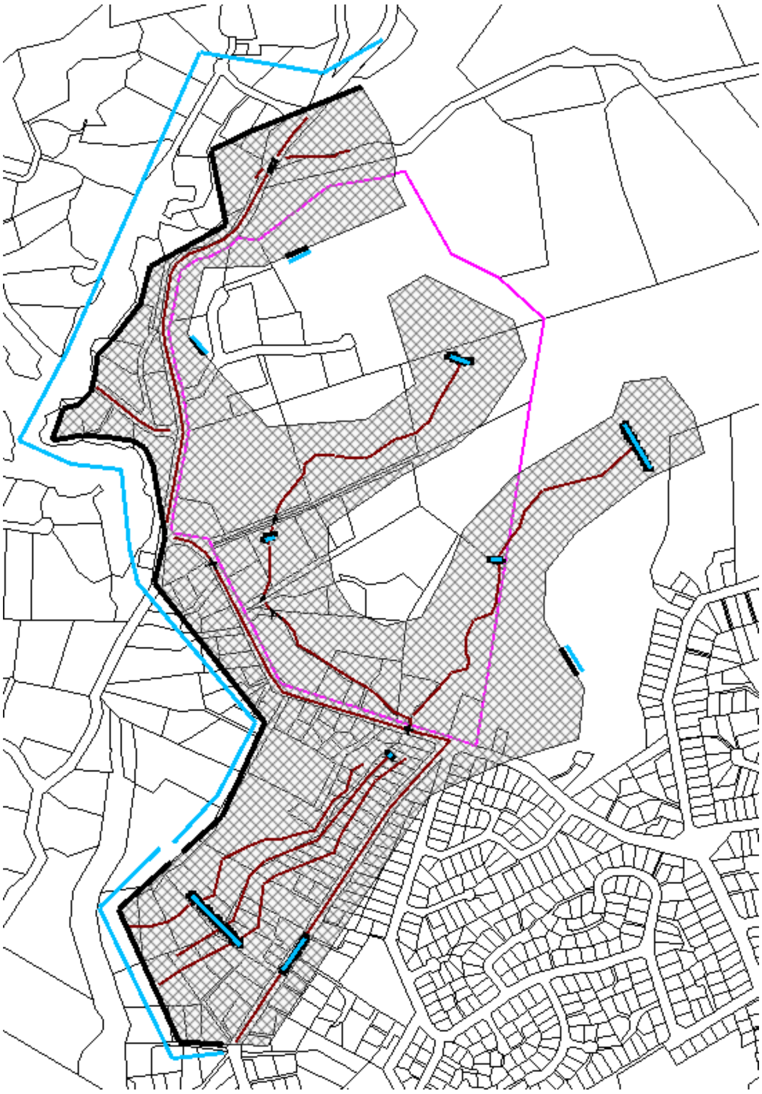

Figure 4-4: HECRAS model overview

4.4.1 Terrain Data

Terrain data used in the flood model utilises LINZ's Northland 2018-2020 1m LiDAR data. Both scenarios used the same terrain data.

4.4.2 Boundary Conditions & Flow Data

Inflow boundaries were used to simulate the flows from the delineated catchments and sub-catchments seen in Table 4-5 and Table 4-6. Each inflow boundary is linked to its respective flow hydrograph produced from HECHMS.

The Current Scenario HECRAS flood model will used the inflow rates seen in Table 4-5 while the Proposed Scenario HECRAS flood model will used the inflow rates seen in Table 4-6. This is one of two factors that makes the Proposed Scenario different to the Current Scenario.

Outflow boundaries has been assigned with a constant stage depth of 3.0m. A stage depth of 3.0m was used due to the location of the outflow boundaries being in areas highly affected by tidal influence. Based off a site investigation, it was determined that high tide level in that area is approximately RL 3.0m (One Tree Point vertical datum) based off comparing LiDAR data to observed water levels on-site.

The stage depth boundary allows water to flood low-lying areas at the beginning of the model. As a result, any water running down from the inflow boundaries will simulate flood levels above the tide level rather than just filling up the low-lying area. This results in a more conservative assessment, but this level of conservatism is considered appropriate when assessing a natural hazard.

4.4.3 Mannings Roughness Coefficient

For the manning's roughness used in the HECRAS model, refer to the tables below. Manning's roughness values were assigned based of the land zoning except for the low-lying river area within the residential properties to the south of the PPC Area and the Mangawhai Heads Road (West). Refer to Table 4-7 and Table 4-8 for the selected Manning's coefficient values for different land cover types. Figure 4-5 shows the location of the different land cover types on a map.

The only difference between the two tables is that the PPC Area has a higher Manning's roughness number to reflect the proposed zoning change. The is the other factor that makes the Proposed Scenario different to the Current Scenario.

Table 4-7: Manning's coefficient values for different land cover types for the Current Flood Model Scenario

Land Cover	Manning's Coefficient Value
Rural zones	0.10
Residential zones	0.15
PPC Area	0.10 (Existing Scenario)
Business: Industrial zone	0.20
Road Parcels	0.03
Vegetated Area	0.20

Table 4-8: Manning's coefficient values for different land cover types for the Proposed Flood Model Scenario

Land Cover	Manning's Coefficient Value
Rural zones	0.10
Residential zones	0.15
PPC Area	0.15 (Proposed Scenario)
Business: Industrial zone	0.20
Road Parcels	0.03
Vegetated Area	0.20

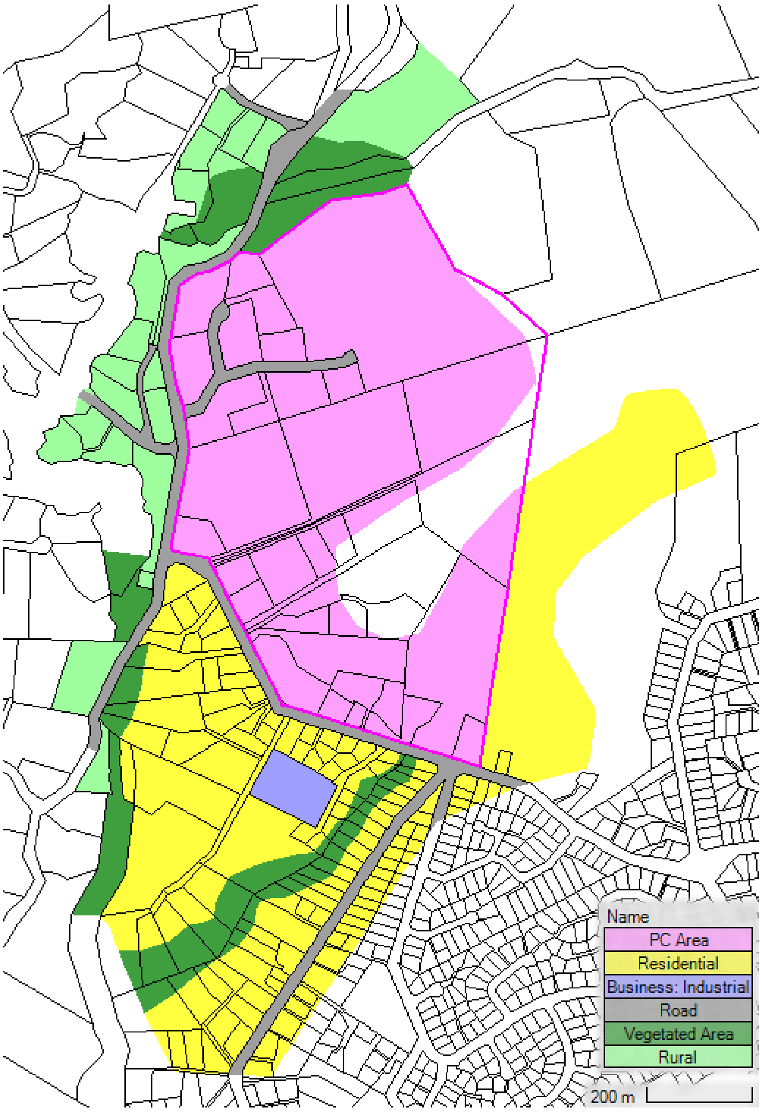

Figure 4-5: HECRAS model Manning's roughness map

4.4.4 Stormwater Network

No stormwater pipes were included in the model. Only the following culverts were included:

- Twin 1.2m diameter culverts along Mangawhai Heads Road (West) in front of 82-88 Mangawhai Heads Road (West) at 0.67% with upstream invert level (IL) at RL 2.28m and downstream IL of RL 2.16m.
- 0.30m diameter culvert along Mangawhai Heads Road (West) in front of 136 Mangawhai Heads Road (West) at 6.2% with upstream IL at RL 7.09m and downstream IL at RL 5.69m.
- Concrete culvert/bridge along Cove Road near Tangaroa Road (private road) modelled as a bridge with the roadway having a top level of RL 10.26m to RL 10.34m with a bottom level of a constant RL 9.5m. A constant bottom level was chosen for simplicity. This results in a 1.7m high by 5.74m wide. rectangular channel for the water to flow through at the upstream end.
- 0.7m, 0.5m, 0.6m diameter private culverts within the PPC Area that can be seen on KDC Utilities GIS Map at 0.1% gradient.

All above culverts utilised a manning's roughness number of 0.013 as these culverts are made from concrete. No blockage factors were introduced to these culverts. Culvert levels and gradients above were estimated based on LiDAR levels.

Culvert data and levels were the same in both the Current and Proposed flood model scenarios.

Culvert data and levels were assumed based off available information provided by KDC Utilities GIS Map and LiDAR data, respectively.

4.4.5 Flood Model Scenarios

Two scenarios were assessed, the Current Scenario and then the Proposed Scenario. The Current Scenario is based on the existing rural zoning within the PPC Area while the Proposed Scenario is based on the proposed residential zoning within the PPC Area.

The only two differences between the Current and Proposed flood scenarios are that the inflow rates and the manning's roughness. Refer to Section 4.4.2 and 4.4.3, respectively for more information.

4.5 Flood Model Results

4.5.1 Current Flood Model Scenario

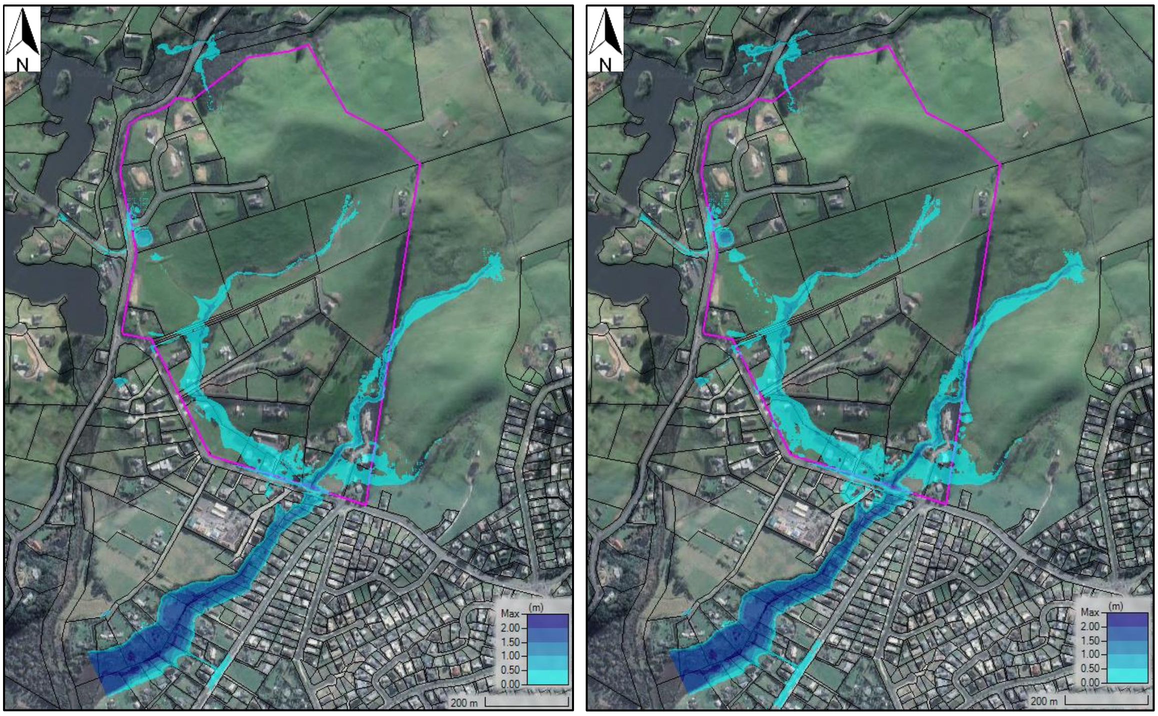

Figure 4-6: Current Scenario Model Results – 10% AEP (left) and 1% AEP (right) peak flood depths.

Flood waters from the North Catchment flow towards the box culvert/bridge under Cove Road and flows towards the water bodies to the west while flows from the West Catchment splits with some flows flowing towards the existing stormwater pond on-site which then overtops to the south while some flows flow towards private road, Robert Hastie Drive which would then flow into the water bodies in that area.

Flows from the majority of the PPC Area flow towards the twin 1.2m culverts and is estimated to flood the existing development along the southern boundary within the PPC Area. The flooding is associated with floodwaters overtopping the channel banks rather than from backwater effects caused by the twin 1.2m diameter culverts. It is noted though that LiDAR data does not accurately capture channel levels as channels are not continuous. However, it is unlikely that these channels have sufficient capacity to contain the 1% AEP levels entirely considering that in the areas where LiDAR does capture the channel terrain flooding still overtops the bank.

Backwater effects from the twin 1.2m diameter culverts is estimated to only affect water levels within the immediate upstream property.

To the south of Mangawhai Heads Road (West), flooding extents are predominantly limited to the vegetated low-lying area located within the backyards of the residential properties in this area. However, there are a few properties still affected by flooding in this area, refer to Figure 4-7 below. These properties likely experience flooding due to flood waters overtopping along Mangawhai Heads Road (West) and flowing through their properties and also the low-lying vegetated land is relatively narrower in this location compared to properties further downstream which causes flooding to spill their banks in this location.

Refer to Appendix C for flood drawings for the flood model results showing the flood depths and also comparison maps of the flood depth between the Current and MPD scenarios for their respective AEP events. All flood maps show maximum modelled values in each 2d cell irrespective of the timing during the simulation.

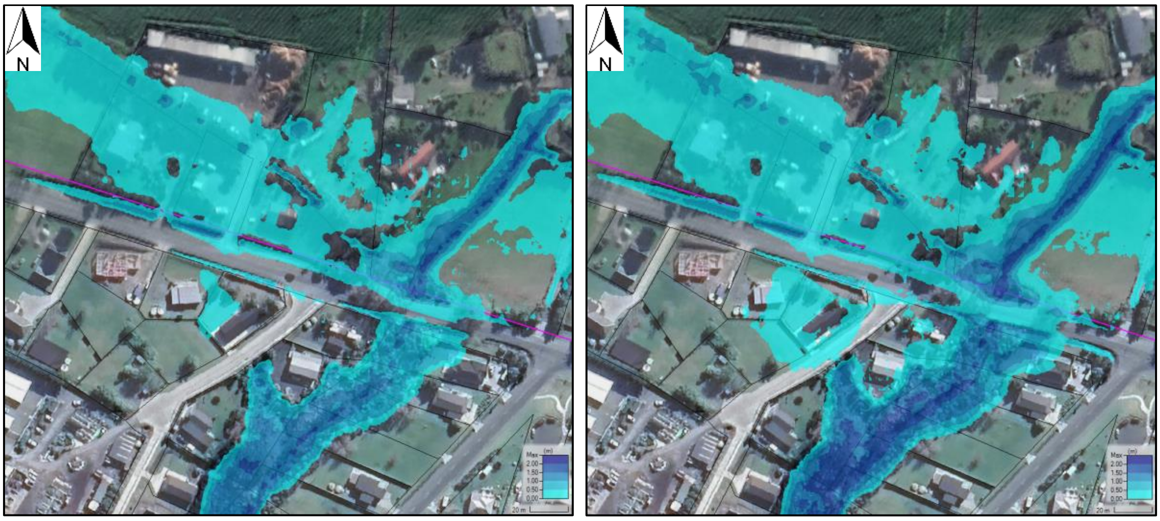

Figure 4-7: Current Scenario Model Results – 10% AEP (left) and 1% AEP (right) peak flood depths.

4.5.2 Proposed Flood Model Scenario

Figure 4-8: Proposed Scenario Model Results – 10% AEP (left) and 1% AEP (right) peak flood depths

The Proposed Scenario does not significantly increase flood hazards compared to the Current Scenario model. Flood extents and depths are slightly larger; approximately 0.50m wider and 0.05m deeper compared to the Current Scenario model; we believe that this increase does not put additional properties or additional buildings at risk of flooding (i.e., does not create new hazards for other properties/structures that were not already estimated to experience flooding).

Refer to Appendix C for flood drawings for the flood model results showing the flood depths and also comparison maps of the flood depth between the Current and MPD scenarios for their respective AEP events. All flood maps show maximum modelled values in each 2d cell irrespective of the timing during the simulation.

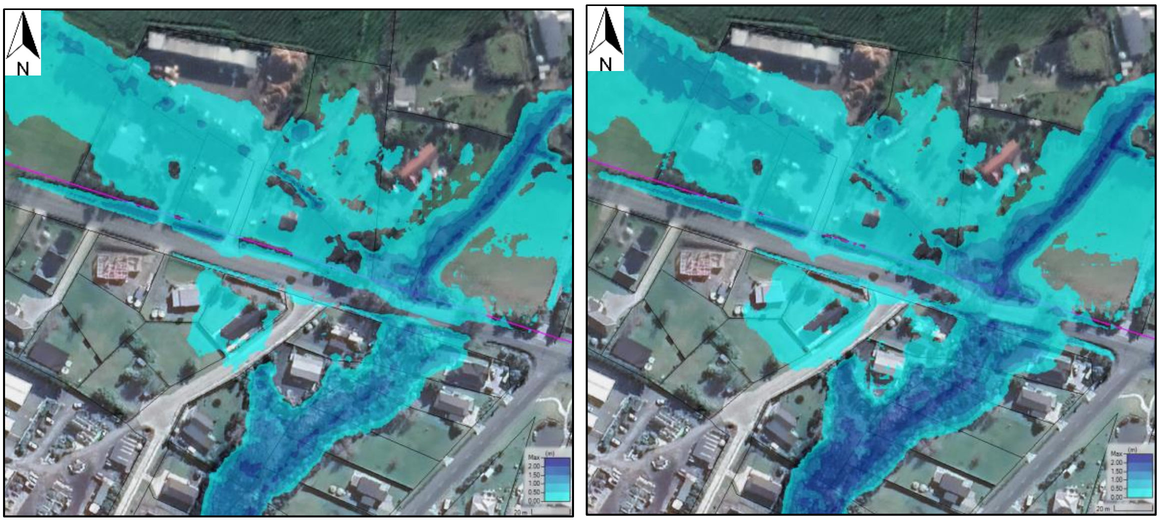

Figure 4-9: Proposed Scenario Model Results – 10% AEP (left) and 1% AEP (right) peak flood depths.

4.5.3 Assessment of the Twin 1.2m Diameter Culverts

To assess if upgrading the culvert could improve flooding in the area, via capital works / upgrades of the existing twin 1.2m culverts under Mangawhai Heads Road (West), a third HECRAS scenario was created.

This third HECRAS scenario uses the same factors (same inflow rates, same manning's roughness and etc) as the Proposed flood scenario except for two differences. One difference is the existing twin 1.2m diameter culverts is replaced with a larger culvert and that this third scenario was assessed with two different outflow boundary conditions.

The existing twin 1.2m diameter culverts was replaced with one 6.0m wide and 1.2m deep box culvert. Culvert gradient remains the same as there is no practical way to steepen the culvert gradient as the land is low-lying and any method to increase the gradient will just cerate topographical depressions that will just pond. Therefore, the only factor that can be upgraded is the conveyance area of the culvert. The 6.0m wide and 1.2m deep box culvert will have a conveyance area that is 3.19 times greater than the existing twin 1.2m diameter culverts (7.2m^2 compared to 2.26m^2).

This flood model scenario has been assessed with two different downstream conditions. One downstream boundary condition is the tidal influence by setting a stage hydrograph at RL 3.0m. This is the same as the above Current and Proposed Scenarios. Since the culvert invert levels will be partially submerged as IL levels are lower than RL 3.0m, this flood scenario was assessed with a different downstream boundary condition to remove the effects caused by the culvert being submerged. A normal depth boundary condition was used to assess the culvert.

Figure 4-10 below shows the 10% AEP flood extent from the indicative upgraded box culvert and the existing twin 1.2m diameter culverts with both having tidal influence (stage hydrograph set at RL 3.0m) at the downstream boundary condition.

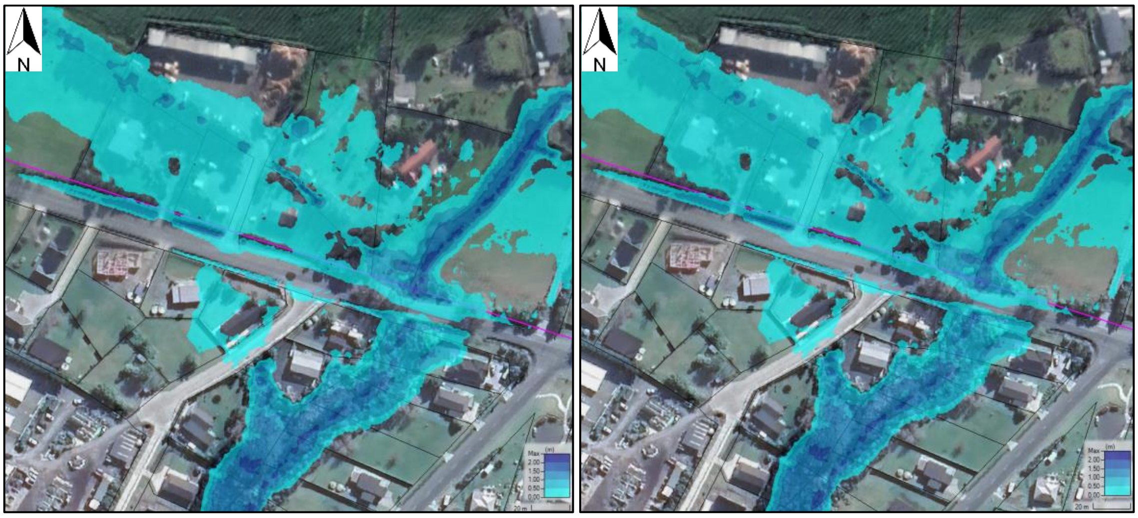

Figure 4-10: Culvert Scenario Model Results for 10% AEP event with tidal influence – Existing twin 1.2m diameter culverts (left) and Indicative upgraded 6.0m wide by 1.2m deep box culvert (right)

Figure 4-11 below shows the 10% AEP flood extent from the indicative upgraded box culvert and the existing twin 1.2m diameter culverts without tidal influence (outflow boundary was replaced with a normal depth boundary condition with a value of 0.01).

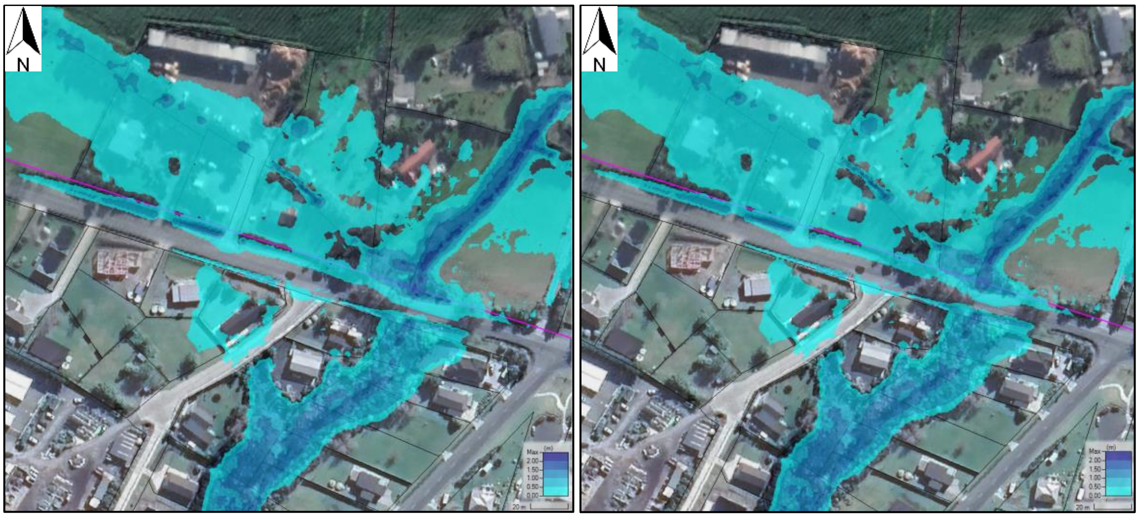

Figure 4-11: Culvert Scenario Model Results for 10% AEP event without tidal influence – Existing twin 1.2m diameter culverts (left) and Indicative upgraded 6.0m wide by 1.2m deep box culvert (right)

Figure 4-12 below shows the 1% AEP flood extent from the indicative upgraded box culvert and the existing twin 1.2m diameter culverts with both having tidal influence (stage hydrograph set at RL 3.0m) at the downstream boundary condition.

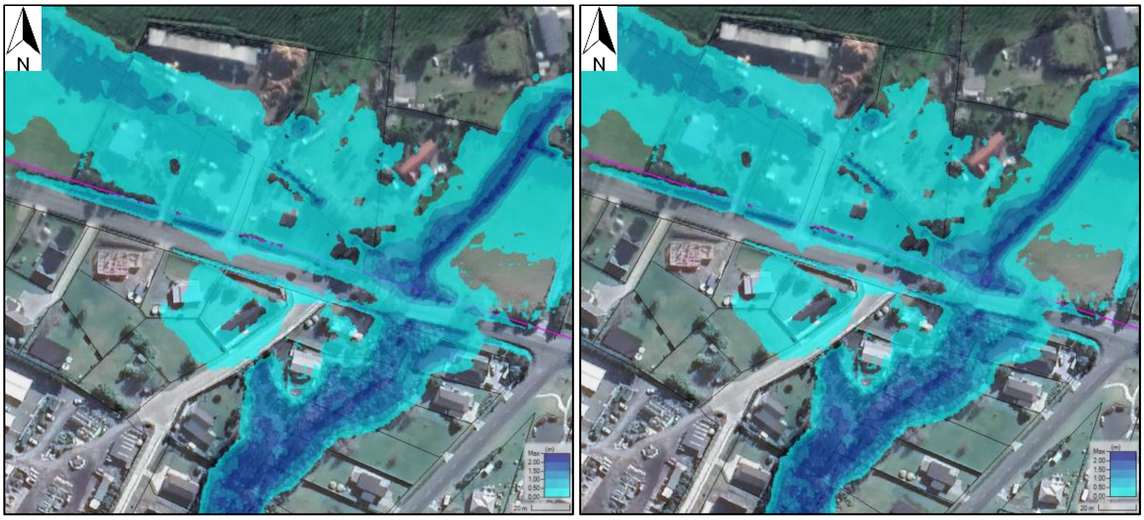

Figure 4-12: Culvert Scenario Model Results for 1% AEP event with tidal influence – Existing twin 1.2m diameter culverts (left) and Indicative upgraded 6.0m wide by 1.2m deep box culvert (right)

Figure 4-13 below shows the 1% AEP flood extent from the indicative upgraded box culvert and the existing twin 1.2m diameter culverts without tidal influence (outflow boundary was replaced with a normal depth boundary condition with a value of 0.01).

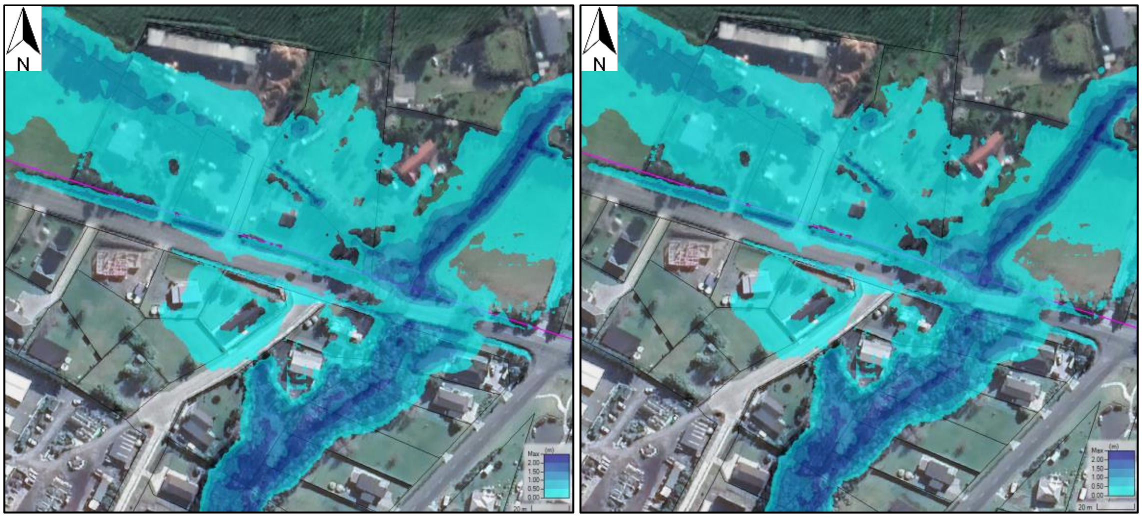

Figure 4-13: Culvert Scenario Model Results for 1% AEP event without tidal influence – Existing twin 1.2m diameter culverts (left) and Indicative upgraded 6.0m wide by 1.2m deep box culvert (right)

From the above assessment, there is no discernible difference when the twin culverts are replaced with a bigger box culvert. Therefore, upgrading the culvert is not estimated to resolve the flooding issues in this area due to the low-lying land in the area and the almost flat gradient between either side of the road.

Refer to Appendix C for flood drawings for the flood model results showing the flood depths and also comparison maps of the flood depth between the Current and MPD scenarios for their respective AEP events. All flood maps show maximum modelled values in each 2d cell irrespective of the timing during the simulation.

5 Conclusion

The PPC area contributes to flooding both in areas within the PPC Area and outside the PPC Area. The majority of the land within the PPC Area flows to the south with the other parts of the PPC Area flowing to the west and to the north.

From the flood models, most of the flooding affects the existing development located on the low-lying land of the PPC Area and where the residential properties are located near the existing twin 1.2m diameter culverts that run under Mangawhai Heads Road (West).

Flooding within the PPC Area in the low-lying land is caused by floodwaters spilling over the channel banks. In the residential properties to the south of the existing twin 1.2m diameter culverts under Mangawhai Heads Road (West), flooding is caused by flood waters overtopping the road and running into their properties from the road frontage or from floodwaters spilling the channel banks.

Based on an indicative upgrade to the existing twin 1.2m culverts, it is not believed that upgrading the culvert will improve the flooding hazard in this area due to the combination of being in low-lying land that is affected by tidal levels, low almost flat culvert slopes due to low-lying ground terrain on either side and the total flows from the contributing catchment.

As the modelling shows flooding as a hazard within and downstream of the PPC affecting properties and culverts in both the 10% and 1% AEP events, we recommend that the 20%, 10% and 1% AEP stormwater attenuation is provided to mitigate the effects from the proposed intensification of the PPC area.

6 Limitations

This assessment contains the professional opinion of Chester Consultants as to the matters set out herein, in light of the information available to it during the preparation, using its professional judgement and acting in accordance with the standard of care and skill normally exercised by professional engineers providing similar services in similar circumstances. No other express or implied warranty is made as to the professional advice contained in this report.

We have prepared this report in accordance with the brief as provided and our terms of engagement. The information contained in this report has been prepared by Chester Consultants at the request of The Rise Limited and is exclusively for its client use and reliance. It is not possible to make a proper assessment of this assessment without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to and the assumptions made by Chester Consultants Ltd. The assessment will not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this assessment by any third party.

The assessment is also based on information that has been provided to Chester Consultants Ltd from other sources or by other parties. The assessment has been prepared strictly on the basis that the information that has been provided is accurate, completed, and adequate. To the extent that any information is inaccurate, incomplete or inadequate, Chester Consultants Ltd takes no responsibility and disclaims all liability whatsoever for any loss or damage that results from any conclusions based on information that has been provided to Chester Consultants Ltd.

7 Appendices

Appendix A – Time of Concentration & CN Calculations

CN & Ia Calculations - Current Scenario

SubBasin	Zone	Area	Within PC Area	Imp. Ratio	Perm. Ratio		Imp. Area	Perm. Area	CN x Imp.	CN x Perm.		
S-PC W.2	Rural	128545	PC Area	10%	90%		12855	115691	1259741	8561097		
S-PC W.2	ROAD	6370		85%	15%		5415	956	530621	70707		
						Total	18269	116646	1790362	8631804	**CN Weighted**	**77.250**
							Total	134915	Total	10422166	**Ia Weighted**	**4.32**
S-PC W.1	Rural	196128	PC Area	10%	90%		19613	176515	1922054.4	13062124.8		
S-PC W.1	Residential	1098		40%	60%		439	659	43041.6	48751.2		
S-PC W.1	ROAD	3901		85%	15%		3316	585	324953.3	43301.1		
S-PC W.1	Rural	3734	PC Area	10%	90%		373	3361	36593.2	248684.4		
						Total	23741	181120	2326642.5	13402861.5	**CN Weighted**	**76.781**
							Total	204861	Total	15729504	**Ia Weighted**	**4.42**
S-PC E.3	Rural	5376	PC Area	10%	90%		538	4838	52684.8	358041.6		
S-PC E.3	Residential	76006		40%	60%		30402	45604	2979435.2	3374666.4		
S-PC E.3	ROAD	966		85%	15%		821	145	80467.8	10722.6		
						Total	31761	50587	3112587.8	3743430.6	**CN Weighted**	**83.257**
							Total	82348	Total	6856018.4	**Ia Weighted**	**3.07**
S-PC E.2	Rural	61369	PC Area	10%	90%		6137	55232	601416.2	4087175.4		
S-PC E.2	Residential	41710		40%	60%		16684	25026	1635032	1851924		
						Total	22821	80258	2236448.2	5939099.4	**CN Weighted**	**79.313**
							Total	103079	Total	8175547.6	**Ia Weighted**	**3.89**
S-PC E.1	Rural	21087	PC Area	10%	90%		2109	18978	206652.6	1404394.2		
S-PC E.1	Residential	307741		40%	60%		123096	184645	12063447.2	13663700.4		
S-PC E.1	ROAD	301		85%	15%		256	45	25073.3	3341.1		
S-PC E.1	Rural	10		10%	90%		1	9	98	666		
S-PC E.1	Rural	58217		10%	90%		5822	52395	570526.6	3877252.2		
						Total	131284	256072	12865797.7	18949353.9	**CN Weighted**	**82.134**
							Total	387356	Total	31815151.6	**Ia Weighted**	**3.31**
S-DS.3	Rural	1672		10%	90%		167	1505	16385.6	111355.2		
S-DS.3	Residential	71577		40%	60%		28631	42946	2805818.4	3178018.8		
S-DS.3	ROAD	1400		85%	15%		1190	210	116620	15540		
						Total	29988	44661	2938824	3304914	**CN Weighted**	**83.641**
							Total	74649	Total	6243738	**Ia Weighted**	**2.99**
S-DS.2	Residential	44496		40%	60%		17798	26698	1744243.2	1975622.4		
S-DS.2	Residential	8897		40%	60%		3559	5338	348762.4	395026.8		
S-DS.2	Residential	2781		40%	60%		1112	1669	109015.2	123476.4		
S-DS.2	ROAD	13946		85%	15%		11854	2092	1161701.8	154800.6		
						Total	34324	35796	3363722.6	2648926.2	**CN Weighted**	**85.748**
							Total	70120	Total	6012648.8	**Ia Weighted**	**2.55**
S-DS.1	Rural	1713	PC Area	10%	90%		171	1542	16787.4	114085.8		
S-DS.1	Residential	1393		40%	60%		557	836	54605.6	61849.2		
S-DS.1	Residential	32		40%	60%		13	19	1254.4	1420.8		

S-DS.1	Business: Industrial	13356		100%	0%		13356	0	1308888	0		
S-DS.1	Residential	111934		40%	60%		44774	67160	4387812.8	4969869.6		
S-DS.1	Residential	16370		40%	60%		6548	9822	641704	726828		
S-DS.1	ROAD	14988		85%	15%		12740	2248	1248500.4	166366.8		
						Total	78159	81627	7659552.6	6040420.2	**CN Weighted**	**85.740**
							Total	159786	Total	13699972.8	**Ia Weighted**	**2.55**
West Catchment	Rural	39400	PC Area	10%	90%		3940	35460	386120	2624040		
						Total	3940	35460	386120	2624040	**CN Weighted**	**76.400**
							Total	39400	Total	3010160	**Ia Weighted**	**4.50**
North Catchment	Rural	73800	PC Area	10%	90%		7380	66420	723240	4915080		
						Total	7380	66420	723240	4915080	**CN Weighted**	**76.400**
							Total	73800	Total	5638320	**Ia Weighted**	**4.50**

CN & Ia Calculations - Proposed Scenario

SubBasin	Zone	Area (m2)	Within PC Area	Imp. Ratio	Perm. Ratio		Imp. Area	Perm. Area	CN x Imp.	CN x Perm.		
S-PC W.2	Rural	128545	PC Area	60%	40%		77127	51418	7558446	3804932		
S-PC W.2	ROAD	6370		85%	15%		5415	956	530621	70707		
						Total	82542	52374	8089067	3875639	**CN Weighted**	**88.683**
							Total	134915	Total	11964706	**Ia Weighted**	**1.94**
S-PC W.1	Rural	196128	PC Area	60%	40%		117677	78451	11532326.4	5805388.8		
S-PC W.1	Residential	1098		40%	60%		439	659	43041.6	48751.2		
S-PC W.1	ROAD	3901		85%	15%		3316	585	324953.3	43301.1		
S-PC W.1	Rural	3734	PC Area	60%	40%		2240	1494	219559.2	110526.4		
						Total	123672	81189	12119880.5	6007967.5	**CN Weighted**	**88.489**
							Total	204861	Total	18127848	**Ia Weighted**	**1.98**
S-PC E.3	Rural	5376	PC Area	60%	40%		3226	2150	316108.8	159129.6		
S-PC E.3	Residential	76006		40%	60%		30402	45604	2979435.2	3374666.4		
S-PC E.3	ROAD	966		85%	15%		821	145	80467.8	10722.6		
						Total	34449	47899	3376011.8	3544518.6	**CN Weighted**	**84.040**
							Total	82348	Total	6920530.4	**Ia Weighted**	**2.91**
S-PC E.2	Rural	61369	PC Area	60%	40%		36821	24548	3608497.2	1816522.4		
S-PC E.2	Residential	41710		40%	60%		16684	25026	1635032	1851924		
						Total	53505	49574	5243529.2	3668446.4	**CN Weighted**	**86.458**
							Total	103079	Total	8911975.6	**Ia Weighted**	**2.40**
S-PC E.1	Rural	21087	PC Area	60%	40%		12652	8435	1239915.6	624175.2		
S-PC E.1	Residential	307741		40%	60%		123096	184645	12063447.2	13663700.4		
S-PC E.1	ROAD	301		85%	15%		256	45	25073.3	3341.1		
S-PC E.1	Rural	10		10%	90%		1	9	98	666		
S-PC E.1	Rural	58217		10%	90%		5822	52395	570526.6	3877252.2		
						Total	141827	245529	13899060.7	18169134.9	**CN Weighted**	**82.787**
							Total	387356	Total	32068195.6	**Ia Weighted**	**3.17**
S-DS.3	Rural	1672		10%	90%		167	1505	16385.6	111355.2		
S-DS.3	Residential	71577		40%	60%		28631	42946	2805818.4	3178018.8		
S-DS.3	ROAD	1400		85%	15%		1190	210	116620	15540		
						Total	29988	44661	2938824	3304914	**CN Weighted**	**83.641**
							Total	74649	Total	6243738	**Ia Weighted**	**2.99**
S-DS.2	Residential	44496		40%	60%		17798	26698	1744243.2	1975622.4		
S-DS.2	Residential	8897		40%	60%		3559	5338	348762.4	395026.8		
S-DS.2	Residential	2781		40%	60%		1112	1669	109015.2	123476.4		
S-DS.2	ROAD	13946		85%	15%		11854	2092	1161701.8	154800.6		
						Total	34324	35796	3363722.6	2648926.2	**CN Weighted**	**85.748**
							Total	70120	Total	6012648.8	**Ia Weighted**	**2.55**
S-DS.1	Rural	1713	PC Area	60%	40%		1028	685	100724.4	50704.8		
S-DS.1	Residential	1393		40%	60%		557	836	54605.6	61849.2		
S-DS.1	Residential	32		40%	60%		13	19	1254.4	1420.8		

S-DS.1	Business: Industrial	13356		100%	0%		13356	0	1308888	0		
S-DS.1	Residential	111934		40%	60%		44774	67160	4387812.8	4969869.6		
S-DS.1	Residential	16370		40%	60%		6548	9822	641704	726828		
S-DS.1	ROAD	14988		85%	15%		12740	2248	1248500.4	166366.8		
						Total	79015	80771	7743489.6	5977039.2	**CN Weighted**	**85.868**
							Total	159786	Total	13720528.8	**Ia Weighted**	**2.53**
West Catchment	Residential	39400	PC Area	60%	40%		23640	15760	2316720	1166240		
						Total	23640	15760	2316720	1166240	**CN Weighted**	**88.400**
							Total	39400	Total	3482960	**Ia Weighted**	**2.00**
North Catchment	Residential	73800	PC Area	60%	40%		44280	29520	4339440	2184480		
						Total	44280	29520	4339440	2184480	**CN Weighted**	**88.400**
							Total	73800	Total	6523920	**Ia Weighted**	**2.00**

ToC Calcs - Current Scenario

CHESTER

JOB #: 15484
DATE: Oct-23

SubBasin	(10-85) Length (m)	(10-85) Slope (m/m)	CN	Factor	tc (hrs)	tc (min)	(min) SCS Lag
S-PC E.1	750	0.046	82.13	1.0	0.355	21.3	14.2
S-PC E.2	468	0.036	79.31	1.0	0.290	17.4	11.6
S-PC E.3	518	0.060	83.26	1.0	0.254	15.2	10.1
S-PC W.1	647	0.048	76.78	1.0	0.339	20.4	13.6
S-PC W.2	792	0.014	77.25	1.0	0.556	33.4	22.2
S-DS.1	722	0.017	85.74	1.0	0.452	27.1	18.1
S-DS.2	460	0.005	85.75	1.0	0.473	28.4	18.9
S-DS.3	396	0.007	83.64	1.0	0.404	24.2	16.1
West Catchment	Use TP108 minimum time of concentration value					10.0	6.7
North Catchment	Use TP108 minimum time of concentration value					10.0	6.7

Reach	Length (m)	Slope (m/m)	CN	Factor	tc (hrs)	tc (min)	SCS Lag
R-PC E.a	411	0.012	98.00	0.8	0.238	14.3	9.5
R-PC E.b	91	0.003	98.00	0.8	0.138	10.0	6.7
R-PC W.a	662	0.008	98.00	0.8	0.378	22.7	15.1
R-DS.a	590	0.003	98.00	0.8	0.450	27.0	18.0
R-DS.b	308	0.003	98.00	0.8	0.313	18.8	12.5

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ToC Calcs - Proposed Scenario

CHESTER

JOB #: 15484
DATE: Oct-23

SubBasin	(10-85) Length (m)	(10-85) Slope (m/m)	CN	Factor	tc (hrs)	tc (min)	(min) SCS Lag
S-PC E.1	750	0.046	82.79	1.0	0.352	21.1	14.1
S-PC E.2	468	0.036	86.46	1.0	0.267	16.0	10.7
S-PC E.3	518	0.060	84.04	1.0	0.251	15.1	10.1
S-PC W.1	647	0.048	88.49	1.0	0.297	17.8	11.9
S-PC W.2	792	0.014	88.68	1.0	0.488	29.3	19.5
S-DS.1	722	0.017	85.87	1.0	0.451	27.1	18.0
S-DS.2	460	0.005	85.75	1.0	0.473	28.4	18.9
S-DS.3	396	0.007	83.64	1.0	0.404	24.2	16.1
West Catchment	Use TP108 minimum time of concentration value					10.0	6.7
North Catchment	Use TP108 minimum time of concentration value					10.0	6.7

Reach	Length (m)	Slope (m/m)	CN	Factor	tc (hrs)	tc (min)	SCS Lag
R-PC E.a	411	0.012	98.00	0.8	0.238	14.3	9.5
R-PC E.b	91	0.003	98.00	0.8	0.138	10.0	6.7
R-PC W.a	662	0.008	98.00	0.8	0.378	22.7	15.1
R-DS.a	590	0.003	98.00	0.8	0.450	27.0	18.0
R-DS.b	308	0.003	98.00	0.8	0.313	18.8	12.5

Appendix B – HECHMS Outputs

Global Summary Results for Run "10% AEP - Current Zoning"

Project: PC82 Simulation Run: 10% AEP - Current Zoning

Start of Run: 01Jan2100, 00:00 Basin Model: Exist PC82
End of Run: 02Jan2100, 00:00 Meteorologic Model: 10% AEP
Compute Time: 16Oct2023, 19:22:22 Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
J-DS.1&.DS.2_DS.3	1.14201	9.42383	01Jan2100, 08:32	142.05117
J-E.1_E.2	0.38724	3.69223	01Jan2100, 08:05	145.81584
J-E.2&E.3_W.2	0.57254	5.22288	01Jan2100, 08:09	144.70684
J-W.1_W.2	0.20480	1.76179	01Jan2100, 08:05	133.00241
J-W.2_DS.1	0.91221	7.98776	01Jan2100, 08:16	139.99617
Outlet-North	0.07380	0.67010	01Jan2100, 07:58	132.60919
Outlet-River	1.21671	9.77171	01Jan2100, 08:43	141.81886
Outlet-West	0.03940	0.35775	01Jan2100, 07:58	132.60919
R-DS.a	0.91221	7.98776	01Jan2100, 08:34	138.92512
R-DS.b	1.14201	9.42383	01Jan2100, 08:44	141.32345
R-PC E.a	0.38724	3.69223	01Jan2100, 08:14	145.28377
R-PC E.b	0.57254	5.22288	01Jan2100, 08:15	144.35144
R-PC W.a	0.20480	1.76179	01Jan2100, 08:20	132.14423
S-DS.1	0.15970	1.55067	01Jan2100, 08:08	154.47241
S-DS.2	0.07010	0.67406	01Jan2100, 08:09	154.43267
S-DS.3	0.07470	0.71615	01Jan2100, 08:07	149.39270
S-North	0.07380	0.67010	01Jan2100, 07:58	132.60919
S-PC E.1	0.38724	3.69223	01Jan2100, 08:05	145.81584
S-PC E.2	0.10300	0.95624	01Jan2100, 08:03	139.17710
S-PC E.3	0.08230	0.83793	01Jan2100, 08:01	148.91282
S-PC W.1	0.20480	1.76179	01Jan2100, 08:05	133.00241
S-PC W.2	0.13487	1.04995	01Jan2100, 08:13	133.43066
S-West	0.03940	0.35775	01Jan2100, 07:58	132.60919

Global Summary Results for Run "10% AEP - MPD Zoning"

Project: PC82 Simulation Run: 10% AEP - MPD Zoning

Start of Run: 01Jan2100, 00:00 Basin Model: Prop PC82
End of Run: 02Jan2100, 00:00 Meteorologic Model: 10% AEP
Compute Time: 16Oct2023, 19:22:23 Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
J-DS.1&.DS.2_DS.3	1.14201	10.41975	01Jan2100, 08:30	152.88399
J-E.1_E.2	0.38724	3.74395	01Jan2100, 08:05	147.44634
J-E.2&E.3_W.2	0.57254	5.39942	01Jan2100, 08:08	149.26717
J-W.1_W.2	0.20480	2.24156	01Jan2100, 08:02	161.92366
J-W.2_DS.1	0.91221	8.93170	01Jan2100, 08:14	153.53253
Outlet-North	0.07380	0.83988	01Jan2100, 07:57	162.09725
Outlet-River	1.21671	10.77596	01Jan2100, 08:42	151.97012
Outlet-West	0.03940	0.44839	01Jan2100, 07:57	162.09725
R-DS.a	0.91221	8.93170	01Jan2100, 08:32	152.42958
R-DS.b	1.14201	10.41975	01Jan2100, 08:42	152.13871
R-PC E.a	0.38724	3.74395	01Jan2100, 08:14	146.91234
R-PC E.b	0.57254	5.39942	01Jan2100, 08:14	148.90825
R-PC W.a	0.20480	2.24156	01Jan2100, 08:17	161.00930
S-DS.1	0.15970	1.55632	01Jan2100, 08:08	154.79977
S-DS.2	0.07010	0.67406	01Jan2100, 08:09	154.43267
S-DS.3	0.07470	0.71615	01Jan2100, 08:07	149.39270
S-North	0.07380	0.83988	01Jan2100, 07:57	162.09725
S-PC E.1	0.38724	3.74395	01Jan2100, 08:05	147.44634
S-PC E.2	0.10300	1.10393	01Jan2100, 08:02	156.86159
S-PC E.3	0.08230	0.85010	01Jan2100, 08:01	150.84257
S-PC W.1	0.20480	2.24156	01Jan2100, 08:02	161.92366
S-PC W.2	0.13487	1.35168	01Jan2100, 08:10	161.80970
S-West	0.03940	0.44839	01Jan2100, 07:57	162.09725

Global Summary Results for Run "1% AEP - Current Zoning"

Project: PC82 Simulation Run: 1% AEP - Current Zoning

Start of Run: 01Jan2100, 00:00 Basin Model: Exist PC82
End of Run: 02Jan2100, 00:00 Meteorologic Model: 1% AEP
Compute Time: 16Oct2023, 19:22:24 Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
J-DS.1&.DS.2_DS.3	1.14201	17.91625	01Jan2100, 08:31	266.19958
J-E.1_E.2	0.38724	6.93971	01Jan2100, 08:05	271.68386
J-E.2&E.3_W.2	0.57254	9.85825	01Jan2100, 08:08	270.17977
J-W.1_W.2	0.20480	3.46788	01Jan2100, 08:04	255.89436
J-W.2_DS.1	0.91221	15.29683	01Jan2100, 08:15	264.16699
Outlet-North	0.07380	1.32016	01Jan2100, 07:57	255.64292
Outlet-River	1.21671	18.55425	01Jan2100, 08:43	265.60521
Outlet-West	0.03940	0.70480	01Jan2100, 07:57	255.64292
R-DS.a	0.91221	15.29683	01Jan2100, 08:33	262.29837
R-DS.b	1.14201	17.91625	01Jan2100, 08:43	264.93429
R-PC E.a	0.38724	6.93971	01Jan2100, 08:14	270.76275
R-PC E.b	0.57254	9.85825	01Jan2100, 08:14	269.56376
R-PC W.a	0.20480	3.46788	01Jan2100, 08:19	254.38016
S-DS.1	0.15970	2.82972	01Jan2100, 08:08	281.71036
S-DS.2	0.07010	1.22989	01Jan2100, 08:09	281.62968
S-DS.3	0.07470	1.32927	01Jan2100, 08:06	275.86225
S-North	0.07380	1.32016	01Jan2100, 07:57	255.64292
S-PC E.1	0.38724	6.93971	01Jan2100, 08:05	271.68386
S-PC E.2	0.10300	1.84011	01Jan2100, 08:02	263.70207
S-PC E.3	0.08230	1.55801	01Jan2100, 08:01	275.54368
S-PC W.1	0.20480	3.46788	01Jan2100, 08:04	255.89436
S-PC W.2	0.13487	2.06299	01Jan2100, 08:12	256.11834
S-West	0.03940	0.70480	01Jan2100, 07:57	255.64292

Global Summary Results for Run "1% AEP - MPD Zoning"

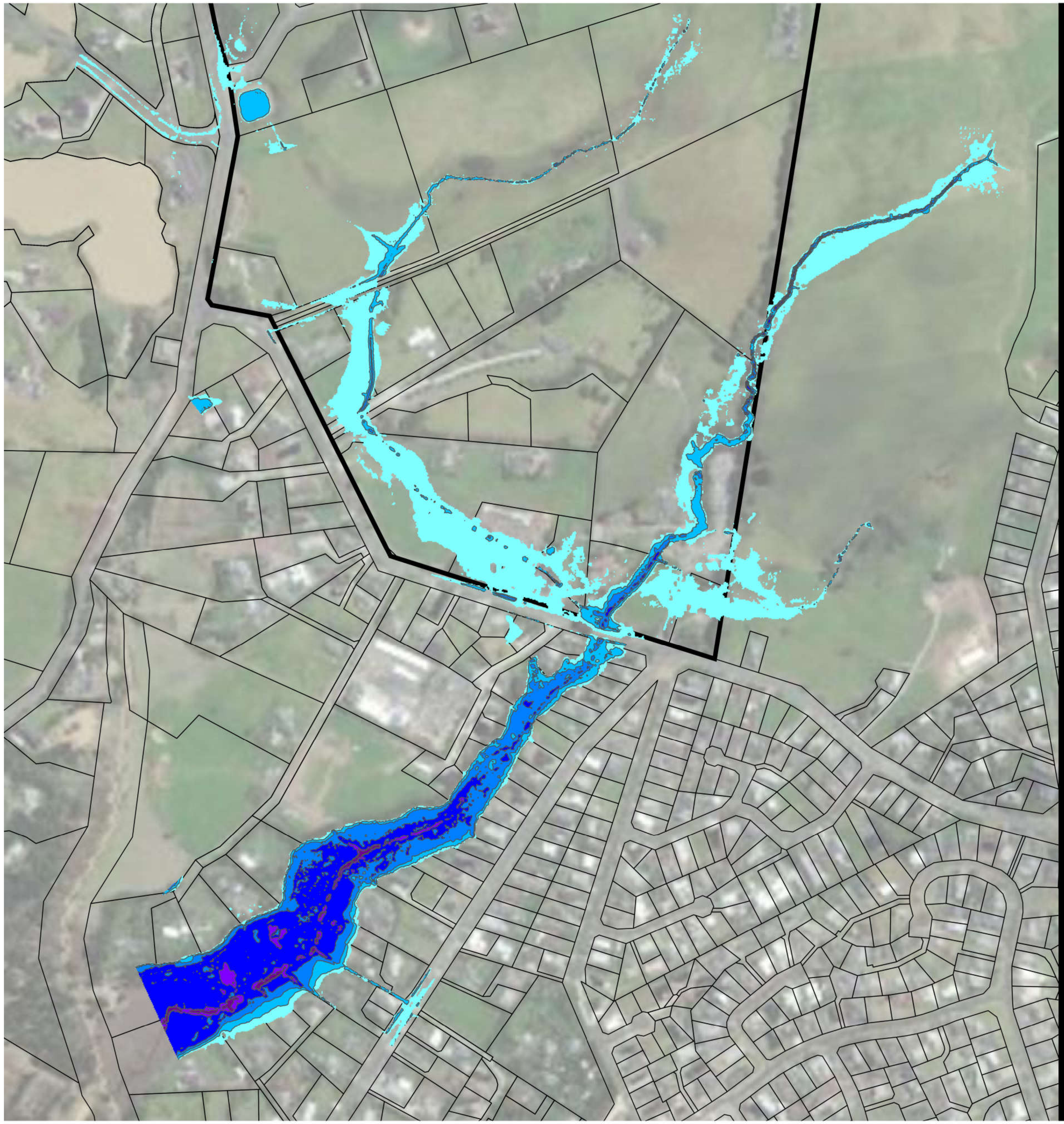
Project: PC82 Simulation Run: 1% AEP - MPD Zoning

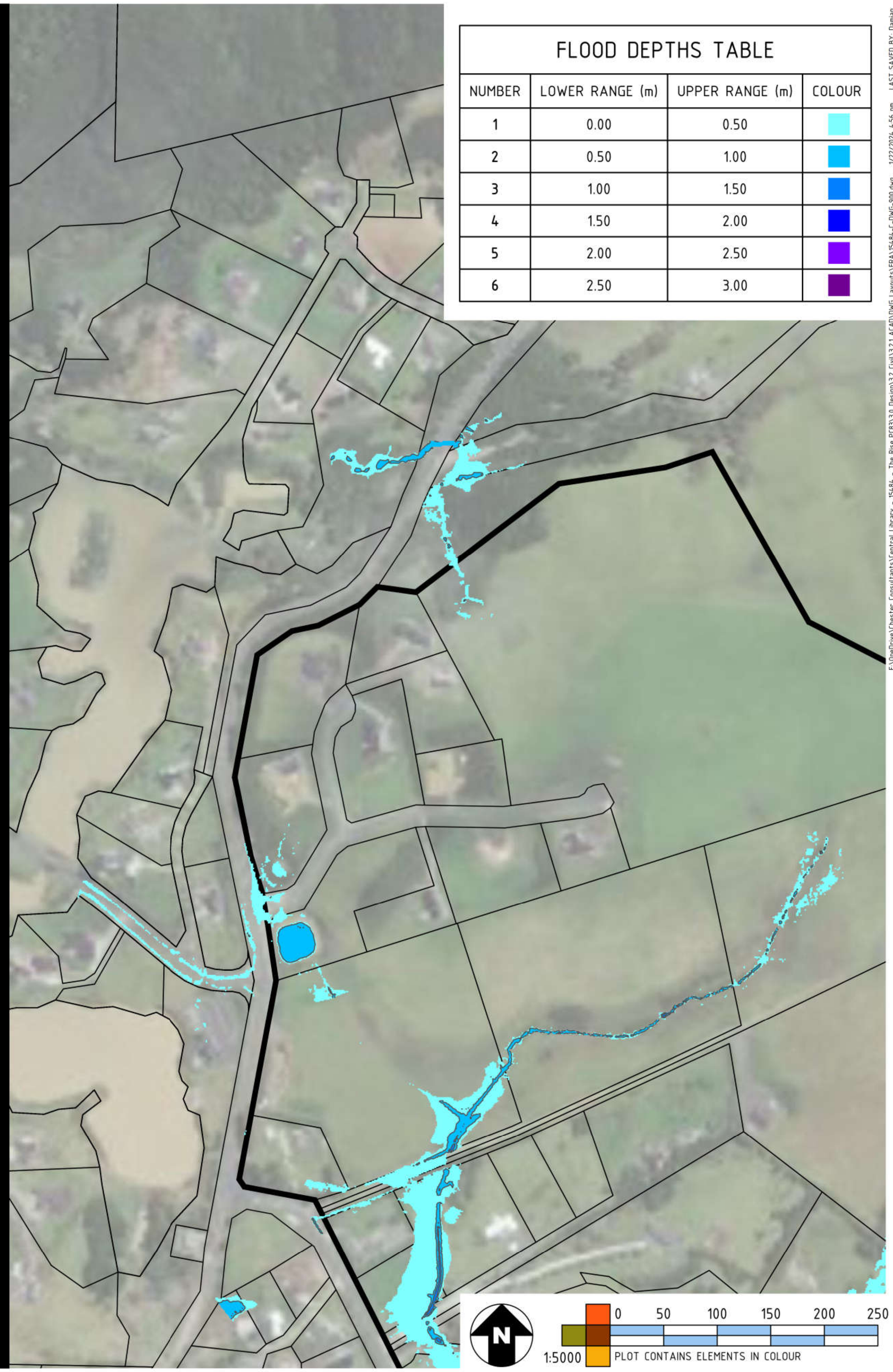
Start of Run: 01Jan2100, 00:00 Basin Model: Prop PC82
End of Run: 02Jan2100, 00:00 Meteorologic Model: 1% AEP
Compute Time: 16Oct2023, 19:22:24 Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
J-DS.1&.DS.2_DS.3	1.14201	19.03628	01Jan2100, 08:30	279.15567
J-E.1_E.2	0.38724	6.99595	01Jan2100, 08:05	273.63692
J-E.2&E.3_W.2	0.57254	10.03849	01Jan2100, 08:08	275.61987
J-W.1_W.2	0.20480	3.99495	01Jan2100, 08:02	290.47417
J-W.2_DS.1	0.91221	16.33571	01Jan2100, 08:14	280.34313
Outlet-North	0.07380	1.49634	01Jan2100, 07:56	290.90351
Outlet-River	1.21671	19.68317	01Jan2100, 08:42	277.75375
Outlet-West	0.03940	0.79886	01Jan2100, 07:56	290.90351
R-DS.a	0.91221	16.33571	01Jan2100, 08:32	278.45119
R-DS.b	1.14201	19.03628	01Jan2100, 08:42	277.87747
R-PC E.a	0.38724	6.99595	01Jan2100, 08:14	272.71440
R-PC E.b	0.57254	10.03849	01Jan2100, 08:14	275.00127
R-PC W.a	0.20480	3.99495	01Jan2100, 08:17	288.91838
S-DS.1	0.15970	2.83670	01Jan2100, 08:08	282.09368
S-DS.2	0.07010	1.22989	01Jan2100, 08:09	281.62968
S-DS.3	0.07470	1.32927	01Jan2100, 08:06	275.86225
S-North	0.07380	1.49634	01Jan2100, 07:56	290.90351
S-PC E.1	0.38724	6.99595	01Jan2100, 08:05	273.63692
S-PC E.2	0.10300	1.99907	01Jan2100, 08:01	284.78371
S-PC E.3	0.08230	1.57017	01Jan2100, 08:01	277.82207
S-PC W.1	0.20480	3.99495	01Jan2100, 08:02	290.47417
S-PC W.2	0.13487	2.40787	01Jan2100, 08:09	289.99844
S-West	0.03940	0.79886	01Jan2100, 07:56	290.90351

Appendix C – Chester Flood Drawings





FLOOD DEPTHS TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	0.00	0.50	
2	0.50	1.00	
3	1.00	1.50	
4	1.50	2.00	
5	2.00	2.50	
6	2.50	3.00	

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Rev	Date	Amendments	By

Drafter: D TEH
Designer: D TEH
Checker: S RANKIN
Date: 19/01/2024

Job Title: FLOOD RISK ASSESSMENT
Client: THE RISE LIMITED
Address: PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI
Drawing Title: FLOOD DEPTHS - 10% AEP - CURRENT SCENARIO

Drawing: 900 Rev: 0
Scale: 1:5000 @ A3
Project: 15484
Issue: CONSENT

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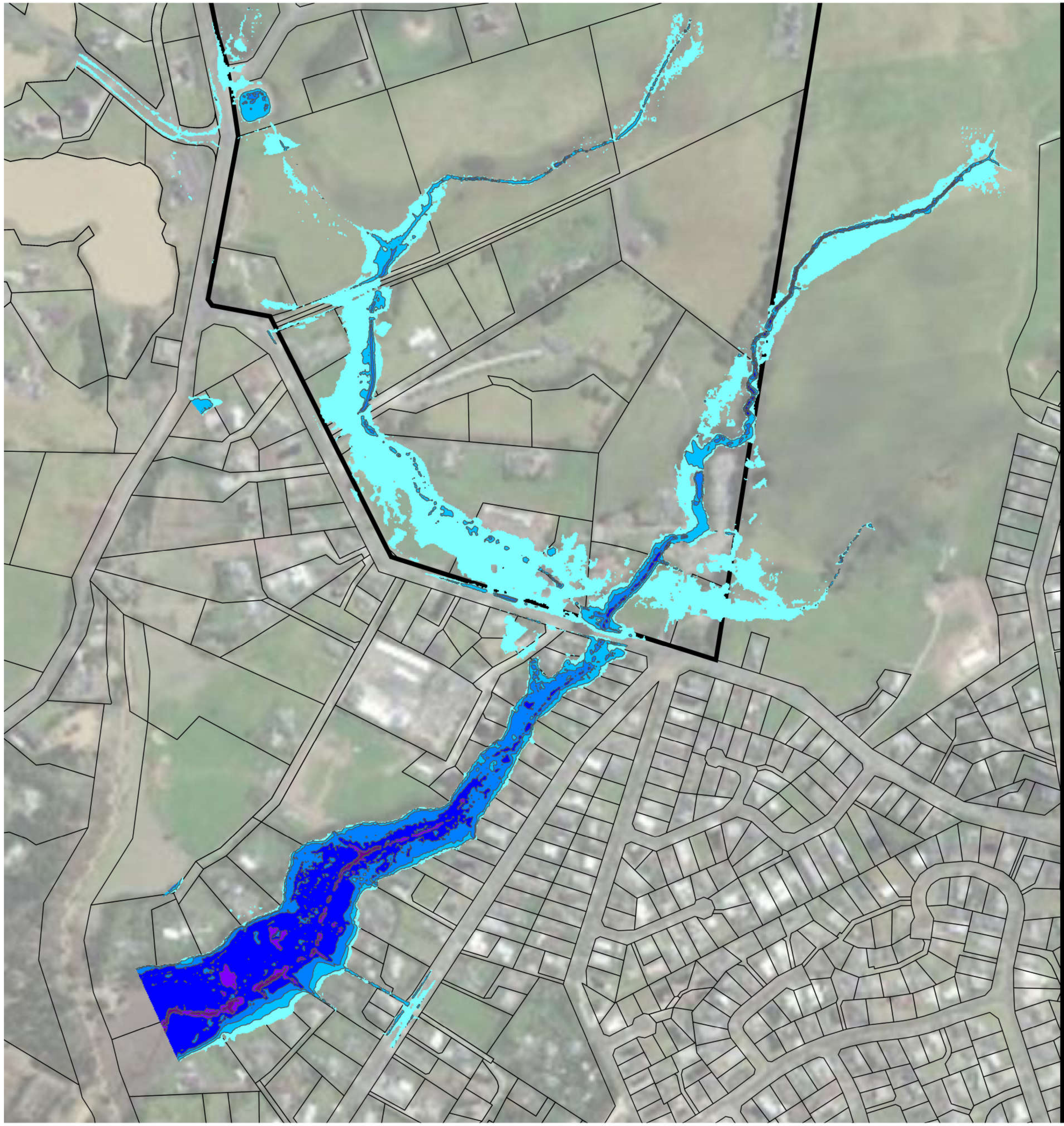

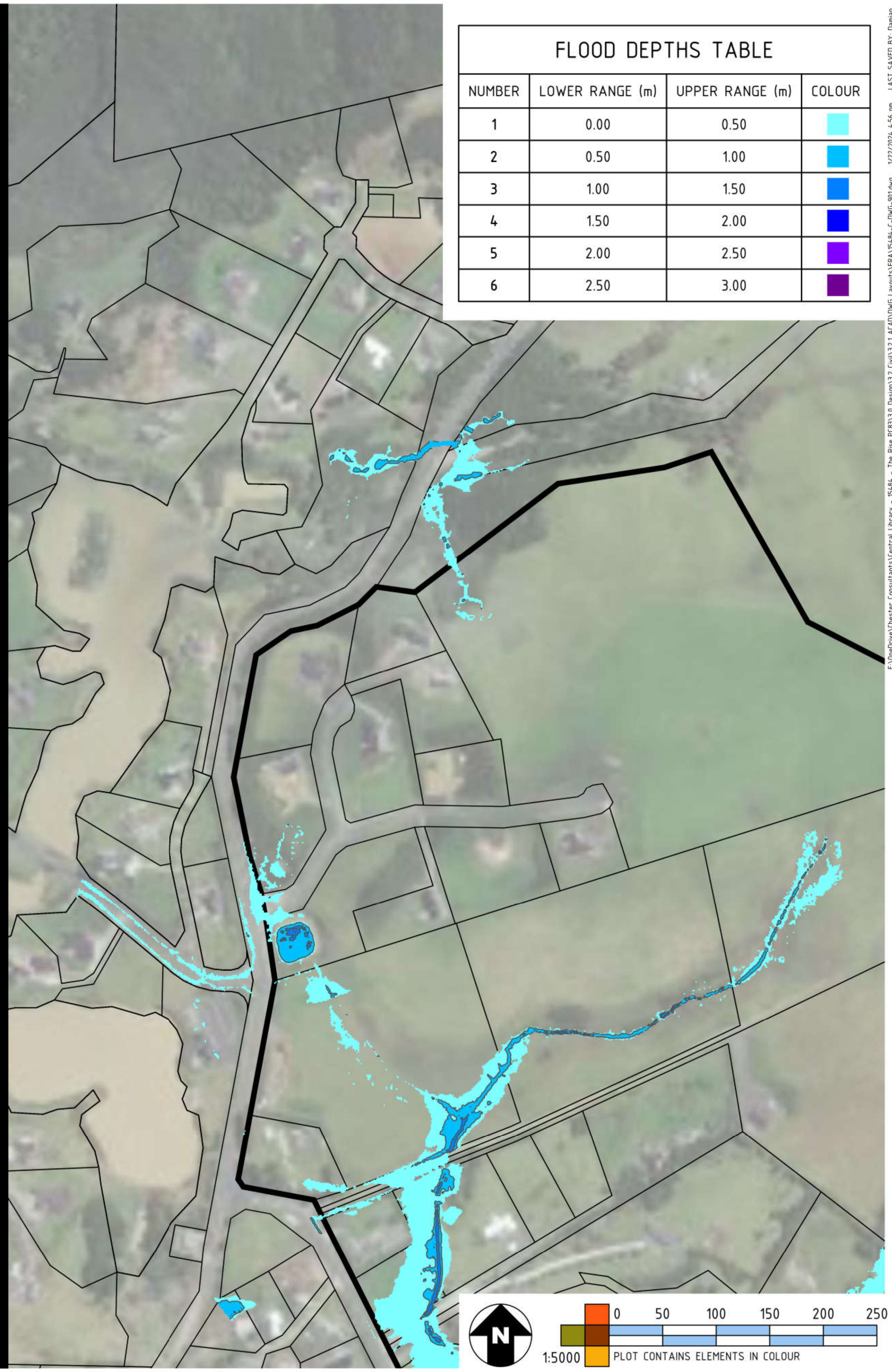

FLOOD DEPTHS TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	0.00	0.50	
2	0.50	1.00	
3	1.00	1.50	
4	1.50	2.00	
5	2.00	2.50	
6	2.50	3.00	

N

1:5000

0 50 100 150 200 250

PLOT CONTAINS ELEMENTS IN COLOUR

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Rev	Date	Amendments	By

Drafter: D TEH

Designer: D TEH

Checker: S RANKIN

Date: 19/01/2024

Job Title: FLOOD RISK ASSESSMENT

Client: THE RISE LIMITED

Address: PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI

Drawing Title: FLOOD DEPTHS - 10% AEP - MPD SCENARIO

Drawing: 901 Rev: 0

Scale: 1:5000 @ A3

Project: 15484

Issue: CONSENT

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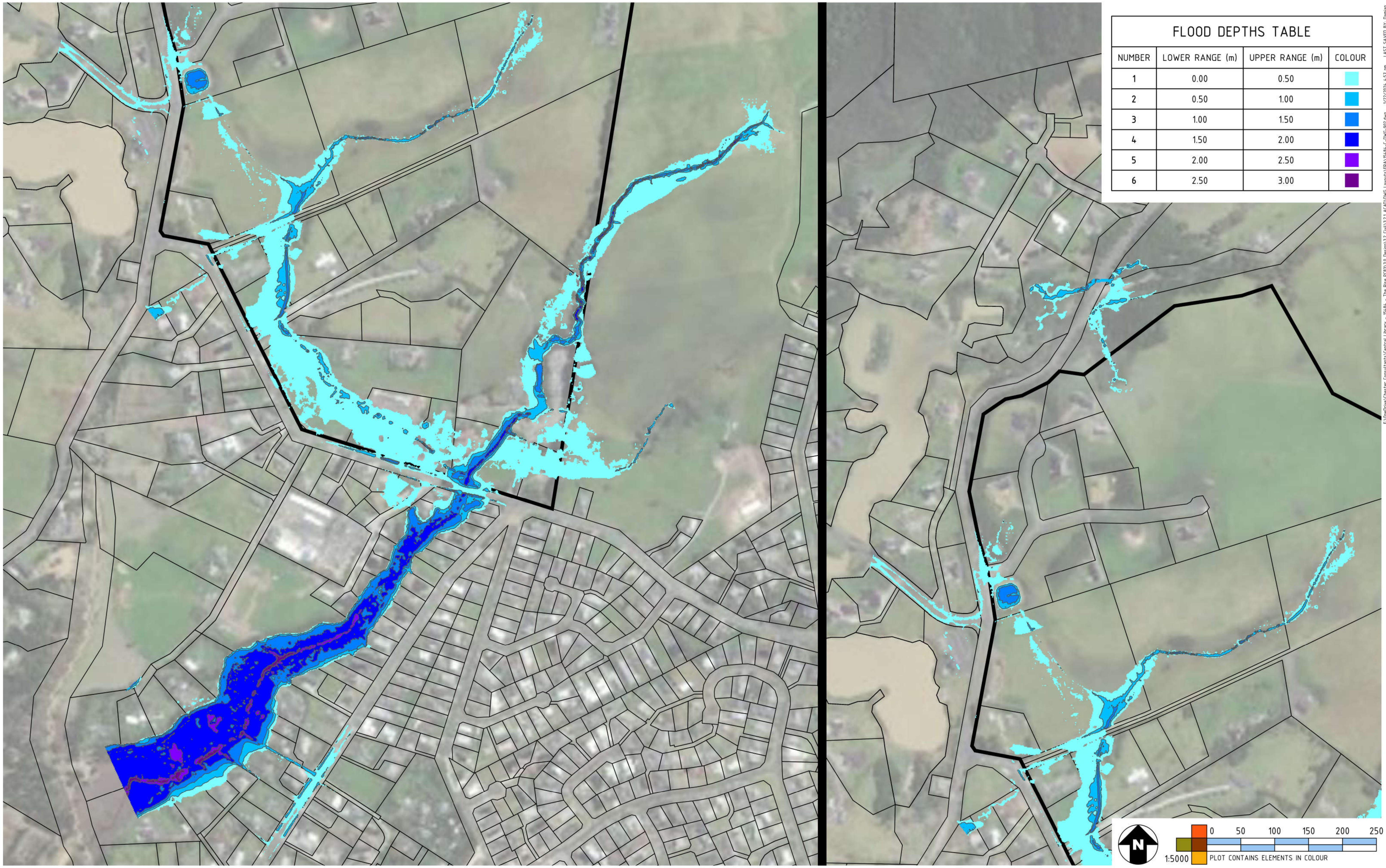

FLOOD DEPTHS TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	0.00	0.50	
2	0.50	1.00	
3	1.00	1.50	
4	1.50	2.00	
5	2.00	2.50	
6	2.50	3.00	

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Rev	Date	Amendments	By

Drafter: D TEH
Designer: D TEH
Checker: S RANKIN
Date: 19/01/2024

Job Title: FLOOD RISK ASSESSMENT
Client: THE RISE LIMITED
Address: PC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI
Drawing Title: FLOOD DEPTHS - 1% AEP - CURRENT SCENARIO

Drawing: 902 Rev: 0
Scale: 1:5000 @ A3
Project: 15484
Issue: CONSENT

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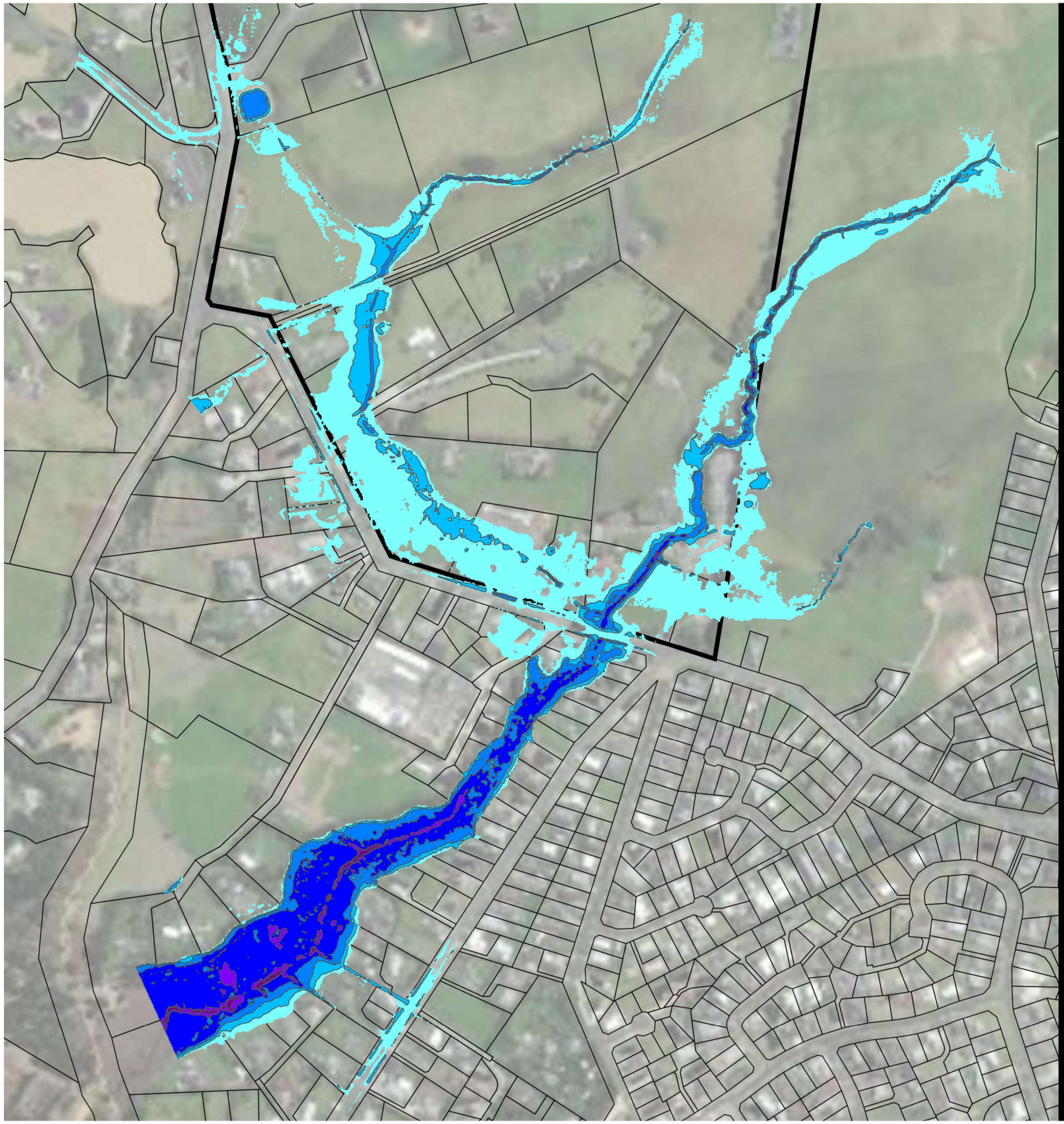

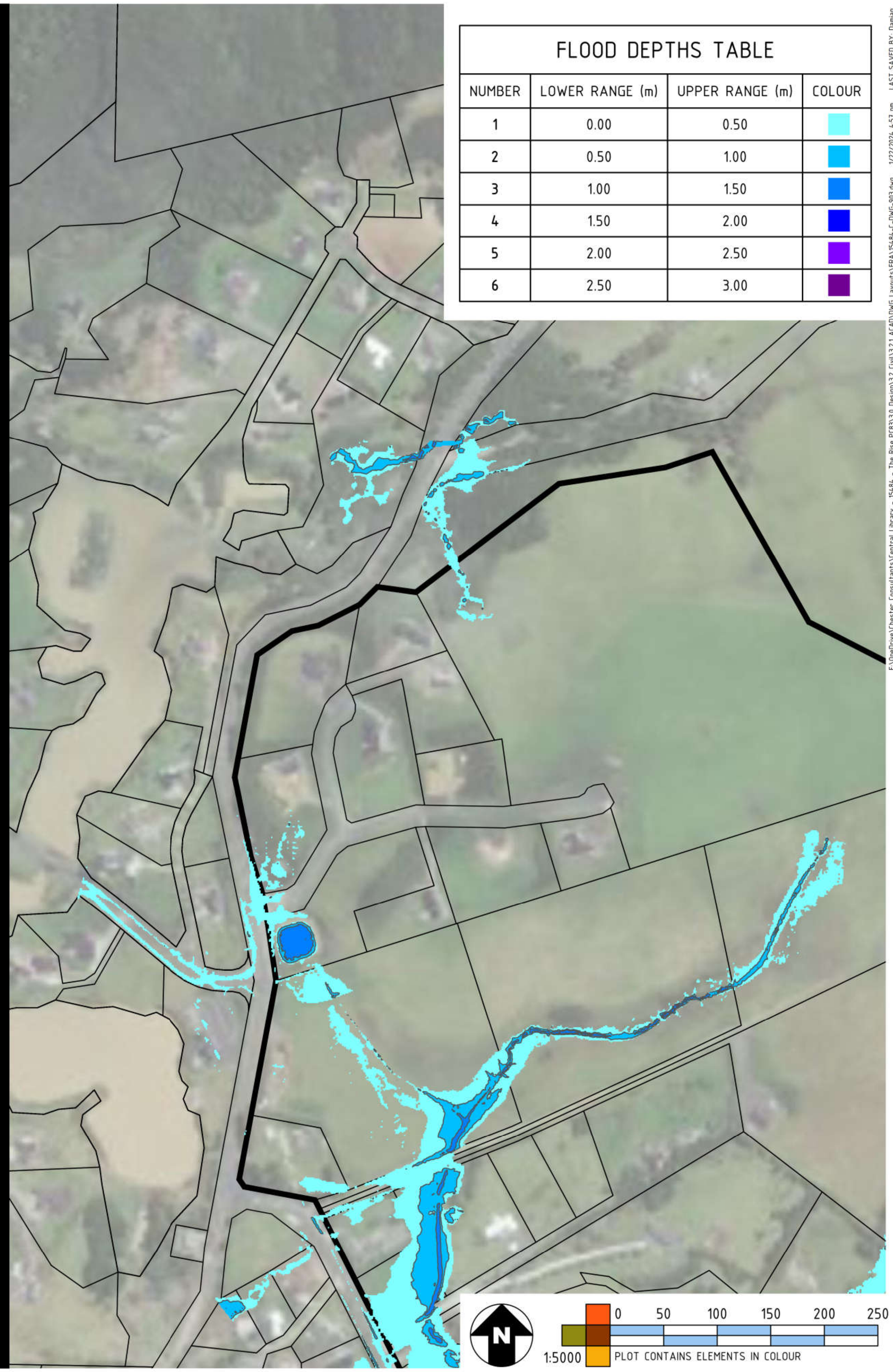

FLOOD DEPTHS TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	0.00	0.50	
2	0.50	1.00	
3	1.00	1.50	
4	1.50	2.00	
5	2.00	2.50	
6	2.50	3.00	

Rev	Date	Amendments	By

Drafter:	D TEH
Designer:	D TEH
Checker:	S RANKIN
Date:	19/01/2024
Job Title:	FLOOD RISK ASSESSMENT
Client:	THE RISE LIMITED
Address:	PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI
Drawing Title:	FLOOD DEPTHS - 1% AEP - MPD SCENARIO
Drawing:	903 Rev: 0
Scale:	1:5000 @ A3
Project:	15484
Issue:	CONSENT

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FLOOD DEPTHS COMPARISON TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	-0.05	0.00	
2	0.00	0.05	
3	0.05	0.10	
4	0.10	0.15	
5	0.15	0.20	
6	0.20	0.25	
7	0.25	0.30	

Rev	Date	Amendments	By

Drafter: D TEH
Designer: D TEH
Checker: S RANKIN
Date: 19/01/2024

Job Title: FLOOD RISK ASSESSMENT
Client: THE RISE LIMITED
Address: PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI
Drawing Title: FLOOD DEPTHS COMPARISON - 10% AEP - CURRENT VS MPD SCENARIO

Drawing: 904 Rev: 0
Scale: 1:5000 @ A3
Project: 15484
Issue: CONSENT

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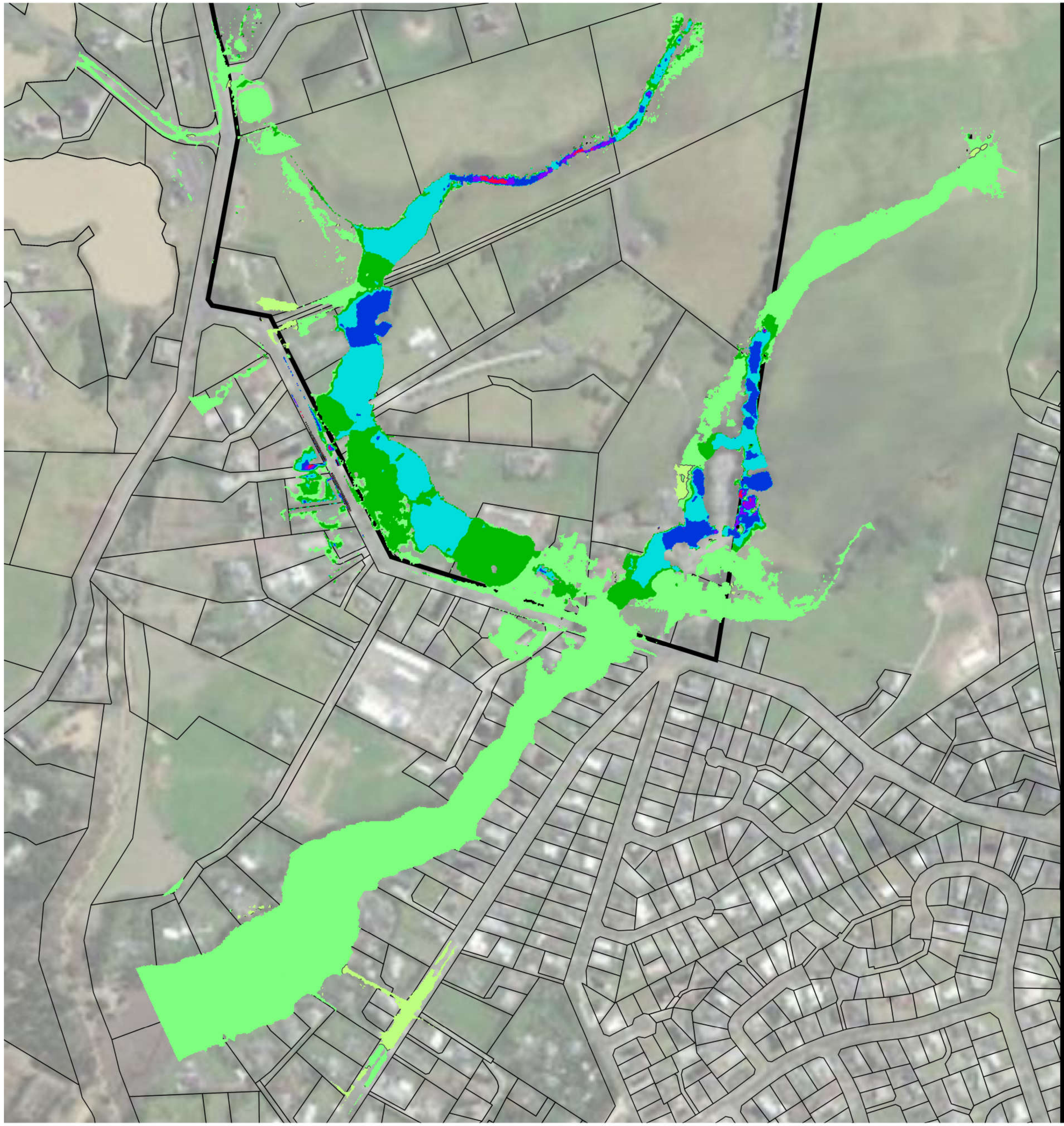

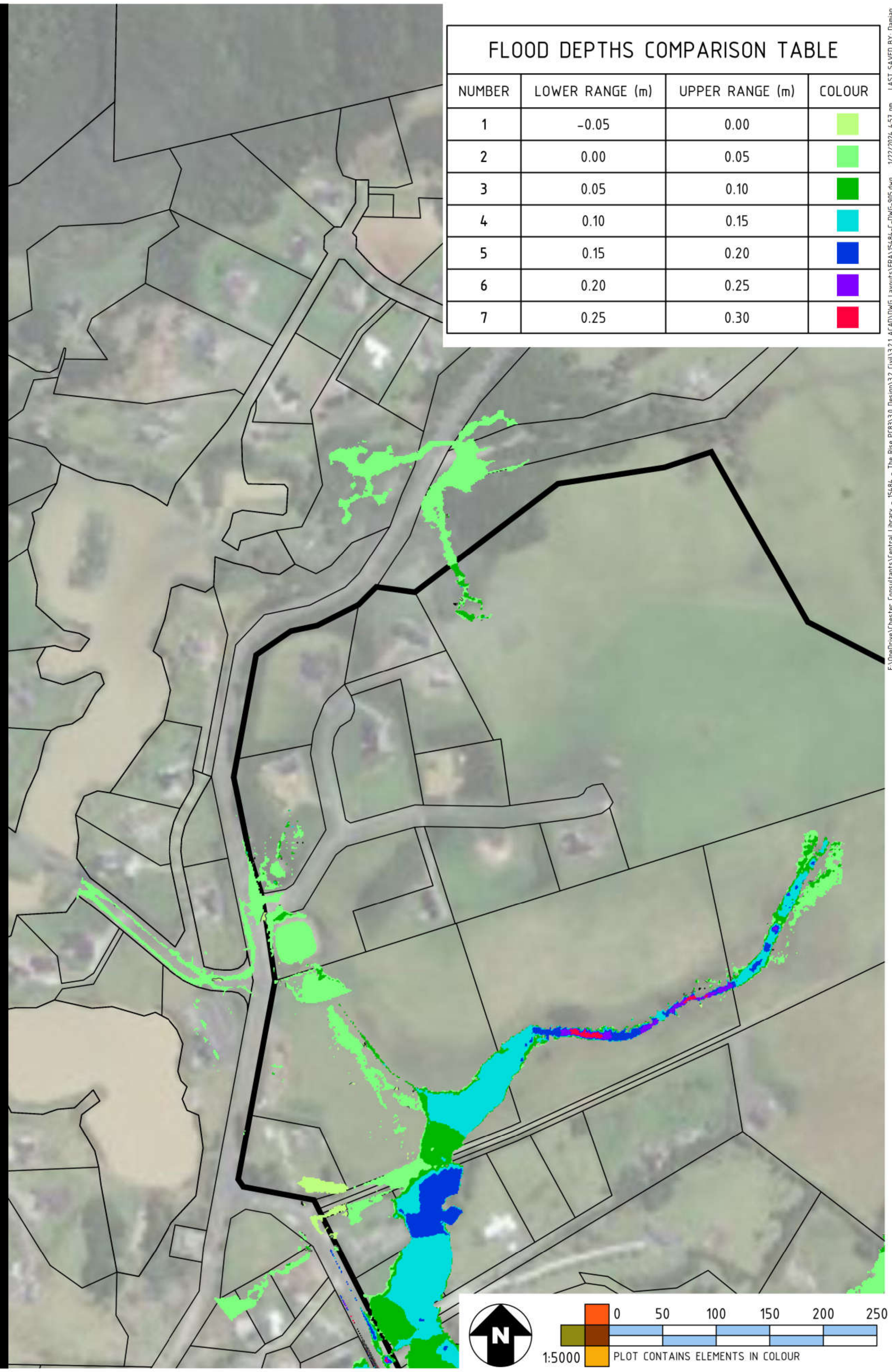

FLOOD DEPTHS COMPARISON TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	-0.05	0.00	
2	0.00	0.05	
3	0.05	0.10	
4	0.10	0.15	
5	0.15	0.20	
6	0.20	0.25	
7	0.25	0.30	

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Rev	Date	Amendments	By

Drafter:	D TEH	Job Title:	FLOOD RISK ASSESSMENT
Designer:	D TEH	Client:	THE RISE LIMITED
Checker:	S RANKIN	Address:	PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI
Date:	19/01/2024	Drawing Title:	FLOOD DEPTHS COMPARISON - 1% AEP - CURRENT VS MPD SCENARIO

Drawing:	905 Rev: 0
Scale:	1:5000 @ A3
Project:	15484
Issue:	CONSENT

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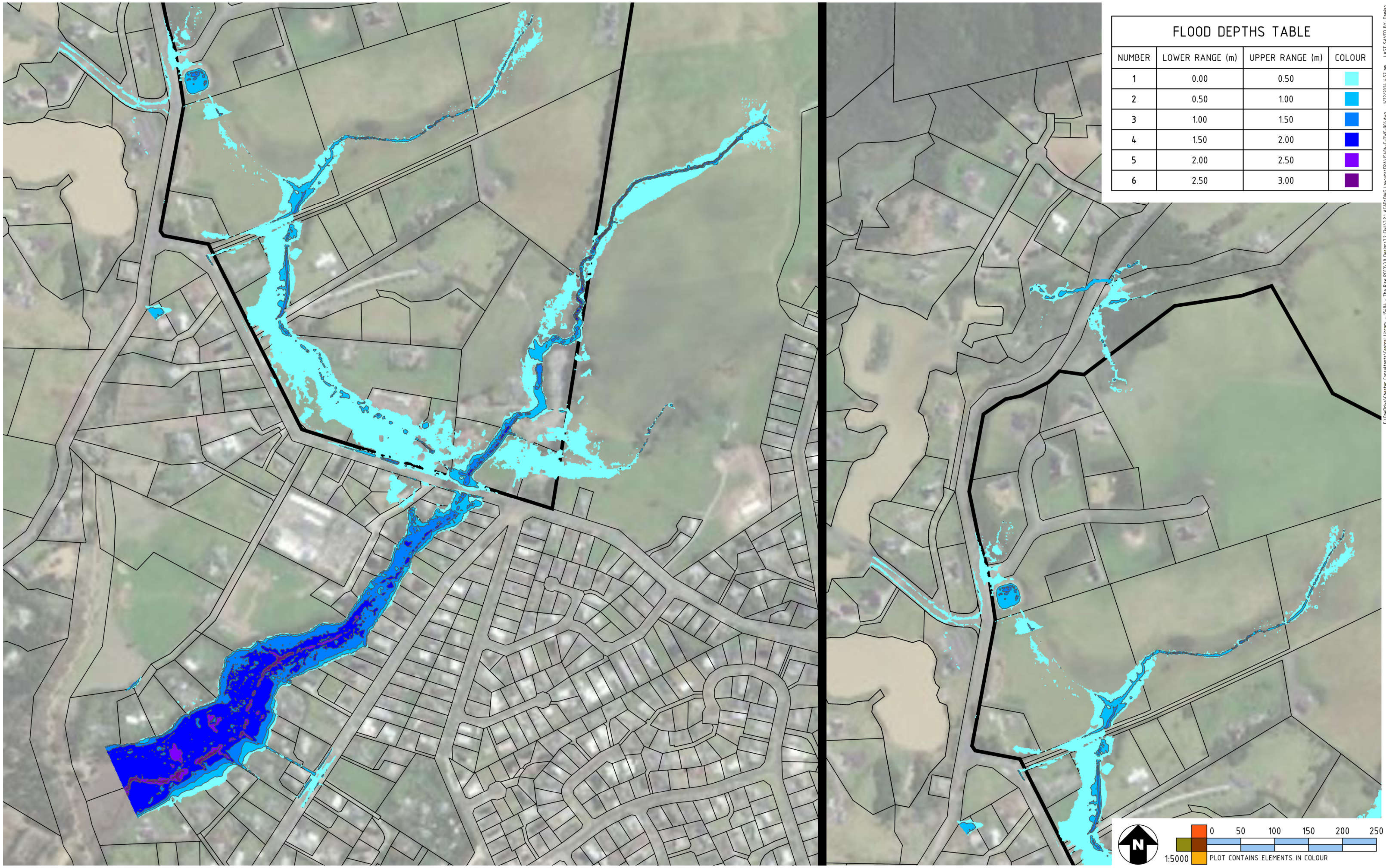

FLOOD DEPTHS TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	0.00	0.50	
2	0.50	1.00	
3	1.00	1.50	
4	1.50	2.00	
5	2.00	2.50	
6	2.50	3.00	

N

0 50 100 150 200 250

1:5000

PLOT CONTAINS ELEMENTS IN COLOUR

Rev	Date	Amendments	By

Drafter: D TEH

Designer: D TEH

Checker: S RANKIN

Date: 19/01/2024

Job Title: FLOOD RISK ASSESSMENT

Client: THE RISE LIMITED

Address: PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI

Drawing Title: FLOOD DEPTHS - 10% AEP & MPD & TIDE - INDICATIVE UPGRADED TWIN CULVERTS

Drawing: 906 Rev: 0

Scale: 1:5000 @ A3

Project: 15484

Issue: CONSENT

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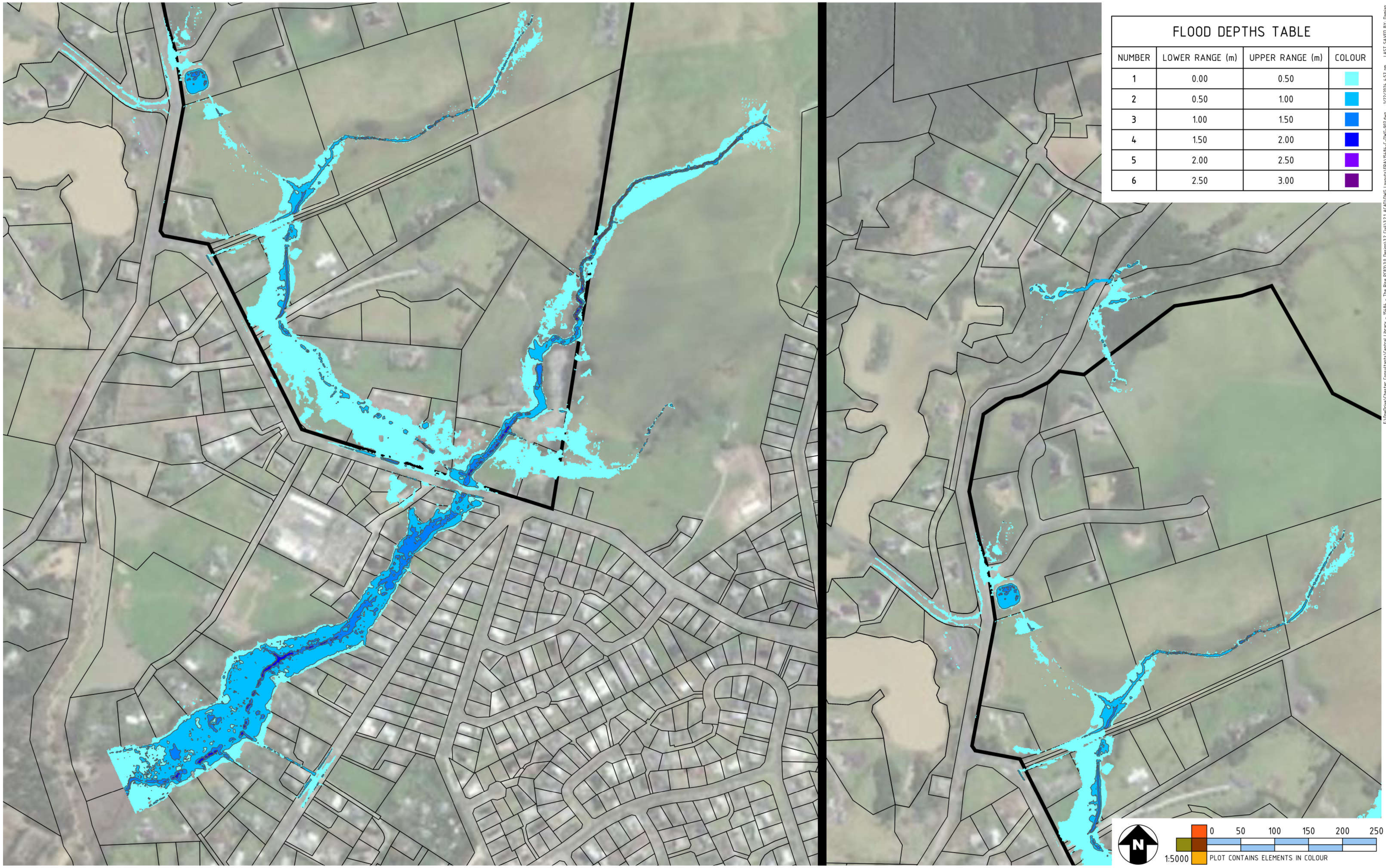

FLOOD DEPTHS TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	0.00	0.50	
2	0.50	1.00	
3	1.00	1.50	
4	1.50	2.00	
5	2.00	2.50	
6	2.50	3.00	

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Rev	Date	Amendments	By

Drafter:	D TEH	Job Title:	FLOOD RISK ASSESSMENT
Designer:	D TEH	Client:	THE RISE LIMITED
Checker:	S RANKIN	Address:	PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI
Date:	19/01/2024	Drawing Title:	FLOOD DEPTHS - 10% AEP & MPD & NO TIDE - INDICATIVE UPGRADED TWIN CULVERTS

Drawing:	907 Rev: 0
Scale:	1:5000 @ A3
Project:	15484
Issue:	CONSENT

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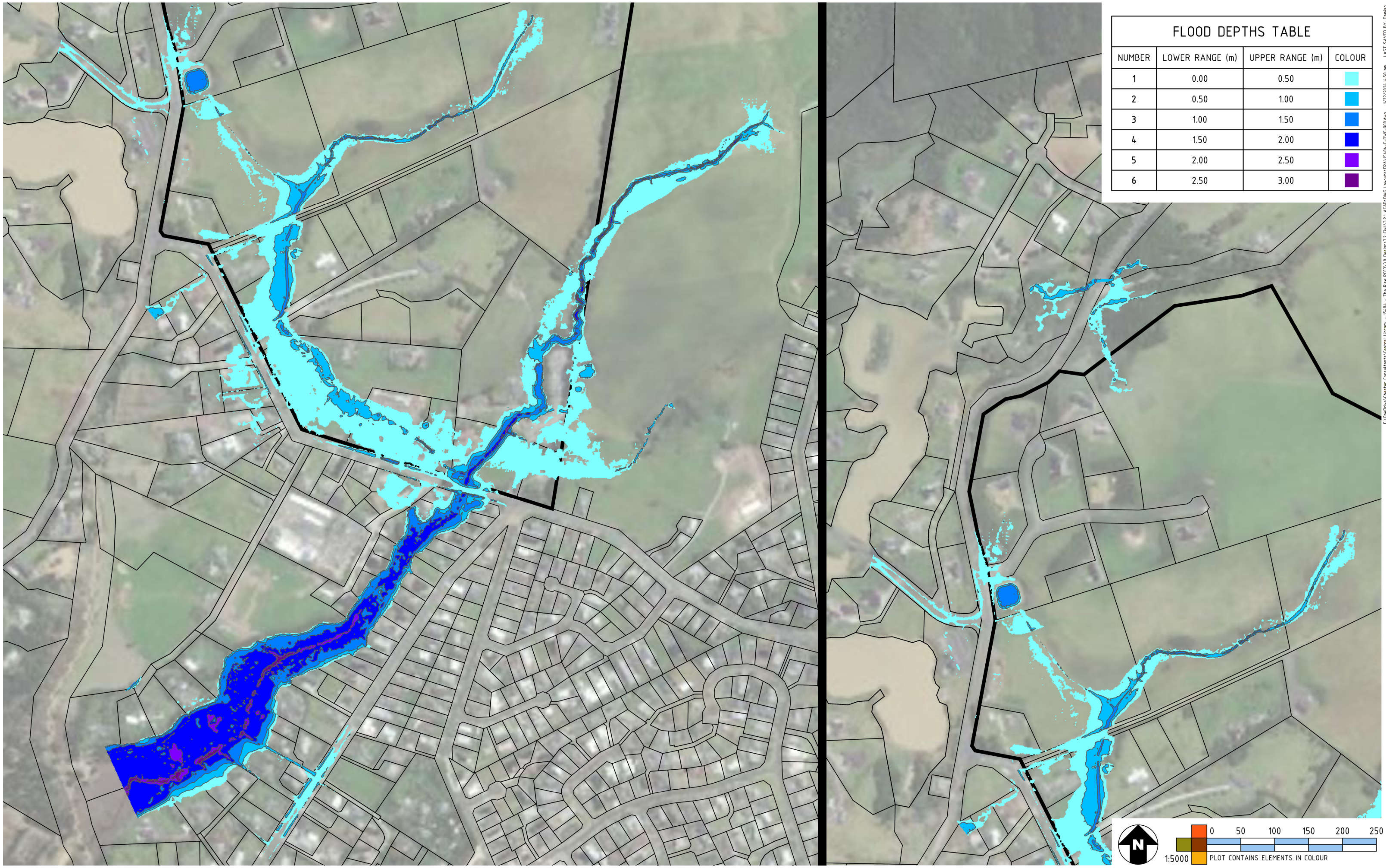

FLOOD DEPTHS TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	0.00	0.50	
2	0.50	1.00	
3	1.00	1.50	
4	1.50	2.00	
5	2.00	2.50	
6	2.50	3.00	

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Rev	Date	Amendments	By

Drafter: D TEH

Designer: D TEH

Checker: S RANKIN

Date: 19/01/2024

Job Title: FLOOD RISK ASSESSMENT

Client: THE RISE LIMITED

Address: PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI

Drawing Title: FLOOD DEPTHS - 1% AEP & MPD & TIDE - INDICATIVE UPGRADED TWIN CULVERTS

Drawing: 908 Rev: 0

Scale: 1:5000 @ A3

Project: 15484

Issue: CONSENT

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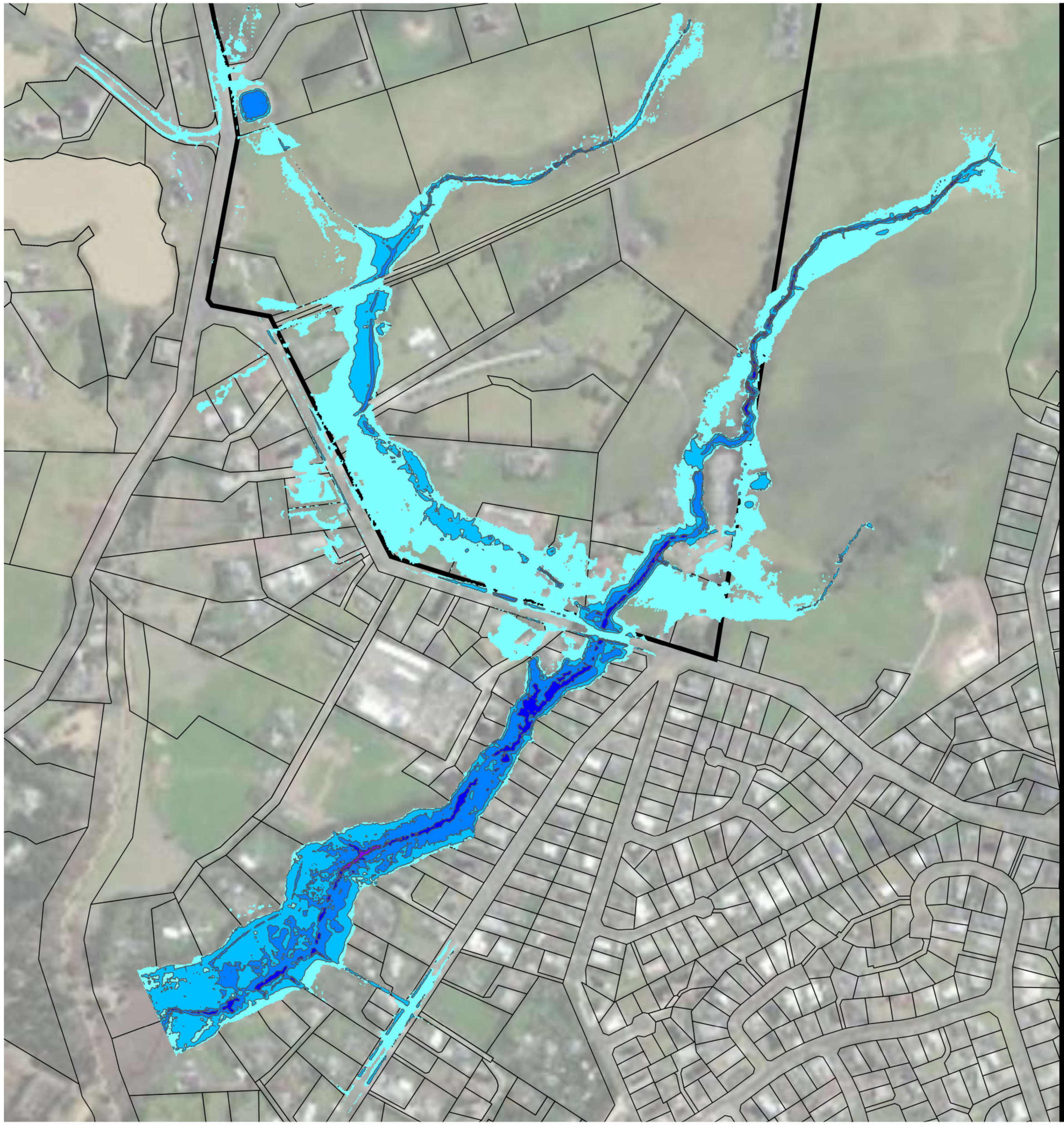

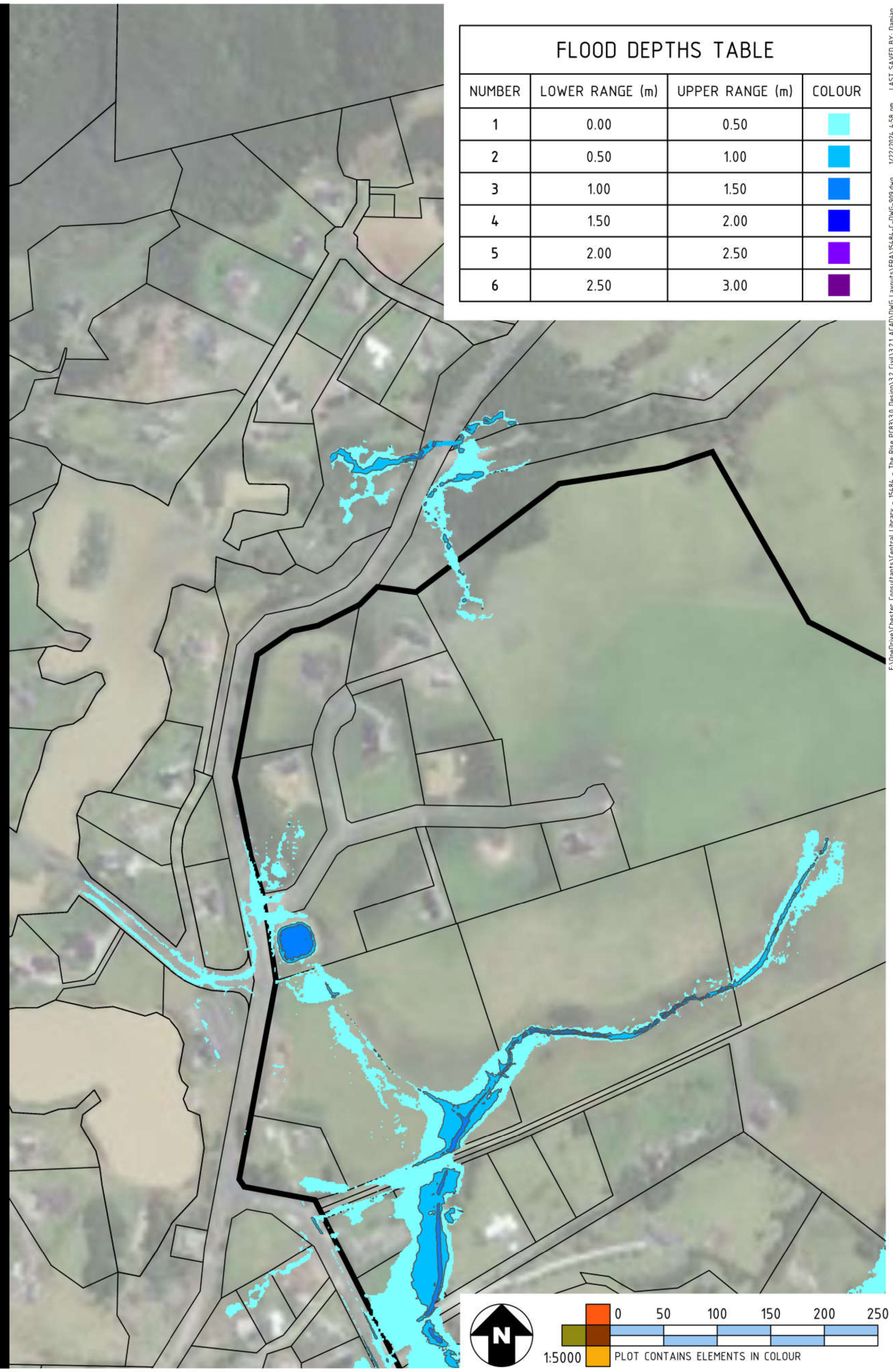

FLOOD DEPTHS TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	0.00	0.50	
2	0.50	1.00	
3	1.00	1.50	
4	1.50	2.00	
5	2.00	2.50	
6	2.50	3.00	

Rev	Date	Amendments	By

Drafter: D TEH
Designer: D TEH
Checker: S RANKIN
Date: 19/01/2024

Job Title: FLOOD RISK ASSESSMENT
Client: THE RISE LIMITED
Address: PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI
Drawing Title: FLOOD DEPTHS - 1% AEP & MPD & NO TIDE - INDICATIVE UPGRADED TWIN CULVERTS

Drawing: 909 Rev: 0
Scale: 1:5000 @ A3
Project: 15484
Issue: CONSENT

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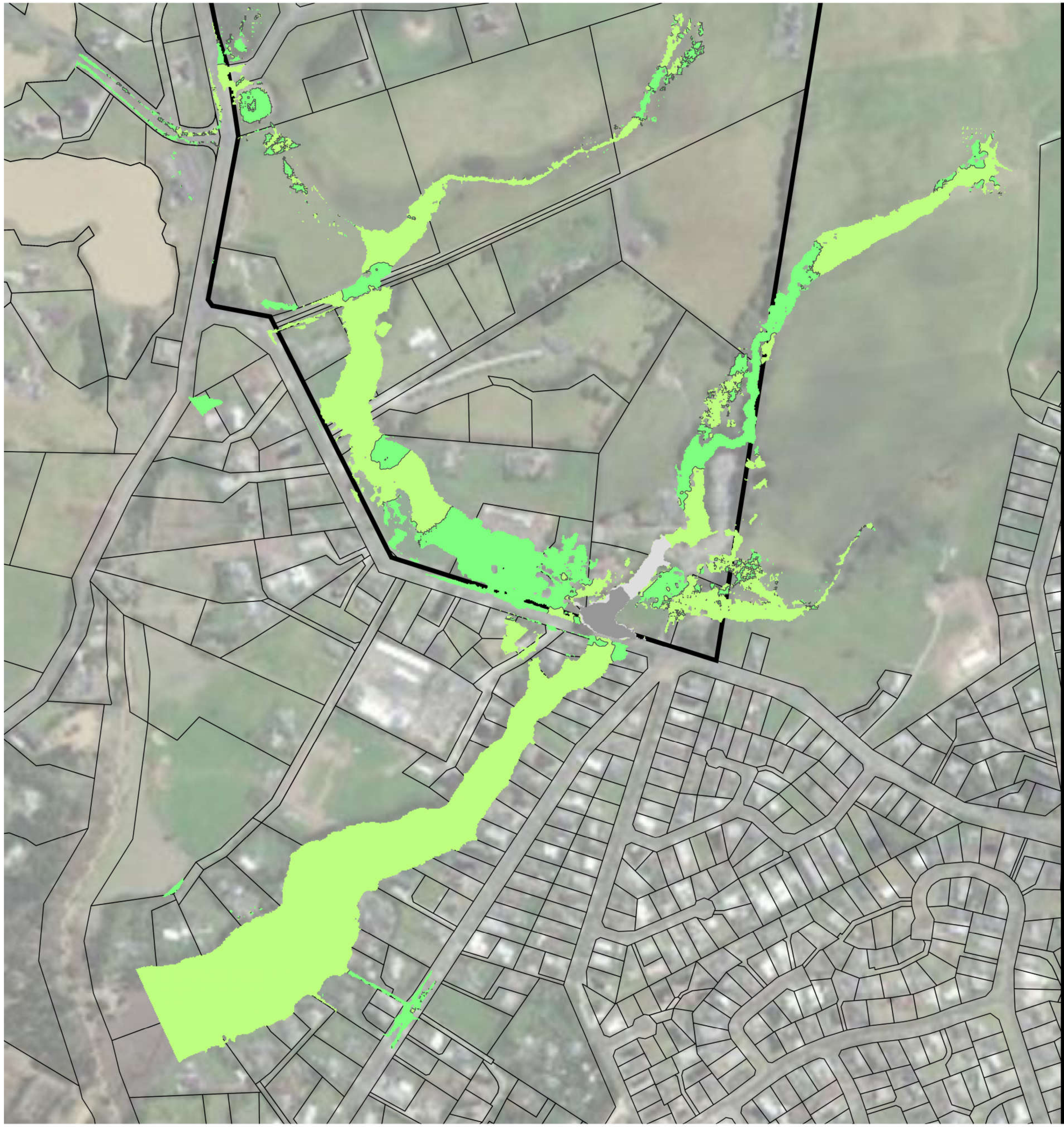

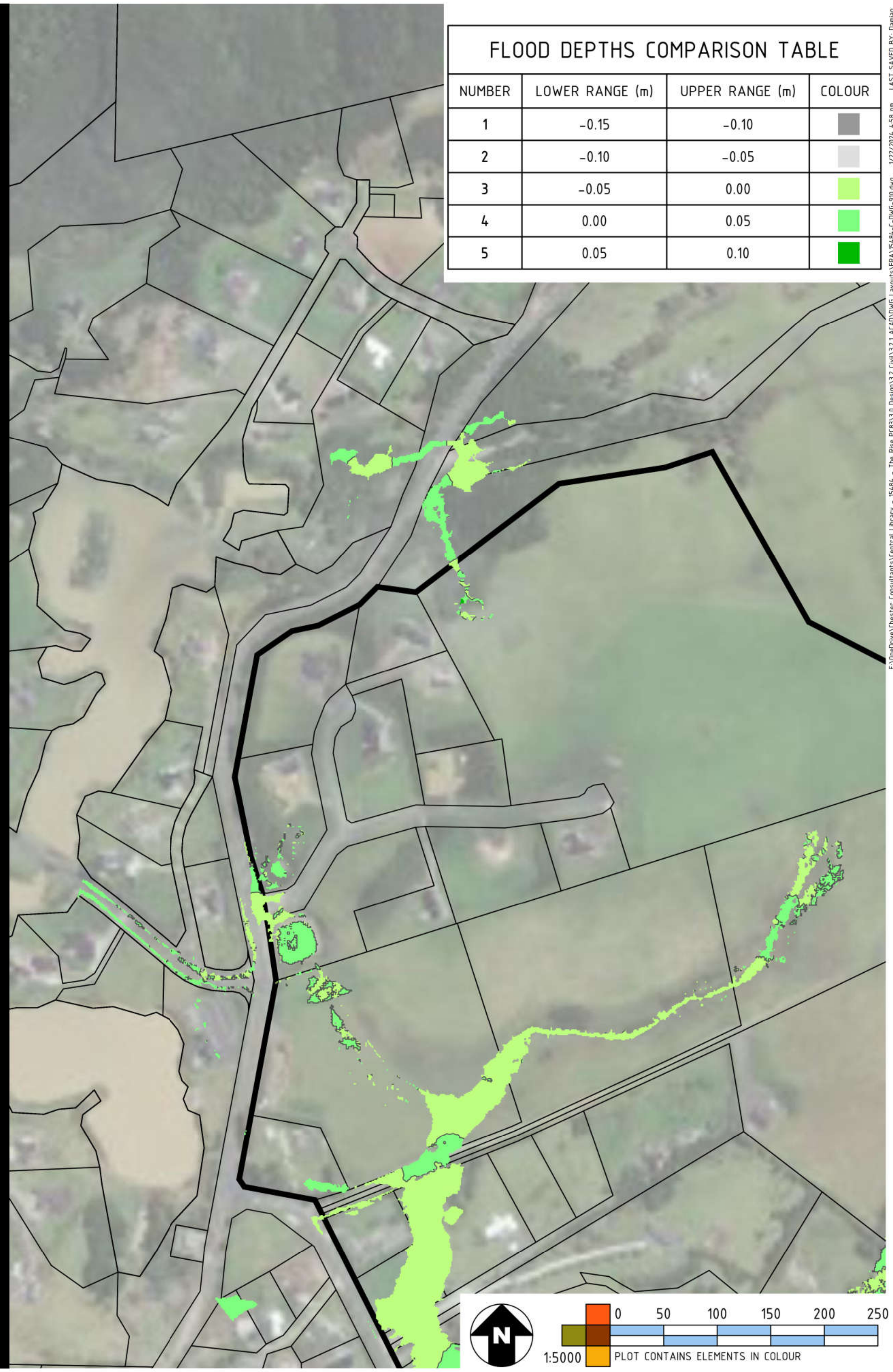

FLOOD DEPTHS COMPARISON TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	-0.15	-0.10	
2	-0.10	-0.05	
3	-0.05	0.00	
4	0.00	0.05	
5	0.05	0.10	

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Rev	Date	Amendments	By

Drafter:	D TEH	Job Title:	FLOOD RISK ASSESSMENT	Drawing:	910 Rev: 0
Designer:	D TEH	Client:	THE RISE LIMITED	Scale:	1:5000 @ A3
Checker:	S RANKIN	Address:	PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI	Project:	15484
Date:	19/01/2024	Drawing Title:	FLOOD DEPTHS COMPARISON - 10% AEP & MPD & TIDE - INDICATIVE VS EXIST. TWIN CULV	Issue:	CONSENT

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FLOOD DEPTHS COMPARISON TABLE

NUMBER	LOWER RANGE (m)	UPPER RANGE (m)	COLOUR
1	-0.15	-0.10	(dark grey)
2	-0.10	-0.05	(light grey)
3	-0.05	0.00	(light green)
4	0.00	0.05	(green)
5	0.05	0.10	(dark green)

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Rev	Date	Amendments	By

Drafter:	D TEH	Job Title:	FLOOD RISK ASSESSMENT	Drawing:	911 Rev: 0
Designer:	D TEH	Client:	THE RISE LIMITED	Scale:	1:5000 @ A3
Checker:	S RANKIN	Address:	PPC83 - COVE ROAD & MANGAWHAI HEADS ROAD (WEST), MANGAWHAI	Project:	15484
Date:	19/01/2024	Drawing Title:	FLOOD DEPTHS COMPARISON - 1% AEP & MPD & TIDE - INDICATIVE VS EXIST. TWIN CULV	Issue:	CONSENT

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