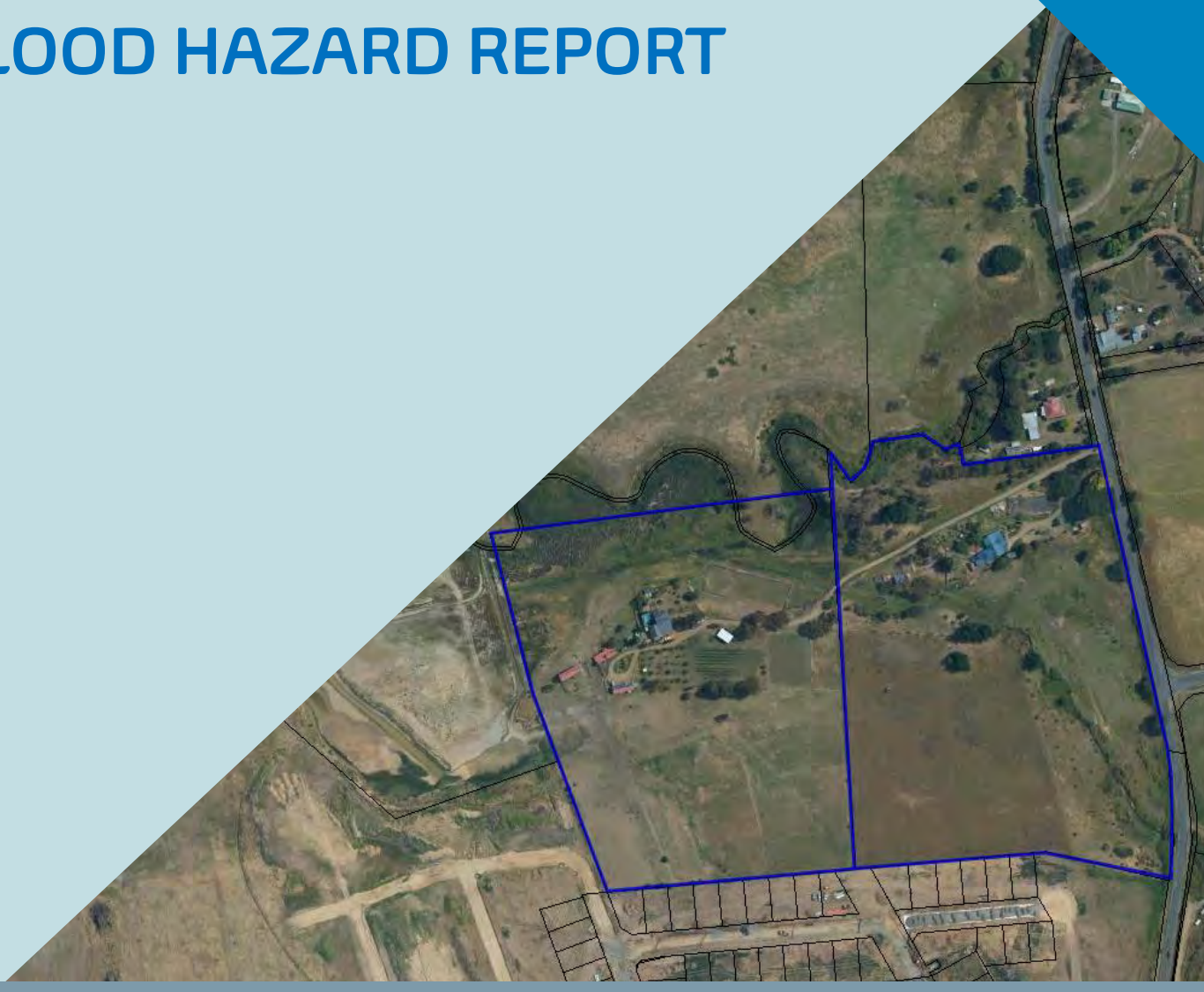
ATTACHMENT 1

Flood Management Report

16th March 2023

FE_22144

203-205 Old Beach Road, Old Beach
FLOOD HAZARD REPORT



Prepared for: JMG Engineers & Planners

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Document Initial Revision

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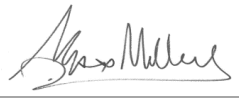
Prepared by	Max W. Moller *Principal Hydraulic Engineer*		02/03/2023
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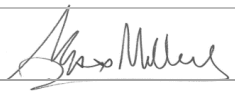
Authorised by	Max W. Moller *Principal Hydraulic Engineer*		17/03/2023

Document Revision History

Rev No.	Description	Prepared by	Authorised by	Date

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1. Introduction

Flüssig Engineers has been engaged by **JMG Engineers and Planners** to undertake a site-specific Flood Hazard Report for the potential development at number 203-205 Old Beach Road, Old Beach in the **Brighton Council** municipality. The purpose of this report is to determine the flood characteristics on the existing and post-development hazard scenarios for the 1% AEP plus climate change, for the purpose of subdivision.

1.1 Development

The proposal relates to a proposed subdivision of land at 203 – 205 Old Beach Road, Old Beach. The site titled 123119/1 and 135401/7 respectively has a combined area of approximately 12.5 ha which is intended to be subdivided into multiple lots in the future. There are currently single residential dwellings on each lot including various sheds and outbuildings. This proposal triggers the inundation code as the development falls within Brighton Council, flood prone area.

1.2 Objectives and Scope

This report is in response to a request for further information under C12.0 Flood Prone Areas Hazard Code (C12.7.1) under the Tasmanian Planning Scheme 2021 (TPS 2021). The objectives of this study are:

- Provide an assessment of the site's flood characteristics under the combined 1% AEP plus climate change (CC) scenario.
- Provide comparison of flooding for post-development against acceptable solution and performance criteria.
- Provide flood mitigation recommendations for a potential future development, where appropriate.

1.3 Limitations

This study is limited to the objectives of the engagement by the clients, the availability and reliability of data, and including the following:

- The post development subdivision layout is an overlay for concept purposes only. It has not been modelled in 3D terrain.
- The flood model is limited to a 1% AEP + CC worst case temporal design storm.
- All parameters have been derived from best practice manuals and available relevant studies (if applicable) in the area.
- All provided data by the client or government bodies for the purpose of this study is deemed fit for purpose.
- The study is to determine the effects of the new development on flooding behaviour and should not be used as a full flood study outside the specified area without further assessment.

1.4 Relevant Planning Scheme Requirements

Table 1. Tasmanian Planning Scheme (Brighton) Requirements

Planning Scheme Code	Objective	Document Reference
C12.7.1 Subdivision within a flood prone hazard area	That subdivision within a flood-prone hazard area does not create an opportunity for use or development that cannot achieve a tolerable risk from flood.	Refer Section 3.1

2. Model Build

2.1 Overview of Catchment

The contributing catchment to the east of 203-205 Old Beach Road, Old Beach is approximately 860 ha encompassing Bobs Creek and Gage Brook and its contributing tributaries originating towards Quoin Ridge at an elevation of approximately 350 mAHD. The overland flow path flows in a westerly direction towards the development site which ranges from 5 – 22 mAHD.

The land use of the catchment contains zones Landscape Conservation and Rural Living in the upper reaches of Quoin Ridge, with the majority of the catchment zoned Rural and the specific site being zoned Future Urban.

Figure 1 below outlines the approximate contributing catchment for the site at 203-205 Old Beach Road.

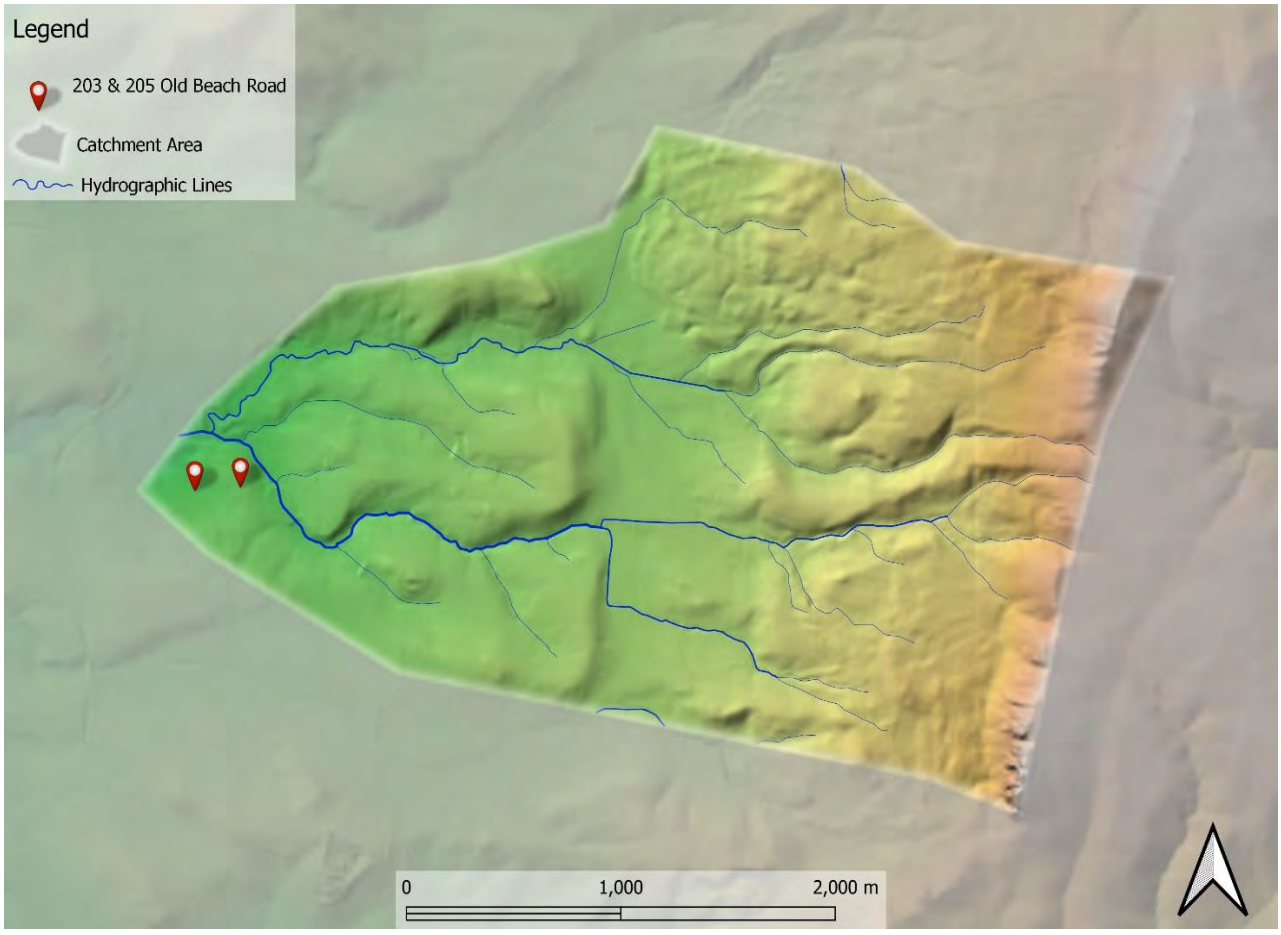


Figure 1. Contributing Catchment, 203-205 Old Beach Road, Old Beach

2.2 Hydrology

The following Table 2 states the adopted hydrological parameters for the RAFTS catchment, as per best practice guidelines.

Table 2. Parameters for RAFTS catchment

Catchment Area (ha)	Initial Loss Perv/imp (mm)	Continuing Loss Perv/imp (mm/hr)	Manning's N pervious	Manning's N impervious	Non-linearity factor
860	27/1	3.8/0.0	0.045	0.02	-0.285

2.2.1 Design Rainfall Events

The Tasmanian Planning Scheme 2021 requires modelling of flood events of 1% AEP (100yr ARI) for the life of the development. Therefore, the design events assessed in this analysis are limited to the 1% AEP + CC design events. Due to the size and grade of the catchment the peak rainfall time was restricted to between 10 min – 36 hrs.

The model ran each duration for the 1% AEP design event against 10 temporal patterns sourced from the ARR data hub. ARR 2019 advises the use of the worst-case duration median temporal pattern to ensure the event is not too conservative. These events were run through a hydrologic model to determine the required storm event. Figure 2 shows the box and whisker output of the model run. The model shows that the 1% AEP 4.5 hrs storm temporal pattern 1 was the worst-case median storm. Therefore, this storm event was used within the hydraulic model.

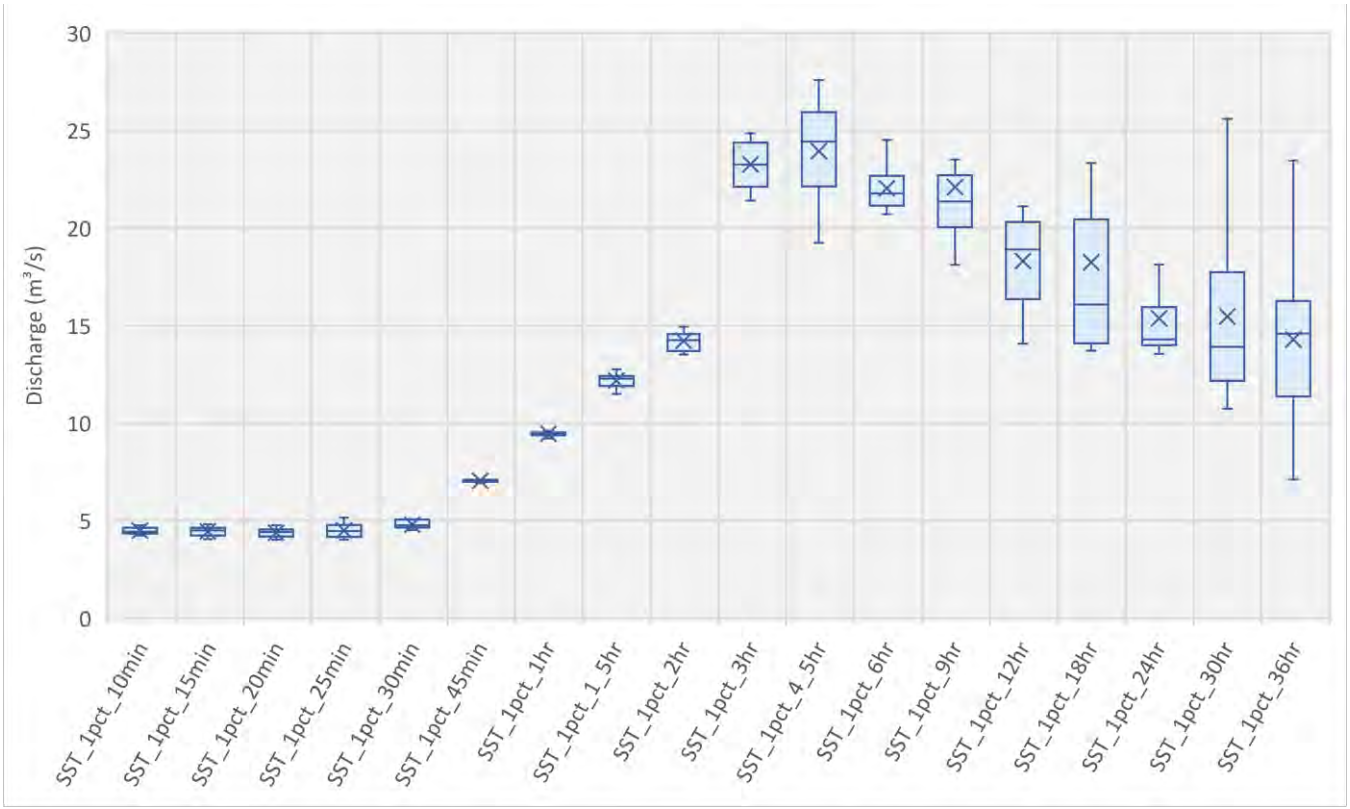


Figure 2. 1% AEP Flood Event Model, Box and Whisker Plot

2.2.2 Climate Change

As per ARR 2019 Guidelines, for an increase in rainfall due to climate change at 2100, it is recommended the use of RCP 8.5. Table 3 shows the ARR 8.5 increase.

Table 3. Climate Change Increases

Catchment	ARR 8.5 increase @ 2100
Southeast Tasmania	16.3%

2.2.3 Calibration/Validation

This catchment has no stream gauge to calibrate the model against a real-world storm event. Similarly, there is little historical information available, and limited available past flood analysis undertaken to validate against the flows obtained in the model.

2.3 Hydraulics

2.3.1 Survey

The 2D surface model was taken from a combination of a site survey undertaken by Survey Plus Tasmania and Greater Hobart LiDAR 2013 (Geoscience Australia) to create a 1m cell size DEM. For the purposes of this report, 1m cells are enough to capture accurate flow paths. The DEM with hill shading can be seen below (Figure 3).

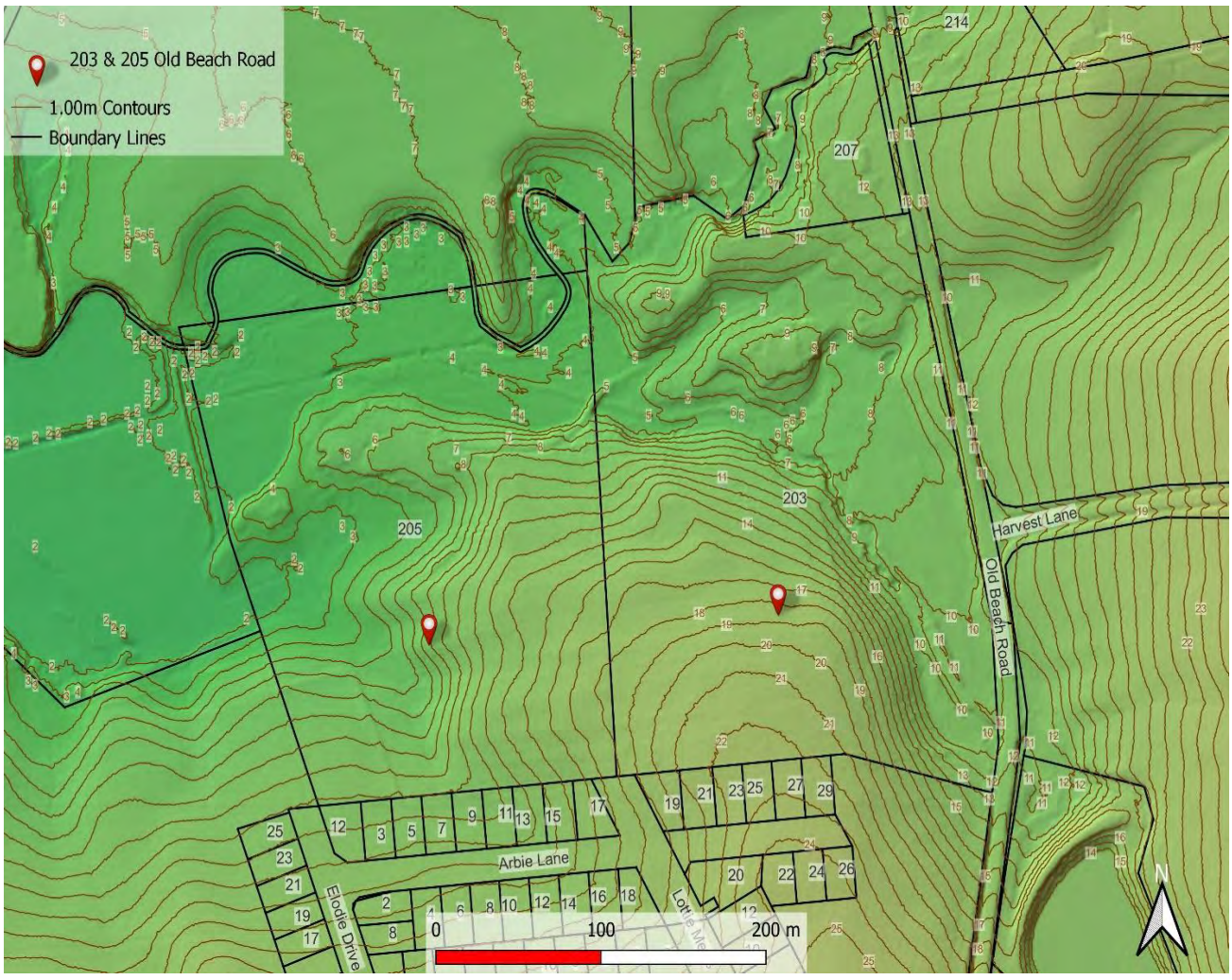


Figure 3. 1m DEM (Hill shade) of Lot Area

2.3.2 Roughness (Manning's n)

Roughness values for this model were derived from the ARR 2019 Guidelines. The Manning's values are listed in Table 4.

Table 4. Manning's Coefficients (ARR 2019)

Land Use	Roads	Open Channel	Rural	Residential	Parks	Buildings	Piped Infrastructure
Manning's n	0.018	0.035	0.04	0.045	0.05	0.3	0.013

2.3.3 Walls

Wall structures were included as base linear structures (walls) within the 2D model.

2.3.4 Buildings

Existing buildings were represented as mesh polygons with a high Manning's n value within the model. Buildings with unknown floor levels were set with a minimum 300mm above ground.

3. Model Results

The result of 1% AEP + CC were run through the existing pre-development model scenarios to determine the flood behaviour on site. The subdivision layout is indicative only as a concept and has not been modelled as a 3D terrain.

3.1 Flood depths and extents

It can be seen in Figure 4, that the site slopes from south to west with Bobs Creek intersecting lot 203 from the south-east before joining with Gage Brook and flowing along the northern lot boundaries. Furthermore, another two overland flow paths from Bobs Creek run from the eastern boundary from a series of culverts under Old Beach Road. The combination of two overland flow paths contributes to a flood depth of 2.55 m and a velocity of 1.00 m/s at the western side of lot 205's boundary and inside the naturally designated Gage Brook channel. There is also a minor overland flow path originating from the residential area at the southern lot boundary of lot 205 that discharges into the ponded area of Gage Brook.

Lot 205 is more significantly affected by flooding with Gage Brook and Bobs Creek discharging into a pond area in the north-western area of the lot. Any future land development of this lot will need to ensure that areas with high hazard ratings (H2 and above) are avoided for development and that access to other lots is not compromised.

Figure 5 and Figure 6 show various points within lots 203 & 205 of flood depths at specific locations including a non-3D terrain overlay of a proposed subdivision layout.

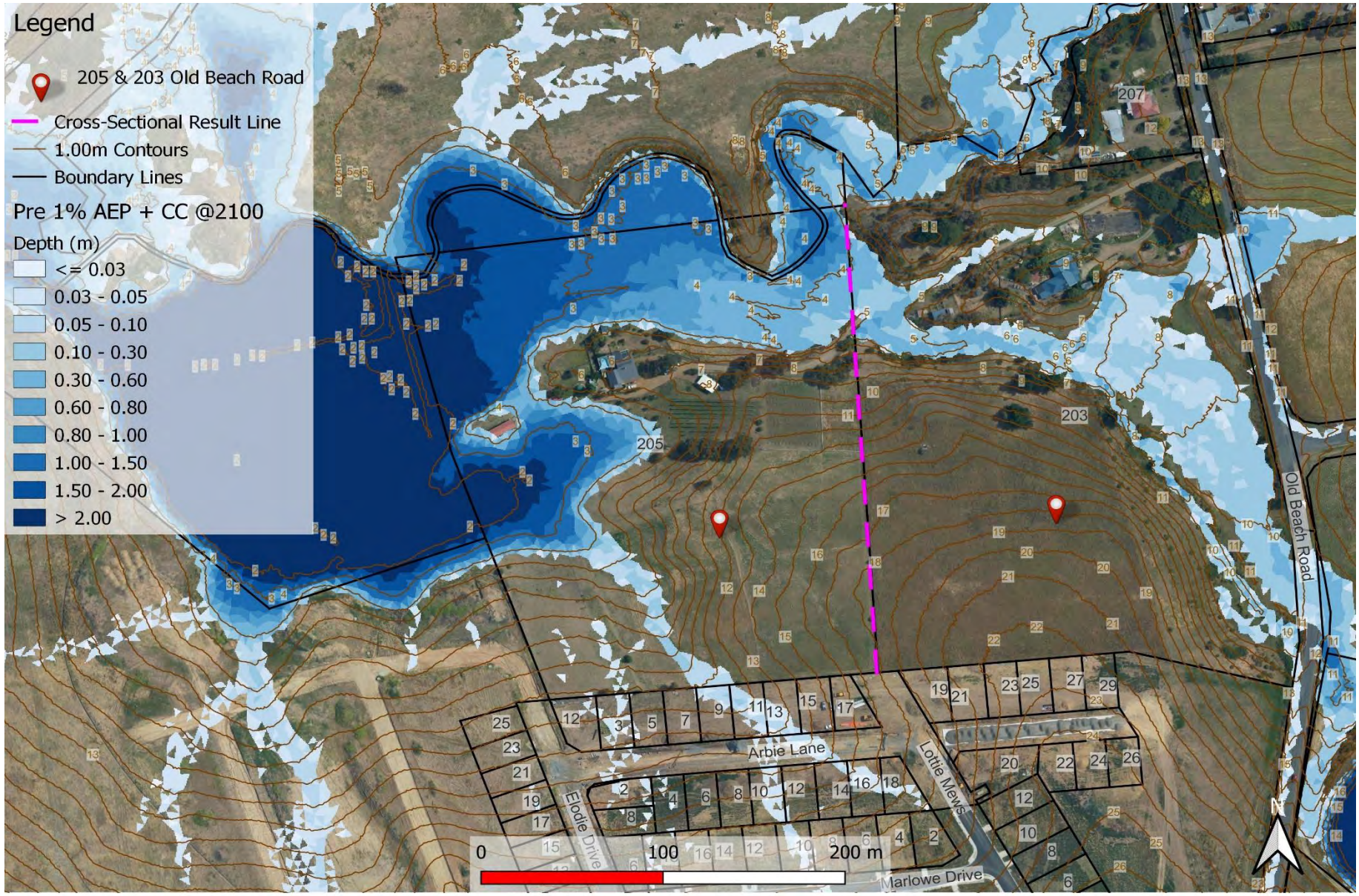


Figure 4. Pre-Development 1% AEP + CC Depth

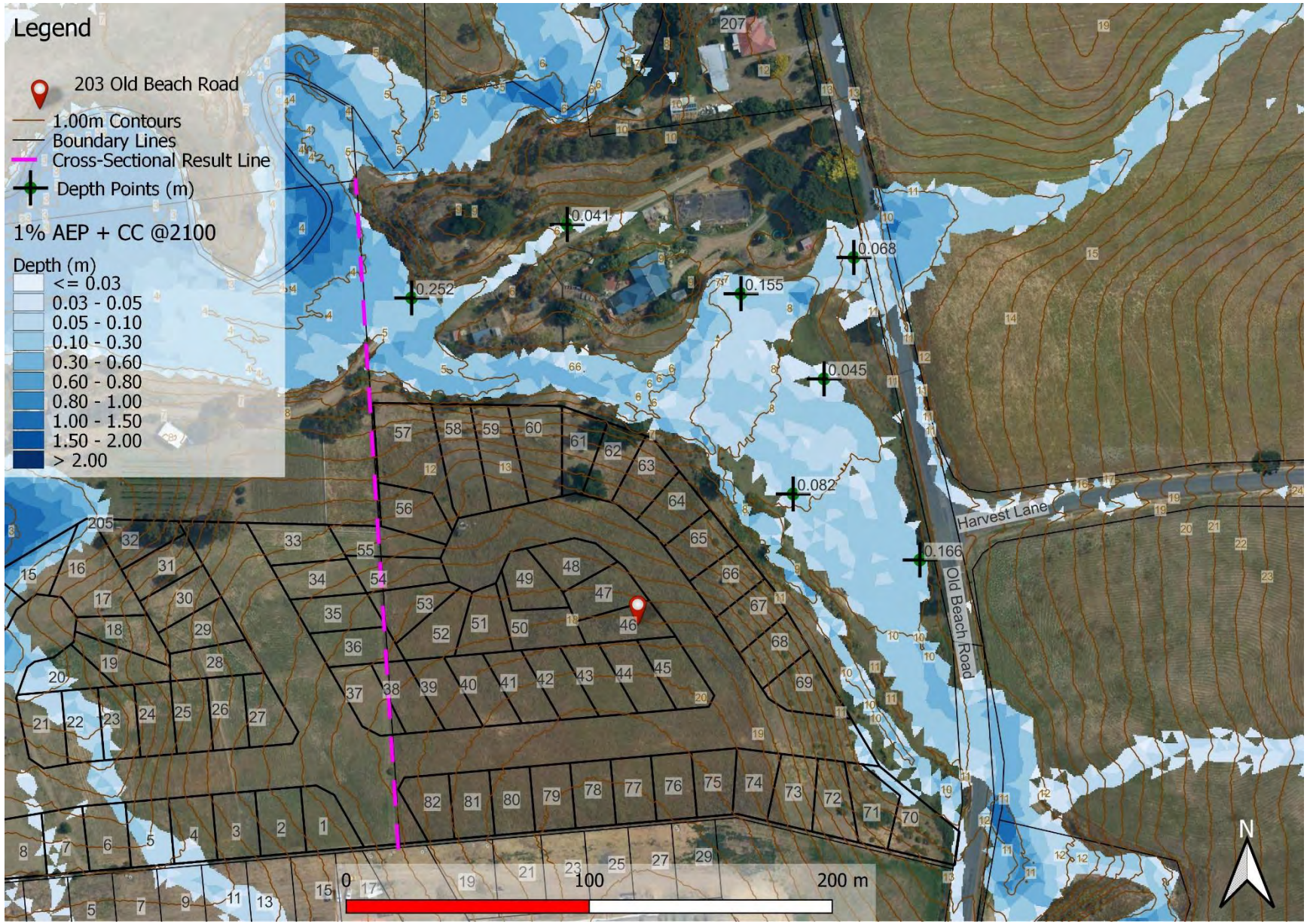


Figure 5. 1% AEP + CC overland flow path Lot 203 with various depth points

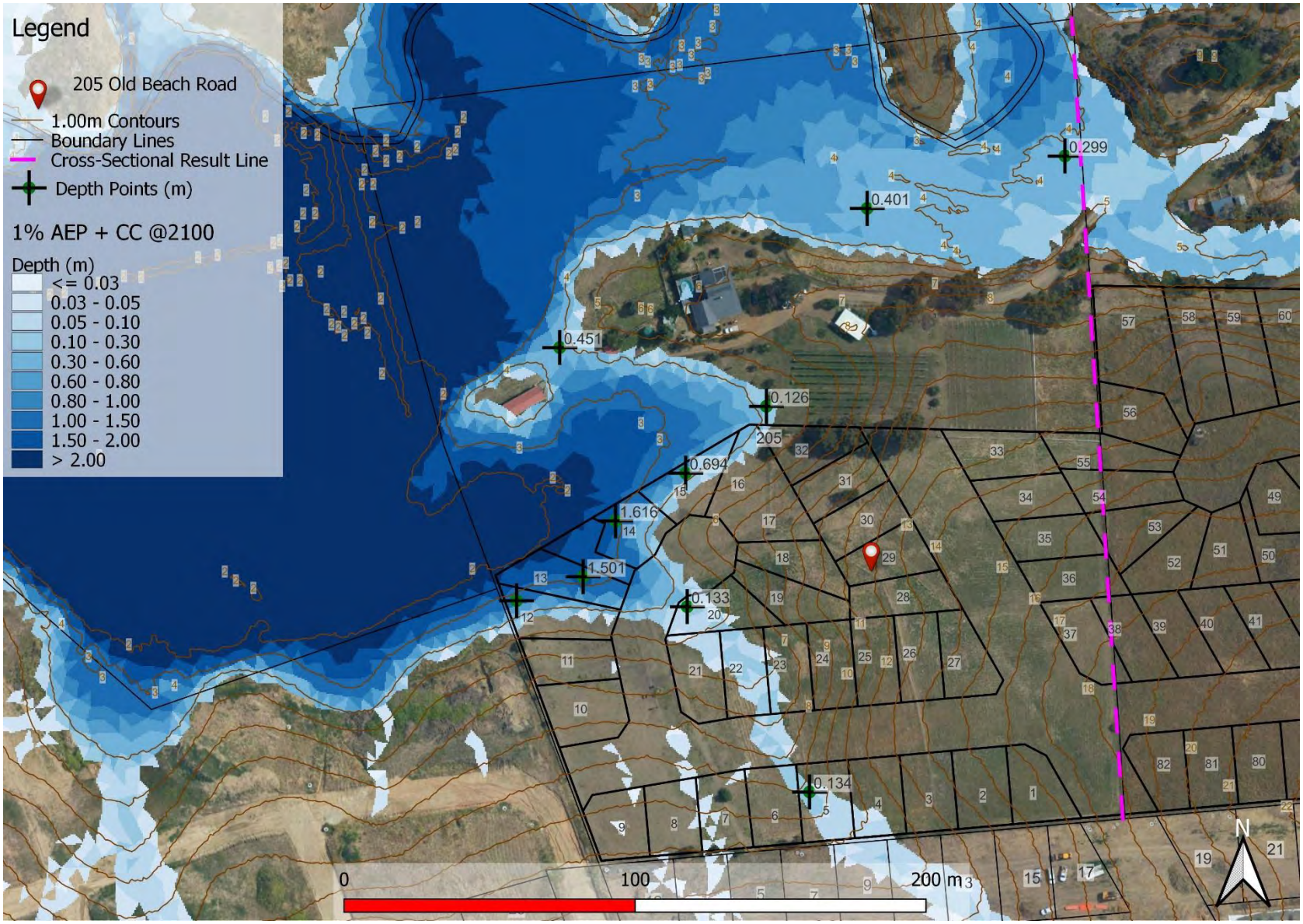


Figure 6. 1% AEP + CC overland flow path Lot 205 with various depth points

3.2 Development Effects on Flooding

Figure 7 below shows the discharge hydrograph from the property boundary for the overland flow through the development area. The graph was captured in the model for the existing conditions to demonstrate the current discharge across the lot boundary. It is a requirement of the C12.0 Flood Prone Areas Hazard Code that the overland flow path and discharge does not change significantly from pre to post development to cause increased risk to people, property or reliance on public infrastructure.

The model demonstrates a discharge of 5.50 m³/s, and velocity of 1.02 m/s across the cross-sectional result line between the two lot boundaries (Figure 4). Due to the relatively high volume of flow discharging into Gage Brook, it is imperative that any future development of these lots avoids development in areas of high flood depth and velocity, and that the natural overland flood path remains relatively unimpeded.

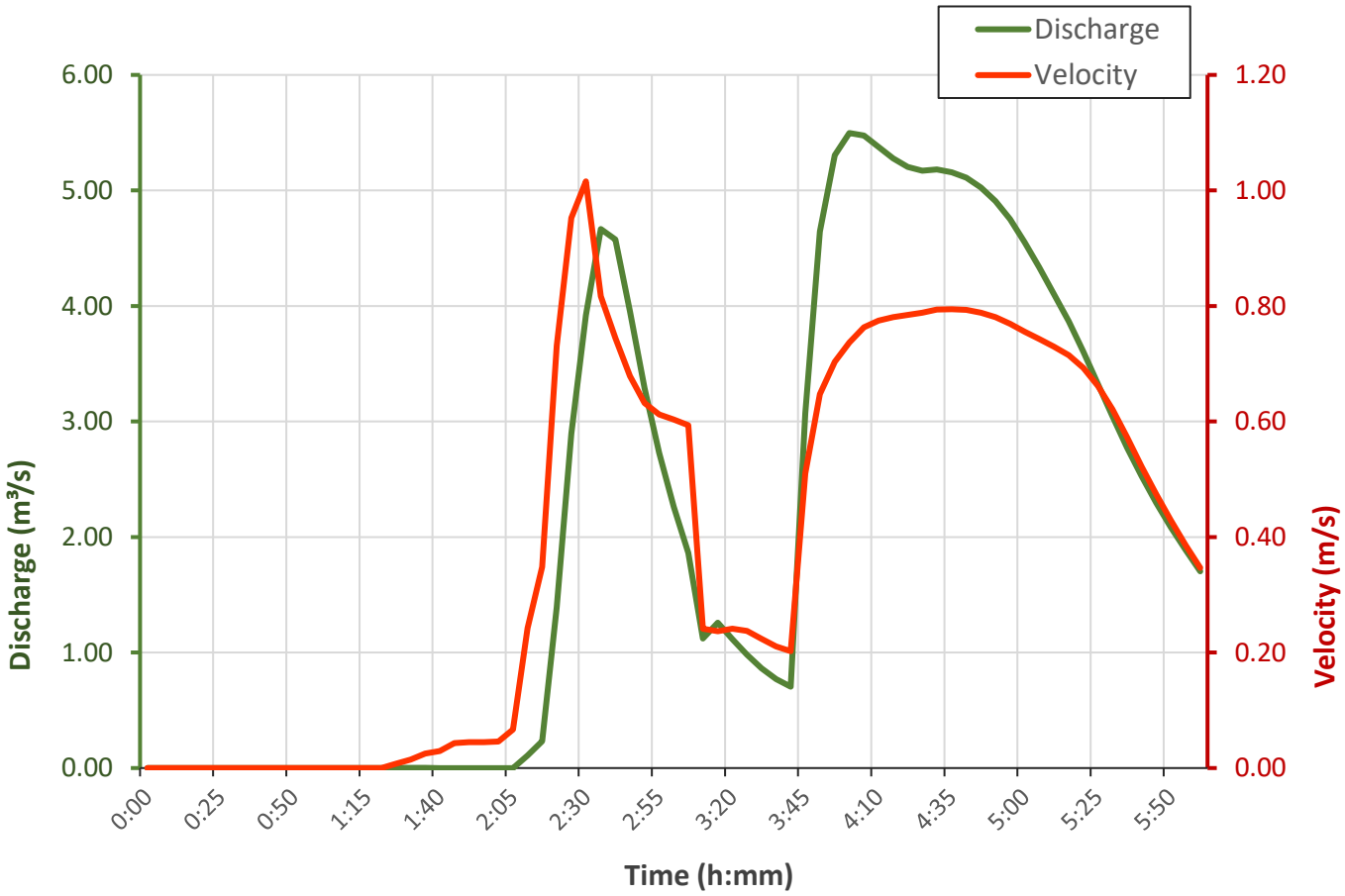


Figure 7. Pre-development net discharge and velocity 1% AEP + CC at cross-sectional result line

4. Flood Hazard

Appendix A shows the velocity and depth maps across the two lots. In the current conditions, the velocity and depth at the cross-sectional result line are 1.02 m/s and 0.84 m respectively. This places the hazard rating at this particular point at the confluence of Gage Brook and Bobs Creek at **H4 – *Unsafe for people and vehicles*** as adopted by Australian Flood Resilience and Design Handbook as shown in Figure 8.

However, the area that follows the existing driveway access to the current residence on lot 205 ranges between **H1 – *Generally safe for people, vehicles and buildings*, to H2 - *unsafe for small vehicles.*** Therefore, access to the internal lot 205 could be via this existing route, or alternatively from the southern side of the lot as shown in the concept plan (Figure 6). The proposed subdivision layout may

pose an unacceptable risk for development of lots on the northern edge that encroaches Gage Brook where areas are evident up to **H5** – ***Unsafe for vehicles and people. All buildings vulnerable to structural damage***.

Lot 203 is less affected by hazard ratings greater than **H3** with the majority of the affected areas, particularly on the eastern side of the lot, affected predominantly by **H1**. Therefore, the risk to people and buildings from any future development of lot 203 may be acceptable. The current subdivision layout is mostly outside the affected flood areas.

As this study does not extend to the public access roads we cannot comment on the accessibility to the site, only within the site. A summary of the hazard ratings is shown in Figure 8.

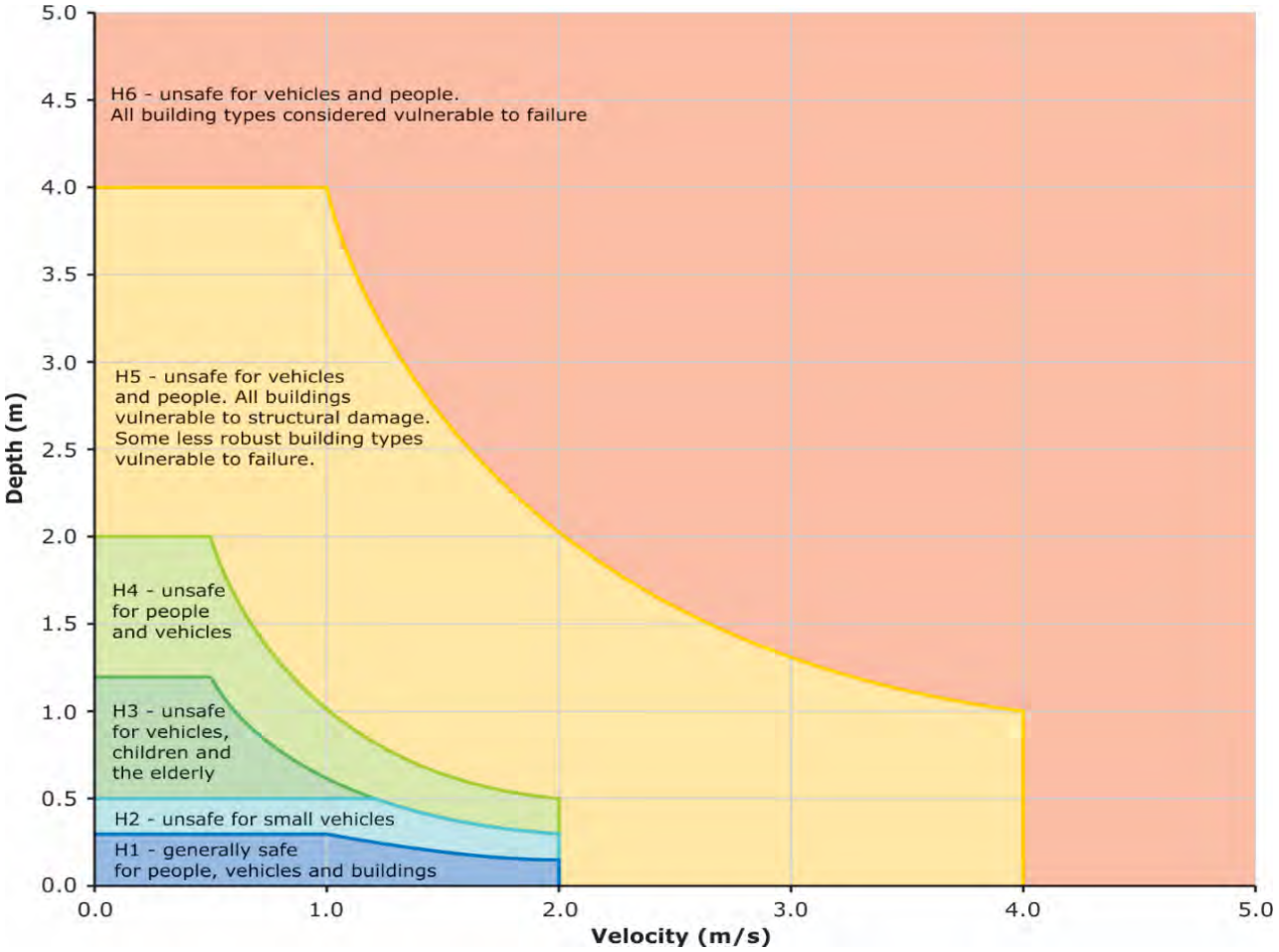


Figure 8. Hazard Categories Australian Disaster and Resilience Handbook

4.1 Tolerable Risk

The lot at 203-205 Old Beach Road Brighton, is susceptible to a deep flood plain flow at moderate velocity affecting mostly the northern area of the lots. Most of lot 203 is classified low (H1) hazard rating in the 1 % AEP + climate change event, while lot 205 is affected by greater hazard ratings as the overland flow from Bobs Creek and Gage Brook form a ponding area in the north west side of the lot.

Even at minor velocity and depths during a storm event, erosion and debris movement nevertheless pose a threat. To ensure suitability, all structures that are built in any area affected by overland flow should be subjected to a hydrostatic/hydrodynamic analysis.

Table 5. Tasmanian Planning Scheme summary

C12.7.1 Subdivision within a flood-prone hazard area			
Objective: That subdivision within a flood-prone hazard area does not create an opportunity for use or development that cannot achieve a tolerable risk from flood.			
Performance Criteria			
P1.1		**P1.1**	
Each lot, or a lot proposed in a plan of subdivision, within a flood-prone hazard area, must not create an opportunity for use or development that cannot achieve a tolerable risk from flood, having regard to:		Response from flood report	
(a)	Any increase in risk from flood for adjacent land;	(a)	Currently, the additional risk to adjancent land and properties would be minimal if areas in the southern sections of the lots 203 & 205 are subdivided.
(b)	The level of risk to use or development arising from an increased reliance on public infrastructure;	(b)	The overland flow discharges into a natural channel (Gage Brook) which, if relatively unimpeded in the post-development scenario would not place increased reliance on public infrastructure.
(c)	The need to minimise future remediation works;	(c)	Future remediation works would be minimal.
(d)	Any loss or substantial compromise by flood of access to the lot, on or off site.	(d)	Access to the lots is achievable from the southern end of the lots, or alternatively following the existing driveway to lot 205, or via Old Beach Road to the east of lot 203.
(e)	The need to locate building areas outside the flood-prone hazard area.	(e)	The majority of lots proposed in the concept plan are outside the flood prone hazard area, with the exception of some lots on the north-western side of the concept that encroaches on Gage Brook extent.
(f)	Any advice from a state authority, regulated entity or a council; and	(f)	N/A
(g)	The advice contained in a flood hazard report.	(g)	Recommendations provided within.

5. Conclusion

The Flood Hazard Report for 203-205 Old Beach Road, Old Beach development site has reviewed the potential development flood scenario.

The following conclusions were derived in this report:

1. Peak flows for the 1% AEP at 2100 were undertaken against C12.7.1 of the TPS Flood Prone Areas Hazard code.
2. Peak discharge sees at the cross sectional result line is 5.50 m^3.
3. Velocity at the cross-sectional result line is 1.02 m/s.
4. The hazard rating within lot 203 is predominantly H1 – H2, with small areas of higher ratings in the vicinity of Bobs Creek and Gage Brook to the north. Hazard ratings within lot 205 range from H1 to H5, particularly in the north-west corner of the lot.

6. Recommendations

Flüssig Engineers therefore recommends the following engineering design be adopted for the development and future use to ensure the works meets the Inundation Code:

1. Any future structures, located in the inundation area, are to be designed to resist flood forces including debris for the given flood conditions.
2. Future use of the subdivision, to be limited to areas deemed safe under the ARR Disaster manual categories.
3. Recommendations for future buildings will vary based on their specific layout and must be assessed separately.
4. Consideration should be given for an easement to allow unimpeded overland flow from the southern lot boundary of lot 205 towards Gage Brook.
5. Building lots that are impacted by hazard ratings H3 or greater should be minimized or designed to allow safe areas for building envelopes under the Australian Flood Resilience and Design Handbook.
6. Final subdivision concept is to be reassessed against this model by incorporating the post-development scenario in a 3D model terrain to ensure compliance with the TPS 2021.

Under the requirements of this Flood Hazard Report, subdivision of lots 203 and 205 Old Beach Road, Old Beach will meet current acceptable solutions and performance criteria under the Tasmanian Planning Scheme 2021.

7. Limitations

Flüssig Engineers were engaged by **JMG Engineers and Planners,** for the purpose of a site-specific Flood Hazard Report for 203-205 Old Beach Road, Old Beach as per C12.0 of the Tasmanian Planning Scheme 2021. This study is deemed suitable for purpose at the time of undertaking the study. If the conditions of the site should change, the report will need to be reviewed against all changes.

This report is to be used in full and may not be used in part to support any other objective other than what has been outlined within, unless specific written approval to do otherwise is granted by Flüssig Engineers.

Flüssig Engineers accepts no responsibility for the accuracy of third-party documents supplied for the purpose of this Flood Hazard Report.

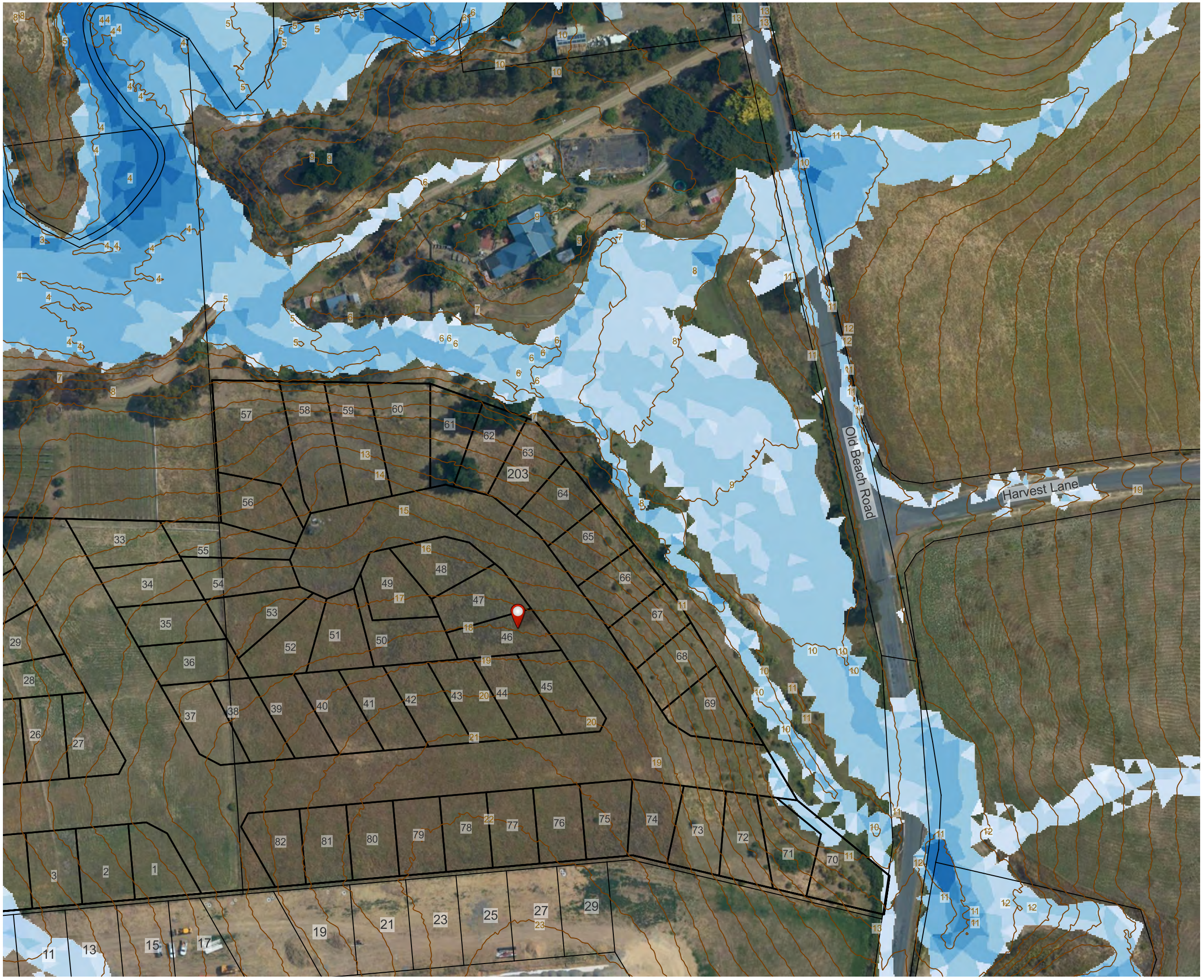
8. References

1. Australian Disaster Resilience Guideline 7-3: Technical flood risk management guideline: Flood hazard, 2014, Australian Institute for Disaster Resilience CC BY-NC
2. Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia
3. Grose, M. R., Barnes-Keoghan, I., Corney, S. P., White, C. J., Holz, G. K., Bennett, J. & Bindoff, N. L. (2010). Climate Futures for Tasmania: General Climate Impacts Technical Report.
4. T.A. Remenyi, N. Earl, P.T. Love, D.A. Rollins, R.M.B. Harris, 2020, Climate Change Information for Decision Making –Climate Futures Programme, Discipline of Geography & Spatial Sciences, University of Tasmania.

Appendices

Appendix A Flood Study Maps

1% AEP + CC @2100



Legend

203 Old Beach Road

Boundary Lines

1.00m Contours

1% AEP + CC @2100

Depth (m)

- <= 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 40 80 m

meters

N

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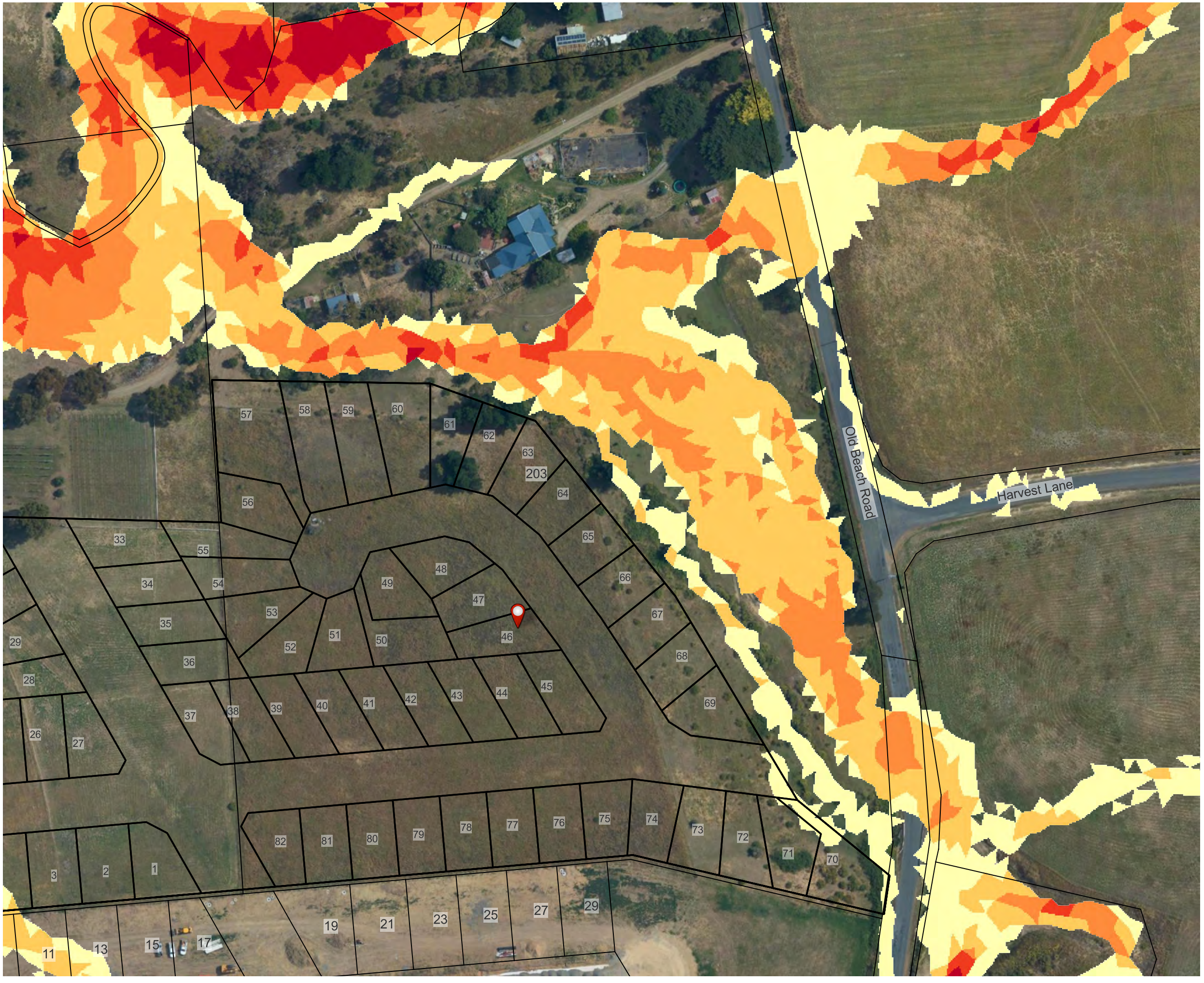
Map CRS: GDA94 / MGA zone 55 EPSG:28355

1% AEP + CC @2100



Legend

- 203 Old Beach Road
- Boundary Lines

1% AEP + CC @2100

Velocity (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 40 80 m

meters

N

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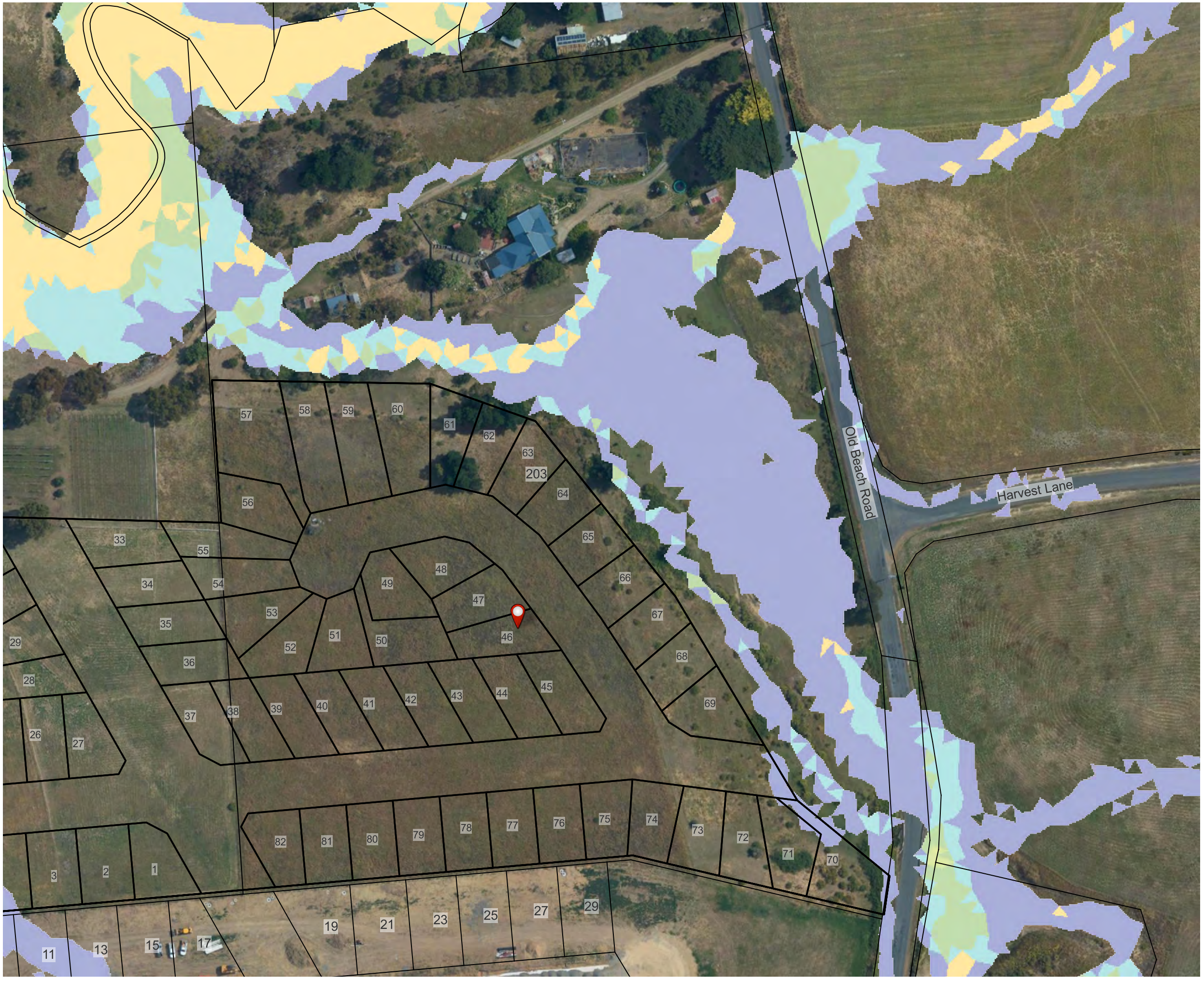

Legend

- 203 Old Beach Road
- Boundary Lines
- 1% AEP + CC @2100

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

0 40 80 m

meters

N

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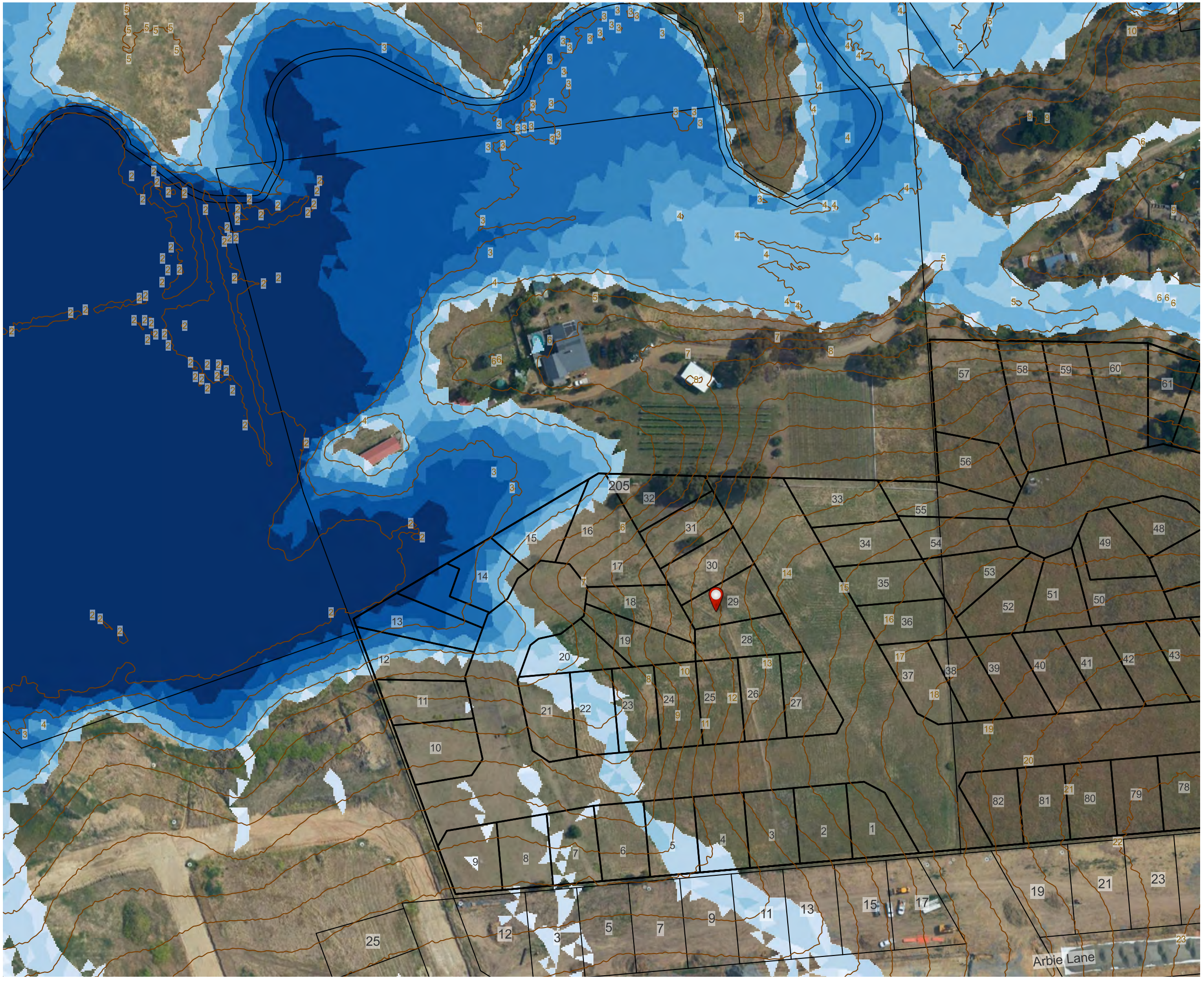

Legend

205 Old Beach Road

1.00m Contours

Boundary Lines

1% AEP + CC @2100

Depth (m)

- <= 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 40 80 m

meters

N

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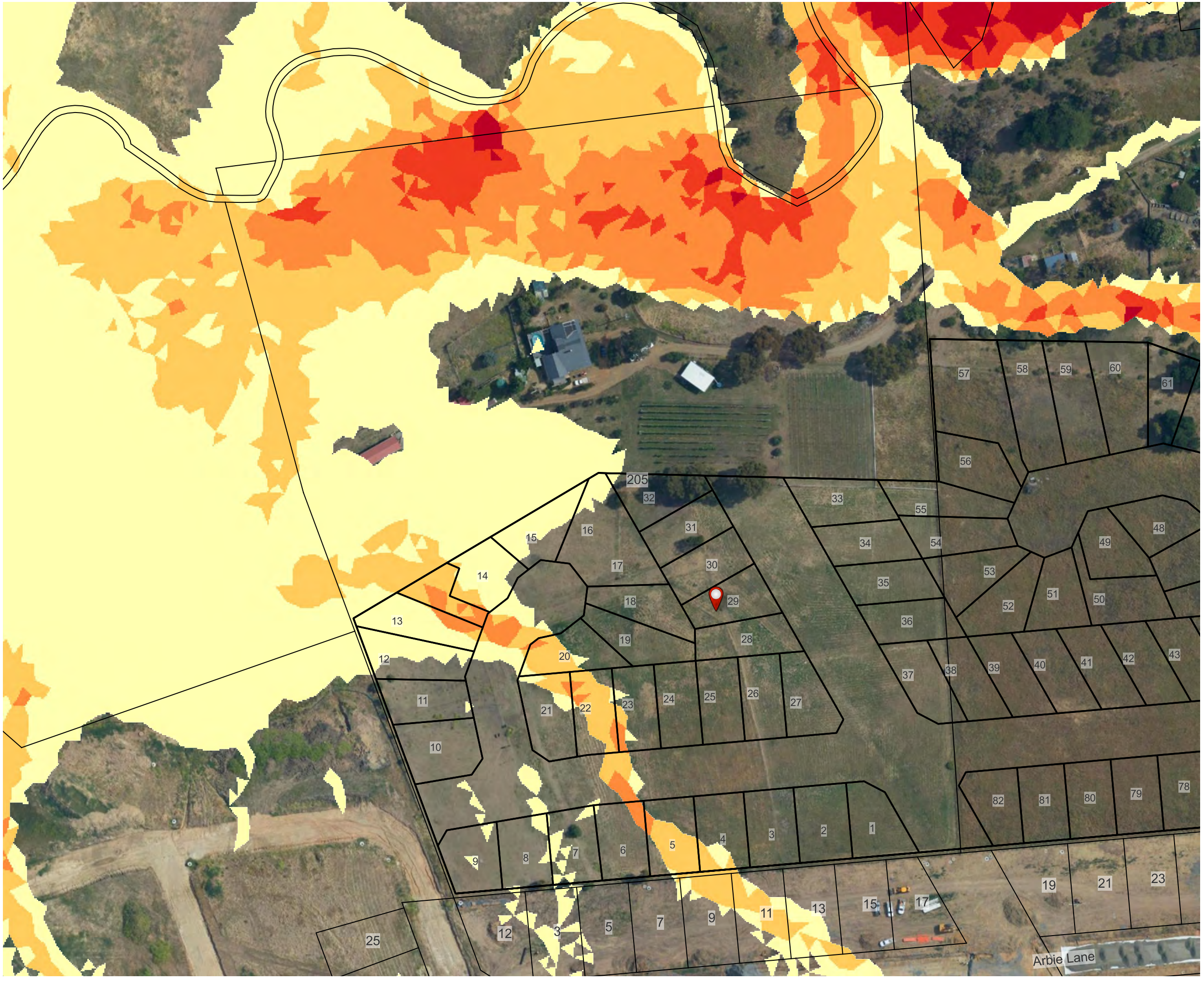
1% AEP + CC @2100



Legend

205 Old Beach Road

Boundary Lines

1% AEP + CC @2100

Velocity (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 40 80 m

meters

N

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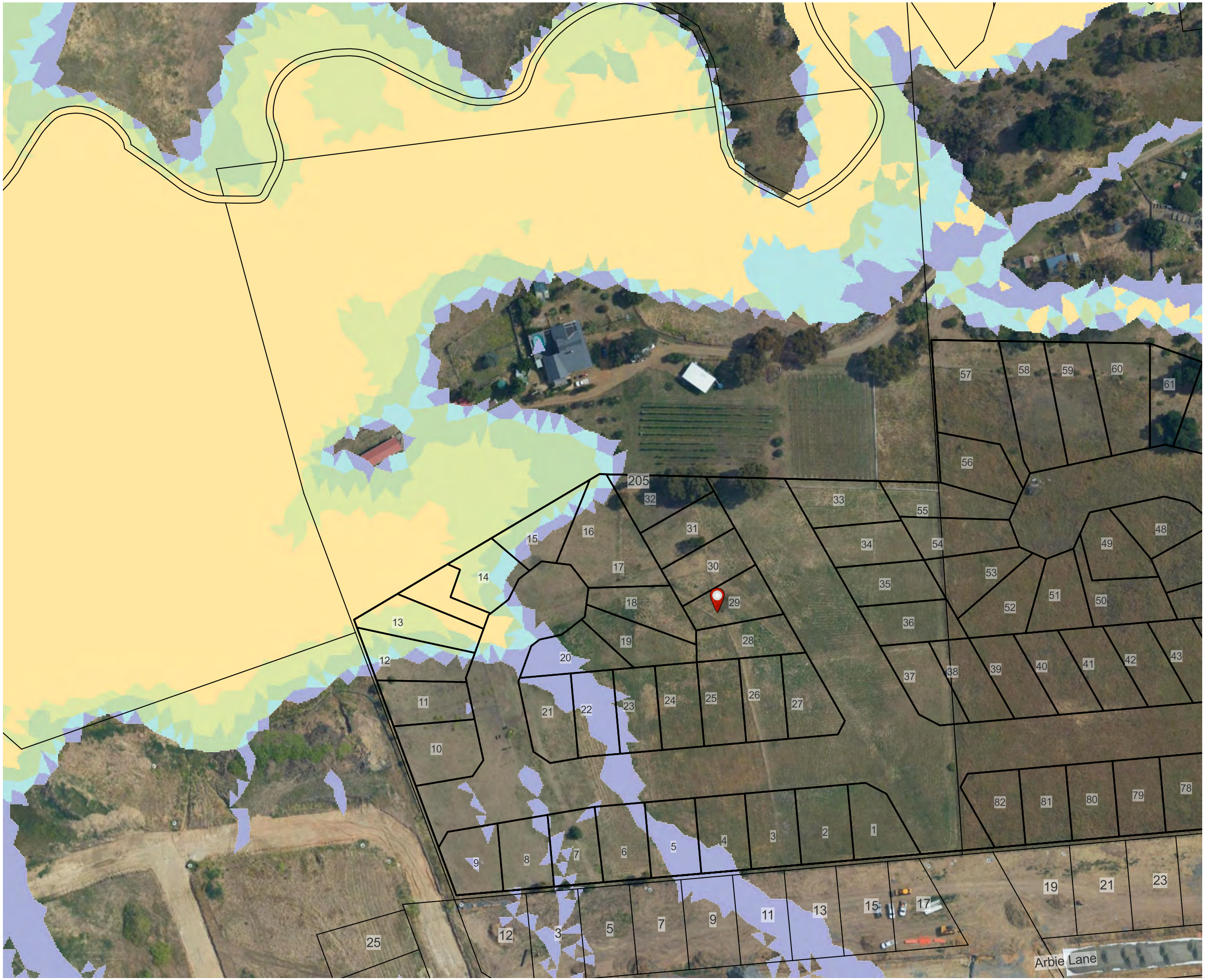

Legend

205 Old Beach Road

Boundary Lines

1% AEP + CC @2100

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

0 40 80 m

meters

N

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