Engineers & Planners

FLOOD HAZARD REPORT

SD-2008/48
182,220 & 252 Droughty Point Road
Stage 4&5

ALABAMA AVENUE, ENCHANTRESS WAY & ACTAEON STREET
ROKEBY, TAS 7019

December 2022

JMG Project No. J220782CS

Engineers & Planners

Johnstone McGee & Gandy Pty Ltd
ABN 76 473 834 852 ACN 009 547 139
www.jmg.net.au

HOBART OFFICE
117 Harrington Street
Hobart TAS 7000
Phone (03) 6231 2555
infohbt@jmg.net.au

LAUNCESTON OFFICE
49-51 Elizabeth Street
Launceston TAS 7250
Phone (03) 6334 5548
infoltn@jmg.net.au

Issuing Office: 117 Harrington Street, Hobart 7000
JMG Project No. J220782CS

Document Issue Status

Ver.	Issue Date	Description	Originator		Checked		Approved	
1	05.11.2022	Issued for Client Review	CAG		JMB		CJM	
2	09.12.2022	Issued for Council Approval	CAG		JMB		CJM	
3	06.03.2023	Section 5 updated to address council comments	CAG		CJM		CJM	

CONDITIONS OF USE OF THIS DOCUMENT

2. The recipient client is licensed to use this document for its commissioned purpose subject to authorisation per 3. below. Unlicensed use is prohibited. Unlicensed parties may not copy, reproduce or retransmit this document or any part of this document without JMG's prior written permission. Amendment of this document is prohibited by any party other than JMG.
3. This document must be signed "Approved" by JMG to authorise it for use. JMG accepts no liability whatsoever for unauthorised or unlicensed use.
4. Electronic files must be scanned and verified *virus free* by the receiver. JMG accepts no responsibility for loss or damage caused by using files containing viruses.
5. This document must only be reproduced and distributed in full colour. JMG accepts no liability arising from failure to comply with this requirement.

TABLE OF CONTENTS

1. Introduction

JMG Engineers & Planners have been engaged to undertake a Flood Hazard Report for the lots in the recently constructed stages 4&5 of the North Bay subdivision development (SD-2019/6) located at Alabama Avenue, Rokeby (7019). The study has been undertaken in accordance with the Clarence City Council (CCC) Planning Scheme.

The study will determine the completed subdivision's hydrology and hydraulic characteristics, considering a 1% AEP storm event plus climate change factor.

1.1 Background and Objectives

The completed subdivision region is currently located under a flood-prone area overlay according to Clarence City Council Flood Mapping as per Figure 1. However, the development has not been considered in the CCC flood modelling as it was not built at the time of modelling.

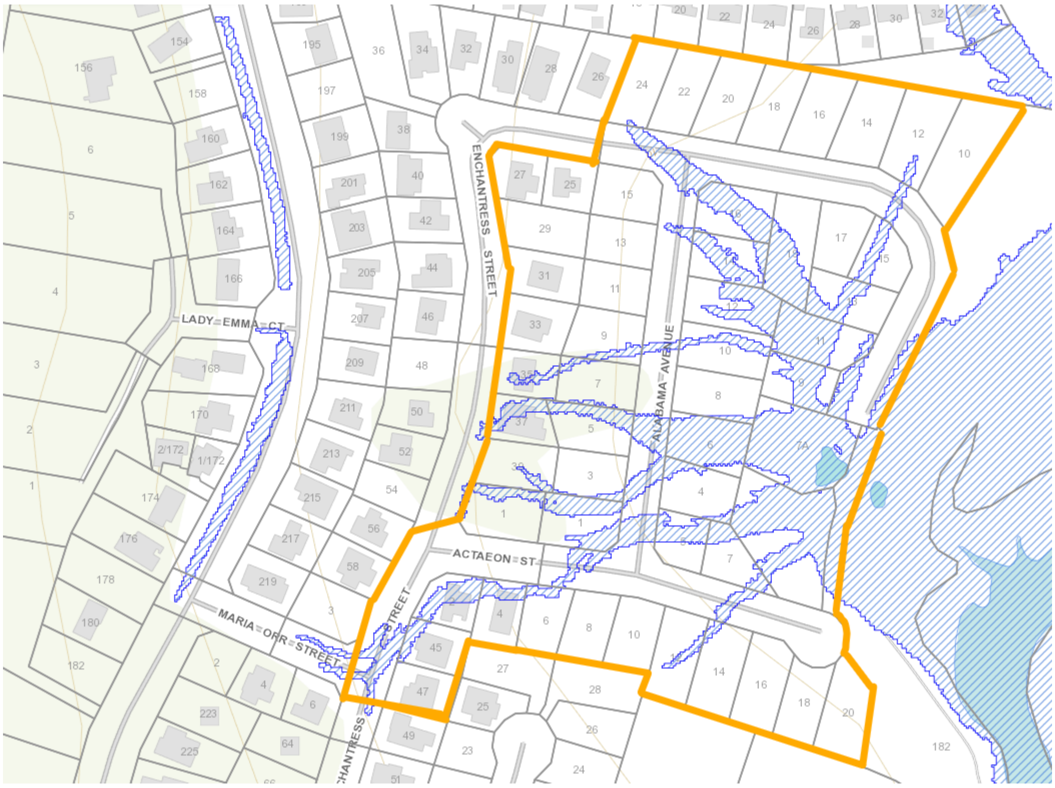

Figure 1: CCC Flood Mapping Modelling Not Considering the Orange Outlined Perimeter

Therefore, this report has been developed to demonstrate an updated overland flow modelling considering the completed subdivision and also to comply with the Tasmanian Planning Scheme – Clarence (TPS) (C12.6.1 – Buildings and Works Within a Flood-Prone Hazard Area) documenting the possible risk concerning riverine flooding across the now developed subject area.

Table 1: Clarence City Council (TPS) Planning Scheme Requirements

State Planning Code	***Objective***	***Acceptable Solution***	***Performance Criteria***	
C12.6.1 Buildings and works within a flood-prone hazard area	(a) Building and works within a flood-prone hazard area can achieve and maintain a tolerable risk from a flood; and (b) Buildings and works do not increase the risk of flood to adjacent land and public infrastructure	*(A1) No Acceptable Solution*	**P1.1** Buildings and works within a flood-prone hazard area must achieve and maintain a tolerable risk from a flood, having regard to the: (a) the type, form, scale and intended duration of the development; (b) whether any increase in the level of risk from a flood requires any specific hazard reduction or protection measures; (c) any advice from a State authority, regulated entity or council; and (d) the advice contained in a flood hazard report	**P1.2** A flood hazard report also demonstrates that the building and works: (a) do not cause or contribute to flooding on the site, on adjacent land or public infrastructure; and (b) can achieve and maintain a tolerable risk from a 1% annual exceedance probability flood event for the intended life of the user without requiring any flood protection measures.

The purpose of this analysis is to:

- Provide an assessment of the site's flood characteristics to the 1% AEP plus climate change.
- Provide a 2D hydraulic analysis of the overland flow and the hazard conditions for the affected area.
- Provide recommendations for the affected area or region, where appropriate.

1.2 Limitations

This report is limited to a range of parameters as per below:

- The hydrology and hydraulic models are restricted and limited to a 1% AEP + Climate Change storm event, considering an ensemble analysis. Adopting the medium storm event from 5min to 24h time analysis, per AR&R 2019 requirements.
- All parameters have been derived from best practice manuals and available relevant studies, including AR&R 2019 guidelines and Clarence City Council advice.

- The present analysis is to be used only for the subject area and should not be used as a general flood study for the region.

2. Catchment Analysis and Surface Parameters

The subject surface has been developed from two different sources. A combination of a survey undertaken on the 21st of October 2022 by Leary, Cox & Cripps (Land & Engineering Surveyors) and a Digital Elevation Model tile, Lidar Image, obtained from Anzlic Committee on Surveying and Mapping (ICSM) – Elvis (Elevation and Depth Foundation Spatial Data) website.

Therefore, the catchment investigation has been detailed in two separate segments as the region presents a mix of rural and urbanised environments described below.

- The furthest upstream catchment, the rural region, presents a blend of light bush and sparse vegetation, with approximately 3.24ha combined and an average surface slope no greater than 25%. The region has been further divided into sub-catchments corresponding to the respective discharge points along Tollard Drive existing stormwater network.

Figure 2: Rural Catchment Discharging to Tollard Drive

- A middle section, right downstream of the rural catchment and still upstream of the area under analysis. This is a medium density residential area, segregated into many sub-catchments, diverting the water to each discharge point on the existing stormwater network across Enchantress Street and Actaeon Street. With this, each sub-basin will present a variation in area, slope and perviousness. Refer section 3.1 for detail.

Figure 3: Residential Catchment Discharging to Enchantress & Acteon Street

All catchments were manually delineated considering the existing stormwater network from Clarence City Council GIS as well as the terrain slope for the overland flow path analysis.

3. Hydrology

3.1 Hydrologic Modelling & General Parameters

The following flows have been calculated using the hydrological modelling software Watercom DRAINS (DRAINS). All meteorological data (Rainfall IFDs, temporal patterns, rainfall pre-burst data and climate change factors) was extracted from the Australian Rainfall & Runoff (ARR) Data Hub and the Bureau of Meteorology (BOM). These parameters are all region-specific based on the following coordinates:

- Longitude: 147.431
- Latitude: -42.9090

The ARR Data Hub (which sources information from the *Climate Change in Australia* Website) provide projections for Interim Climate Change Factors all around the country. However, ARR advises that the design of significant stormwater infrastructure is based on a predicted Climate Change increase in the year 2100, but the Data Hub only provides data up until 2090. The data was extrapolated linearly to determine the factor for the year 2100—a simple yet appropriate extrapolation that best fits the data set.

Table 2: Climate Change, Allowance

Location	Risdon, Tasmania
Representative Concentration Pathway (RCP)	8.5
Year	2090
Factor	3.090 (16.3%)
Year	2100
Factor (Extrapolated)	**18.3%**

The DRAINS RAFTS hydrological model from the Watercom Drains software has been utilised to determine catchment flow rates. The model has been calculated using two different hydrological approaches, RAFTS and IL-CL, as the region presents two different catchment environments, rural and urban, as described in section 2.

RAFTS is a storage routing hydrological model considered appropriate for rural or larger urban catchments.

The sub-catchment areas, average channel lengths and slopes vary as per the following range:

Catchment Area: 0.135 – 0.880 (Ha)

Average Slope: 20 – 25 (%)

Average Channel Length: 160 - 180m

Secondly, IL-CL is the hydrological model more appropriate for urban and developed areas as per Book 5 – Chapter 3 – 3.5.3 (AR&R 2019) in utilising stormwater structures.

The IL-CL values were selected based on recommendations from ARR and CCC Subdivision, and Work Engineer Jardinne Warwick's advice was emailed to JMG Senior Engineer Justin Boocock dated: 23/09/2022. In this way, it is mentioned that 2mm/hr (Continuing Loss) is a more appropriate value based on Council calibration investigations. This email provided no comment on the Initial Loss value for rural catchments such as this one, therefore, 30mm IL has been adopted (per ARR data hub).

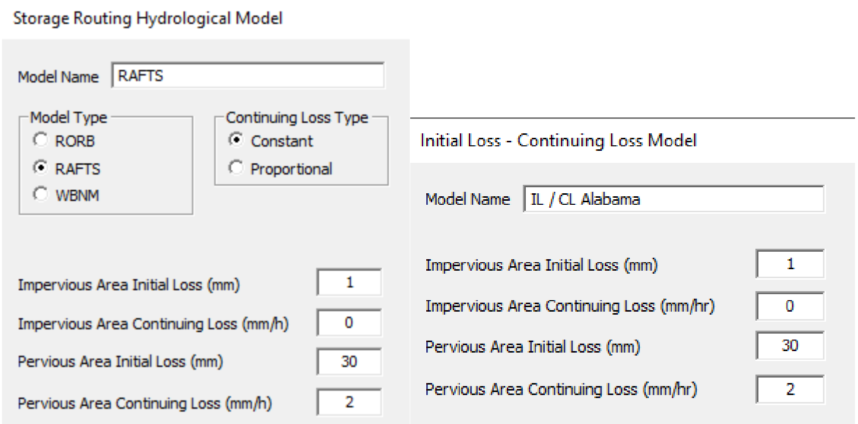

Figure 4: Screenshot from Drains - Hydrological Models Impervious & Pervious Values Adopted for Rural and Urbanized Catchments Respectively

3.2 *Sub-Catchment Properties*

It has been adopted for the Rural catchment the following properties:

Table 3: Physical Parameters for Typical Rural Sub-Catchment

Condition	Manning's 'n' value	Percentage Impervious
Rural Catchment	0.040	10

A Manning's n value of 0.04 is typically selected for natural streams with some obstacles and pools. As this stream only flows in flood events, it is reasonable to adopt a high n-value to reflect the likely overgrown and unmaintained nature of the flow path.

However, the residential catchments were more detailed as they were calculated considering not only the surface and the GIS stormwater network but also additional parameters such as:

- Effective Impervious Area (EIA)
- Remaining Impervious Area (RIA) and
- Pervious Area (PA)
- Additional Time - "Time in minutes required for the longest water drop's distance to get into the stormwater network."
- Retardance Coefficient n*

*Table 4: Retardance Coefficient n**

Surface Type	*Roughness Coefficient n**
Concrete or Asphalt	0.01-0.013
Bare Sand	0.01-0.016
Gravelled Surface	0.012-0.03
Bare Clay-Loam Soil (eroded)	0.012-0.033
Sparse Vegetation	0.053-0.130
Short Grass Prairie (Veldt or Scrub)	0.10-0.20
Lawns	0.17-0.48

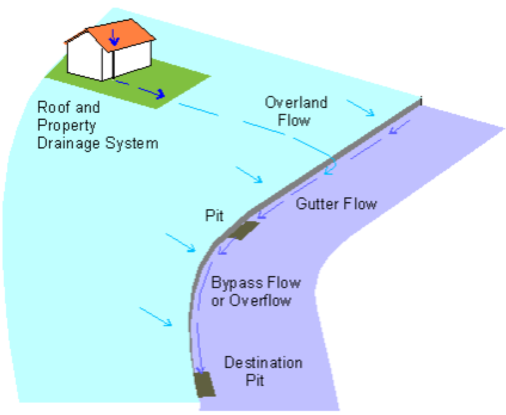

Figure 5: Screenshot from Drains - Overland Flow Scheme

Therefore, the delineation was cautiously marked, considering only two scenarios. Scenario 1 assumes the public roads & footpaths. On the other hand, scenario 2 considers private properties, including landscaping, house and driveways.

	EIA	RIA	PA
Percentage of area	65	10	25
Additional time (mins)	1	2	3
Flow path length (m)			
Flow path slope (%)			
Retardance coefficient n*	0.010	0.012	0.053

	EIA	RIA	PA
Percentage of area	85	5	10
Additional time (mins)	2	3	3
Flow path length (m)			
Flow path slope (%)			
Retardance coefficient n*	0.010	0.012	0.053

Figure 6: Screenshot from Drains – Scenarios 1 & 2 Respectively

Observation:

- Additional Time and flow path slope from Figure 5 can vary depending on different pit locations and surface parameters in the under-analysis spot.
- These values were assumed based on a review of the catchment and best practice guidelines.
- Pipes and node levels were derived from CCC GIS Network Shape Files. In the absence of an invert level of pipes, it has been adopted that the subject segment is laid in parallel with the surface with 600mm of cover and matching levels of the closest invert of the pit.
- Grated and Side-entry pits are considered with 20% of blockage factor.

4. Hydraulics

4.1 Drains

Drains has also been used to calculate the hydraulic condition of the model. A sequence of side-entry pits/manholes, pipes and overland flows has been designed based on the CCC GIS stormwater network shapefile parameters. In the absence of an invert level of pipes, it has been adopted that the subject segment is laid in parallel with the surface with 600mm of cover and matching levels of the closest invert of the pit.

4.2 Overland Flow Results

Calculated the subject region, the developed area, delimited in Figure 1, is affected by some overland flows from three different locations. Firstly, a significant flow runs along 35 & 37 Enchantress Street down to 5 & 7 Alabama Avenue, identified as (Inflow 1). Furthermore, a secondary and tertiary flow comes from the northern (Inflow 2) and southern (Inflow 3) corners of Enchantress & Acteon Street to Alabama Avenue.

- Inflow 1: 0.186m^3/s
- Inflow 2: 0.036m^3/s
- Inflow 3: 0.028m^3/s

Figure 7: Overland Flow Scheme

4.3 HEC-RAS (2D Analysis)

A HEC-RAS model has been used to undertake a 2D unsteady flow analysis using the flows described above. The software is an ARR-recognised 2D modelling program, ideal for overland flows, depths, velocities and overland flood extents.

4.4 Surface, Geometry and Flow Boundaries

The analysed surface has been built and considered the parameters described in section 2 – first paragraph. In addition, the geometry mesh has been defined as an appropriate region surrounding the watercourse.

The inflow and the outflow set a suitable distance upstream and downstream from the target modelling area to ensure that the model has time to stabilise at the upstream end and is not influenced by backwater at the downstream end.

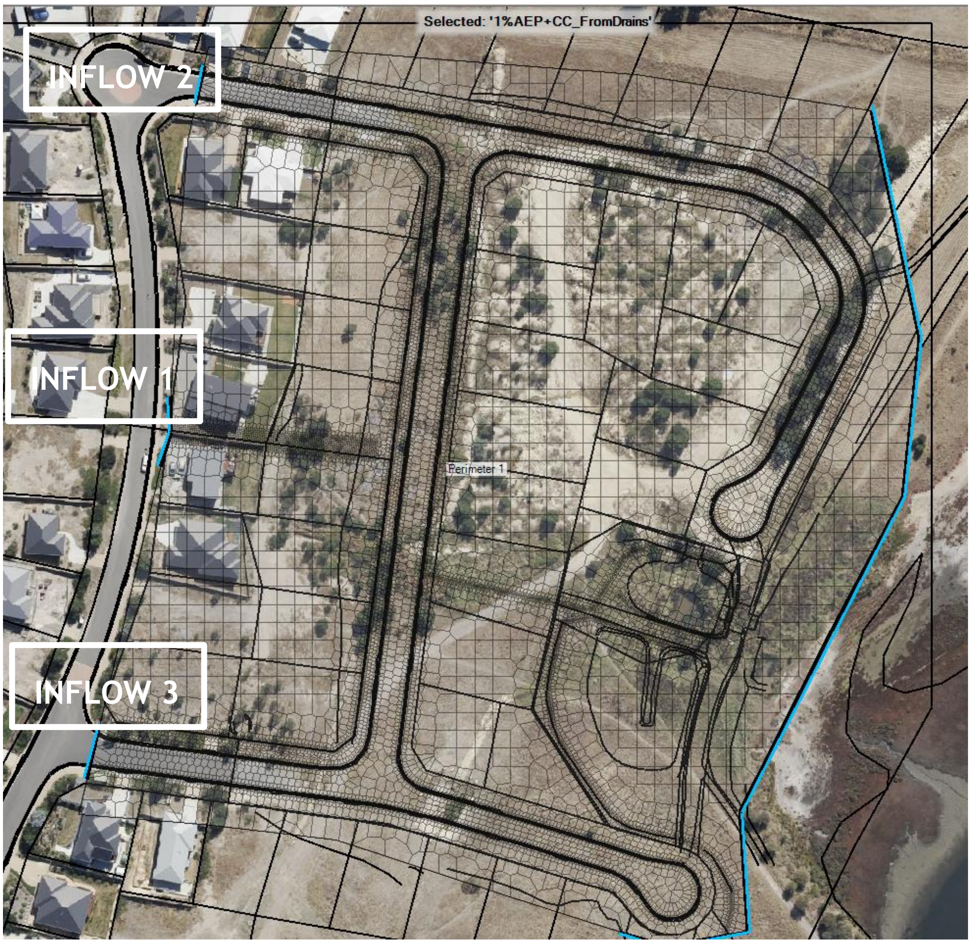

Figure 8: HEC-RAS Screenshot: Geometry Mesh and Flow Boundaries

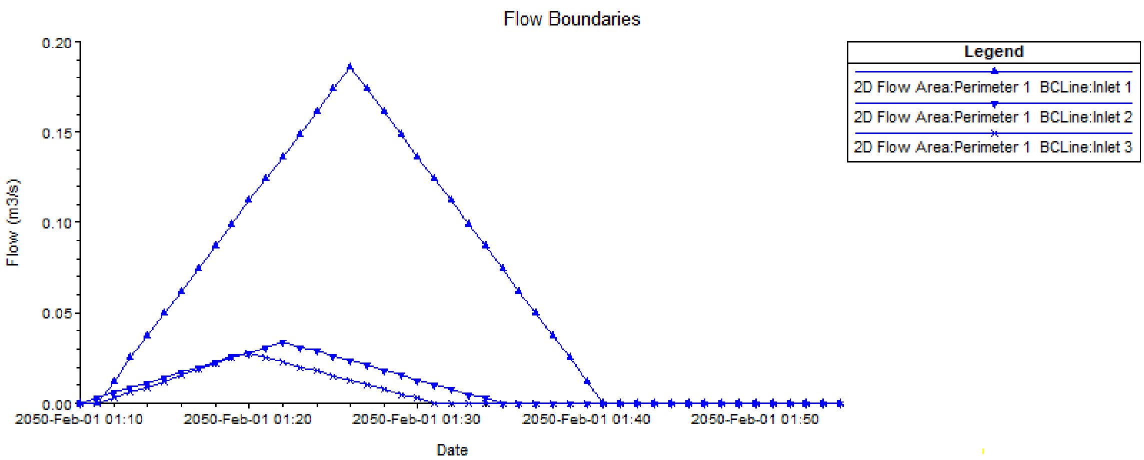

Figure 9: HEC-RAS Screenshot: Overland Hydrographs from Drains Analysis

4.5 HEC-RAS Results

The following results present the maximum water depth, velocity and water surface elevation (WSE) for the 1% AEP + CC.

Figure 10: HEC-RAS Screenshot: Maximum Depth Along Alabama Avenue and maximum offset from the boundary of lots 6 & 8.

Figure 11: HEC-RAS Screenshot: Maximum Velocity Along Alabama Avenue and Downstream Blocks

Figure 12: HEC-RAS Screenshot: Maximum Water Surface Elevation (WSE) Along Alabama Avenue and Downstream Blocks

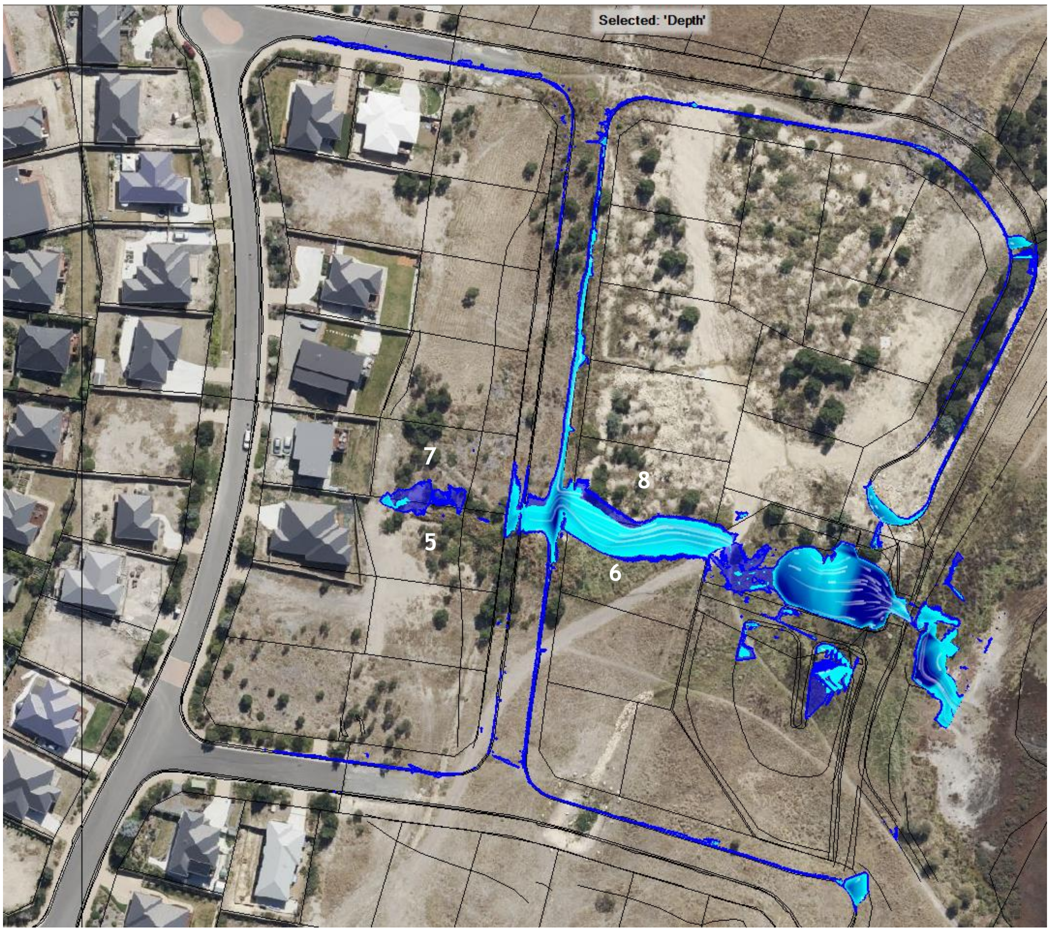

Figure 13: HEC-RAS Screenshot: Inundation Boundary Extents for the 1%AEP + CC

In summary, the 2D analysis provided the following results:

- Alabama Avenue
  - Maximum Depth: ≤130mm
  - Maximum Velocity: ≤ 1.70m/s
  - Maximum (Depth * Velocity): 0.110

- Lots (5, 6, 7 and 8)
  - Maximum Depth: ≤50mm
  - Maximum Velocity: ≤ 2.00m/s
  - Maximum (Depth * Velocity): 0.115

Overall, the model demonstrates that Alabama Avenue, Enchantress & Acteon Street accommodate the runoff from the 1% AEP + CC event with no further flood extents along the developed region except lots 5, 6, 7 and 8, which is further analysed in Section 5.

5. Flood Hazard Analysis

Flood Risk Hazard Levels are typically classified based on the depth (m), velocity (m/s, or a combination of depth and velocity as per the following graphic and table from 'Updating National Guidance on Best Practice Flood Risk Management (D. McLuckie et al., 2014).

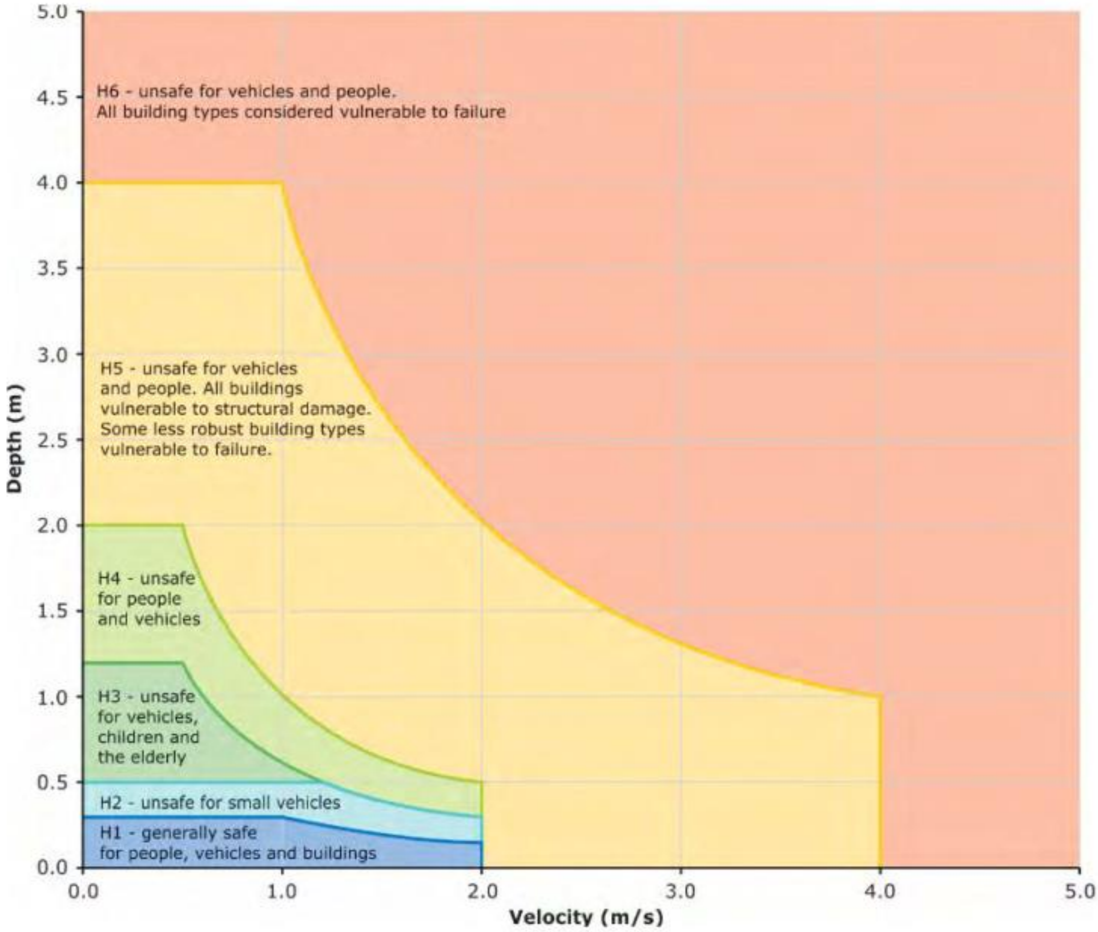

Figure 14: Combined Flood Hazard Curve Classification

Hazard Classification	Description (and defined limits)
H1	Relatively benign flow conditions. No vulnerability constraints. (D < 0.3 m, V < 2.0 m/s, or V x D < 0.3)
H2	Unsafe for small vehicles. (D < 0.5 m, V < 2.0 m/s, or V x D < 0.6)
H3	Unsafe for all vehicles, children and the elderly. (D < 1.2 m, V < 2.0 m/s, or V x D < 0.6)
H4	Unsafe for all pedestrians and vehicles. (D < 2.0 m, V < 2.0 m/s, or V x D < 1.0)
H5	Unsafe for all pedestrians and vehicles. Buildings require special engineering design and construction. (D < 4.0 m, V < 4.0 m/s, or V x D < 4.0)
H6	Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure. (D > 4.0 m, V > 4.0 m/s, or V x D > 4.0)

Figure 15: Hazard Classifications – Vulnerability Thresholds

Alabama Avenue and lots (5, 6, 7 and 8) region are subject to be inundated to <300mm depth and <2.0m/s or (v*d <0.30). Therefore, in the event of flooding, the predicted overland flow will be considered as H1 (Relatively benign flow conditions. No vulnerability constraints).

6. Response to TPS C12.6.1

Table 1: JMG Response to Clarence City Council (TPS) Planning Scheme Requirements

State Planning Code	***Performance Criteria* 1.2** A flood hazard report also demonstrates that the building and works:	***JMG Assessment***
C12.6.1 Buildings and works within a flood-prone hazard area	(a) do not cause or contribute to flooding on the site, on adjacent land or on public infrastructure	As demonstrated in Sections 4.5 & 5, Alabama Avenue, Enchantress & Acteon Street accommodate the calculated runoff. Furthermore, the remaining runoff along lots 5, 6, 7 and 8 presents low hazard (H1) vulnerability constraints due to the low velocities and minimal depths as per the hazard classification in figure 14. Lots 6 & 8 have a maximum offset of inundation boundary of 8.90m south and 7.4m north as presented in figure 10. It is recommended to set a minimum 300mm of freeboard to the finished floor level for <u>any</u> development in the affected Lots. Therefore the completed subdivision, within the flood-prone area, redirects flows to a small number of lots, removing the risk from the remainder of the subdivision development and achieving a tolerable risk level under the 1% AEP flood event to those lots which area affected.
	(b) can achieve and maintain a tolerable risk from a 1% annual exceedance probability flood event for the intended life of the user without requiring any flood protection measures.	

APPENDIX A

JMG Drawing Set

CLARENCE CITY COUNCIL ENGINEERS COMMENT

Gopal Neupane
Mar 7, 2023, 4:50 PM (8 days ago)

to Christopher, Caetanno, me

Thanks Chris,
The report is satisfactory and would suggest that it is passed on to the property owners/future owners for submitting or assisting with their build.

Regards,

Icon

Description automatically generated

Gopal Neupane
Senior Development Engineer | Clarence City Council
a 38 Bligh Street | PO Box 96 Rosny Park TAS 7018
p 03 6217 9702
e gneupane@ccc.tas.gov.au | w www.ccc.tas.gov.au

Johnstone McGee & Gandy Pty Ltd

ABN 76 473 834 852 ACN 009 547 139

www.jmg.net.au

HOBART OFFICE
117 Harrington Street
Hobart TAS 7000
Phone (03) 6231 2555
infohbt@jmg.net.au

LAUNCESTON OFFICE
49-51 Elizabeth Street
Launceston TAS 7250
Phone (03) 6334 5548
infoltn@jmg.net.au

Engineers & Planners