

HOPE VALE ABORIGINAL SHIRE COUNCIL (HVASC)



LOCAL DRAINAGE ASSESSMENT & FLOOD STUDY 2024/25

*PREPARED FOR THE STATE OF QUEENSLAND (ACTING THROUGH THE
DEPARTMENT OF WOMEN, ABORIGINAL AND TORRES STRAIT
ISLANDER PARTNERSHIPS AND MULTICULTURALISM (DWATSIPM).
REMOTE INDIGENOUS LAND AND INFRASTRUCTURE PROGRAM
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TABLE OF CONTENTS

1.0	INTRODUCTION	1
2.0	BACKGROUND	2
3.0	EXISTING ENVIRONMENTS.....	5
3.1	Land use and ZONING	5
3.2	local drainage issues	7
4.0	SITE INSPECTION.....	8
4.1	flood mapping	8
4.2	mannings 'N' Values.....	8
4.3	stormwater infrastructure	8
4.4	road infrastructure	11
5.0	LOCAL DRAINAGE ASSESSMENT	11
5.1	Drain West of Cemetery	12
5.2	Drain east of school	14
6.0	COST ESTIMATE	15
7.0	CONCLUSION.....	16
8.0	CERTIFICATION STATEMENT AND AUTHORISATION	17

APPENDICES

APPENDIX A – HOPE VALE FLOOD STUDY (REF: R.M00605.001.00)

APPENDIX B – DRAIN AND CULVERT SIZING CALCULATIONS

APPENDIX C – COST ESTIMATES

LIST OF FIGURES

Figure 1: Hope Vale, Site locality Plan (Source: Queensland Globe – Not to Scale)	3
Figure 2: Townships of Hope Vale, Site Locality Plan (Source: Queensland Globe – Not to Scale)	3
Figure 3: Precinct Map / Zoning (Source: Hope Vale Aboriginal Shire Council Planning Scheme)	6
Figure 4: Hope Vale Master Plan (Source: Hope Vale Aboriginal Shire Council Master Plan)	7
Figure 5: Local Drainage Issue	11
Figure 6: Proposed Drain Location	12
Figure 7: Required Drain Profile	12
Figure 8: Downstream Flow Path	13
Figure 9: Proposed Drain East of School	14
Figure 10: Required Drain Profile	14
Figure 11: Downstream of Drain	15

ACRONYM GLOSSARY

AEP:	Annual Exceedance Probability
AHD:	Australian Height Datum
ARI:	Annual Recurrence Intervals
BOM:	Bureau of Meteorology
DEM:	Digital elevation model
DEM:	Digital Elevation Model

DSDSATSIP:	Department of Seniors, Disability Services and Aboriginal & Torres Strait Islander Partnerships
GIS:	Graphical Information System
HVASC:	Hope Vale Aboriginal Shire Council
LiDAR:	Light Detection and Ranging
MESE:	Matters of state environmental significance
QUDM:	Queensland Urban Drainage Manual
RCBC:	Reinforced Concrete Box Culverts
RCP:	Reinforced Concrete Pipes

1.0 INTRODUCTION

Langtree Consulting has been engaged by the Department of Women, Aboriginal and Torres Strait Islander Partnerships and Multiculturalism (DWATSIPM), Remote Indigenous Land and Infrastructure Program Office (RILIPO) and Hope Vale Aboriginal Shire Council (HVASC) to undertake flood and local drainage modelling for the Hope Vale township.

The agreed tasks to be completed as part of the Local Drainage Assessment are as follows:

- Undertake a site inspection on site and meet with the key members of the Hope Vale Community and Council;
- Investigate the Township to fully understand the local drainage including:
 - The surrounding low-lying areas;
 - Reviewing access requirements to areas on the outskirts of the community;
 - The current drainage channels and their direction of flow; and
- Review the current master plan with particular attention to potential flood event impacts on residential and economic development;
- Prepare plans of the community with the available State Planning Policy Interactive Mapping information and existing/planned infrastructure overlaid over the top;
- Based on the observations and information collected at the site visit attempt to calibrate the available TUFLOW hydraulic model and the method for determining the hydrological inputs (flows) to the hydraulic model will be reviewed to ensure model is suitable for this study;
- Using first principal hydrologic and hydraulic calculations (Rational Method and Manning's Equations) to highlight the areas of the community that will be negatively impacted due to increased flood levels either on infrastructure, housing and facilities and create a developed flood model;
- Investigate and recommend design strategies to ensure the community is more flood resilient by reviewing the developed food model and determine what mitigation measures will assist in reducing the impact of increased flood levels on the community including, regrading/realigning and creating additional drains, making the drains deeper and wider, building detention/storage basins, building earth levees to redirect the floodwaters, etc, to ensure that the impact of flood waters on existing and future infrastructure, housing and facilities is minimised; and
- Identify and document the requirements and scope of works for future hydrologic and hydraulic flood models that will aid Council's emergency and disaster management planning and inform a planning scheme amendment for flood related management, mapping and risks

- Prepare a cost estimate of preferred proposals & infrastructure development.

2.0 BACKGROUND

The Hope Vale community includes the Guugu Yimithirr people who each have their language and cultural differences. Hope Vale is located inland on the Cape York Peninsula, surrounded by a landscape of open woodlands, sandstone escarpments, and tropical savannah. The community lies approximately 46 kilometres northwest of Cooktown, with the closest major centre being Cairns, located about 370 kilometres to the south. Refer to **Figure 1 and 2**.

Hope Vale is accessible by road throughout much of the year via the Endeavour Valley Road and the Cooktown–Battle Camp Road. However, like many Cape York communities, road access can be significantly impacted during the wet season, typically from December to April, when heavy rainfall and flooding can cause road closures and isolation.

The community is serviced by regular freight deliveries from Cairns and Cooktown, with increased supply runs scheduled in the lead-up to the wet season to ensure adequate provision of essential goods.

When road access is restricted during the wet season, the most reliable means of accessing Hope Vale is via air travel. Charter flights from Cooktown and Cairns operate as needed, supporting ongoing access for residents, health and emergency services, and urgent freight.

Hope Vale is governed by the Hope Vale Aboriginal Shire Council, which administers an area of approximately 110 square kilometres. The region is rich in environmental and cultural significance, with nearby coastal ecosystems, wetlands, and diverse native flora and fauna. Important environmental areas surrounding Hope Vale contribute to regional biodiversity and are recognised for conservation value.

Hope Vale features a blend of residential, commercial, and community infrastructure, including schools, a health clinic, and a range of cultural and service facilities. Land use and development are guided by the Hope Vale Aboriginal Shire Planning Scheme, which sets out long-term strategies for community growth, infrastructure development, economic opportunities, and the protection of cultural heritage and environmental values. The aspirations of the local community and the guidance

of Traditional Owners are central to all planning and decision-making processes in the region.

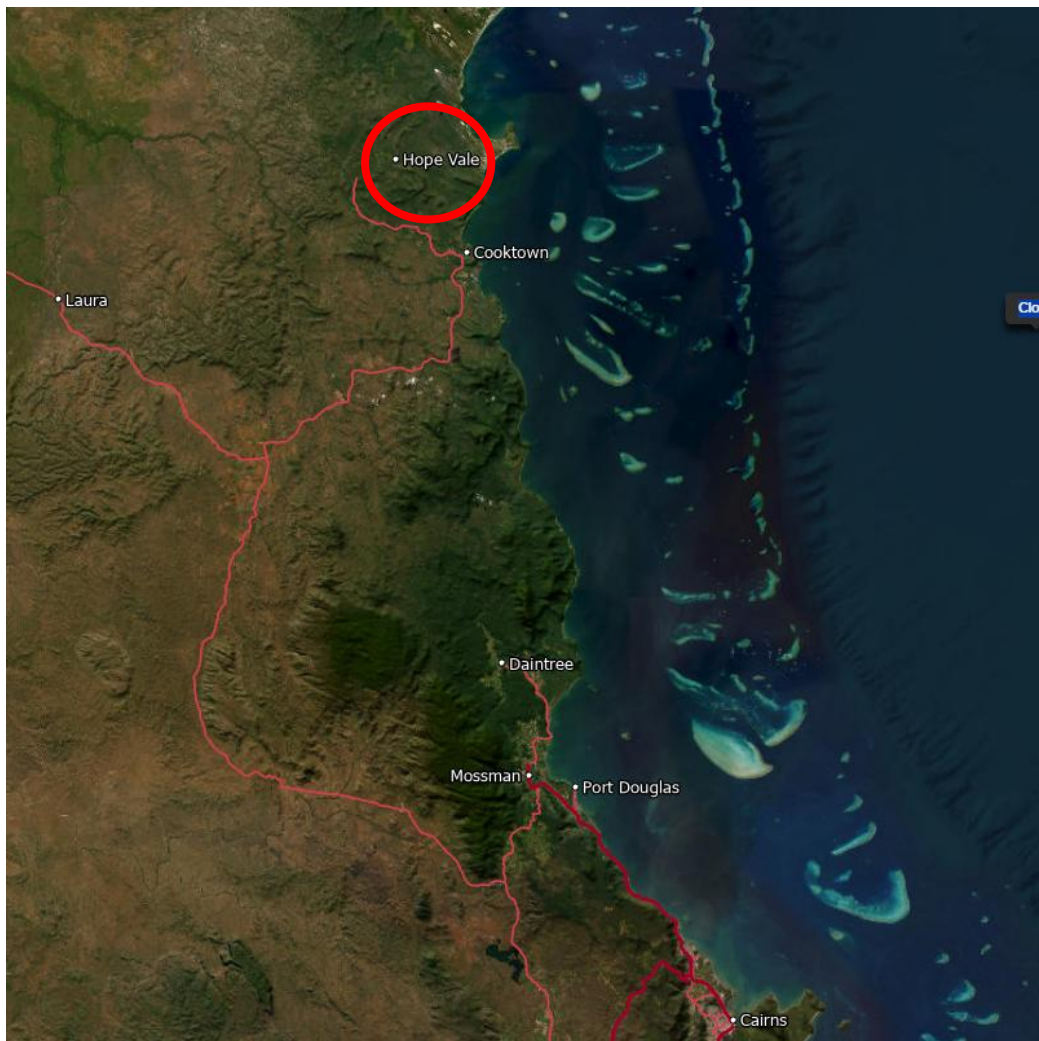


Figure 1: Hope Vale, Site locality Plan (Source: Queensland Globe – Not to Scale)



Figure 2: Townships of Hope Vale, Site Locality Plan (Source: Queensland Globe – Not to Scale)

One objective of this project is to review the current master plan in retrospect of potential flood events in regard to access, safety and the wellbeing of the communities. This review is required to be undertaken in consultation with the Hope Vale community and Council.

The flood study will:

- be an essential tool in assisting with the rectification of the current flooding and drainage issues the community experiences for planning any immediate and long-term future development in and around community; and
- identify requirements and scope for future hydrologic and hydraulic models that will aid Council's emergency and disaster management planning and inform a planning scheme amendment for flood related management, mapping and risks.

As part of the Hope Vale Regional Flooding Assessment, Langtree Consulting, in collaboration with Venant Solutions, has undertaken both hydrological and hydraulic mapping for the region. The hydrological assessment determines the rate of water flow from catchments across Hope Vale under various flood scenarios (based on probability of occurrence). These flows are then applied in a hydraulic model to estimate the extent, depth, level, and velocity of flooding across affected areas.

The catchment hydrology across the Hope Vale region is highly variable and complex, and given budgetary constraints, this study has adopted a conservative approach to estimating flow rates. Fortunately, detailed LiDAR data is available across key areas of the Hope Vale, allowing for the creation of an accurate Digital Elevation Model (DEM). This data supports the development of a detailed hydraulic model to estimate flood levels, with the understanding that the precision of these estimates is ultimately limited by the accuracy of the underlying hydrological inputs.

This Regional Flooding Assessment is currently compiled as a standalone report, with technical details and mapping included in **Appendix A**.

In addition to the regional assessment, a Local Drainage Assessment was conducted across Hope Vale—to gain a comprehensive understanding of localised drainage issues. This process included on-ground inspections and engagement with key community representatives and Council staff. The assessment used regional flood modelling and mapping to evaluate the suitability of proposed development areas within each community. Areas impacted by poor drainage were reviewed, and potential design modifications were explored to address and mitigate localised flooding and drainage challenges. These

efforts aim to increase the resilience of Hope Vale communities to both regional flooding and localised drainage impacts.

3.0 EXISTING ENVIRONMENTS

3.1 LAND USE AND ZONING

Hope Vale is an Aboriginal community located approximately 46 kilometres northwest of Cooktown, on the east coast of Cape York Peninsula. The region is surrounded by rugged terrain, tropical savannah, and culturally significant lands. It is accessible via the Endeavour Valley Road, which connects to the Mulligan Highway leading to Cooktown and other southern centres. During the wet season, typically from late December to March, heavy rainfall can cause road closures and temporary isolation due to flooding.

Freight and supply services to Hope Vale are generally delivered by road from Cairns via Cooktown, with increased frequency ahead of the wet season to ensure adequate provisioning. Hope Vale Airport also provides a vital transport and logistics link for passenger travel and essential goods delivery, particularly during periods of road inaccessibility.

The Hope Vale township includes designated zones for Residential, Community Services, Business, and Light Industrial use. Essential infrastructure such as the local airstrip, emergency services, and community facilities support the functioning of the town. The surrounding areas are predominantly Indigenous land, with zones prioritised for Environmental Management, Cultural Heritage Protection, and Traditional Land Use, reflecting the community's strong connection to country and ongoing stewardship of natural resources. Refer to **Figure 3** below for current land use zoning in Hope Vale.

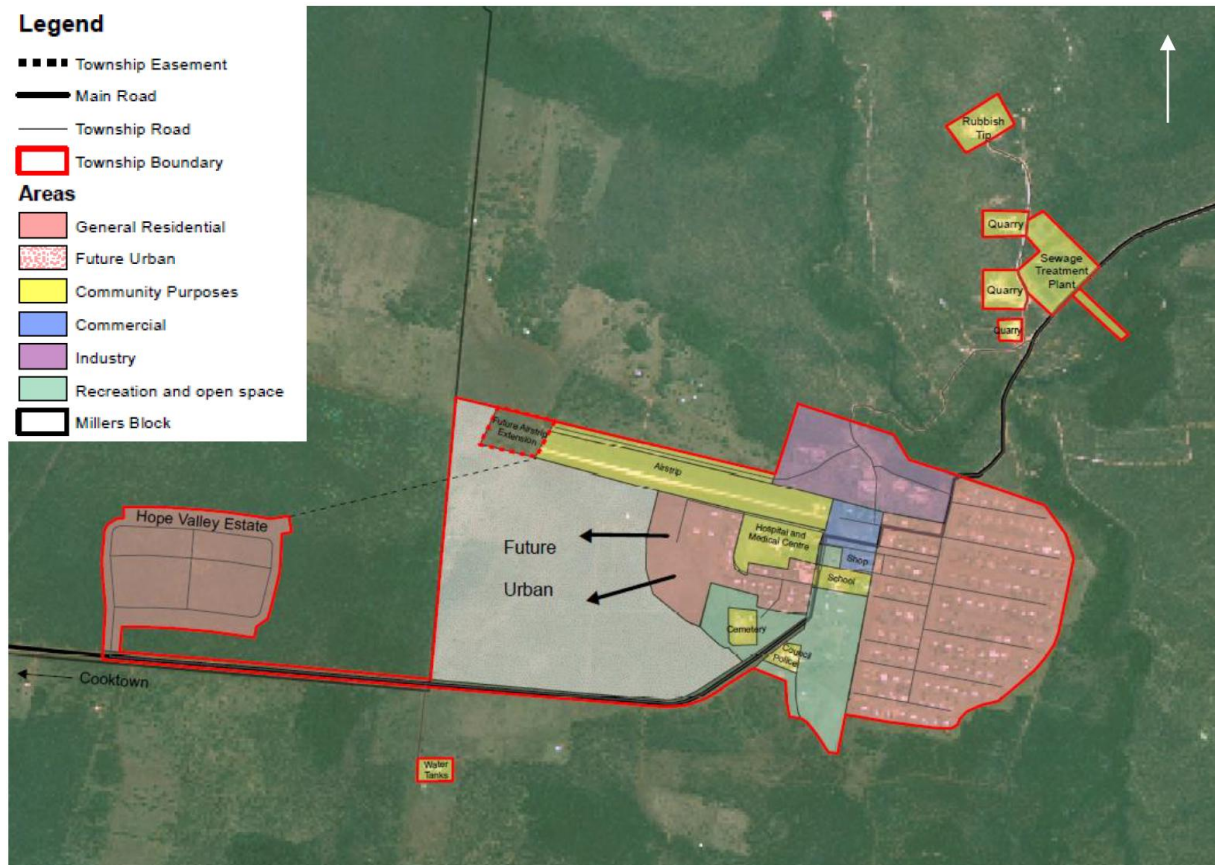


Figure 3: Precinct Map / Zoning (Source: Hope Vale Aboriginal Shire Council Planning Scheme)

In accordance with Hope Vale Aboriginal Shire Council Planning Scheme, there is a mixture of proposed future industrial, residential and community facilities located throughout the Township. Refer to **Figure 4** for projected zoning of land as per the Master Plan (completed by Cardno in 2019).

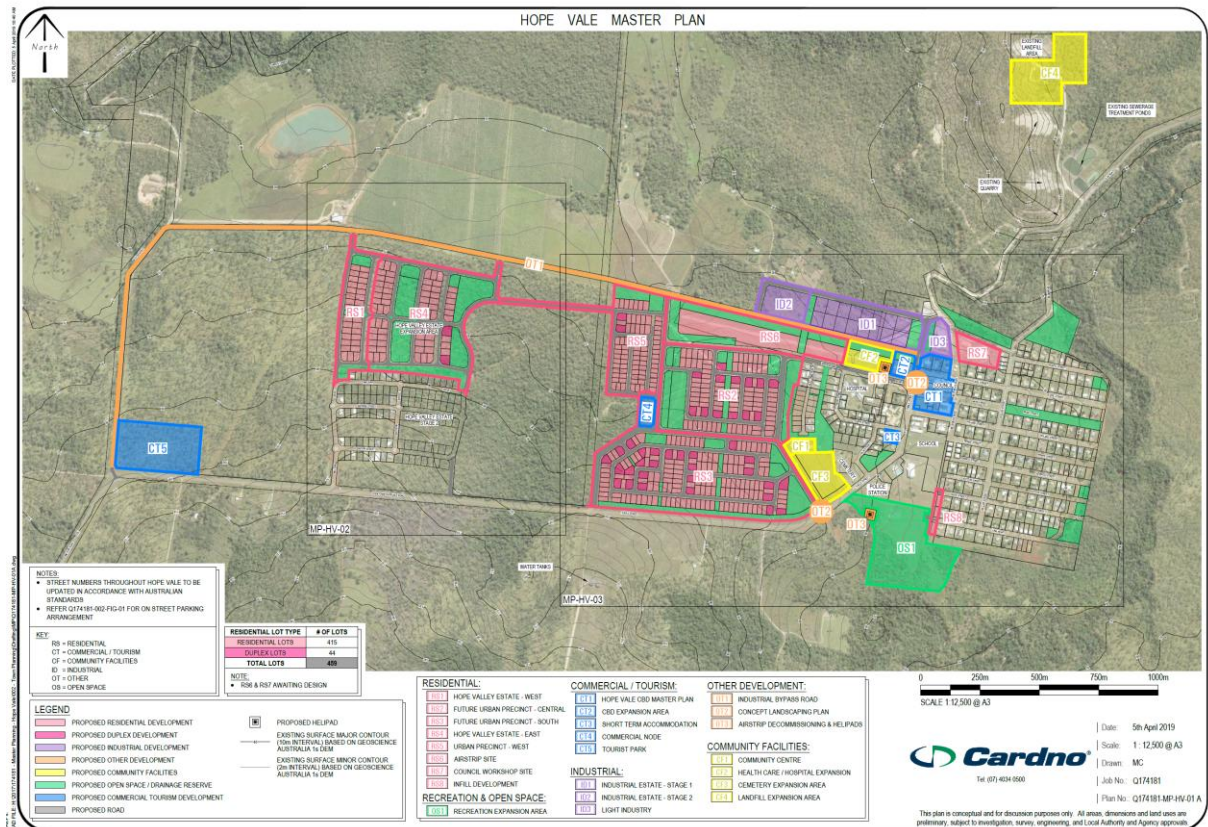


Figure 4: Hope Vale Master Plan (Source: Hope Vale Aboriginal Shire Council Master Plan)

3.2 LOCAL DRAINAGE ISSUES

Prior to attending the site inspection on 17th July 2025, Venant Solutions undertook preliminary regional flood modelling and prepared preliminary flood mapping within the Township, so that:

1. The adopted Manning's n values could be given a sensibility check on site. Manning's Roughness Coefficient (' n ') is generally referred to as Manning's ' n '. Manning's ' n ' is a coefficient which represents the roughness or friction applied to the flow by the channel. Manning's ' n ' values are generally selected from Tables, but can be back calculated from field measurements;
2. The existing stormwater infrastructure (i.e. culverts and causeways) locations could be identified so that they could be inspected on site and their geometry recorded; and
3. Flood depth levels could be produced so that an idea of the local flooding areas could be identified and that local drainage issues could be highlighted prior to arriving in the Township.

4.0 SITE INSPECTION

A site inspection of the Township of Hope Vale was conducted by Langtree Consulting on the 17th July 2025 in conjunction with DSDSATSIP and HVASC staff as well as with key members of the Communities.

Field inspections confirmed that many existing drainage assets—culverts, swales, and causeways—are undersized or poorly aligned with natural drainage lines.

4.1 FLOOD MAPPING

Venant Solutions have provided final flood maps for Hope Vale, presenting flood depth, extent, and velocity for the 1%, 20% and 50% AEP scenarios, as well as other design events. These maps are essential tools for identifying at-risk infrastructure and prioritizing upgrades. Flood depth outputs (Figures 5-1 to 5-3 in the Venant report) show inundation footprints varying in severity by location. Refer **Appendix A** for the Venant Solutions flood report.

4.2 MANNINGS 'N' VALUES

Surface roughness values were adopted in line with ARR2019 and verified through field observations. Table 2 in the Venant report provides values specific to parcels, dirt roads, vegetation types, and channels. For example:

- Parcels: 0.10
- Dirt Roads: 0.03
- Medium Vegetation: 0.06
- Open Channel: 0.05

These values were integrated into the TUFLOW model for the township.

4.3 STORMWATER INFRASTRUCTURE

All significant stormwater infrastructure was identified, measured and recorded to assist with this Local Drainage Assessment as well as the Regional Flooding Assessment. Refer to **Table 1** below. It was observed that there is limited stormwater infrastructure within Hope Vale with very little positive underground drainage (i.e. pit and pipe). The majority of the stormwater infrastructure observed is located within the township.

The existing stormwater infrastructure located in the Township is designed to drain toward Eveline Creek. Hope Vale consists of marge table drains with culvert crossings for the majority of driveways.

Table 1. Significant Stormwater Infrastructure

ID	Infrastructure type
1	600 RCP
2	900 RCP and 1200x600 RCBC
3	600 RCP
4	450 RCP
5	2/900x600 RCBC
6	
7	1200x600 RCBC
8	1200x600 RCBC
9	300 RCP and 2/600 RCP
10	600 RCP
11	300 RCP and 2/600 RCP
12	300 RCP
13	525 RCP
14	450 RCP
15	600 RCP
16	Drainage Issue
17	450 CSP
18	900x300 RCBC
19	2/900x300 RCBC
20	900x750 RCBC
21	900 CSP
22	600 RCP
23	600 RCP
24	2/600 RCP
25	6/900x600 RCBC
26	750x300 RCBC
27	750x300 RCBC
28	750x300 RCBC
29	1200x300 RCBC
30	450x450 STEEL BC
31	3/150 CLAY PIPES
32	600x600 RCBC
33	900x600 RCBC
34	450 CSP

ID	Infrastructure type
35	Baffle walls
36	2/450 uPVC
37	900x600 RCBC
38	600x450 RCBC
39	600x300 RCBC
40	2/900x300 RCBC
41	600x300
42	2/600x450
43	2.5m x 450 BRIDGE
44	600x450 RCBC
45	2/900x600 RCBC
46	375 RCP
47	600x450 CAST INSITU
48	600 RCP
49	450 RCP
50	300 RCP
51	300 RCP
52	600x450 RCBC
53	300 RCP
54	300 RCP
55	300 RCP
56	300 RCP
57	300 RCP
58	300 RCP
59	300 RCP
60	300 RCP
61	300 RCP
62	300 RCP
63	300 RCP
64	300 RCP
65	300 RCP
66	300 RCP
67	300 RCP
68	300 RCP

ID	Infrastructure type
69	300 RCP
70	300 RCP
71	300 RCP
72	300 RCP
73	300 RCP
74	300 RCP
75	300 RCP
76	300 RCP
77	300 RCP
78	450 RCP
79	600x300 RCP
80	300 RCP
81	600x300 RCBC
82	2/300 RCP
83	600x450 RCBC
84	600x450 RCBC
85	600x450 RCBC
86	600x450 RCBC
87	600x450 RCBC
88	600x450 RCBC
89	2/600x450
90	600x450 RCBC
91	600x450 RCBC
92	600x450 RCBC
93	600x450 RCBC
94	1200x600 RCBC
95	600x450 RCBC
96	600x450 RCBC
97	600x450 RCBC
98	600x450 RCBC
99	600x450 RCBC
100	Bridge
101	900 RCP
102	600x450 RCBC

ID	Infrastructure type
103	2/1200x450 RCBC
104	2/1200x450 RCBC
105	3/900 RCP
106	Causeway
107	1200x450 RCBC
108	600 HDPE
109	3/600x450 RCBC
110	2/700 INSITU
111	4/1200x600 RCBC
112	750 RCP
113	2/900 RCP

4.4 ROAD INFRASTRUCTURE

The key roads within Hope Vale to allow entry/exit and main traffic routes were inspected, assessed and our findings recorded. A record of our finding is contained in **Table 2** below.

Table 2. Key Roads

Road Name	Location	Purpose	Ownership	Condition
Theile Street	West of Town	Main connection road	HVASC	Sealed - ok
Aerodrome Road	West of Town	Connects to health care centre	HVASC	Sealed – Poor
Keller Road	Centre of town	Main collector road	HVASC	Sealed – Poor

These roads are typically sealed. The majority of roads have no positive underground drainage (i.e. pit and pipe) and are currently in very poor condition.

5.0 LOCAL DRAINAGE ASSESSMENT

Upon completion of the site inspection and the flood study, one large local drainage issue was observed. The stormwater to the west of Hope Vale flows east through the town as shown in **Figure 5**.



Figure 5: Local Drainage Issue

5.1 DRAIN WEST OF CEMETERY

A drain is proposed on the western side of the cemetery to collect stormwater and stop it flowing through the town. The Q100 flow rate was provided by Venant Solutions across this area which was $19.8\text{m}^3/\text{s}$.

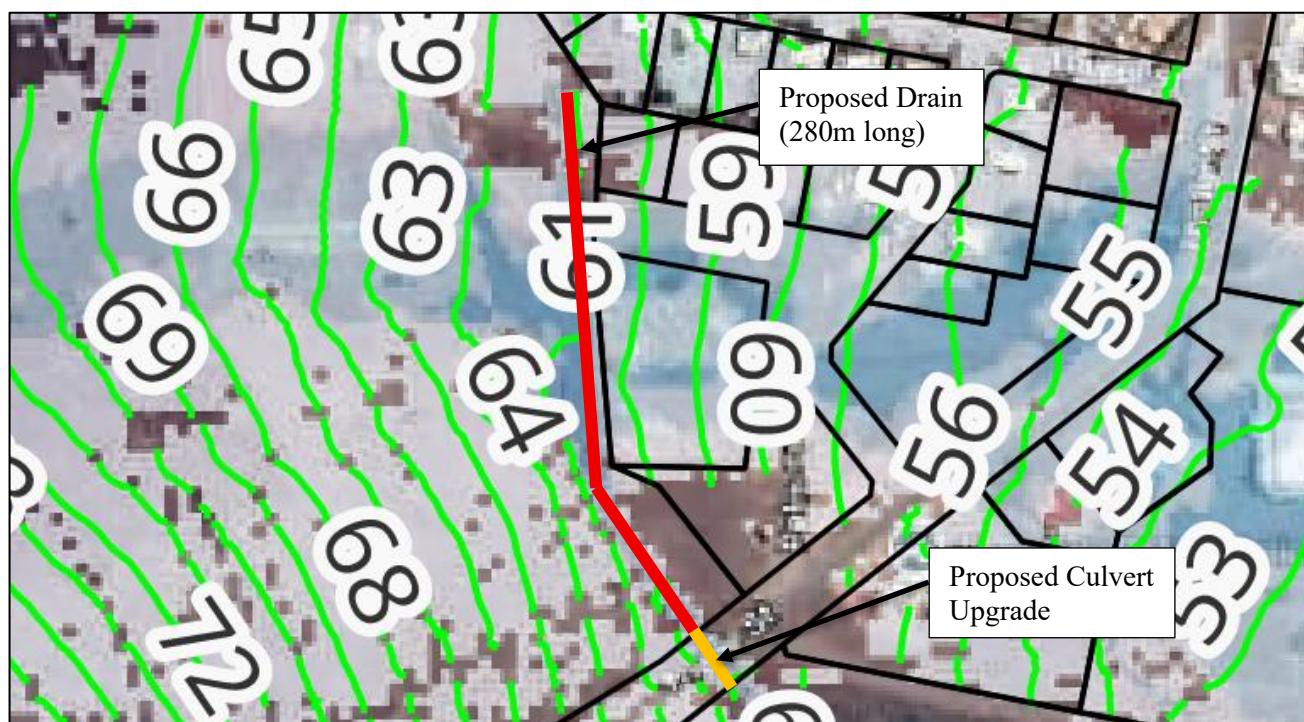


Figure 6: Proposed Drain Location

The drain required to cater for the above flow is shown in **Figure 7** below. This drain is proposed to be 280m long, grassed and a slope of 1% was taken for calculation purposes. Refer to **Appendix B** for drain sizing calculations.

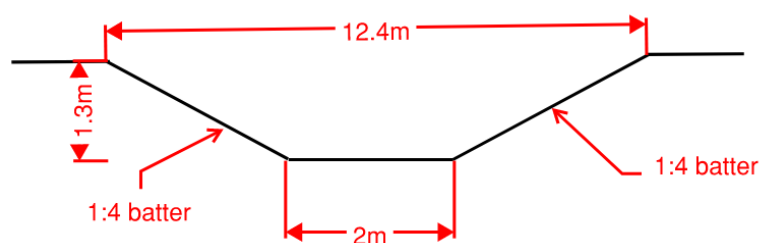


Figure 7: Required Drain Profile

This drain flows towards the existing culverts under Theile Street which are 6/900x600 RBCBs. As this is the main road into Hope Vale this road is classed as a major road which has an immunity of a Q50 event in accordance with QUDM Table 7.3.1. The flow within the drain for a Q50 event is $17.9\text{m}^3/\text{s}$.

The existing culverts have a capacity of $7.95\text{m}^3/\text{s}$ which has capacity for a Q2 event based on flows provided by Venant Solutions. Therefore, to comply with QUDM requirements the culverts are to be upgraded to 6/1200x900 RCBCs which has a capacity of $20.16\text{m}^3/\text{s}$. Rock protection will also be installed at the culvert outlet. Refer to **Appendix B** for culvert sizing calculations.

The downstream of the culvert is an existing flow path that flows into Eveline Creek. There are no properties downstream that will be affected by this increase in flow. This is to be confirmed by further flood modelling. Refer to **Figure 8** for the downstream flow path of the culvert.

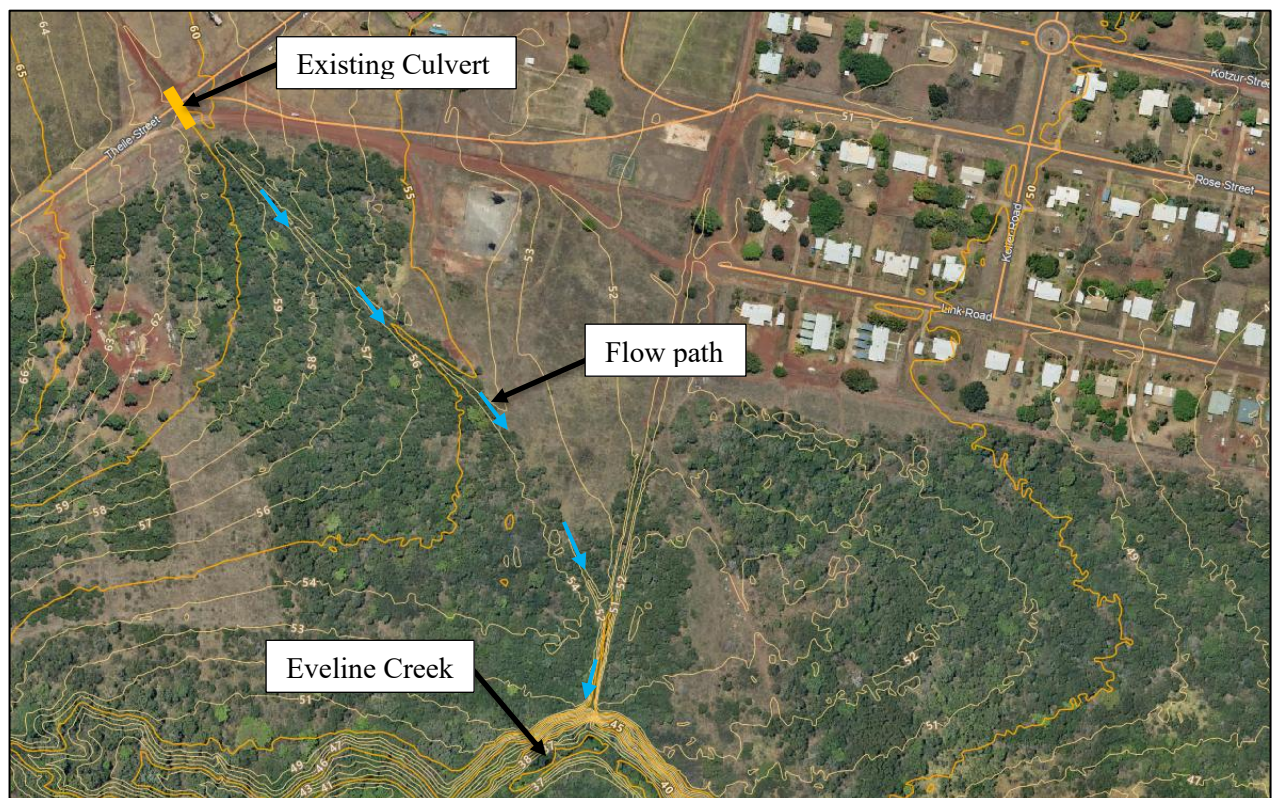


Figure 8: Downstream Flow Path

5.2

A drain is proposed on the eastern side of the school top collect water before it flows into the residential area. **Figure 9** shows the proposed location of the proposed drain. As there is a proposed drain west of the cemetery from Section 5.1, the flows provided by Venant Solutions don't take this into account. As a worst case scenario, the flow from Venant Solutions of 15.3m³/s has been used to size the proposed drain.



Figure 9: Proposed Drain East of School

The minimum required drain profile for this drain is shown in **Figure 10** below. This is based on a grassed drain with a 1% slope. **Note that this drain profile will change once the new drain near the cemetery is implemented.** Refer to **Appendix B** for drain sizing calculations.

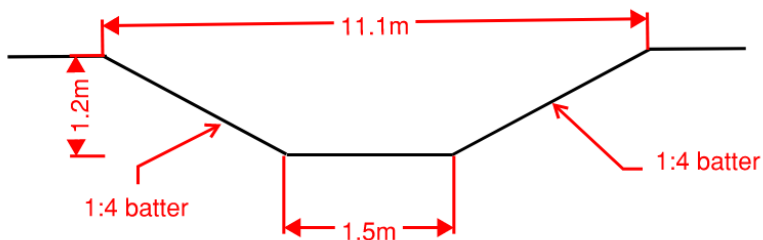


Figure 10: Required Drain Profile

Similarly to the Section 5.1, the downstream of the culvert is an existing flow path that flows into Eveline Creek. There are no properties downstream that will be affected by this increase in flow. This is to be confirmed by further flood modelling. Refer to **Figure 11** for the downstream flow path of the culvert.

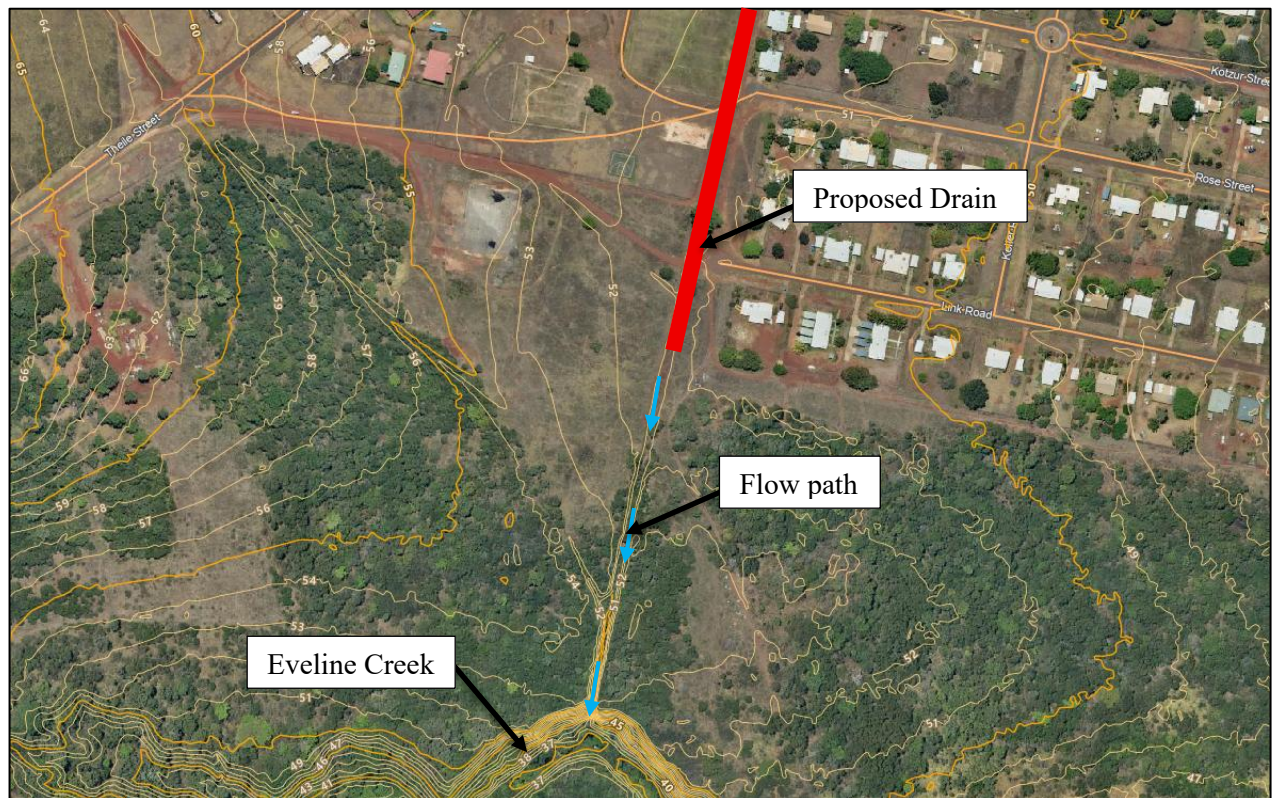


Figure 11: Downstream of Drain

6.0 COST ESTIMATE

A detailed cost estimate for each site outlined in Section 5.0 is provided in **Appendix C**. The rates used have been based on local Cairns rates times a factor of 3 (x3) to represent the rate inflation experienced in Hope Vale.

The culvert structure proposed have been designed and based on standard sizing of pre-cast structures available from several suppliers. The culvert also requires pavement reinstatement and sealing to support traffic over this area.

7.0 CONCLUSION

The findings from this Local Drainage Assessment are that the Township of Hope Vale requires little to no infrastructure improvements to assist in providing increased flood relief to the Community.

One large local drainage issue was observed and a mitigation measure was provided to reduce the impact of this issue. It is recommended that the existing culverts and drains be cleaned out where required to assist with stormwater discharge.

It is hoped that this report assists Council in highlighting the constant flooding issues that they are facing on a regular basis and that sufficient funds can be secured to allow the mitigation measures contained in this report to be designed and constructed.

8.0 CERTIFICATION STATEMENT AND AUTHORISATION

This report has been prepared under the direction of Brett Langtree (RPEQ No 11932), a civil engineer with 24 years' experience in the planning, design and implementation of urban residential, industrial and commercial land development and the provision of infrastructure services to urban and rural communities and the preparation of stormwater assessments for developments.



Brett Langtree – Principal Civil Engineer (RPEQ No 11932), Langtree Consulting

Date: 18 December 2025

APPENDIX A

DRAFT HOPE VALE FLOOD STUDY (REF: R.M00605.001.00)

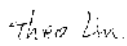


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Contents

1	Introduction	1
1.1	Background	1
1.2	Scope of Works	1
1.3	Study Methodology	1
1.3.1	Data Collection	1
1.3.2	Hydrological Modelling	2
1.3.3	Hydraulic Modelling	2
1.3.4	Future Development Impact Assessment	2
2	Data Collection & Analysis	4
3	Hydrological Assessment	6
3.1	Regional Flood Frequency Estimation	6
3.2	Rational Method	6
3.3	Climate Change	7
4	Hydraulic Modelling	9
4.1	Design Event Modelling	9
4.2	Model validation	12
5	Existing Conditions Flood Mapping	14
6	Preliminary Mitigation Advice	29
7	Summary & Conclusion	31
8	References	32

List of Figures

Figure 1-1	Locality	3
Figure 2-1	LiDAR DEM and 10 m Contours	5
Figure 3-1	Catchment Adopted for TUFLOW Model Validation	8
Figure 4-1	TUFLOW Model Schematisation	13
Figure 5-1	Existing Case Flood Depth – 50% AEP	15
Figure 5-2	Existing Case Flood Depth – 20% AEP	16
Figure 5-3	Existing Case Flood Depth – 10% AEP	17
Figure 5-4	Existing Case Flood Depth – 5% AEP	18
Figure 5-5	Existing Case Flood Depth – 2% AEP	19

Figure 5-6	Existing Case Flood Depth – 1% AEP	20
Figure 5-7	Existing Case Flood Depth – 1% AEP + 2100 Climate Change	21
Figure 5-8	Existing Case Flood Velocity – 50% AEP	22
Figure 5-9	Existing Case Flood Velocity – 20% AEP	23
Figure 5-10	Existing Case Flood Velocity – 10% AEP	24
Figure 5-11	Existing Case Flood Velocity – 5% AEP	25
Figure 5-12	Existing Case Flood Velocity – 2% AEP	26
Figure 5-13	Existing Case Flood Velocity – 1% AEP	27
Figure 5-14	Existing Case Flood Velocity – 1% AEP + 2100 Climate Change	28
Figure 6-1	Locations for Mitigation Options	30

List of Tables

Table 3-1	Peak flows for the various AEPs produced by RFFE	6
Table 4-1	Adopted Manning's 'n' values.	9
Table 4-2	Adopted storm losses	10
Table 4-3	Adopted critical events	10
Table 6-1	Peak flows at selected locations	29

1 Introduction

1.1 Background

Venant Solutions was engaged by Langtree Consulting to prepare flood mapping of the town of Hope Vale and surrounds for the Department of Women, Aboriginal and Torres Strait Islander Partnerships, and Multiculturalism on behalf of the Hope Vale Aboriginal Shire Council (HVASC).

Hope Vale is located approximately 25 km northwest of Cooktown in North Queensland as shown in Figure 1-1. The existing township is located at the confluence of the Endeavour River (Right Branch) and Eveline Creek but most of the township is elevated well above these major watercourses and hence flooding from these watercourses is not part of this investigation. However, the township is subject to overland flooding from the local catchment to the southwest which is the focus of this report. Future planning for Hope Vale has identified areas to the west of the existing township for possible future development and these areas are also included in the assessment.

1.2 Scope of Works

The flood mapping by Venant Solutions informs an overarching assessment being undertaken by Langtree Consulting of the existing local drainage, drainage improvement opportunities and flooding constraints for future development around Hope Vale. Therefore scope of work for the flood mapping component is to undertake hydrologic and hydraulic modelling of Hope Vale and surrounds, prepare flood mapping to identify opportunities to improve drainage in the existing urban areas and to identify constraints for future growth of the town.

1.3 Study Methodology

The methodology for the flood mapping component is summarised as follows with further detail provided in the sections below:

- Data collection
- Hydrological modelling to quantify the runoff from the catchment to provide inflows for the hydraulic modelling for the 50%, 20%, 10%, 5%, 2% and 1% AEP (annual exceedance probability) design events and a 1% AEP plus climate change event
- Preliminary hydraulic modelling of the 1% AEP event to provide mapping of flood extent and depth for the site visit and consultation
- Final hydraulic modelling incorporating feedback from the consultation and drainage structure data collected during the site visit and run for all AEP events
- Final flood mapping of extent, depth, level and velocity for all AEP events
- Assessment of impacts of filling in areas proposed for future development
- Reporting

The adopted methodology is described below with further details on the hydrologic and hydraulic modelling provided in Chapters 2 and 4.

1.3.1 Data Collection

There are no previous flood studies of Hope Vale and so the only data collection in the initial phase was terrain data and rainfall input data for the hydrological modelling. The available terrain data is LiDAR digital elevation models (DEM) and 10 m ground level contours. During the site visit, which is after the preliminary modelling and mapping, drainage infrastructure data is collected.

1.3.2 Hydrological Modelling

The hydrological modelling was undertaken in accordance with the methodologies provided in Australian Rainfall and Runoff (Version 4.2) (Ball et al. 2019) (ARR2019). Options considered for this catchment were:

- Develop a hydrological model of the catchment using the runoff routing approach which provides inflows to the hydraulic model which covers the area of interest for the flood mapping. This approach uses software packages such as RORB, URBS, WBNM and XP-RAFTS; or
- Develop a rain-on-grid (RoG) two-dimensional (2D) TUFLOW hydraulic model which combines the hydrologic and hydraulic modelling into a single model. RoG modelling requires that the TUFLOW model covers the full catchment and requires a suitable DEM for the entire catchment. The rainfall runoff process for the full catchment is undertaken entirely within the hydraulic model. A disadvantage of this approach is that the TUFLOW model covers a larger area than the area of interest for the flood mapping and hence run times can be significantly longer.

Given the availability of suitable DEM data and the catchment being relatively small, the RoG approach was adopted.

Rainfall pre-burst and losses were adopted in accordance with ARR2019. As required by ARR2019 the near-term rainfall data (2021 to 2040) was adjusted for climate change effects not accounted for in the Bureau of Meteorology (BoM) design rainfall which is based on a statistical analysis of long-term historical data.

In accordance with ARR2019 an ensemble of 10 temporal patterns was run for each duration. To determine the range of durations of interest the RoG model was initially run for durations ranging from 20 minutes to 6 hours using a single temporal pattern. Following a review of these results the range of durations was reduced to 20 minutes to 2 hours, and ten temporal patterns were run for each duration. Across the area of interest, the critical durations and temporal patterns were selected. The selected temporal pattern for each duration was that which provided the mean flood level of the ten temporal patterns.

There was no data available for model calibration to historical events so the peak flow output from the RoG model was validated to the Regional Flood Frequency Estimation model (RFFE) and the Rational Method.

1.3.3 Hydraulic Modelling

As noted above the hydraulic modelling was undertaken using the 2D TUFLOW software package which is an industry standard software package in Australia. For the preliminary assessments to determine critical storm durations and temporal patterns and to prepare the preliminary flood mapping, a 6 m computational grid was adopted. Following the site visit and the collection of the stormwater infrastructure data the updated and final model was modified to use a 3 m grid across the urban areas and a 6 m grid elsewhere; this was done using the Quadtree feature in TUFLOW. The 3 m grid in the urban area in combination with the sub-grid sampling (SGS) feature in TUFLOW provided an increased resolution suitable for this area.

For each AEP event assessed the outputs from each duration were enveloped to provide the maximum water level.

1.3.4 Future Development Impact Assessment

The hydraulic model is used to assess the potential impact of future development on flooding. Urbanisation can impact by both increasing runoff as a result of an increase in the impervious surfaces, and by blocking of existing flowpaths potentially resulting in increased flood levels and velocities on neighbouring properties.

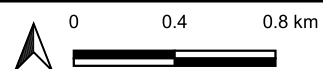
To assess the impact of future development the TUFLOW model was updated by modifying the fraction imperviousness and by modifying ground levels to represent the proposed fill.



Title: Hope Vale Flood Study
Locality

Figure:
1-1

Rev:
A



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Filename: S:\Projects\M00605.MJ.HopeValeFloodStudy\GIS\Drawings\L.M00605.001.00\Fig1-1_Locality.qgz

By: TL

Jun 2025

2 Data Collection & Analysis

The following data was obtained for the development of the hydrologic and hydraulic models:

- Terrain data
- Cadastral
- Rainfall data
- Drainage infrastructure

A DEM of the entire catchment is required for the RoG TUFLOW model. The following LiDAR DEMs were available on the Geoscience Australia ELVIS website¹:

- Hope Vale 1 m LiDAR DEM flown in 2009
- Cooktown 0.5 m DEM flown in 2013
- State 10 m ground level contours sourced from the Queensland Spatial Catalogue²

Across the Hope Vale area the Hope Vale and Cooktown LiDAR provided the same coverage. Although the Cooktown LiDAR was flown more recently and was a higher resolution DEM (0.5 m c.f. 1.0 m) the Hope Vale LiDAR was adopted because of better filtering of the raw data.

The LiDAR DEM did not cover the upper part of the catchment, and hence did not provide full coverage for the TUFLOW model as shown in Figure 2-1. Therefore a DEM was generated from the 10 m contours to infill the upper catchment. Unsurprisingly there was a discontinuity at the interface between the two DEMs and so the DEM from the 10 m contours was lowered to tie in with the LiDAR DEM. A low accuracy of the DEM in the upper catchment is acceptable as this is not an area of interest for the flood mapping and is only required in the RoG TUFLOW model to ensure the full catchment is generating runoff.

Cadastral data was also sourced from the Queensland Spatial Catalogue.

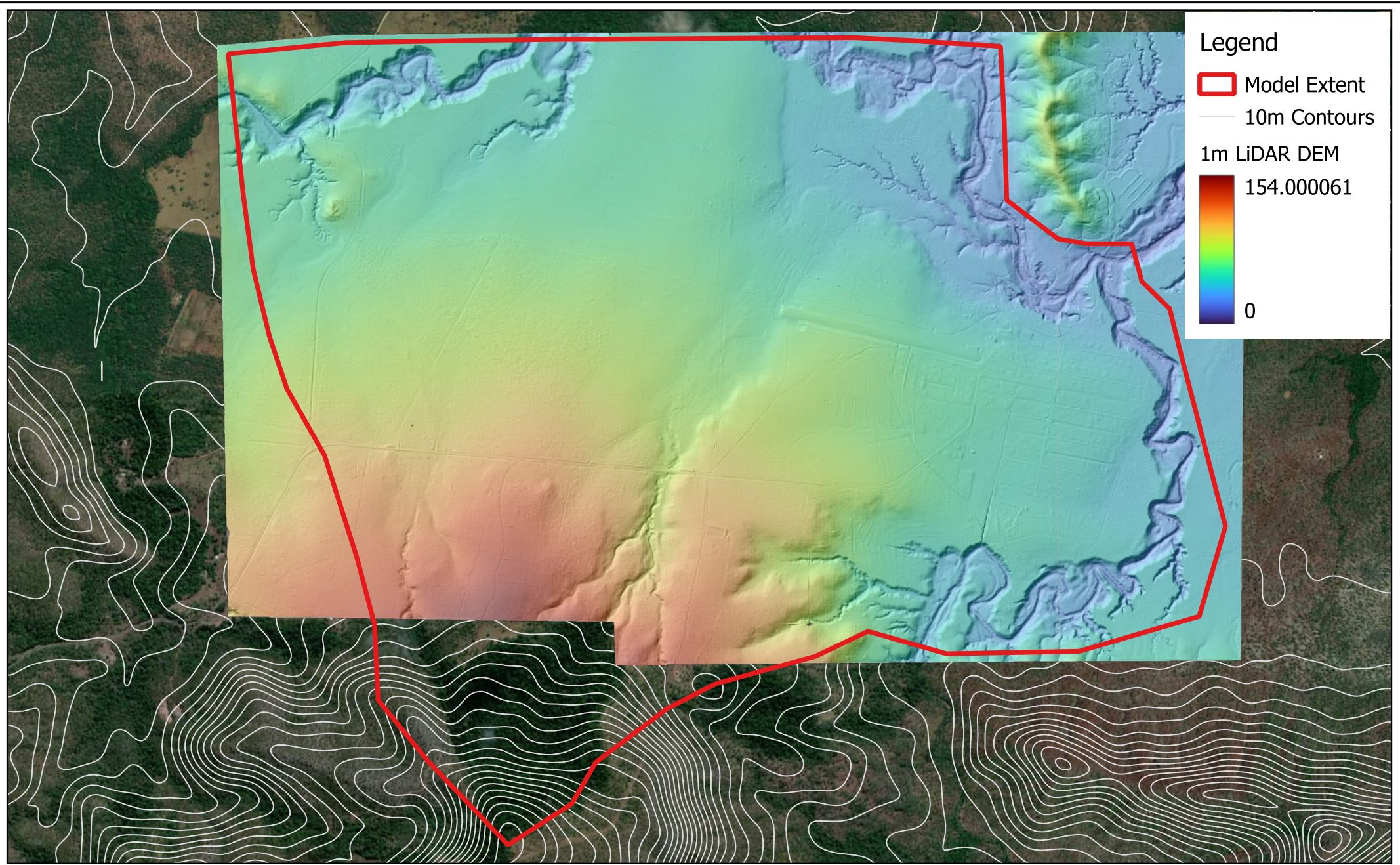
The rainfall data included rainfall depths and temporal patterns for the range of AEP and storm durations required for the assessment. The data specific to this catchment was sourced from the ARR2019 Datahub³ and the BoM.

The drainage infrastructure (stormwater pipes and culverts) was located and dimensions measured during the site visit. Pipe invert elevations were adopted from the DEM.

¹ <https://elevation.fsdf.org.au/>

² <https://qldspatial.information.qld.gov.au/catalogue/custom/index.page>

³ <https://data.arr-software.org/>



Legend

 Model Extent

— 10m Contours

1m LiDAR DEM

154.000061

0

3 Hydrological Assessment

Being a RoG modelling approach a separate hydrological model was not developed. This chapter details the RFFE model and Rational Methods which were used to validate the peak flow rate from the RoG modelling. There are in effect multiple catchments flowing to the different areas of interest for the study. Therefore, for the purposes of model validation the catchment shown in Figure 3-1 was used for the validation as it is the dominant catchment flowing to the urban area.

The 1% AEP flow rates determined from the RFFE model and the Rational Method are presented in this chapter and the TUFLOW validation against these results is presented in Section 0. As noted in Section 1.3.2 the design rainfall data was updated to account for the effects of climate change to current day (2021-2040) which is not accounted for in the BoM design rainfall data; further explanation is provided in Section 3.3. The RFFE model does not account for these effects either as it is based on historical flow records as discussed below. Therefore for the purposes of validating the TUFLOW RoG model the RFFE results could not be directly used unless an extensive exercise was undertaken in running the RoG TUFLOW model using the unfactored rainfall data. Therefore the Rational Method was applied using both the unfactored and factored rainfall data to allow a comparison point against the RFFE and the likely effects on the flow rate of the factored rainfall data.

3.1 Regional Flood Frequency Estimation

ARR2019 recommends that RFFE be undertaken to provide indicative peak flow rates for ungauged catchments for the purposes of validating hydrological models. The RFFE is based on research as part of ARR2019 and provides peak flood estimation based on the catchment size, location, and shape. The software uses this information and, based on relationships developed for neighbouring catchments, estimates the peak flow rates. The 1% AEP RFFE peak flows can be seen in Table 3-1. The flows for overall catchments were recommended by the RFFE software and were adopted for this assessment.

Table 3-1 Peak flows for the various AEPs produced by RFFE

AEP (%)	RFFE Flow (m ³ /s)	RFFE 5% Confidence Limit (m ³ /s)	RFFE 95% Confidence Limit (m ³ /s)
1	17.7	9.2	32.2

3.2 Rational Method

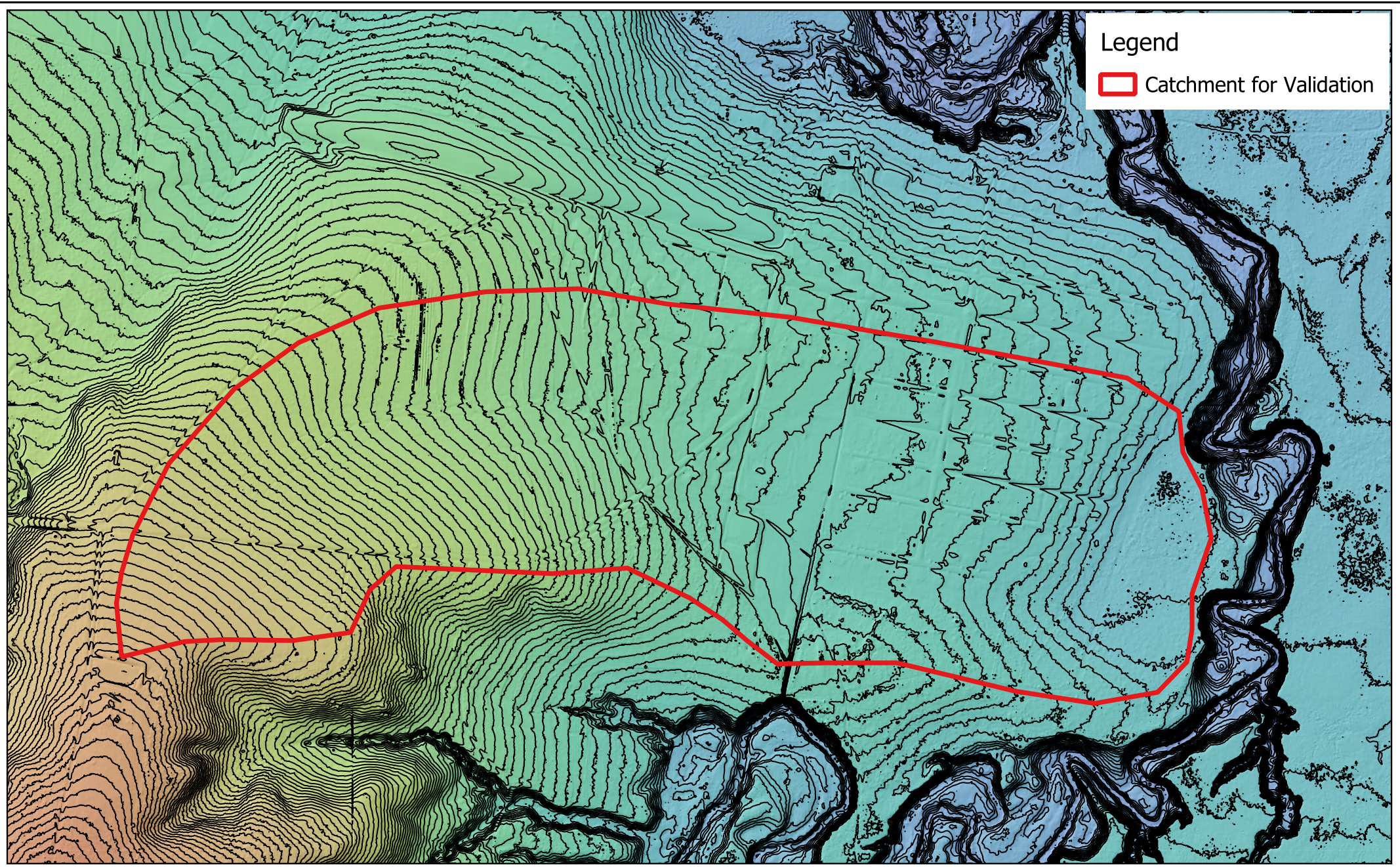
The Rational Method was applied in accordance with Section 4.3 of QUDM (IPWEA, 2017). The runoff coefficient for 1% AEP was determined from QUDM Tables 4.5.2 and 4.5.4. The land within the catchment was generally classified as 'Dense bushland' and medium soil permeability was assumed. The time of concentration was determined by TUFLOW model simulation. The simulation indicated a time of concentration of 140 minutes. As noted above the Rational Method was applied using two sets of rainfall data; the BoM data and the BoM data factored to the near term for climate change. The runoff coefficient for the 1% AEP event was 0.84. The catchment area was determined to be 127 ha. The Rational Method peak flow for 1% AEP is 20.8 m³/s and 37.2 m³/s using the unfactored and factored rainfall respectively.

There is good agreement between the RFFE and Rational Method using the unfactored rainfall data and hence it is considered reasonable to use the Rational Method flow using the factored rainfall data for the TUFLOW validation.

3.3 Climate Change

The BoM IFDs were published in 2016 and best represent the climate period between 1961 and 1990. To represent current climate conditions IFDs were derived via the methodology outlined in Book 1, Chapter 6, Climate Change Considerations of ARR. The Shared Socio-economic Pathway (SSP) 5-8.5 current and near-term (2021-2040) scenario was used for the design events for this study as it is the climate scenario that best represents emissions to date and in the immediate future (Schwalm, et al. 2020). The resulting increase in rainfall intensity is 20% for a duration of 1 hour and less, decreasing to a 16% increase for the 3 hour duration. Initial loss and continuing loss were also increased in the TUFLOW RoG model due to climate change in accordance with ARR2019. The increases were 1% and 3% respectively.

For the 1% AEP + climate change to the year 2100 scenario the SSP5-8.5 was also adopted. The increase in rainfall intensity for durations of 1 hour and less is 40%, decreasing to 31% for the 3 hour duration.



4 Hydraulic Modelling

A TUFLOW 2D 'rain-on-grid' hydraulic model was developed to define catchment runoff, flood risk behaviour across the site and assess impacts of proposed developments. The model layout is shown in Figure 4-1.

TUFLOW version 2025.1.0-iSP-w64 was used for this assessment. The models were run with TUFLOW's HPC solver.

Details of the model development include:

- The model covers the entire catchment area potentially contributing flood flows to the area of interest.
- Model grid size
 - 6 m was adopted for the initial testing to determine critical durations and temporal patterns
 - For detail mapping the Quadtree feature was used with 3 m adopted across the existing urban areas and 6 m across the remainder of the catchment
- Sub-Grid Sampling (SGS) was used with a sample frequency of seven.
- The base topography was defined by a LiDAR DEM over most of the catchment merged with 10 m contours in the upper part of the catchment as described in Chapter 2.
- The adopted Manning's 'n' surface roughness values are presented in Table 4-1 and mapped in Figure 4-1.

Table 4-1 Adopted Manning's 'n' values.

Surface type	Manning's 'n'
Building	0.013 < 0.1 m depth, 0.350 > 0.1 m depth
Parcel	0.100
Dense Vegetation	0.080
Medium Vegetation	0.060
Dirt Road	0.030
Paved Road	0.022
Open Channel	0.050
Open Space	0.066

- Rainfall was applied uniformly across the model using the global rainfall command with initial and continuing losses applied through a materials layer (see below for further details).
- External outflow (downstream) boundaries were represented using automatically generated 2D HQ (height-flow) boundaries.

4.1 Design Event Modelling

- The 50%, 20% and 1% AEP events were modelled for this draft report with the remaining events to be assessed for the final report.
- Rainfall was applied evenly across the model and was defined in accordance with ARR2019 using the following rainfall parameters and the TUFLOW rainfall extraction plugin in QGIS:
 - **Intensity-Frequency-Duration (IFDs)** - Sourced from the BoM's Design Rainfall Data System (2016) for the coordinates; Latitude -15.294200, Longitude 145.095150.
 - **Temporal Patterns** - As per ARR2019 for catchments smaller than 75 km² point temporal patterns for the Wet Tropics region were used. An ensemble of 10 temporal patterns was assessed per duration.
 - **Aerial Reduction Factors (ARFs)** - ARFs were applied.

- **Storm losses** - The regional initial and continuing loss values of 33.3 mm and 3.0 mm/hr from the ARR2019 DataHub with current and near-term (2021-2040) SSP5-8.5 factors were adopted for pervious areas. The initial loss was reduced to account for pre-burst depths. The median percentile pre-burst depths were applied. For storm durations shorter than an hour the 1 hour pre-burst depth was applied.
- For impervious areas it was assumed that roads were effective impervious areas (EIA) and that building parcels (mostly residential) were indirectly connected areas (ICA) with initial losses being 70% of rural (pervious area) initial losses. An ICA continuing loss of 13.8 mm/hr was adopted as recommended for southeastern Australia in Book 5, Chapter 6 of ARR2019.
- The resulting initial and continuing losses for each surface type are presented in Table 4-2.

Table 4-2 Adopted storm losses

Surface type	Initial loss (mm)	Continuing loss (mm/hr)
Building	1	0
Building Parcel	13.8 ¹	2.5
Dense Vegetation	19.7 ¹	3.0
Medium Vegetation	19.7 ¹	3.0
Dirt Road	1	0
Paved Road	1	0
Open Channel	19.7 ¹	3.0
Open Space	19.7 ¹	3.0

¹ Initial loss was reduced from the value presented to account for median percentile pre-burst depth

- The critical durations for the area of interest were selected from storm durations ranging from 20 minutes to 3 hours but only using one temporal pattern. The range of durations was then shortened to 20 minutes to 2 hours and the ensemble of ten temporal patterns was run for each duration. For each duration a mean flood surface was generated and the selected temporal pattern for each duration was that which gave the flood level closest to the mean but higher. Because the area of interest covers a large area, rather than say a single location, multiple durations and critical patterns were identified as being critical. The 50%, 20%, 10%, 5%, 2% and 1% AEP critical events are presented in Table 4-3.

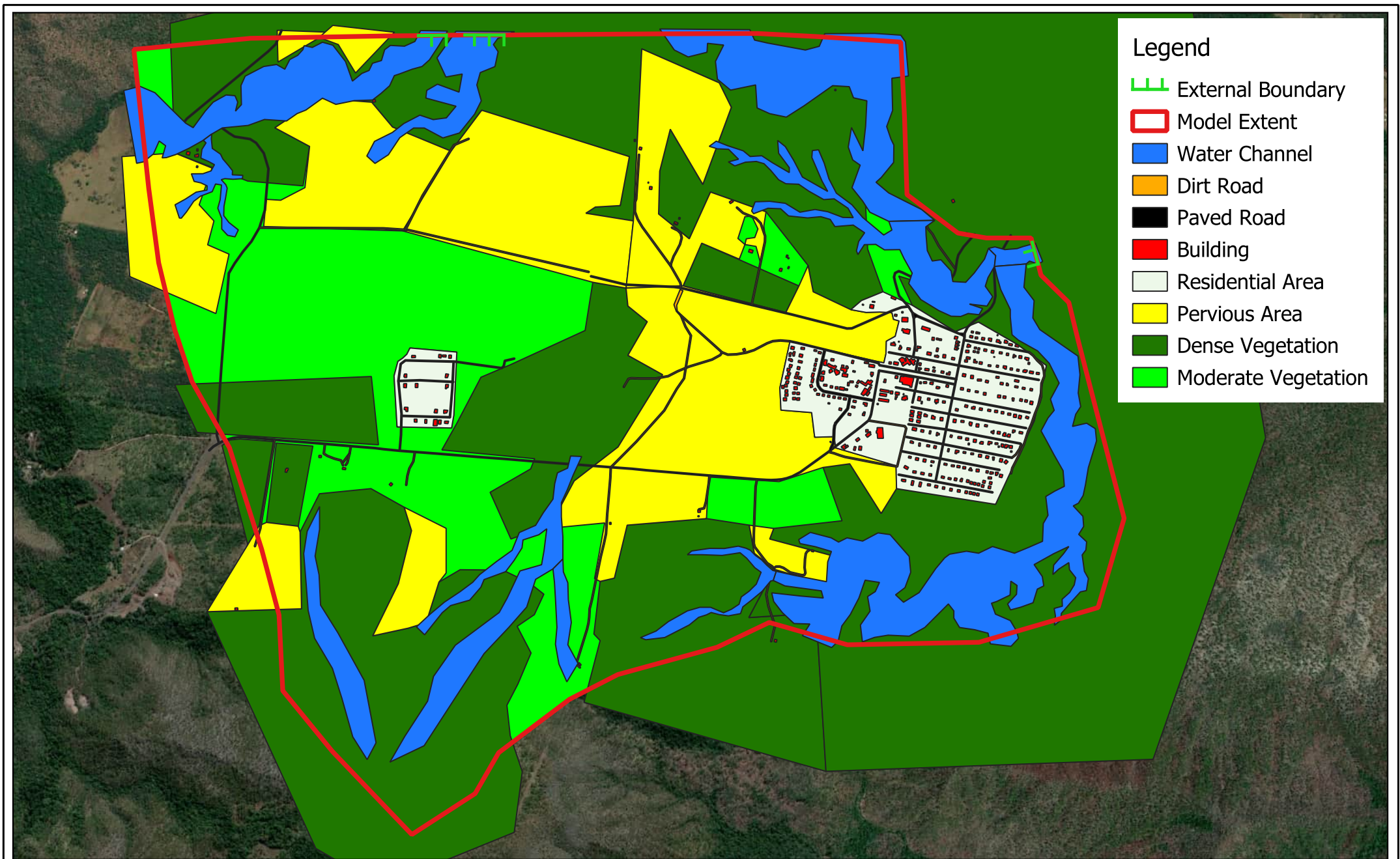
Table 4-3 Adopted critical events

AEP	Duration	Temporal Pattern
50%	45m	1, 3, 7, 8
	60m	5, 7, 8, 9
	90m	6, 8, 9
	120m	1, 6, 7, 9
20%	45m	3, 6, 7, 8
	60m	5, 7, 8, 9
	90m	5, 6, 8, 9
	120m	1, 2, 5, 9
10%	45m	5, 8, 9
	60m	4, 5, 7
	90m	1, 2, 3, 6, 7, 8, 10

5%	45m	5, 8, 9
	60m	4, 5
	90m	2, 6, 8, 10
2%	45m	1, 7, 8, 10
	60m	2, 8
	90m	8, 10
1%	45m	1, 6, 7, 8, 10
	60m	2, 4, 6, 7, 8, 9,
	90m	1, 4, 5, 8, 9

4.2 Model validation

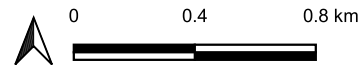
The TUFLOW RoG model was validated against the 1% AEP Rational Method peak flow. The Rational Method flow at the outlet location shown in Figure 3-1 is 37.2 m³/s and the TUFLOW model is 40.5 m³/s. This indicates that the parameters adopted in the TUFLOW RoG model are reasonable.



Title: Hope Vale Flood Study
TUFLOW Model Schematisation

Figure:
4-1

Rev:
A



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Filename: S:\Projects\M00605.MJ.HopeValeFloodStudy\GIS\Drawings\L.M00605.001.00\Fig4-1_TUFLOW_Model_Schematisation.qgz

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Jun 2025

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5 Existing Conditions Flood Mapping

The outputs from the RoG TUFLOW model for the range of durations and temporal patterns assessed were enveloped to provide the flood surfaces for depth, level and velocity. Feedback obtained during the Site visit by Langtree Consulting confirmed that the depth mapping was generally consistent with on-ground observations. Mapping is provided as follows:

- Figure 5-1 Existing Case Flood Depth – 50% AEP
- Figure 5-2 Existing Case Flood Depth – 20% AEP
- Figure 5-3 Existing Case Flood Depth – 10% AEP
- Figure 5-4 Existing Case Flood Depth – 5% AEP
- Figure 5-5 Existing Case Flood Depth – 2% AEP
- Figure 5-6 Existing Case Flood Depth – 1% AEP
- Figure 5-7 Existing Case Flood Depth – 1% AEP + 2100 Climate Change
- Figure 5-8 Existing Case Flood Velocity – 50% AEP
- Figure 5-9 Existing Case Flood Velocity – 20% AEP
- Figure 5-10 Existing Case Flood Velocity – 10% AEP
- Figure 5-11 Existing Case Flood Velocity – 5% AEP
- Figure 5-12 Existing Case Flood Velocity – 2% AEP
- Figure 5-13 Existing Case Flood Velocity – 1% AEP
- Figure 5-14 Existing Case Flood Velocity – 1% AEP + 2100 Climate Change

The mapping shows that the southern part of the town is most affected by flooding, particularly along Link Rd and the western end of Rose St and Kotzur St. Preliminary ideas for mitigation options are presented in Chapter 6.



Title: Hope Vale Flood Study
Existing Case Flood Depth - 50% AEP

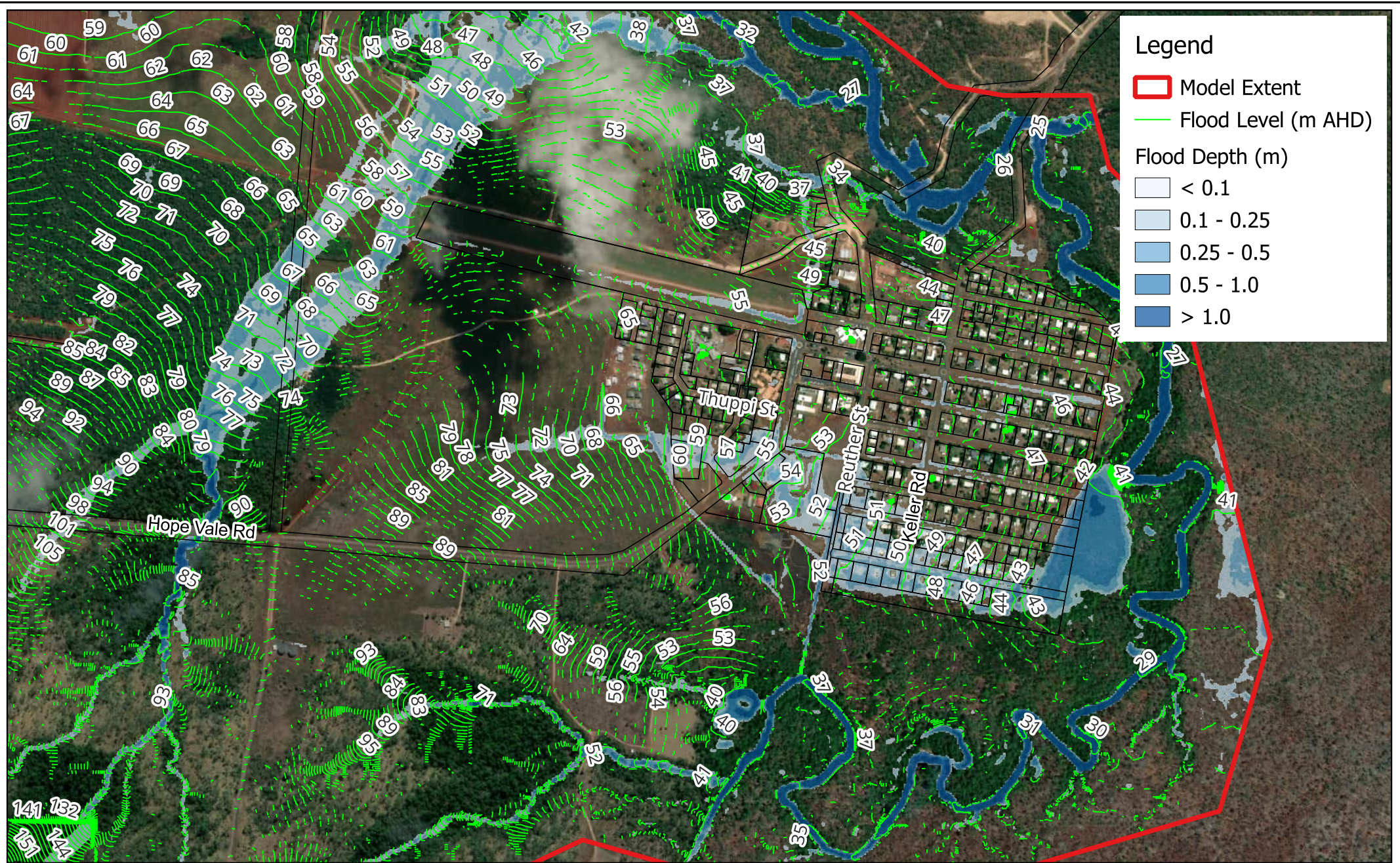
Figure:
5-1

Rev:
A



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Legend

Model Extent

--- Flood Level (m AHD)

Flood Depth (m)

	< 0.1
	0.1 - 0.25
	0.25 - 0.5
	0.5 - 1.0
	> 1.0

Title: Hope Vale Flood Study
Existing Case Flood Depth - 20% AEP

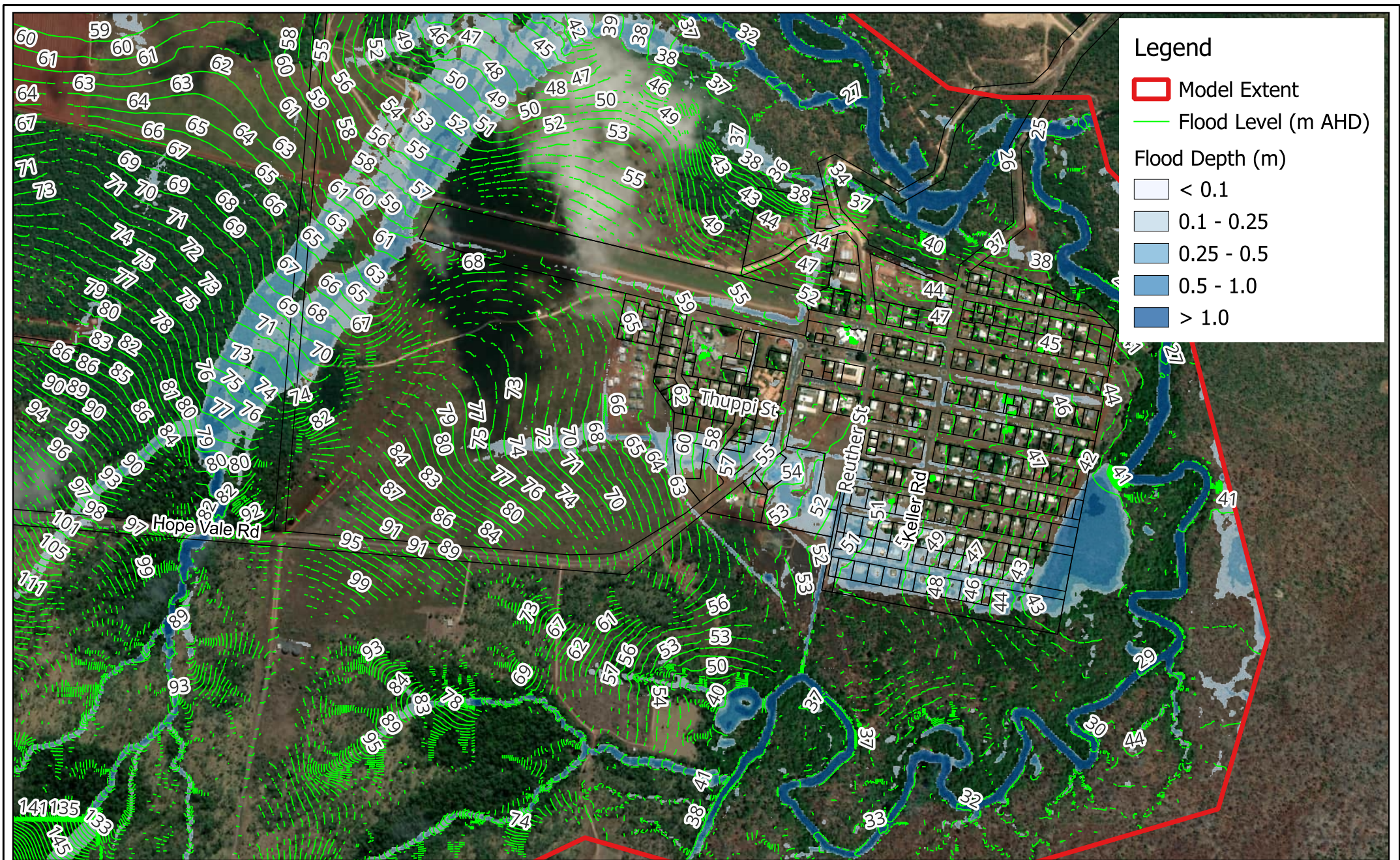
Figure:
5-2

Rev:
A



This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

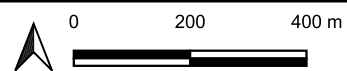




Title: Hope Vale Flood Study
Existing Case Flood Depth - 10% AEP

Figure:
5-3

Rev:
A



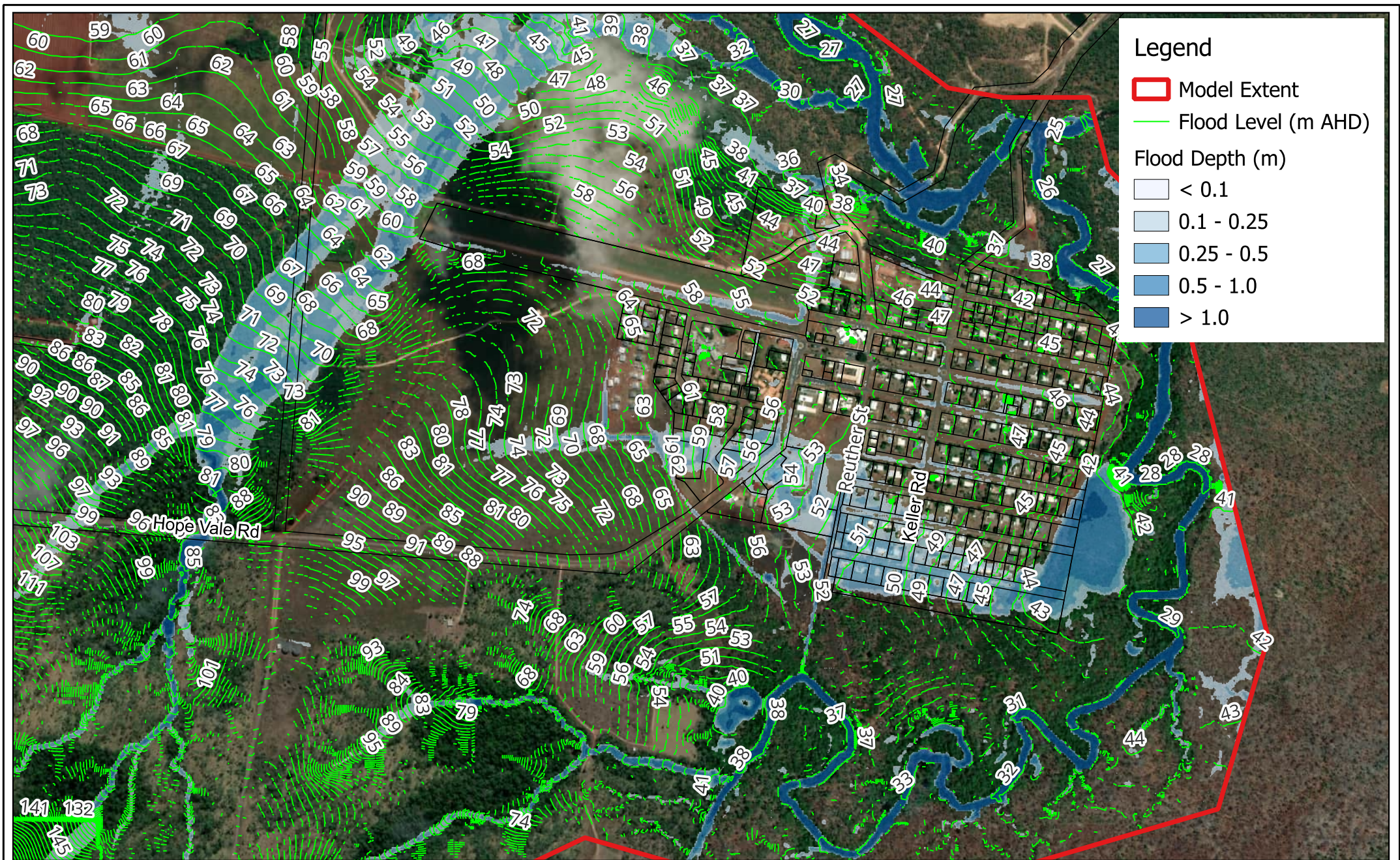
This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.



Filename: S:\Projects\M00605.MJ.HopeValeFloodStudy\GIS\Drawings\L.M00605.001.01\Fig5-3_HVFS_Near-term_SSP5-8.5_10y_005_d_MaxMax.qgz

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Title: Hope Vale Flood Study
Existing Case Flood Depth - 5% AEP

Figure:
5-4

Rev:
A



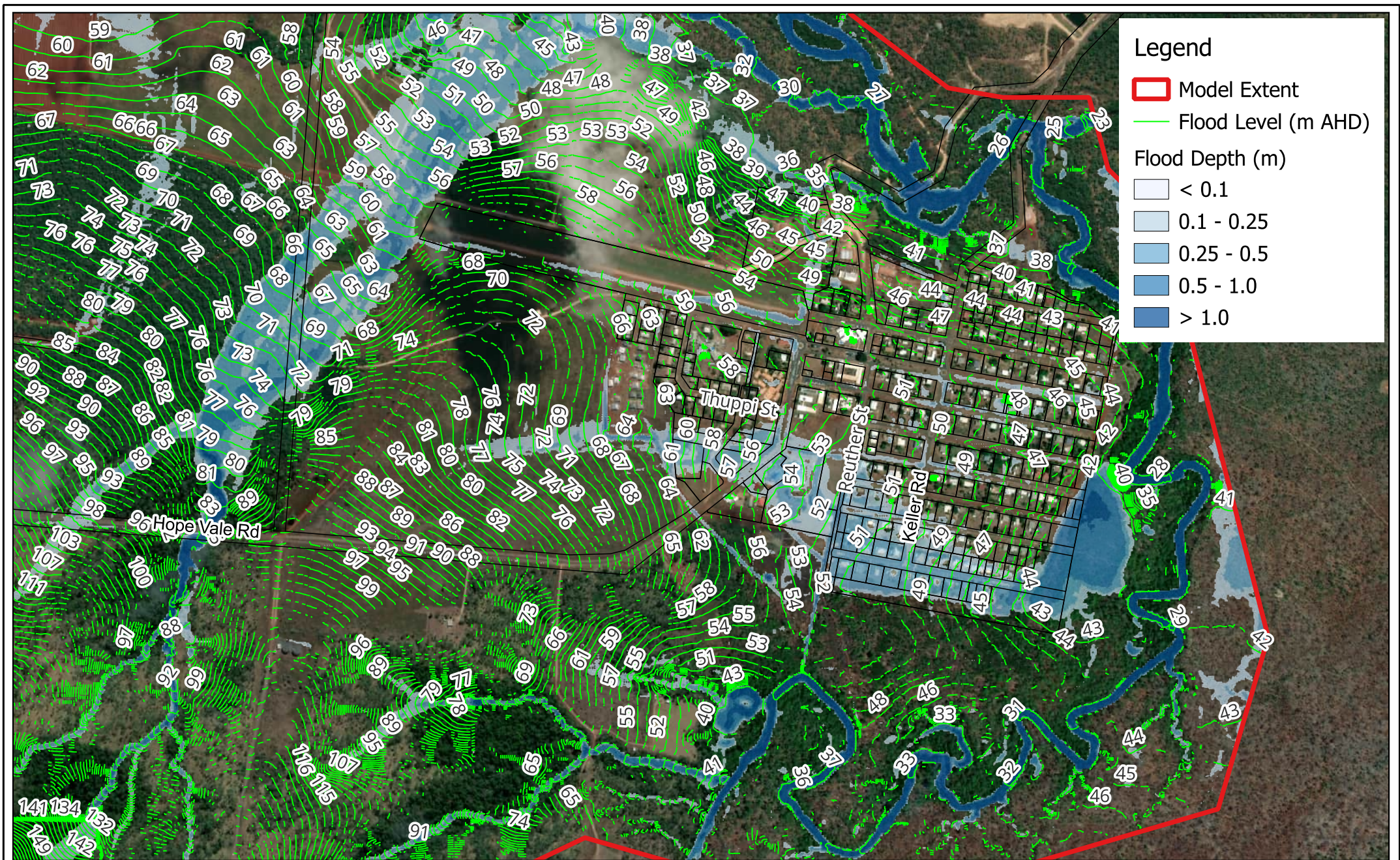
This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.



Filename: S:\Projects\M00605.MJ.HopeValeFloodStudy\GIS\Drawings\L.M00605.001.01\Fig5-4_HVFS_Near-term_SSP5-8.5_20y_005_d_MaxMax.qgz

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Title: Hope Vale Flood Study
Existing Case Flood Depth - 2% AEP

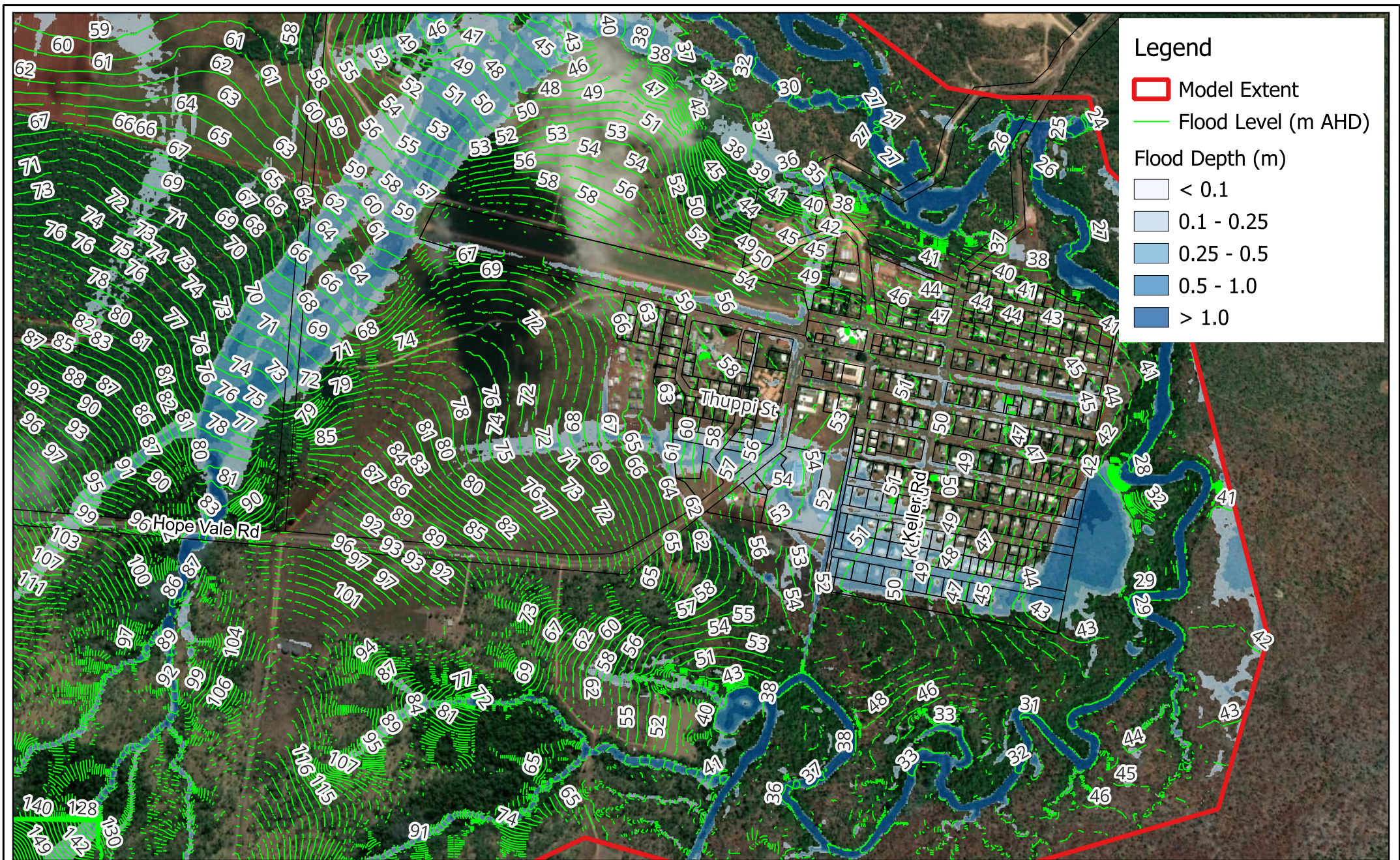
Figure:
5-5

Rev:
A



This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.

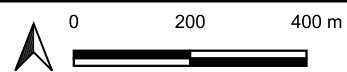




Title: Hope Vale Flood Study
Existing Case Flood Depth - 1% AEP

Figure:
5-6

Rev:
A



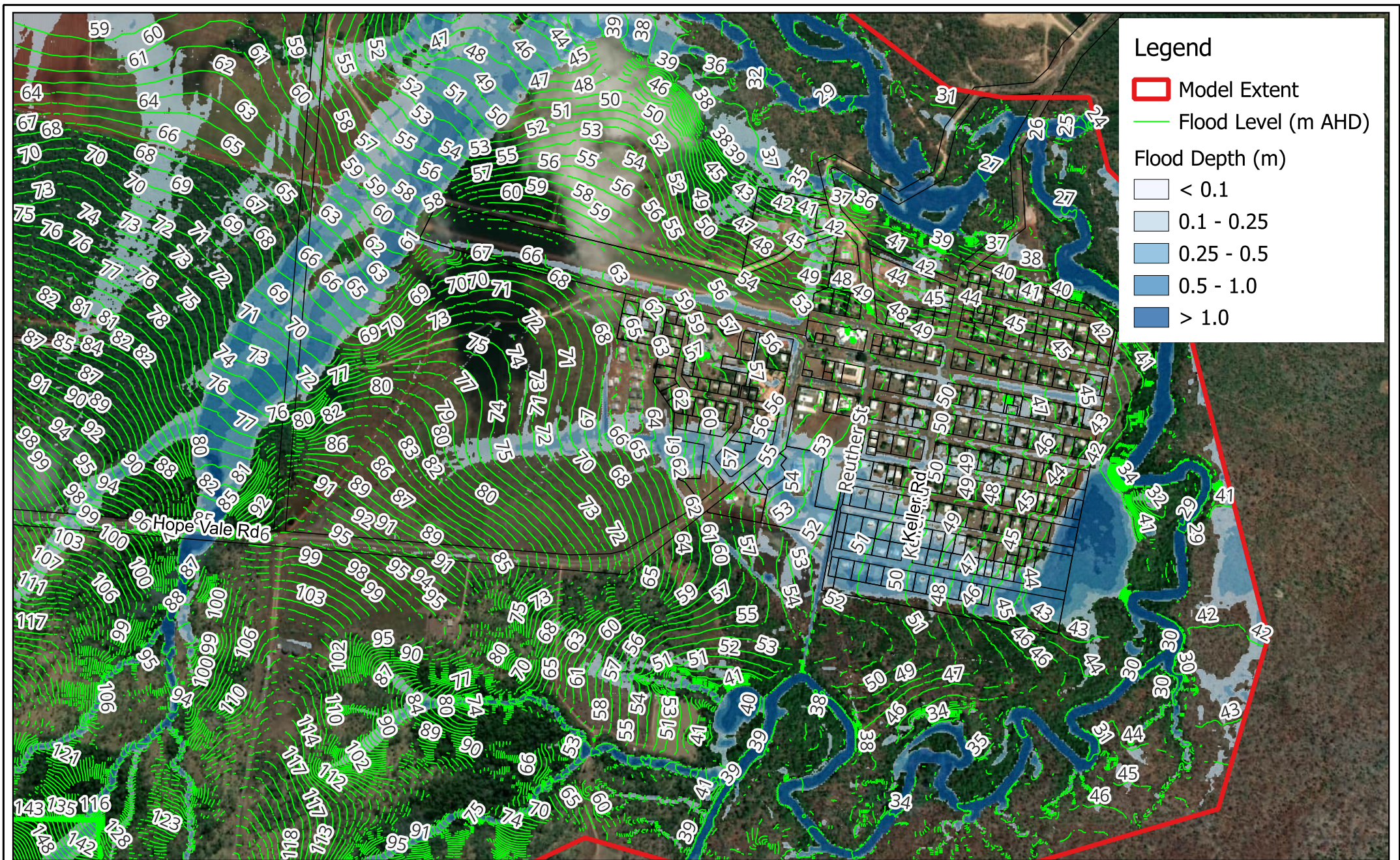
This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.



Filename: S:\Projects\M00605.MJ.HopeValeFloodStudy\GIS\Drawings\L.M00605.001.01\Fig5-6_HVFS_Near-term_SSP5-8.5_100y_005_d_MaxMax.qgz

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Title: Hope Vale Flood Study
Existing Case Flood Depth - 1% AEP + 2100 Climate Change

Figure:
5-7

Rev:
A



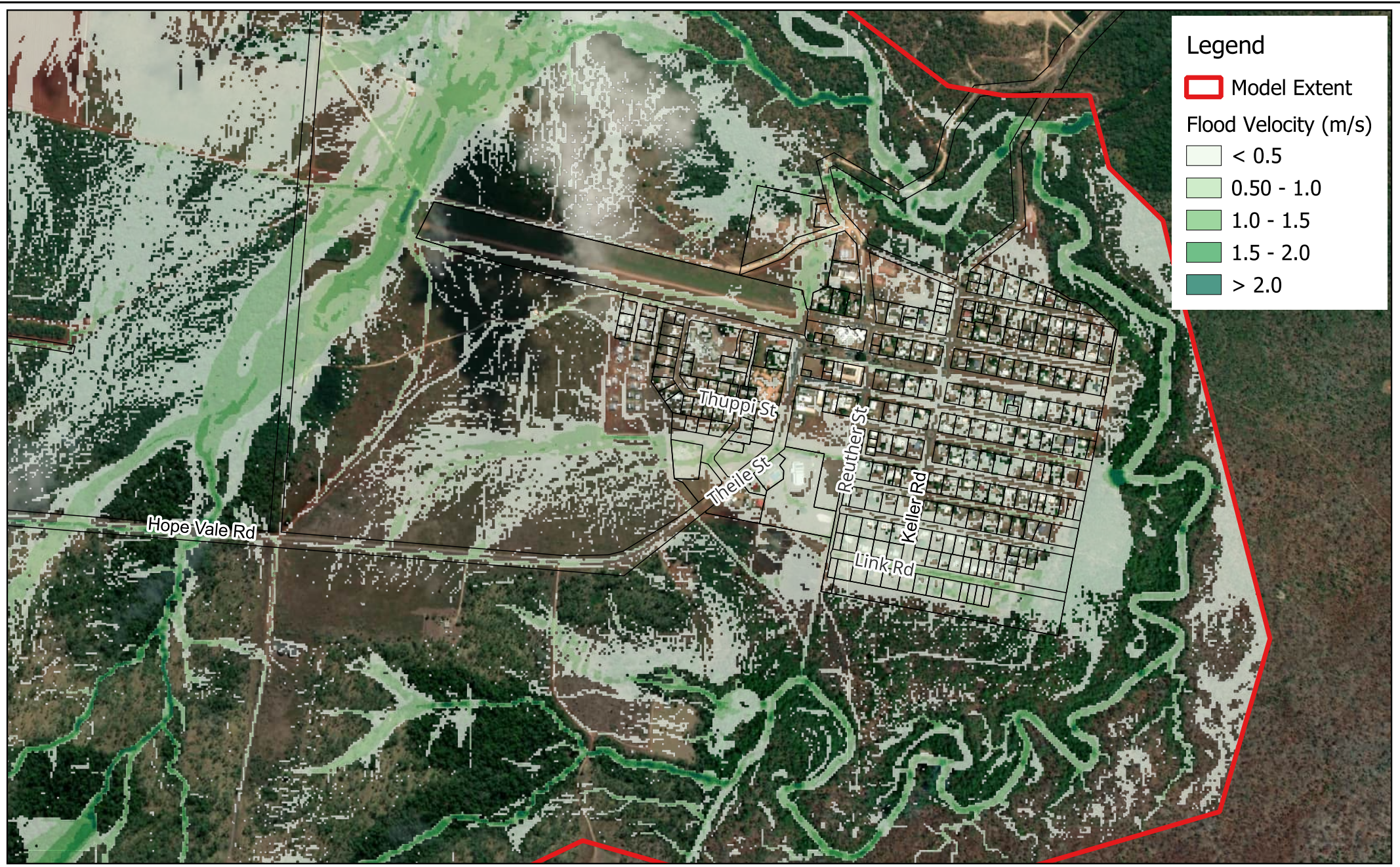
This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented.



Filename: S:\Projects\M00605.MJ.HopeValeFloodStudy\GIS\Drawings\L.M00605.001.01\Fig5-7_HVFS_long-term_SSP5-8.5_100y_005_d_MaxMax.qgz

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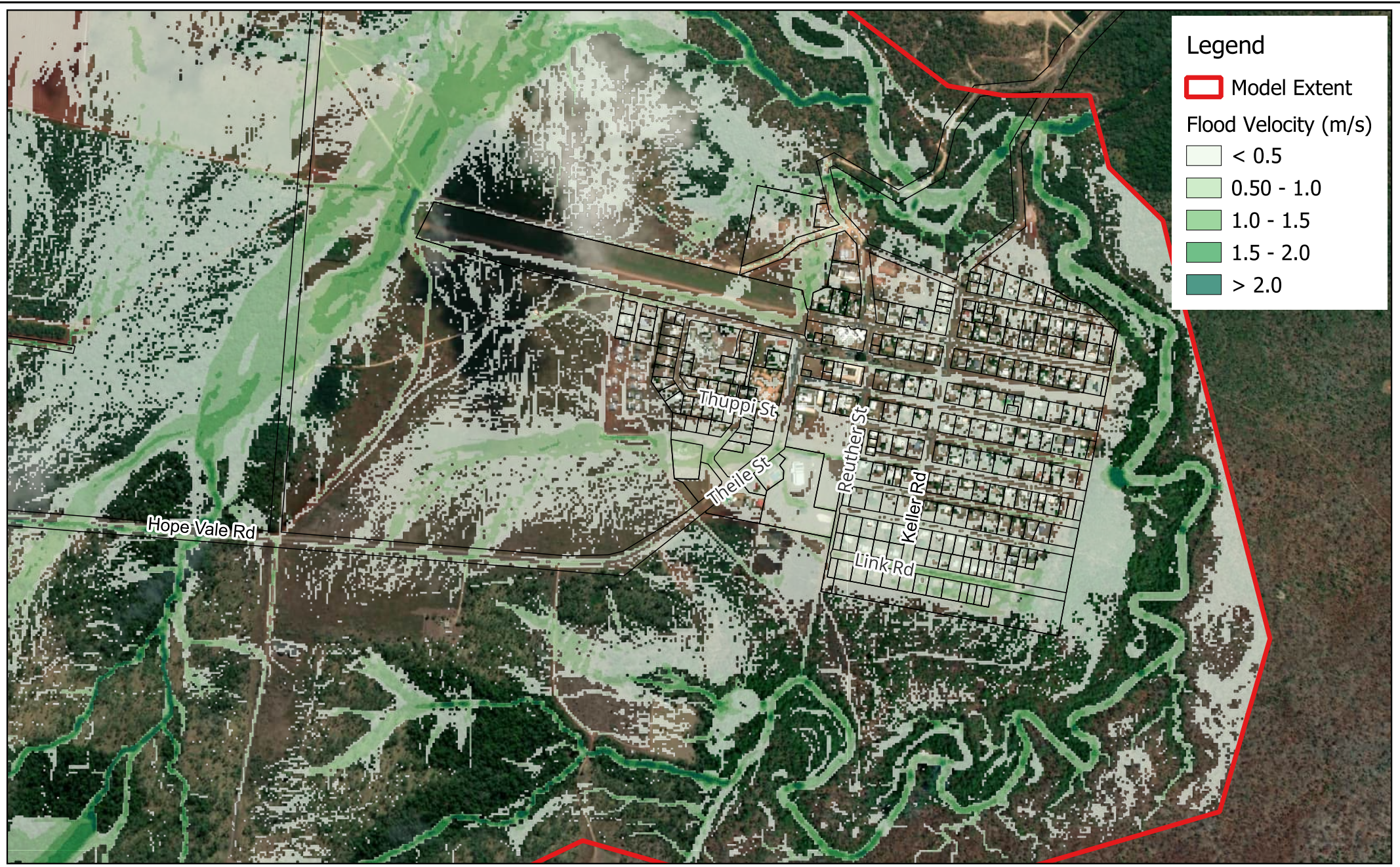


Legend

Model Extent

Flood Velocity (m/s)

- < 0.5
- 0.50 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0



Legend

Model Extent

Flood Velocity (m/s)

- < 0.5
- 0.50 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0



Legend

Model Extent

Flood Velocity (m/s)

- < 0.5
- 0.50 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0



Legend

Model Extent

Flood Velocity (m/s)

- < 0.5
- 0.50 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0



Legend

Model Extent

Flood Velocity (m/s)

- < 0.5
- 0.50 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0



Legend

Model Extent

Flood Velocity (m/s)

- < 0.5
- 0.50 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0



Legend

Model Extent

Flood Velocity (m/s)

- < 0.5
- 0.50 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

6 Preliminary Mitigation Advice

As noted in Chapter 6, the mapping shows that the southern part of the town is most affected by flooding, particularly along Link Rd and the western end of Rose St and Kotzur St. It may be possible to mitigate flooding in these areas by drainage upgrades at the two locations shown in Figure 6-1. The intent of upgrading these drains would be to capture the flow from the west and take it to the river to the south rather than flowing through the residential areas. Included on Figure 6-1 are locations where flows are extracted from the model. These flows are listed in Table 6-1 and could be used for preliminary sizing of drains.

Table 6-1 Peak flows at selected locations

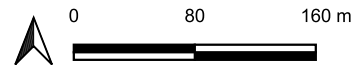
Location \ AEP	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
4	6.4	8.2	10.4	13.3	16.0	17.4
5	7.2	8.2	12.0	15.4	17.9	19.8
6	0.7	0.8	0.9	1.0	1.1	1.1
4	6.4	8.2	10.4	13.3	16.0	17.4
8	6.0	8.4	9.5	11.5	13.9	15.3
9	1.2	1.8	2.3	2.9	3.6	3.9
12	2.3	2.5	2.6	2.9	3.0	3.1
13	2.0	2.2	2.4	2.6	2.8	3.0
15	1.5	1.6	1.7	1.7	1.8	1.8



Title: Hope Vale Flood Study
Flow Locations for Mitigation Options

Figure:
6-1

Rev:
A



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Mar 2026

7 Summary & Conclusion

Flood mapping has been prepared for the town of Hopevale and surrounds 50%, 20% and 1% AEP design flood events. A TUFLOW hydraulic model was developed to assess flood levels and depths for regional catchment flooding. Rain-on-grid modelling within the TUFLOW model rather than a separate hydrological model was used to simulate rainfall-runoff.

Preliminary ideas for mitigation of flood impact residential areas in the south part of town were presented.

8 References

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M and Testoni I (Ed) (2019), *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Version 4.2, Commonwealth of Australia (Geoscience Australia).

Schwalm C, Glendon S, Duffy P (2020), 'RCP8.5 tracks cumulative CO2 emissions', *Proceedings of the National Academy of Sciences*, Vol. 117, No. 33.

APPENDIX B

DRAIN AND CUVLERT SIZING CALCULATIONS

HYDRAULICS ASSESSMENT

(OPEN DRAIN CAPACITY - TRAPIZOIDAL)

Manning's Equation

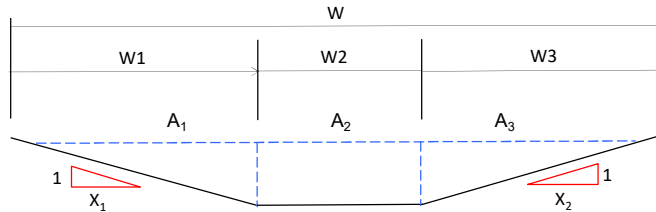
Site 1 - Drain West of Cemetery

(1) Design Flow

$$Q_{Des} = 19.800 \text{ m}^3/\text{s}$$

Input
Output

(2) Open Drain - Trapizoidal



Channel Properties

$X_1 =$	4.0	
$X_2 =$	4.0	
Material =	Grass	
Manning's, n =	0.035	
Channel length =		m
USIL =		m
DSIL =		m
Slope =	0.010	1.0%
Base width =	2.0	m
Flow depth =	1.30	m
Freeboard =	0.00	m

Manning's Calculation:

Flow Areas

$A_1 =$	3.380	m^2
$A_2 =$	2.600	m^2
$A_3 =$	3.380	m^2

Wetted Perimeters

$P_1 =$	5.360	m
$P_2 =$	2.000	m
$P_3 =$	5.360	m

Hydraulic Radius

$$R = 0.736 \text{ m}$$

Capacity

$$Q = 21.797 \text{ m}^3/\text{s}$$

Velocity: 2.329 m/s

WARNING!! - VELOCITY IN CATCH DRAIN EXCEEDS 2.0m/s

$D_g \times V_{ave}$: $3.027 \text{ m}^2/\text{s}$

WARNING!! - $dg \times Vave > 0.60$

Total Capacity: $21.797 \text{ m}^3/\text{s}$

OK

V-Drain Design:

Top width, W1	5.20	m
Top width, W2	2.00	m
Top width, W3	5.20	m
Total Width, W	12.400	m
Base width	2.000	m
Side Slope (LHS)	1 on 4	
Side Slope (RHS)	1 on 4	
Channel Depth	1.300	m
Channel Slope	0.010	m/m

HYDRAULICS ASSESSMENT

(BOX CULVERT CAPACITY)

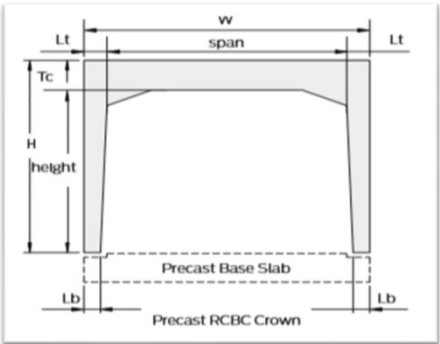
Manning's Equation

Site 1 - Drain West of Cemetery

(1) Design Flow

$Q_{Des} = 17.900 \text{ m}^3/\text{s}$

(2) Box Culvert Flow



Box Culvert Properties

Span =	1200	mm
Height =	900	mm
Manning's, n =	0.013	
Culvert length =		m
USIL =		m
DSIL =		m
Slope =	0.0100	m/m
No. of cell =	6	

1.00%

Manning's Calculation:

Flow Areas

$A = 6.480 \text{ m}^2$

Wetted Perimeters

$P = 25.200 \text{ m}$

Hydraulic Radius

$R = 0.257 \text{ m}$

Capacity

$Q = 20.156 \text{ m}^3/\text{s}$

Velocity: 3.111 m/s OK

Total Capacity: 20.156 m³/s OK

Box Culvert Design:

Span	1200	mm
Height	900	mm
No. of Cell	6.0	
Culvert Slope	0.0100	m/m

Input
Output

HYDRAULICS ASSESSMENT

(OPEN DRAIN CAPACITY - TRAPIZOIDAL)

Manning's Equation

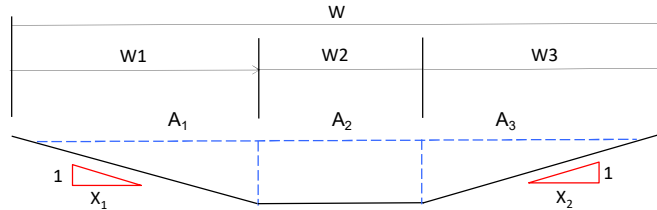
Site 2 - Drain East of School

(1) Design Flow

$Q_{Des} = 15.300 \text{ m}^3/\text{s}$

Input
Output

(2) Open Drain - Trapizoidal



Channel Properties

$X_1 =$	4.0	
$X_2 =$	4.0	
Material =	Grass	
Manning's, n =	0.035	
Channel length =		m
USIL =		m
DSIL =		m
Slope =	0.010	m/m 1.0%
Base width =	1.5	m
Flow depth =	1.20	m
Freeboard =	0.00	m

Manning's Calculation:

Flow Areas

$A_1 =$	2.880	m^2
$A_2 =$	1.800	m^2
$A_3 =$	2.880	m^2

Wetted Perimeters

$P_1 =$	4.948	m
$P_2 =$	1.500	m
$P_3 =$	4.948	m

Hydraulic Radius

$R =$	0.663	m
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Capacity

$Q =$	16.430	m^3/s
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Velocity: 2.173 m/s

WARNING!! - VELOCITY IN CATCH DRAIN EXCEEDS 2.0m/s

$D_g \times V_{ave}$: 2.608 m^2/s

WARNING!! - $d_g \times V_{ave} > 0.60$

Total Capacity: 16.430 m^3/s

OK

V-Drain Design:

Top width, W1	4.80	m
Top width, W2	1.50	m
Top width, W3	4.80	m
Total Width, W	11.100	m
Base width	1.500	m
Side Slope (LHS)	1 on 4	
Side Slope (RHS)	1 on 4	
Channel Depth	1.200	m
Channel Slope	0.010	m/m

APPENDIX C

COST ESTIMATES

ENGINEERS ESTIMATE

HOPE VALE LOCAL DRAINAGE ASSESSMENT

SITE 1 - DRAIN WEST OF CEMETERY

Job No. 1399
 Ref No. -
 Date.

ITEM	DESCRIPTION	TOTAL
1	SCHEDULE A - PRELIMINARY	\$86,000.00
2	SCHEDULE B - EARTHWORKS	\$180,980.00
3	SCHEDULE C - STORMWATER	\$390,500.00
4	SCHEDULE D - ROADWORKS	\$75,000.00
	CONTINGECNY 20%	\$146,496.00
SUBTOTAL		\$878,976.00
10% GST		\$87,897.60
CONSTRUCTION TOTAL		\$966,873.60

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	SCHEDULE A - PRELIMINARY				
1.1	Site Establishment/Dis-establishment	Item	1.0	\$50,000.00	\$50,000.00
1.2	Provision for traffic	Item	1.0	\$15,000.00	\$15,000.00
1.3	Environmental management plan	Item	1.0	\$5,000.00	\$5,000.00
1.4	Erosion and Sediment Control Measures	Item	1.0	\$10,000.00	\$10,000.00
1.5	Public consultation (notification to residents/property owners)	Item	1.0	\$1,000.00	\$1,000.00
1.6	As-constructed documentation	Item	1.0	\$5,000.00	\$5,000.00
SCHEDULE A - PRELIMINARY (EXCL. GST)					\$86,000.00
2	SCHEDULE B - EARTHWORKS				
2.1	Clearing and grubbing	m ²	3640.0	\$5.00	\$18,200.00
2.2	Topsoil Stripping (50mm to Stockpile)	m ³	182.0	\$15.00	\$2,730.00
2.3	Earthworks:				\$0.00
	(a) Cut to spoil (including drain extension)	m ³	2621.0	\$40.00	\$104,840.00
	(b) Unsuitable material replacement - Type 2.3 150mm thick (Provisional Qty)	m ³	25.0	\$150.00	\$3,750.00
2.4	Trim, water and compact slab subgrade (compaction 98% SRDD)	m ²	100.0	\$5.00	\$500.00
2.5	Compact and final trim of batters	m ²	3640.0	\$4.00	\$14,560.00
2.6	50mm topsoil and grass seed to verges, batters and disturbed areas	m ²	3640.0	\$10.00	\$36,400.00
SCHEDULE B - EARTHWORKS (EXCL. GST)					\$180,980.00
3	SCHEDULE C - STORMWATER				
3.1	Supply and install of drainage structures complete including excavation, bedding, backfill, compact and dispose of surplus materials:				
	(a) 6/1200x900 RCBC	m	43.0	\$7,500.00	\$322,500.00
	(b) Blinding Concrete	m ³	15.0	\$800.00	\$12,000.00
	(c) Reinforced Concrete Culvert Base Slab	m ³	20.0	\$1,800.00	\$36,000.00
	(d) Reinforced Concrete Headwall, apron, wingwall and cutoff wall	No.	2.0	\$7,500.00	\$15,000.00
3.2	Dumped rock protection including excavation, geofabric under, supply and place of rock (300mm thick d ₅₀ = 200mm)	m ²	50.0	\$100.00	\$5,000.00
SCHEDULE C - STORMWATER (EXCL. GST)					\$390,500.00
4	SCHEDULE D - ROADWORKS				
4.1	Pavement reinstatement over culverts	m ²	150.0	\$500.00	\$75,000.00
SCHEDULE D - ROADWORKS					\$75,000.00

ENGINEERS ESTIMATE
HOPE VALE LOCAL DRAINAGE ASSESSMENT
 SITE 2 - DRAIN EAST OF SCHOOL

Job No. 1399
 Ref No. -
 Date.

ITEM	DESCRIPTION	TOTAL
1	SCHEDULE A - PRELIMINARY	\$86,000.00
2	SCHEDULE B - EARTHWORKS	\$216,121.25
	CONTINGECNY 20%	\$60,424.25
SUBTOTAL		\$362,545.50
10% GST		\$36,254.55
CONSTRUCTION TOTAL		\$398,800.05

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	SCHEDULE A - PRELIMINARY				
1.1	Site Establishment/Dis-establishment	Item	1.0	\$50,000.00	\$50,000.00
1.2	Provision for traffic	Item	1.0	\$15,000.00	\$15,000.00
1.3	Environmental management plan	Item	1.0	\$5,000.00	\$5,000.00
1.4	Erosion and Sediment Control Measures	Item	1.0	\$10,000.00	\$10,000.00
1.5	Public consultation (notification to residents/property owners)	Item	1.0	\$1,000.00	\$1,000.00
1.6	As-constructed documentation	Item	1.0	\$5,000.00	\$5,000.00
SCHEDULE A - PRELIMINARY (EXCL. GST)					\$86,000.00
2	SCHEDULE B - EARTHWORKS				
2.1	Clearing and grubbing	m ²	4715.0	\$5.00	\$23,575.00
2.2	Topsoil Stripping (50mm to Stockpile)	m ³	235.8	\$15.00	\$3,536.25
2.3	Earthworks:				\$0.00
	(a) Cut to spoil (including drain extension)	m ³	3075.0	\$40.00	\$123,000.00
	(b) Unsuitable material replacement - Type 2.3 150mm thick (Provisional Qty)	m ³	0.0	\$150.00	\$0.00
2.4	Trim, water and compact slab subgrade (compaction 98% SRDD)	m ²	0.0	\$5.00	\$0.00
2.5	Compact and final trim of batters	m ²	4715.0	\$4.00	\$18,860.00
2.6	50mm topsoil and grass seed to verges, batters and disturbed areas	m ²	4715.0	\$10.00	\$47,150.00
SCHEDULE B - EARTHWORKS (EXCL. GST)					\$216,121.25