DOWNS ROADSIDE ENGINEERING

5th April 2024

Flood Risk Assessment

130 BAHRS SCRUB ROAD
BARHS SCRUB QLD 4207

Prepared by: Downs Roadside Engineering

FOR: JITENDRA AHLAWAT

DOCUMENT CONTROL

REPORT DETAILS	
Report Title:	**Flood Risk Assessment**
Project No.:	**10080**
Report Author:	**Caleb Schipplock**

DOCUMENT CONTROL					
Revision	**Author**	**Reviewer**	**Approved for Issue**		
			Name	**Signature**	**Date**
0	C. Schipplock	B. Tomkins	C. Schipplock	 ***RPEQ 23827***	05/04/2024

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Contents

Figures

1 INTRODUCTION

1.1 General

Downs Roadside Engineering Pty Ltd (DRE) has been commissioned by Jitendra Ahlawat to prepare a Flood Risk to support a development application at Bahrs Scrub Road. The site is located in the Logan City Council Local Government Area (LGA) at 130 Bahrs Scrub Road, Barhs Scrub QLD 4207 on lot formally described as 12 on SP 317949.

A flood model has been developed for the subject site. The hydraulic analysis outlined in this report is limited to the resultant changes in topography from the subject development, which include a proposed pedestrian bridge, sports field, and amenities block. A flood assessment was undertaken based on advice from Council from a Pre-Lodgement Meeting undertaken on the 1st of November 2022. This report addresses items specifically limited to the catchment/s affected by the subject development.

1.2 Basis of report

This report has been compiled based on:

- Discussions between DRE and the Client
- Council Information Request (RFI) 01/12/23 – RL/136/2023 – Document Number 17163583
- Email from Council dated 18/12/23 with additional information request, specifically:

FLOODING

Critical Planning Issue - Temporary Local Planning Instrument – Flood

1. Demonstrate compliance with the Temporary Local Planning Instrument (TLPI) Flood, by submitting a Flood Risk Assessment report, prepared in accordance with Section 2.2.1 - Localised flood risk assessment report (FRA) of Planning Scheme Policy 10 - Flood.

Advice Note: Council's Temporary Local Planning Instrument TLPI No. 1/23 commenced on 30 October 2023 and applies to this development application. The proposed plan of development involves the creation of one additional lot, intended for further residential development, associated with a site mapped within the Flood Investigation Area identified on Flood hazard overlay map OM-05.01.

The FRA is required to determine the flood risk for the site and demonstrate the proposed development complies with the applicable assessment benchmarks of the TLPI. The proposal must comply with AO5/PO5 and AO7/PO7 of the Flood overlay code and include a building envelope.

It should also be noted the FRA will need to extend beyond the property to demonstrate flood free or low flood hazard access is available to a suitable flood-free area that contains local goods and services in accordance with AO17/PO17 and AO18/PO18 of the code.

Figure 1 – Council Additional Information Request (18/12/2023)

- Site Plan B230151P2.dwg by DTS 25/08/2023
- Queensland LiDAR Data - Logan 2017 Project
- Software:
    - RORB – Version 6.45
    - TUFLOW – Version 2023-03-AC

1.2.1 Report Limitations

This report is client/site specific for the subject development only and the provided engineering advice is provided solely for consideration by the Client and Council. It should be noted that this report and its' content has been compiled based on information (including the proposed site layout arrangements) current at the time of the report printing, and that recommendations within this report are valid based solely on the above.

1.3 Site Description

The site is formally described as 12 on SP 317949 and its locality is generally in **Figure 2**.

The site covers an area of approximately 3.50 hectares and drains predominantly from south-west to a creek (Windaroo Creek) located to the north and east of the site. The site consists of large grassed areas with a two storey dwelling located on site.

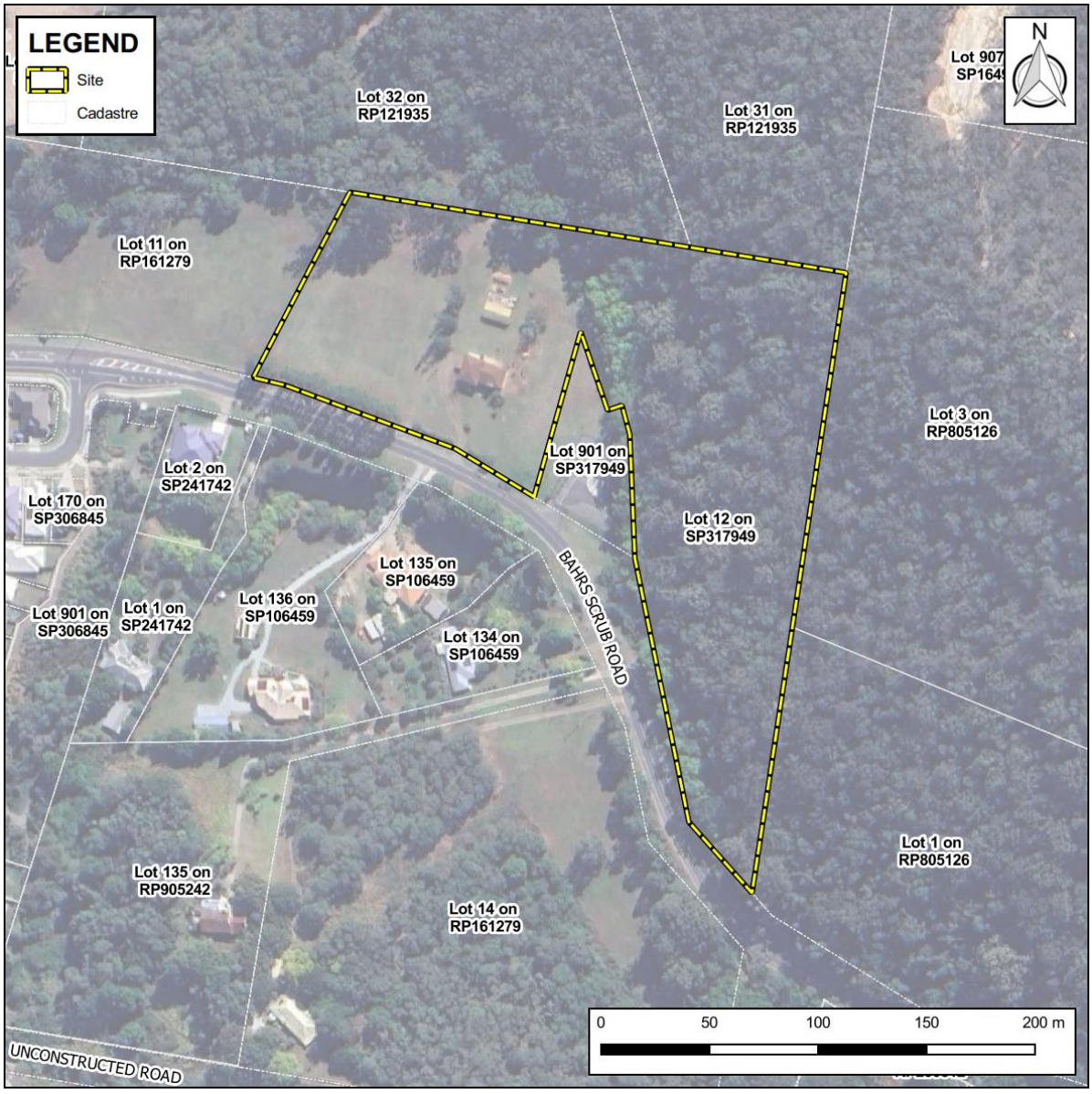


Figure 2 – Locality Plan

1.4 Clarifications

The primary objectives of this Flood Risk Assessment (FRA) are to resolve the points raised within the Councils RFI (01/12/23) and Councils email (18/12/23). The assessment correspondingly includes responses to the following Performance Outcomes (PO's) and Acceptable Outcomes (AO's):

- AO5/PO5 – flood free envelope area;
- AO7/PO7 – located outside high hazard;
- AO17/PO17 – low hazard access to a local goods store;
- AO18/PO18 – low hazard access to a flood free road.

2 PROPOSED DEVELOPMENT LAYOUT

The proposed development layout prepared by DTS (dated 25/08/2023) is shown in **Figure 3**. The current development layout revision can be summarised as:

- One lot turned into two lots while maintaining existing dwelling.

Refer to planning report accompanying this application for further details.

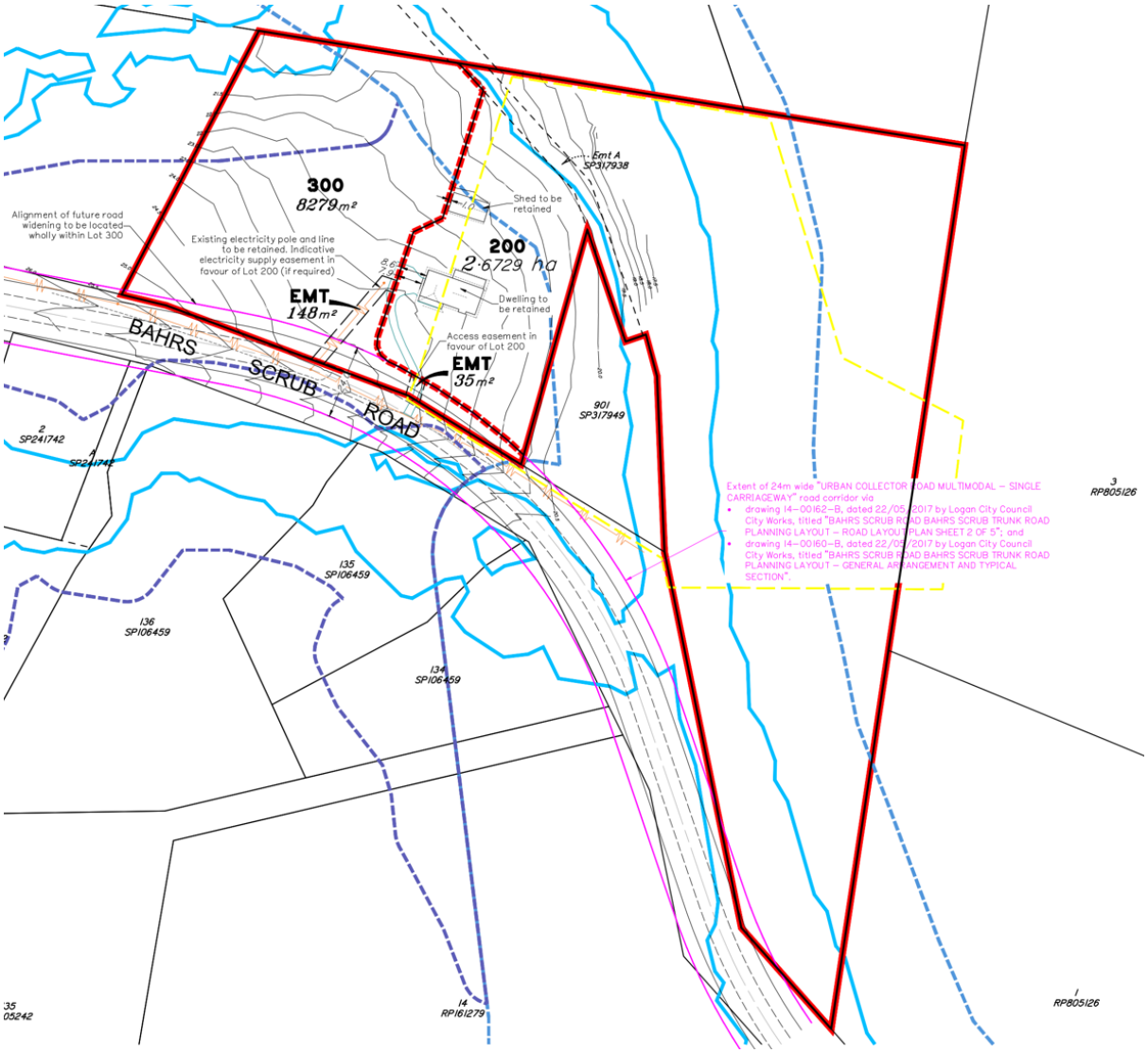


Figure 3 –Site Layout by DTS (25/08/2023)

The following sections detail the hydraulic modelling approach and outcomes from the proposed site layout design.

3 HYDROLOGY (RORB)

3.1 Hydrological model

A RORB hydrological model was developed for the site to model both the existing and design case scenarios. Model outputs were used as inflow hydrographs within the TUFLOW model to assess flood behaviour in both the existing and design site scenarios.

The RORB parameters outlined within **Table 1** were utilized within the model.

Table 1 – RORB Input Details

RORB Parameter	Value
Kc	2.59
m	0.8

3.2 Rainfall data and losses

The average centroid of the contributing catchments latitude and longitude were used as inputs to the Australian Bureau of Meteorology website to extract the Intensity Frequency Duration (IFD) Table. The IFD table was then used within existing and design scenario RORB models. AR&R 2019 procedures have been used in the hydrologic analysis and the adopted IFD table is provided in **Table 2**.

Table 2 – 2019 IFD table rainfall depths (mm) (Australian Bureau of Meteorology)

Duration	63.20%	50%	20%	10%	5%	2%	1%
5 min	8.81	9.98	13.7	16.2	18.8	22.1	24.7
10 min	14.6	16.6	22.5	26.5	30.3	35.2	38.8
15 min	18.6	21.1	28.6	33.6	38.4	44.5	49.1
20 min	21.5	24.4	33.2	39	44.6	51.9	57.3
25 min	23.8	27	36.8	43.4	49.7	58	64.2
30 min	25.7	29.1	39.8	47	54	63.2	70.2
45 min	29.8	33.9	46.6	55.3	64	75.6	84.6
1 hour	32.8	37.3	51.6	61.6	71.6	85.2	95.9
1.5 hour	37.3	42.4	59.2	71.1	83.2	100	113
2 hour	40.7	46.4	65.1	78.6	92.5	112	128
3 hour	46.3	52.9	74.9	90.9	107	131	150
4.5 hour	53.2	60.9	86.8	106	126	154	177
6 hour	59	67.8	97.1	119	141	173	199
9 hour	69.1	79.6	115	141	167	205	236

The storm losses from the AR&R datahub are shown in **Figure 4**.

ID	27987.0
Storm Initial Losses (mm)	27.0
Storm Continuing Losses (mm/h)	1.6

Figure 4 – AR&R Data Hub Storm Losses

Median pre-burst rainfall of 22.6mm was also utilized within the model which reduced the initial loss to 4.6mm.

3.3 Imperviousness

Percent impervious layers were generated from an assessment of existing land use, aerial imagery. Impervious plans have been provided in **Appendix C**.

3.4 Existing Catchment Details

The existing catchment boundaries were developed based on stormwater drainage information from Logan City Councils Online Portal and contour information derived from Queensland LiDAR Data - Logan 2017 Project. Existing case catchment plan is provided in **Appendix B** and is generally summarised in **Table 3** below.

Table 3 – Existing Case RORB Catchment Details

Catchment Name	Area (km²)	Impervious (%)
Cat_2	0.043	21.5
Cat_3	0.335	13.8
Cat_4	0.320	65.3
Cat_5	0.052	24.3
Cat_6	0.592	52.0
Cat_7	0.187	63.6
Cat_8	0.269	45.8
Cat_9	0.140	15.4
Cat_10	0.020	76.3
Cat_11	0.450	6.9
Cat_12	0.160	38.5
Cat_13	0.610	5.2
Cat_14	0.100	18.3
Cat_15	0.710	28.7
Cat_16	0.440	39.0
Cat_17	0.180	10.3
Cat_18	0.040	15.6

Catchment Name	Area (km²)	Impervious (%)
Cat_19	0.440	53.8
Cat_20	0.380	7.1
Cat_21	0.150	39.3
Cat_22	0.160	16.0
Cat_23	0.250	10.4
Cat_24	0.170	40.5
Cat_25	0.280	10.4
Cat_26	0.950	15.8
Cat_27	0.260	13.5

Further details are provided in Appendix B which contains figures of the catchment delineation and adopted percentage impervious values.

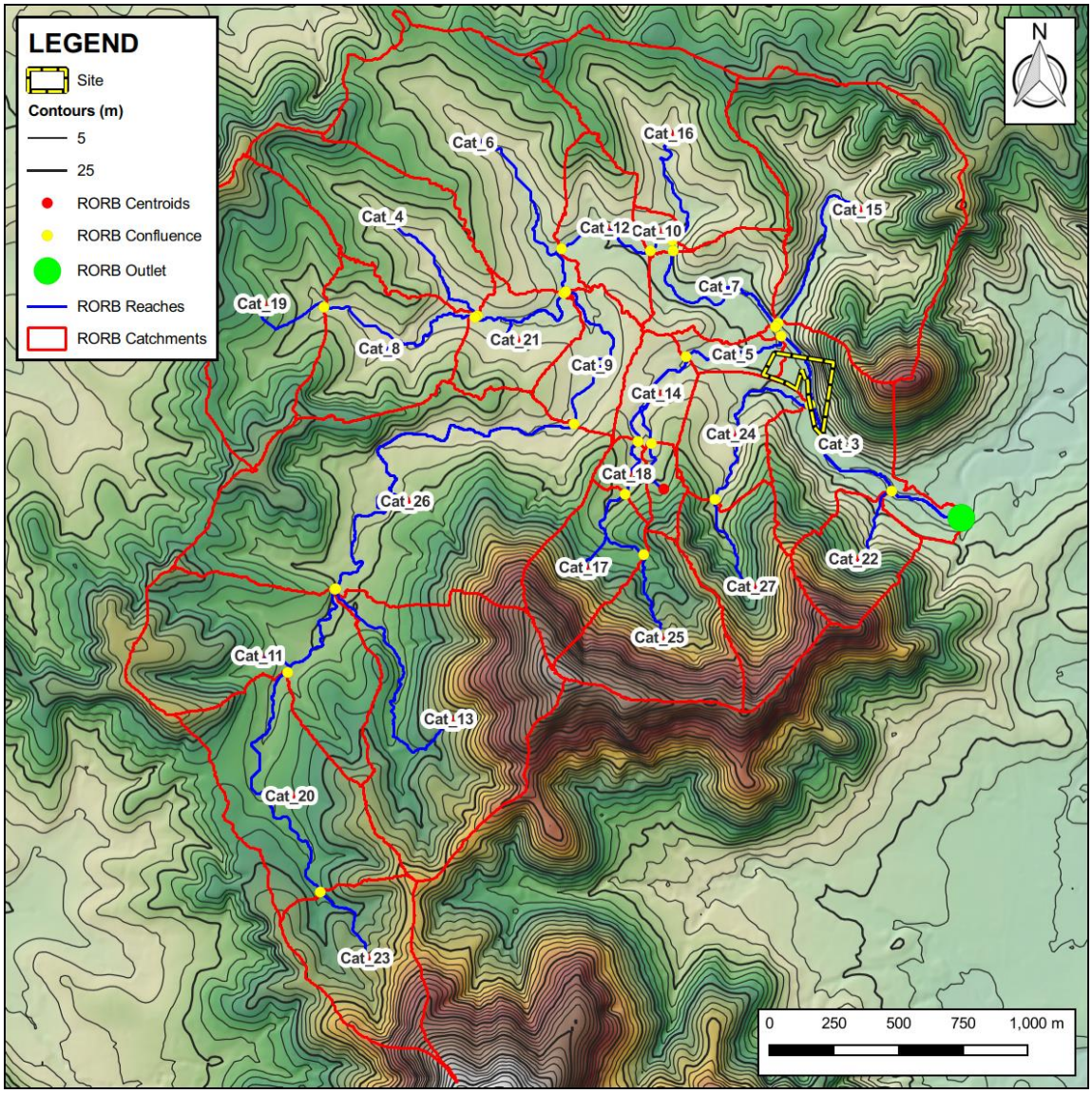


Figure 5 – Catchment Plan

3.5 Results

The RORB model results for the 50% AEP to 1% AEP events along with the critical duration and temporal patterns are presented in **Table 4**. **Table 4** represents the peak-median discharges which were observed at the RORB outlet location as shown in **Figure 5**.

Table 4 – RORB Results at RORB Outlet

	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	1% AEP + CC^
Critical Duration	0120min	0120min	0180min	0120min	0090min	0120min	0090min
Temporal Pattern	TP07	TP07	TP04	TP09	TP03	TP03	TP03
Discharge (m^3/s)	31.52	47.81	60.96	73.20	87.13	100.50	113.23

^+CC = *Climate Change of 9.5% in accordance with RCP 4.5 2090*

3.6 RFFE Assessment

The Regional Flood Frequency Estimation (RFFE) Model is a tool to estimate the frequency and magnitude of floods in a specific region. An RFFE assessment was undertaken on the catchment study area and output details have been provided within **Appendix B**. Input details are provided in **Table 5** and output details are provided **Table 6**.

Table 5 – RFFE Input Details

Latitude Outlet	-27.7425
Latitude Outlet	153.184
Latitude Centroid	-27.7398
Latitude Centroid	153.167
Area (km^2)	7.76

Table 6 – RFFE Discharges

	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
Discharge (m^3/s)	55.0	114	170	238	349	453
Lower Confidence Limit (5%) (m^3/s)	26.6	56.5	76.9	96.0	120	138
Upper Confidence Limit (95%) (m^3/s)	114	234	377	587	1000	1450

3.7 Sensitivity Test

A sensitivity analysis was undertaken comparing the RORB model outputs to the results derived from the RFFE model. As the 1% AEP peak flow rates were less than the Lower Confidence Limit (5%) of the RFFE model, a neighbouring catchment analysis was undertaken to calibrate the RORB model for a sensitivity test.

To transpose discharges between catchments the following method was utilized which was provided in Grayson et al. (1996):

$$\frac{Qc}{Qg} = \left(\frac{Ac}{Ag}\right)^{0.7}$$

Where:

- Qc = Ungauged Catchment Discharge
- Qg = Gauged Catchment Discharge
- Ac = Ungauged Catchment Area
- Ag = Gauged Catchment Area

Results of the analysis have been provided in **Appendix B**. The peak design discharge for a 1% AEP for the catchment study area was found to be 148m³/s based on the analysis outlined above. To calibrate the 1% AEP to a peak discharge of 148m³/s the parameters outlined within **Table 7** were used.

Table 7 – RORB Parameters Sensitivity Analysis

RORB Parameter	Value
Kc	1.40
m	0.8

Table 8 shows the peak discharges for the various modelled existing case and sensitivity case events.

Table 8 – RFFE and RORB Results at Outlet

Description	1% AEP	1% AEP + CC
Neighbouring Catchment Analysis – Median (Grayson et al. 1996)	148.5	-
Existing Case (E001)	100.5	113.2
Sensitivity Case (S001)	150.1	166.7

4 HYDRAULIC MODEL SETUP

4.1 General

A two-dimensional (2D) TUFLOW model was developed for the site to model Windaroo Creek in relation to the site, as well as existing culvert crossing for roads connecting the site.

Eight flood event scenarios were assessed for the existing scenario. Details on the adopted flood event scenarios are outlined in **Table 9**

Table 9 – TUFLOW model scenarios

Flood Event	Durations (mins)
50% AEP	10, 15, 20, 25, 30, 45, 60, 90, 120, 180, 270, 360
20% AEP	10, 15, 20, 25, 30, 45, 60, 90, 120, 180, 270, 360
10% AEP	10, 15, 20, 25, 30, 45, 60, 90, 120, 180, 270, 360
5% AEP	10, 15, 20, 25, 30, 45, 60, 90, 120, 180, 270, 360
2% AEP	10, 15, 20, 25, 30, 45, 60, 90, 120, 180, 270, 360
1% AEP	10, 15, 20, 25, 30, 45, 60, 90, 120, 180, 270, 360
1% AEP + CC	10, 15, 20, 25, 30, 45, 60, 90, 120, 180, 270, 360
1% AEP (Sensitivity)	10, 15, 20, 25, 30, 45, 60, 90, 120, 180, 270, 360
1% AEP + CC (Sensitivity)	10, 15, 20, 25, 30, 45, 60, 90, 120, 180, 270, 360

4.2 Existing Case Model

The existing TUFLOW model was developed by DRE and is site specific. The TUFLOW solution scheme utilised the TUFLOW HPC GPU version 2023.03.AC.iSP.

4.2.1 Materials

The TUFLOW model consisted of eight general materials types which are shown in **Table 10** should be read in conjunction with **Appendix D.03**. A global mannings 'n' value of 0.060 was used within the areas not through ESRI shape layers.

The manning 'n' values adopted for each material type within the TUFLOW models are provided in **Table 10.**

Table 10 – Mannings 'n' Values Adopted in TUFLOW Model

Mannings 'n' Value	Description
0.022	Road Corridor
0.050	Middle of Channel
0.060	Sparse Scrub
0.080	Urban Parcels
0.100	Dense Vegetation
0.300	Buildings

4.2.2 Topography

The existing case TUFLOW model topography was layered with the following elevation data:

- Queensland LiDAR Data - Logan 2017 Project DEM.

4.2.3 Major Hydraulic Structures

Existing culvert structures were modelled within TUFLOW to assess the site access to a local goods store / service centre and the performance of the existing hydraulic infrastructure during design flood events. Details of the major culvert structures are included in **Table 11** and their locations are generally shown on **Appendix D.02**.

Table 11 – Existing Major Culvert Crossing Details

TUFLOW Culvert ID	Description	Length (m)	Upstream IL (mAHD)	Downstream IL (mAHD)
Culv_1	2/1050 RCP	14.4	27.53	27.04
Culv_2	2/1500 RCP	10.8	38.05	37.56
Culv_3	1/600 RCP	19.2	39.34	38.95
Culv_4	4/825 RCP	9.6	32.02	31.84
Culv_5	8/600 RCP	15.6	14.40	14.27
Culv_6	3/675 RCP	13.2	10.80	10.54
Culv_7	2/1200 RCP	12	16.41	16.17
Culv_9	3/1500 RCP	10.8	22.60	22.38

5 RESULTS

5.1 Water Surface Elevations

The 1% AEP including climate change scenario mapping is shown in **Figure 6** in relation to the site. The water surface elevation across the site ranges from 21.4 mAHD to 20.2 mAHD as generally shown on **Figure 6**. As the site is located within the LCC Flood Investigation Area a minimum freeboard of 500mm is required to habitable floor levels. Therefore, the minimum habitable floor level for the western lot is 21.9 mAHD and the minimum habitable floor level for the eastern lot is 21.0 mAHD.

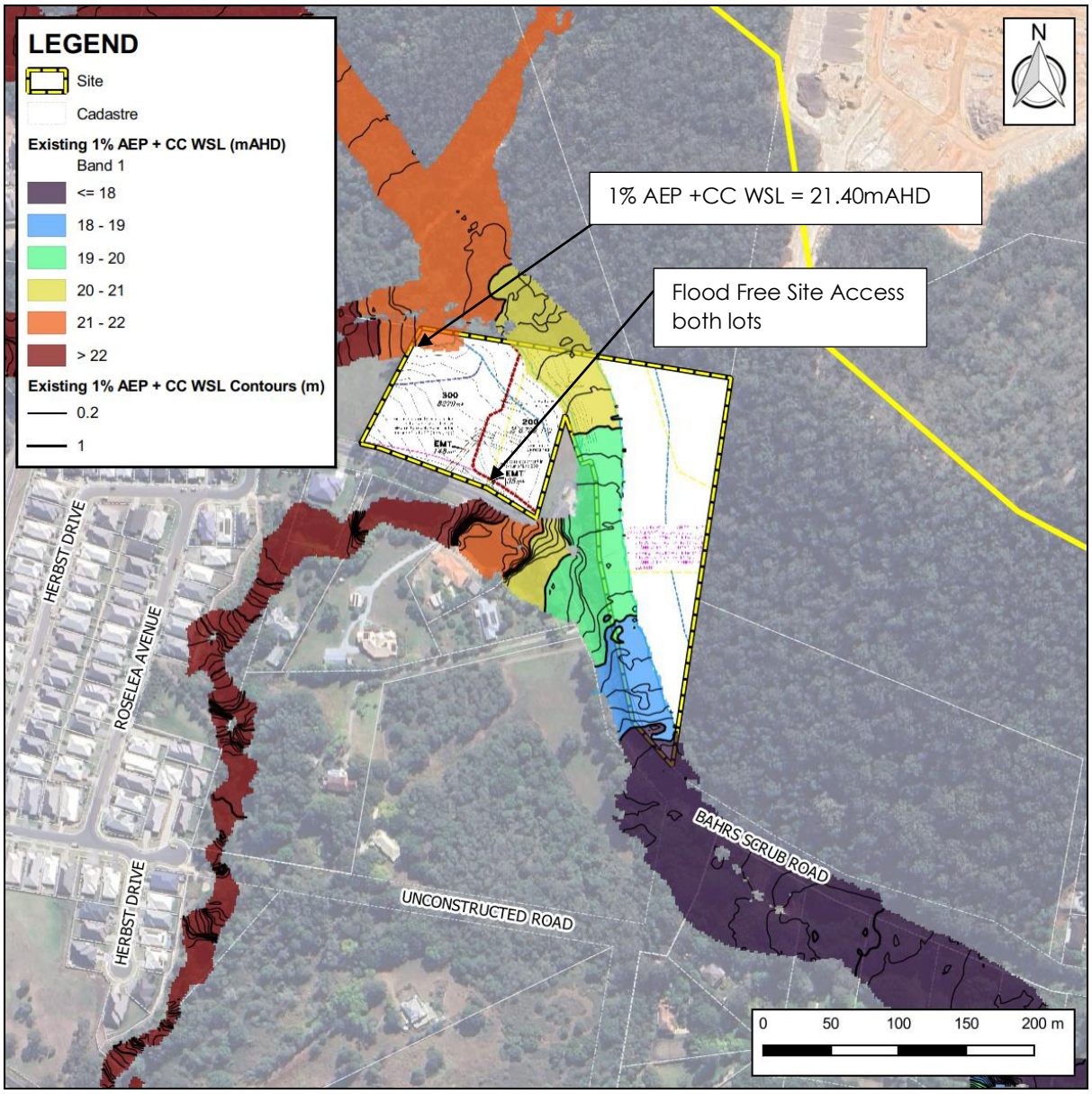


Figure 6 – 1% AEP +CC Water Surface Levels

This proposed development therefore has a developable footprint of approximately 4250m² on the eastern lot and 8030m² on the western lot. Water surface level mapping has been

provided for all other modelled events and can be seen in **Appendix E** and **Appendix F**.

5.2 Hazard mapping

Hazard mapping for the existing scenarios are provided in **Appendix E**. The hazard mapping has been based on scenario results from the 50%, 20%, 10%, 5%, 2%, 1% AEP's and 1% AEP plus climate change flood events. The 1% AEP plus climate change hazard mapping has been provided in **Figure 8**. The mapping was based upon the updated design case RORB and TUFLOW models. **Figure 7** represents the hazard classifications for varying velocity depth product criteria.

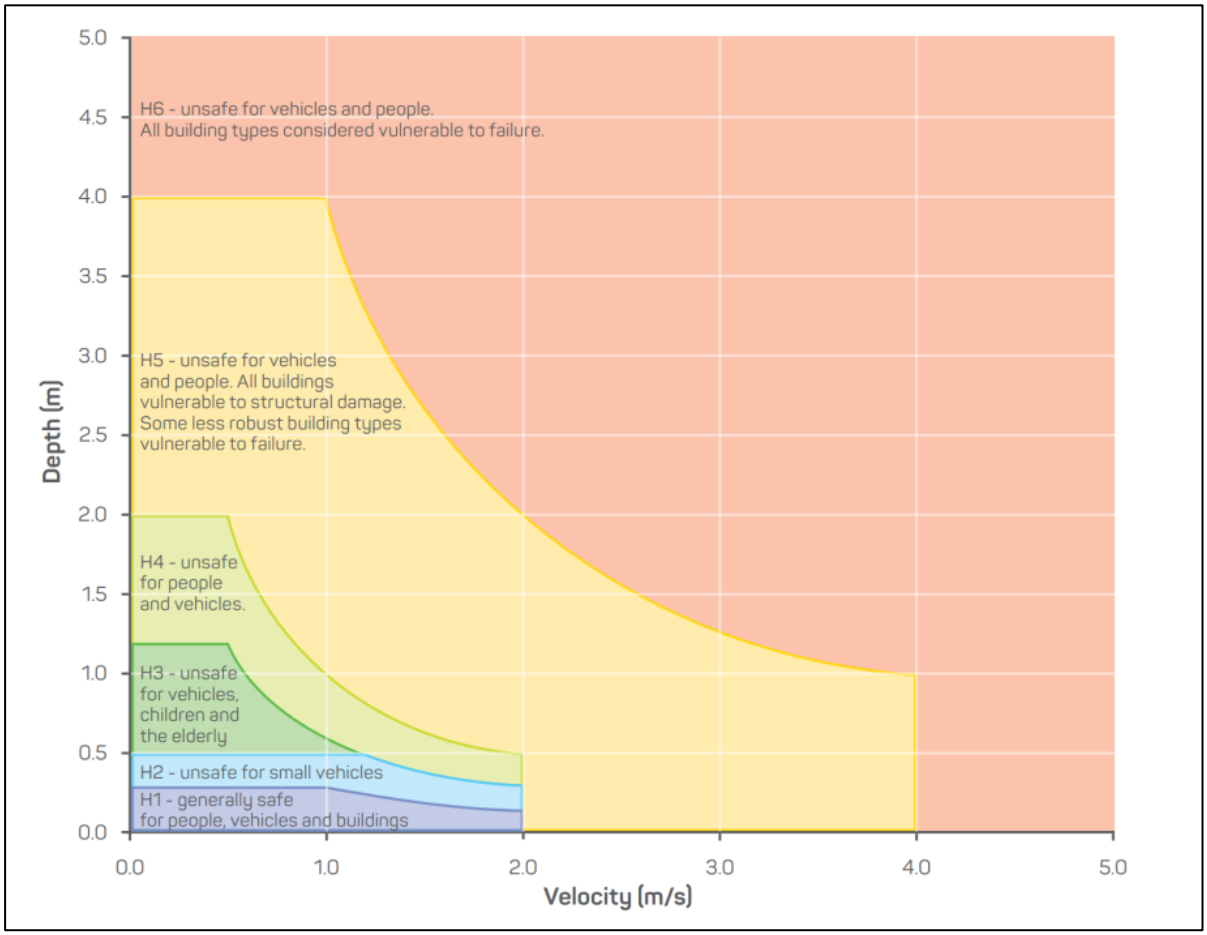


Figure 7 – Flood Hazard Vulnerability Curves

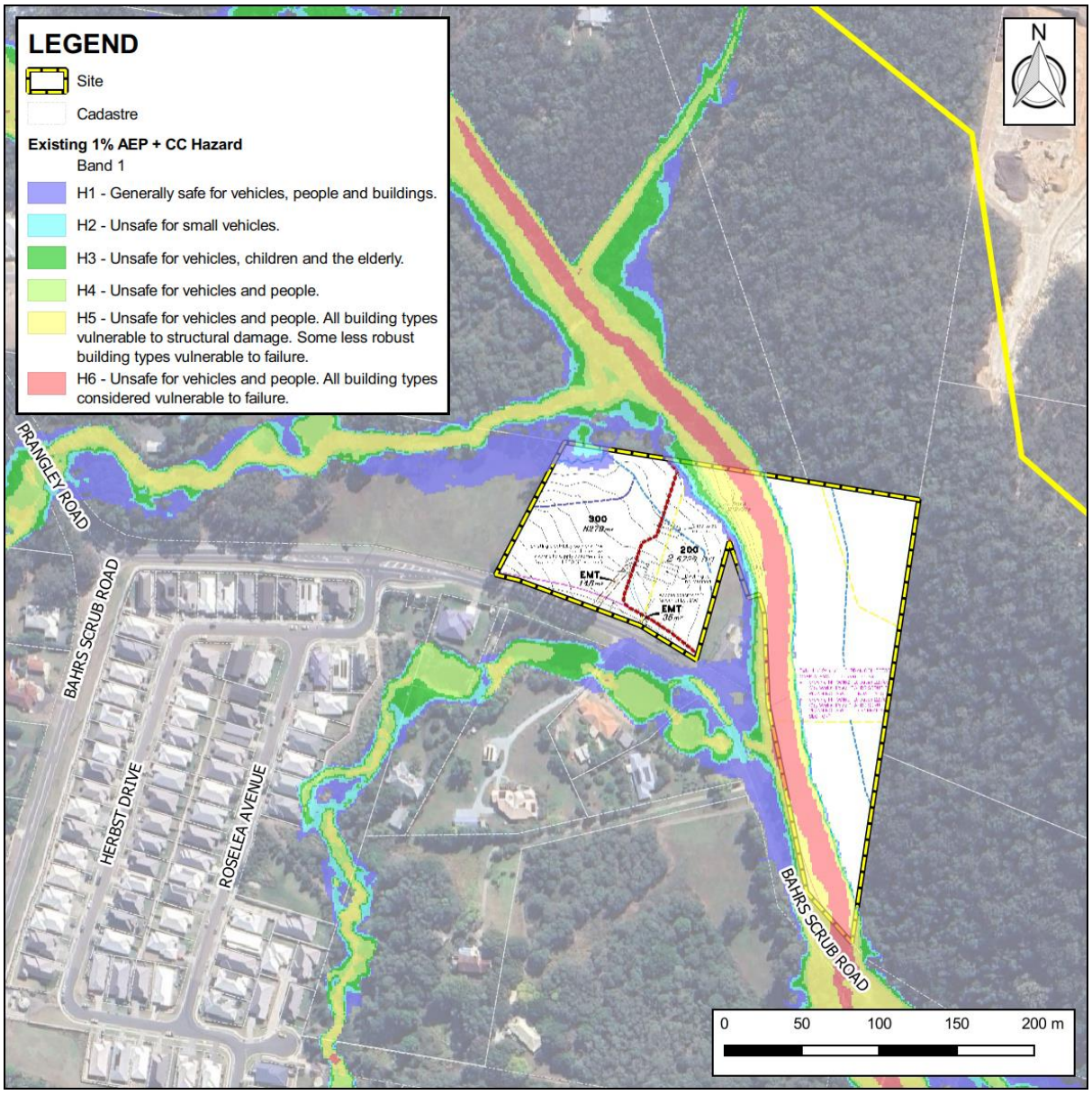


Figure 8 – Existing 1% AEP plus Climate Change Hazard Mapping

5.3 Flood Free Access to Local Goods

The following section discusses the access from the site to a local goods store. The most viable route during a flood event from the site to a local goods store (ie Woolworths) is generally shown on **Figure 9**.

It can be seen that this route along Bahrs Scrub Road is inundated during a 1% AEP flood event. This section specifically describes the level of flood risk for this route and duration of flood inundation.

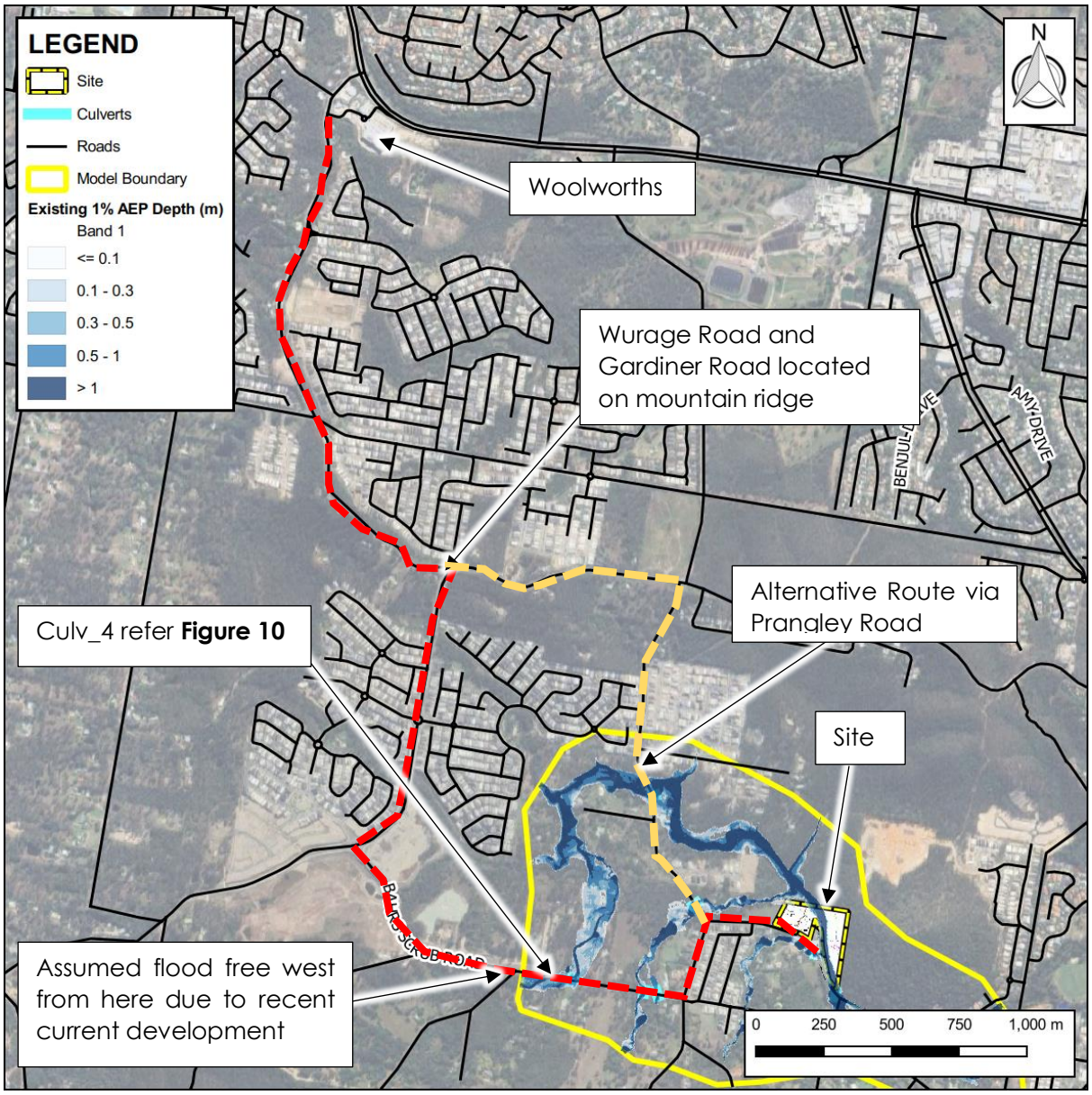


Figure 9 – Site Access to Local Goods

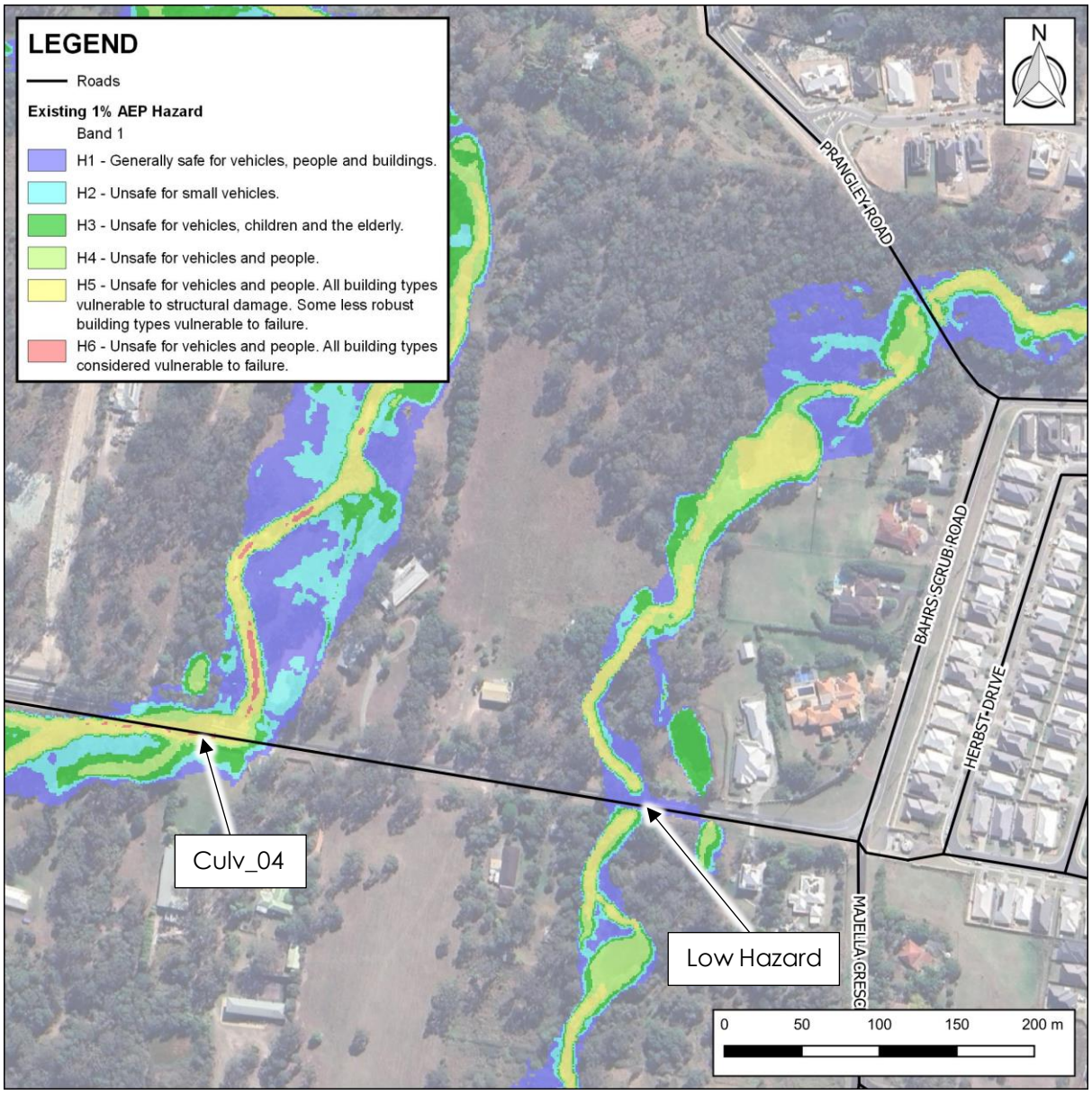


Figure 10 – Peak Discharges at Bahrs Scrub Road

Due to the relatively small catchment size, the time of closure during a 1% AEP event is 7.5hours for a 12hour storm event for Bahrs Scrub Road and 6.5hrs for Prangley Road. A time of closure plan is shown in **Figure 12** for the Culv_2, Culv3 and Culv_4 culverts on Bahrs Scrub Road. Peak discharge rates across Bahrs Scrub Road are also provided in **Figure 11**. Figure 13 shows time of closure for Prangley Road.

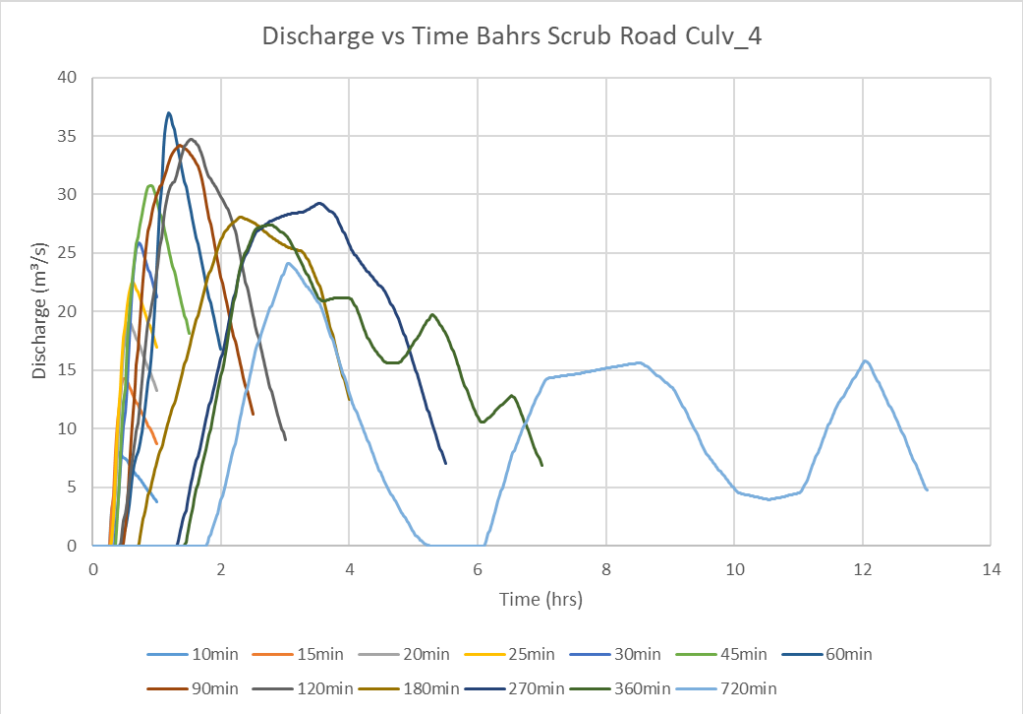


Figure 11 – Critical Duration Hydrographs 1% AEP at PO_L_17 (Bahrs Scrub Road Culv_4)

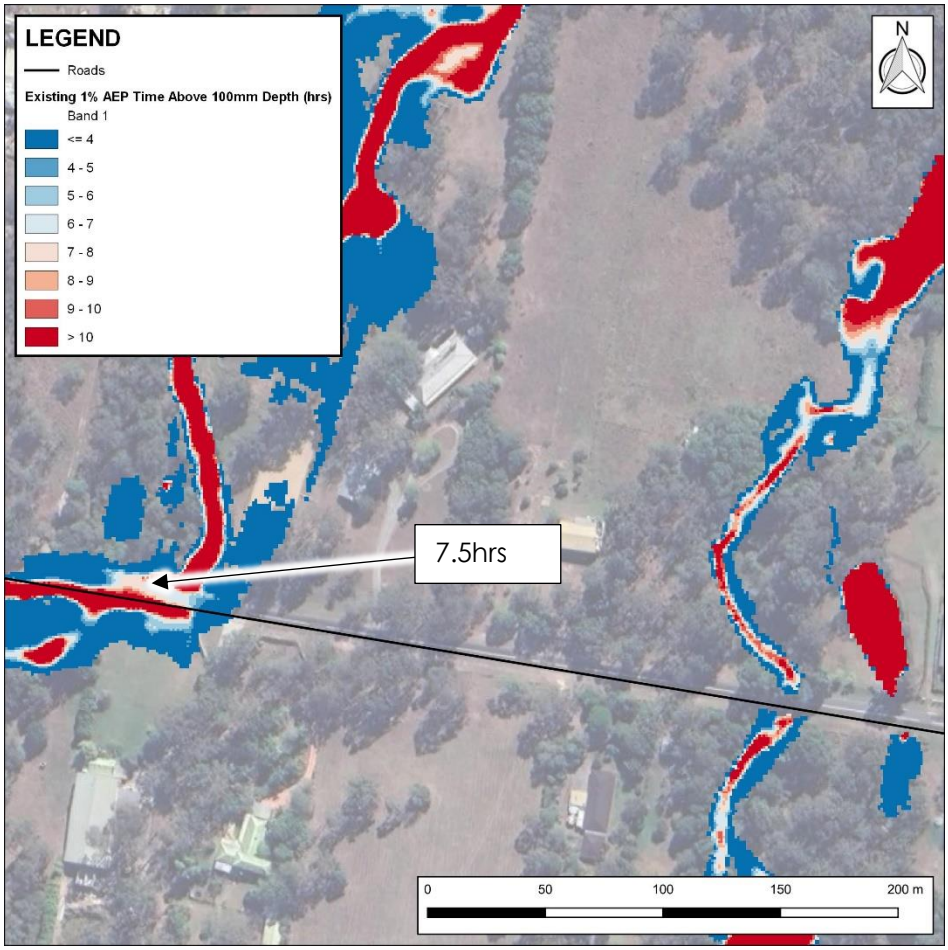


Figure 12 – Time of Closure Plan Depth Above 100mm Bahrs Scrub Road

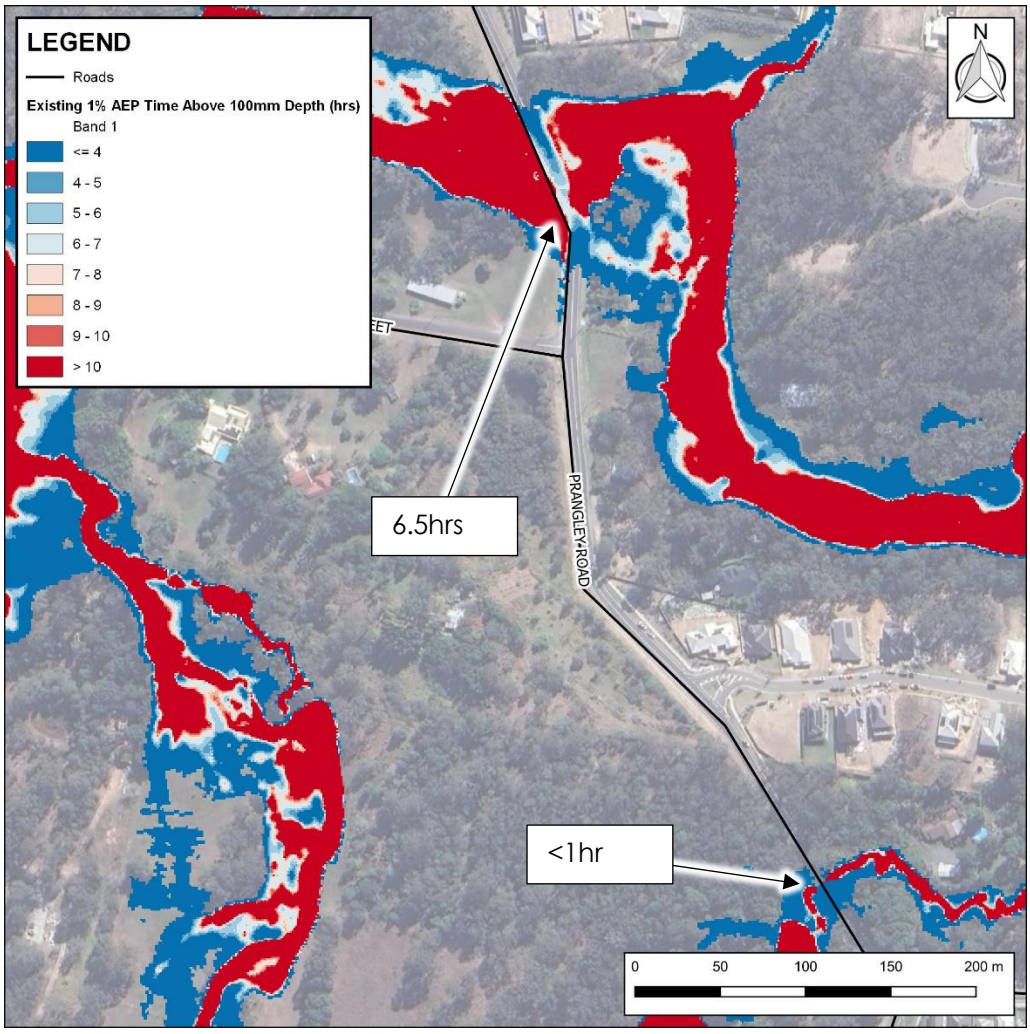


Figure 13 – Time of Closure Plan Depth Above 100mm Prangley Road

The TUFLOW modelling indicates the time of closures for Bahrs Scrub Road and Prangley Road are relatively short durations due to the small contributing catchment sizes. Given grocery stores are typically closed for up to 11hours a day (between 9:00pm and 8:00am) and greater than 24hours on public holidays, it is not uncommon for people to be without access to a local grocery store for up to 24hours. As the time of closure is less than 8hours, we believe the proposed development is acceptable to the level of flood risk surrounding it.

5.4 Sensitivity Analysis

A sensitivity analysis was undertaken within TUFLOW which involved increasing the flow rates based on the methodology outlined within **Section 3.7** of this report. Flood mapping results have been provided within **Appendix F**. Based on the sensitivity analysis, the flood risk to the site and development isn't significantly different to the existing case scenario. A water surface level of 21.7mAHD was observed when compared to the existing case scenario of 21.4mAHD.

5.5 Logan City Council TLPI 2023 Reponses

Responses to the Logan City Council Temporary Planning Instrument 2023 have been provided within **Appendix G**.

6 SUMMARY

This Flood Risk Assessment has been developed to provide an assessment of development of the site, in the context of how it relates to the current engineering environment surrounding it.

The following observations are made:

- Flood modelling outcomes identified within this report show that the proposed development has a developable footprint outside the low flood hazard category for events up to the 1% AEP including climate change.
- The development has flood free access to Bahrs Scrub Road.
- Time of Closure for Bahrs Scrub Road is 7.5hrs in a 1% AEP.
- Time of Closure for Prangley Road is 6.5hrs in a 1% AEP.

Based on all the findings outlined in this report, we believe the proposed development is compatible the with the level of flood risk relative to the environment surrounding it. We do not foresee any reasonable flood risks that would preclude the development being approved by Council.

APPENDIX A PROPOSED DEVELOPMENT PLAN

Statistics	
Total Area of Subdivision	3.501 ha
Number of Residential Lots	2
Contour Interval	1.0 m

300
8279m²

200
2·6729 ha

EMT
148m²

EMT
35m²

Alignment of future road widening to be located wholly within Lot 300

Existing electricity pole and line to be retained. Indicative electricity supply easement in favour of Lot 200 (if required)

Shed to be retained

Dwelling to be retained

Access easement in favour of Lot 200

Emt A SP317938

BAHRS SCRUB ROAD

HERBST DRIVE

Extent of 24m wide "URBAN COLLECTOR ROAD MULTIMODAL – SINGLE CARRIAGEWAY" road corridor via
- drawing 14–00162–B, dated 22/05/2017 by Logan City Council City Works, titled "BAHRS SCRUB ROAD BAHRS SCRUB TRUNK ROAD PLANNING LAYOUT – ROAD LAYOUT PLAN SHEET 2 OF 5"; and
- drawing 14–00160–B, dated 22/05/2017 by Logan City Council City Works, titled "BAHRS SCRUB ROAD BAHRS SCRUB TRUNK ROAD PLANNING LAYOUT – GENERAL ARRANGEMENT AND TYPICAL SECTION".

LEGEND
- Subject Site
- Flood Hazard Overlay
- Waterway Corridor (Medium)
- Waterway Corridor (Minor)
- Mapped Regional Basin Footprint

dts urban planning, surveying & development

Brisbane
PO Box 3128, West End QLD 4101
Ph: 07 3118 0600
brisbane@dtsqld.com.au

Mackay
PO Box 11711, Mackay Caneland QLD 4740
Ph: 1300 278 783
mackay@dtsqld.com.au

Issue	Revision	Int	Date
A	Original issue	AV	25/08/23

Property Description
Lot 12 on SP317949

SUBDIVISION PROPOSAL PLAN

130 Bahrs Scrub Road, Bahrs Scrub

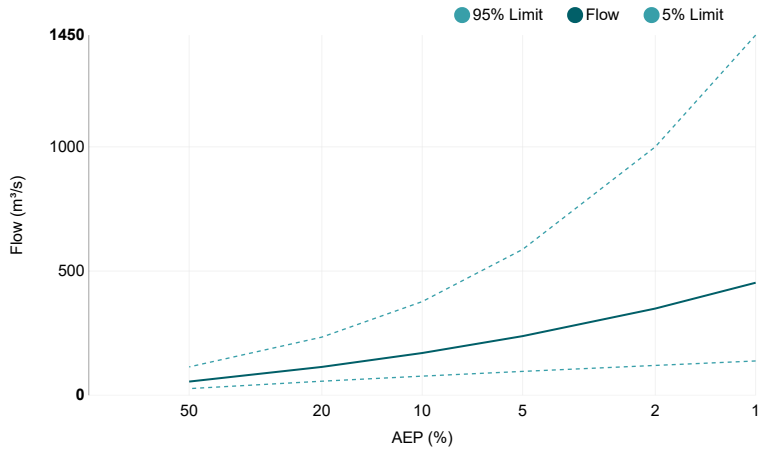
SCALE 1:1000 @ A2
10 0 10 20 30 40 50

Local Authority: Logan City Council
Client: Jitendra Ahlawat

Project BNE230151
File B230151P2.dwg
Date 25/08/2023
Drawing A2 1184
Revision A
Sheet 1 of 1

APPENDIX B RFFE OUTPUTS

Results | Regional Flood Frequency Estimation Model



AEP (%)	Discharge (m^3/s)	Lower Confidence Limit (5%) (m^3/s)	Upper Confidence Limit (95%) (m^3/s)
50	55.0	26.6	114
20	114	56.5	234
10	170	76.9	377
5	238	96.0	587
2	349	120	1000
1	453	138	1450

Statistics

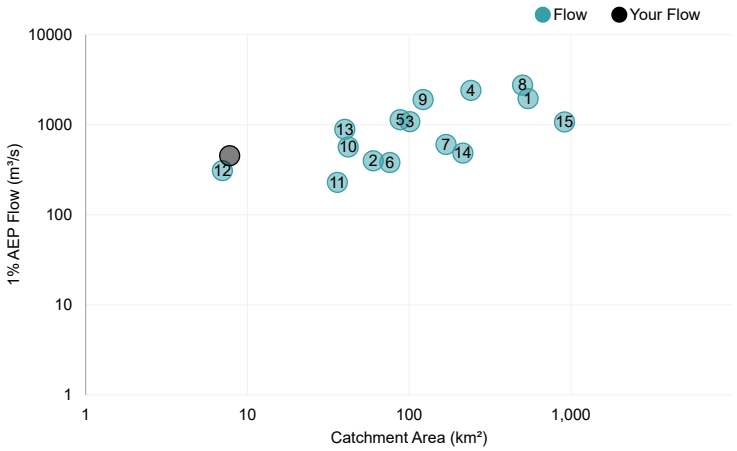
Variable	Value	Standard Dev
Mean	4.154	0.436
Standard Dev	0.937	0.309
Skew	0.103	0.030

Note: These statistics come from the nearest gauged catchment. Details.

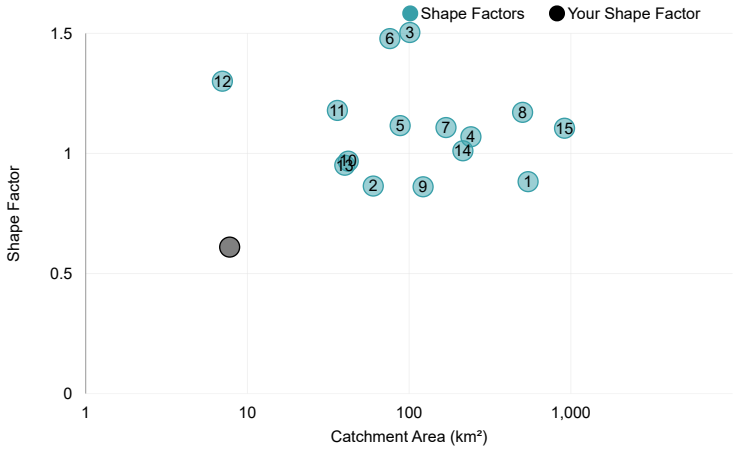
Correlation		
1.000		
-0.330	1.000	
0.170	-0.280	1.000

Note: These statistics are common to each region. Details.

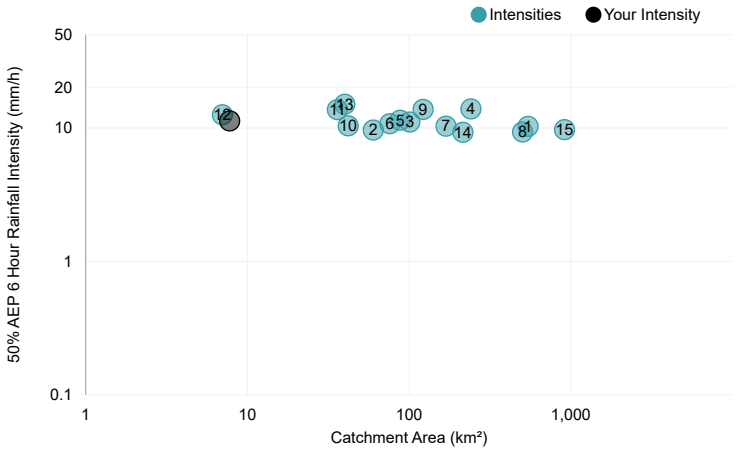
1% AEP Flow vs Catchment Area



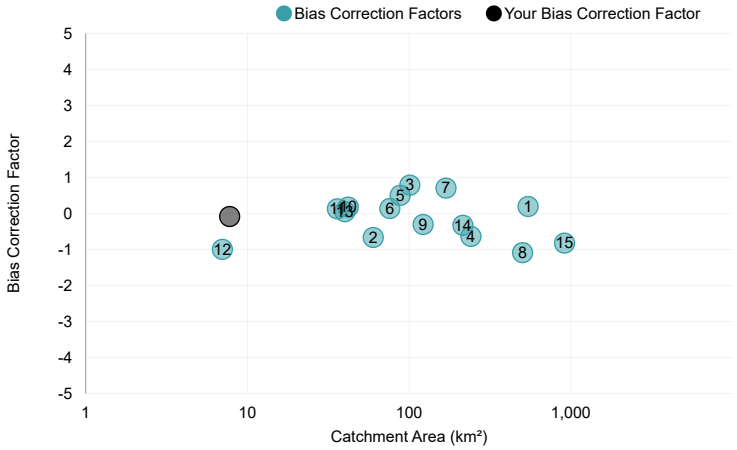
Shape Factor vs Catchment Area



Intensity vs Catchment Area



Bias Correction Factor vs Catchment Area



Download

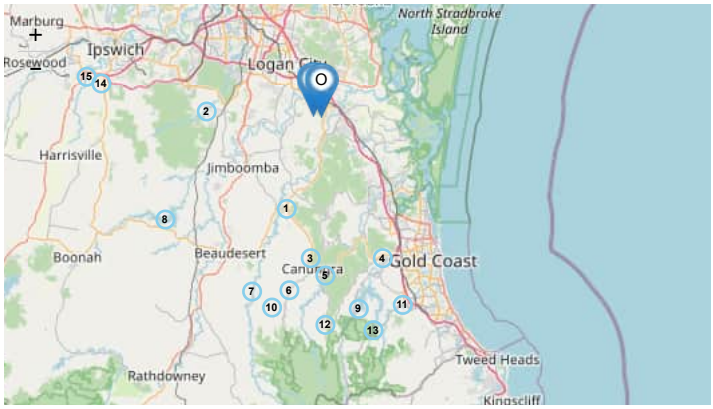
TXT Nearby JSON

Input Data

Date/Time	2024-03-18 19:42

Input Data

Catchment Name	10080 Total
Latitude (Outlet)	-27.7425379574
Longitude (Outlet)	153.184293369
Latitude (Centroid)	-27.7398488804
Longitude (Centroid)	153.167395388
Catchment Area (km^2)	7.76472399976
Distance to Nearest Gauged Catchment (km)	20.0
50% AEP 6 Hour Rainfall Intensity (mm/h)	11.299108
2% AEP 6 Hour Rainfall Intensity (mm/h)	28.823179
Rainfall Intensity Source (User/Auto)	Auto
Region	East Coast
Region Version	RFFE Model 2016 v1
Region Source (User/Auto)	Auto
Shape Factor	0.61
Interpolation Method	Natural Neighbour
Bias Correction Value	-0.084



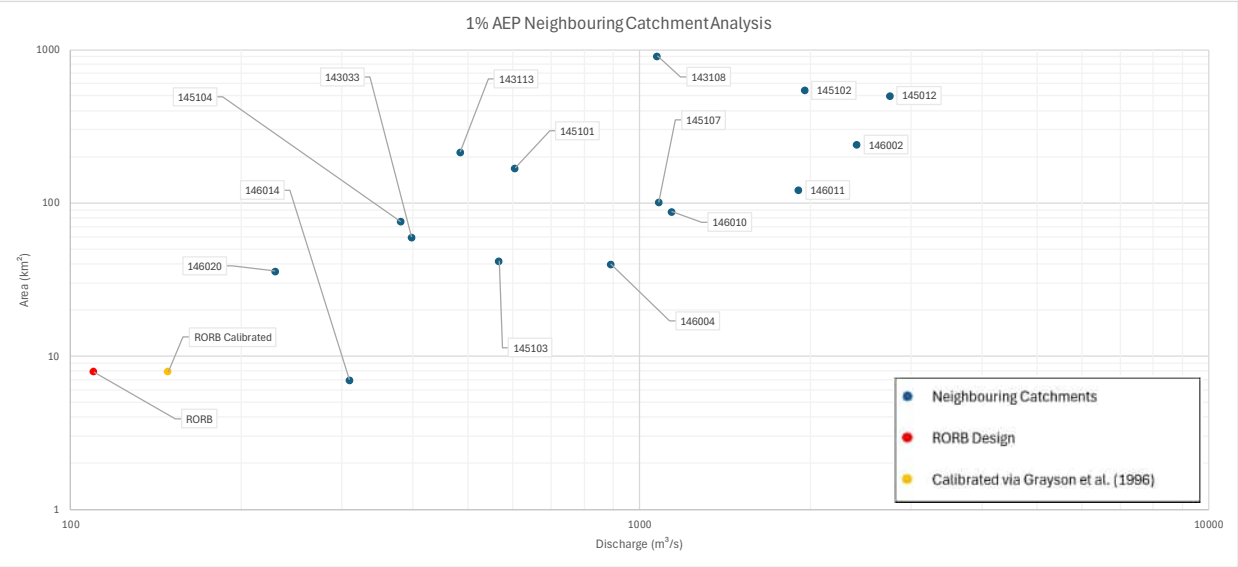
Method by Dr Ataur Rahman and Dr Khaled Haddad from Western Sydney University for the Australian Rainfall and Runoff Project. Full description of the project can be found at the project page (http://arr.ga.gov.au/revision-projects/project-list/projects/project-5) on the ARR website. Send any questions regarding the method or project here (mailto:admin@arr-software.org).

ENGINEERS AUSTRALIA (http://www.engineersaustralia.org.au)

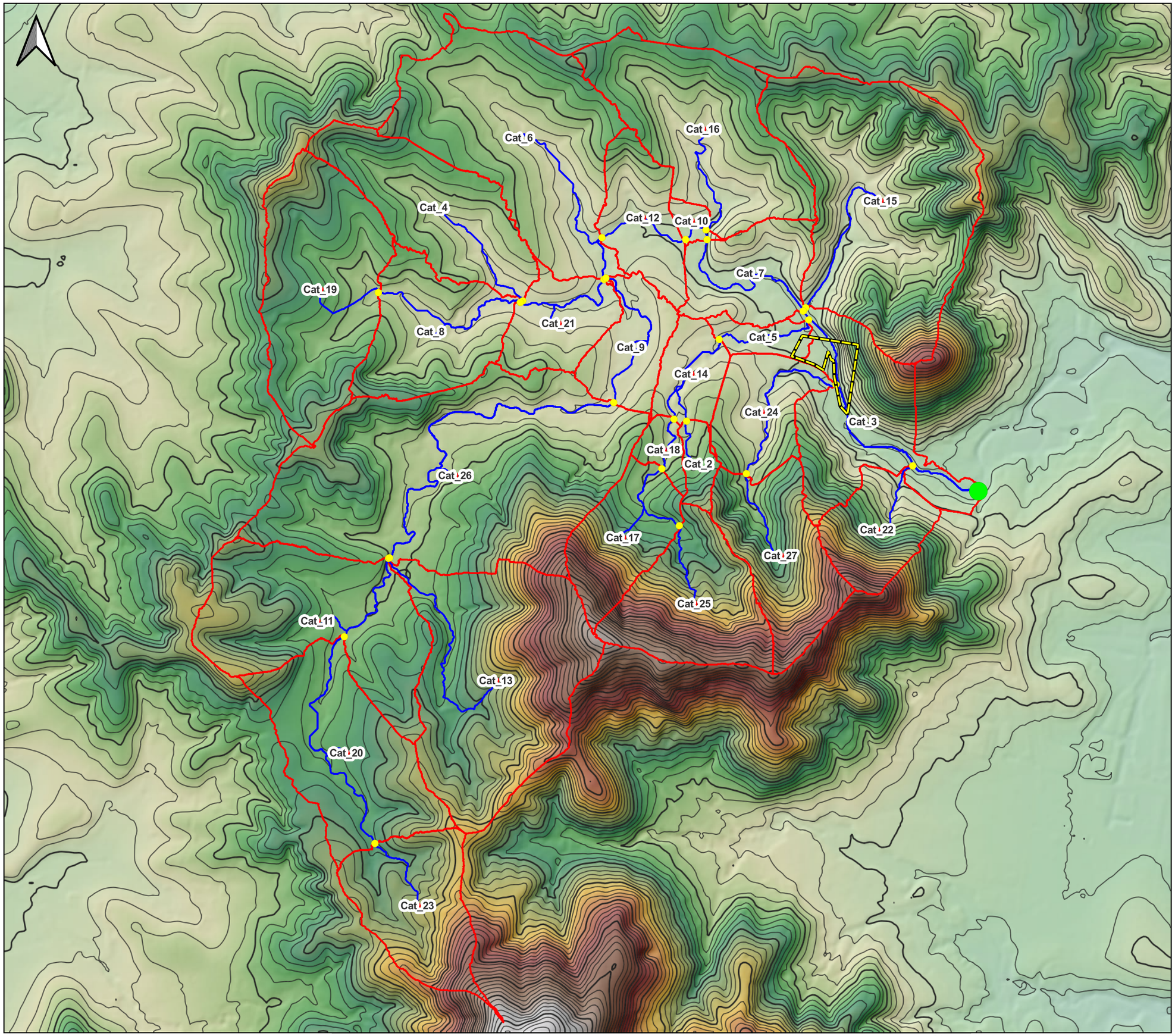
WESTERN SYDNEY UNIVERSITY (http://www.uws.edu.au)

Catchment Area (km^2)	7.76

ID	Distance (km)	Catchment area (km^2)	Neighbouring Catchments - Q_G						Equivalent Flow - Q_C					
			50% AEP Flow (m3/s)	20% AEP Flow (m3/s)	10% AEP Flow (m3/s)	5% AEP Flow (m3/s)	2% AEP Flow (m3/s)	1% AEP Flow (m3/s)	50% AEP Flow (m3/s)	20% AEP Flow (m3/s)	10% AEP Flow (m3/s)	5% AEP Flow (m3/s)	2% AEP Flow (m3/s)	1% AEP Flow (m3/s)
145102	20	544	281	706	1028	1334	1703	1952	14	36	52	68	87	100
143033	23.58	60	12	126	220	296	365	398	3	30	53	71	87	95
145107	28.73	101	94	224	356	522	807	1082	16	37	59	87	134	179
146002	31.18	241	215	566	899	1289	1891	2408	19	51	81	116	171	217
146010	31.97	88	112	332	520	713	961	1138	20	61	95	130	176	208
145104	35.73	76	75	142	194	248	322	381	15	29	39	50	65	77
145101	38.04	169	137	303	403	482	561	604	16	35	47	56	65	70
145012	38.1	503	79	300	589	1016	1856	2755	4	16	32	55	100	149
146011	39.53	122	240	472	694	971	1445	1903	35	69	101	141	210	277
145103	39.97	42	41	150	249	350	478	566	13	46	76	107	147	174
146020	41.41	36	93	130	154	177	207	229	32	44	52	60	71	78
146014	41.98	7	16	64	114	170	249	310	18	69	122	182	268	333
146004	44.32	40	137	302	433	568	750	890	44	96	137	180	238	282
143113	45.26	215	51	134	207	286	397	484	5	13	20	28	39	47
143108	48.35	914	136	345	515	688	911	1074	5	12	18	24	32	38
Min									2.8	12.3	18.3	24.4	32.3	38.1
Mean									17.2	42.9	65.7	90.4	125.9	154.9
Max									43.5	95.8	137.3	182.4	267.5	332.7
Median									**15.5**	**37.2**	**52.7**	**70.7**	**100.1**	**148.5**



APPENDIX C RORB CATCHMENT PLANS



Legend

- Site
- RORB Catchments
- RORB Centroids
- RORB Confluence
- RORB Outlet
- RORB Reaches

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

RORB Impervious Plan

Scale (at A3)
1:15,000
0 100 200 300 400
Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

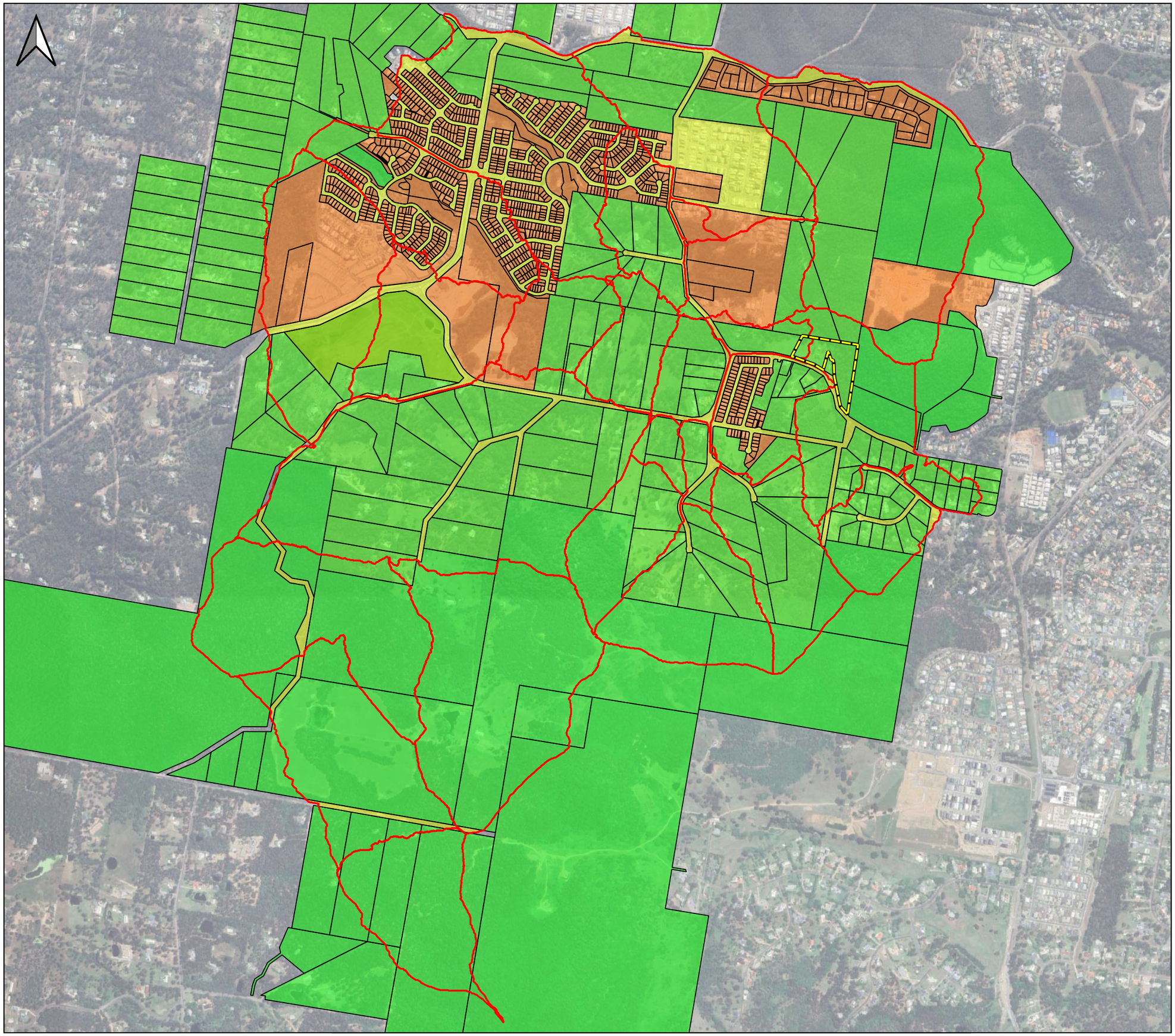
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix C.01

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Site
- RORB Catchments

Impervious (%)

- 0 - 10
- 10 - 20
- 40 - 50
- 70 - 80

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

RORB Impervious Plan

Scale (at A3)
1:15,000
0 100 200 300 400
Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

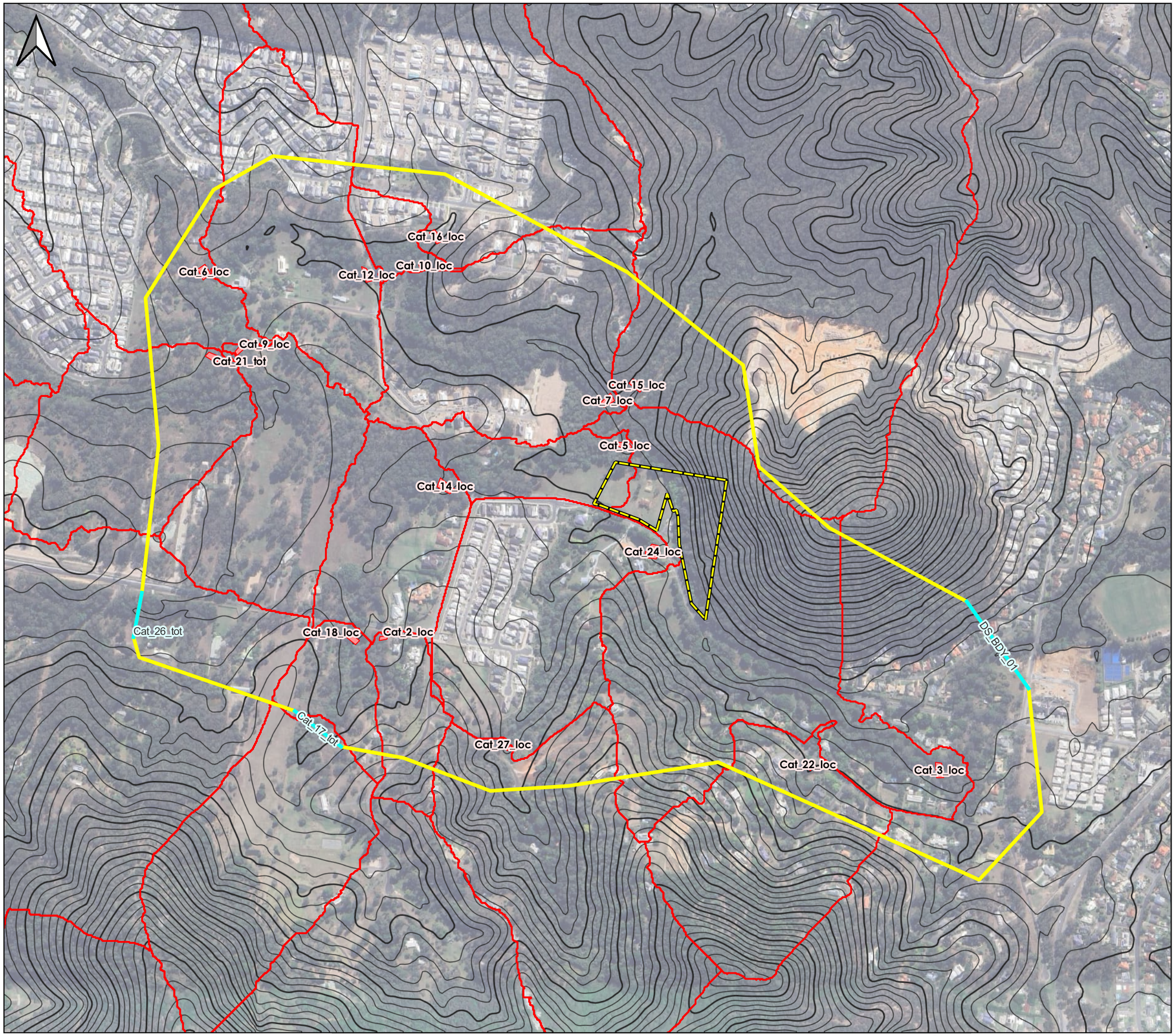
Project Number:	Rev:
10080	A

Appendix C.02

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz

APPENDIX D TUFLOW SETUP



Legend

- Model Boundary
- Site
- RORB Catchments
- Inflow Locations
- Boundary Conditions

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

TUFLOW Model Area

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number: 10080 | Rev: A

Appendix D.01

Date: 01/04/2024

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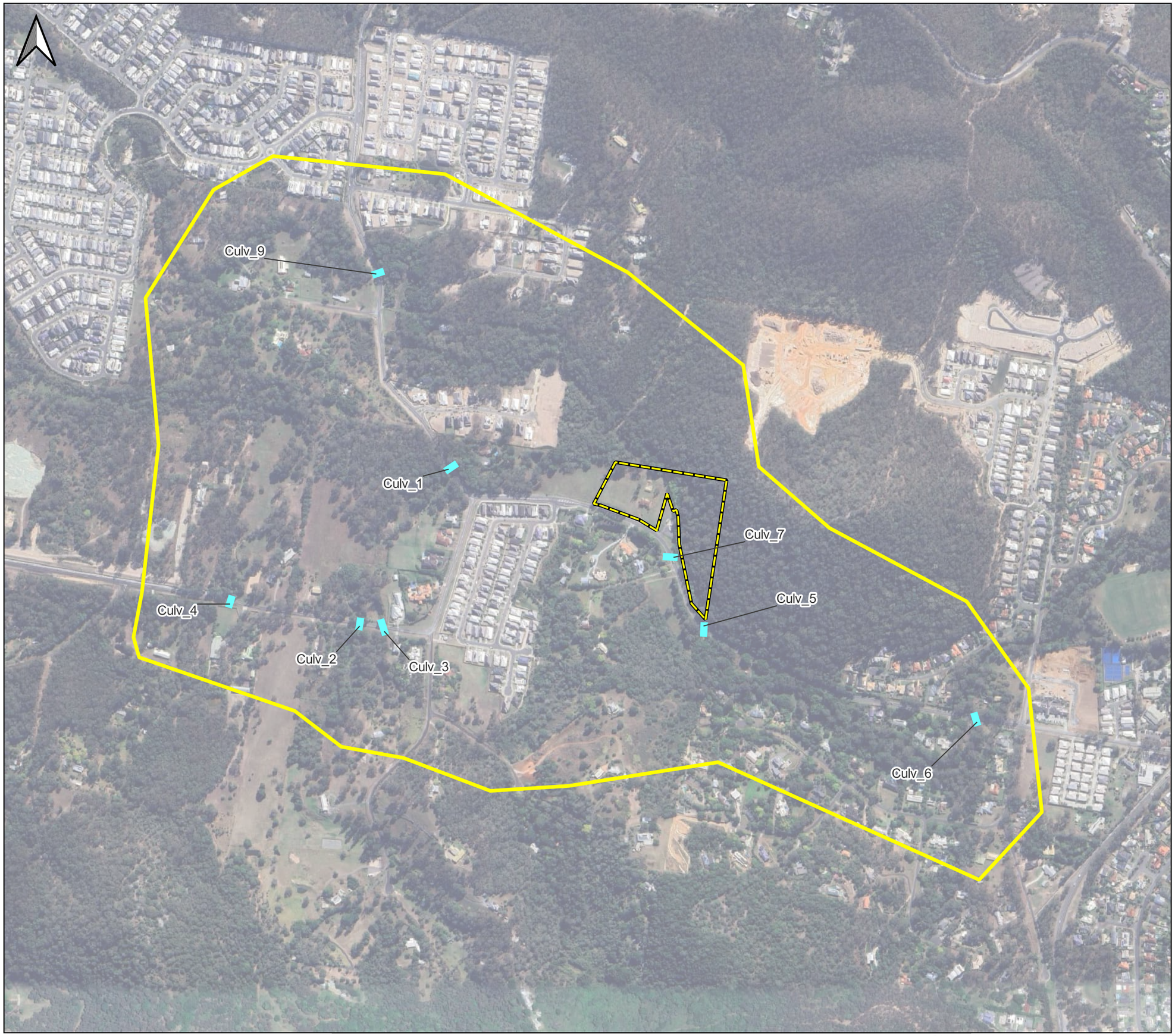

Legend

- Model Boundary
- Site
- Culverts

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

TUFLOW Culverts

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix D.02

Date: 01/04/2024

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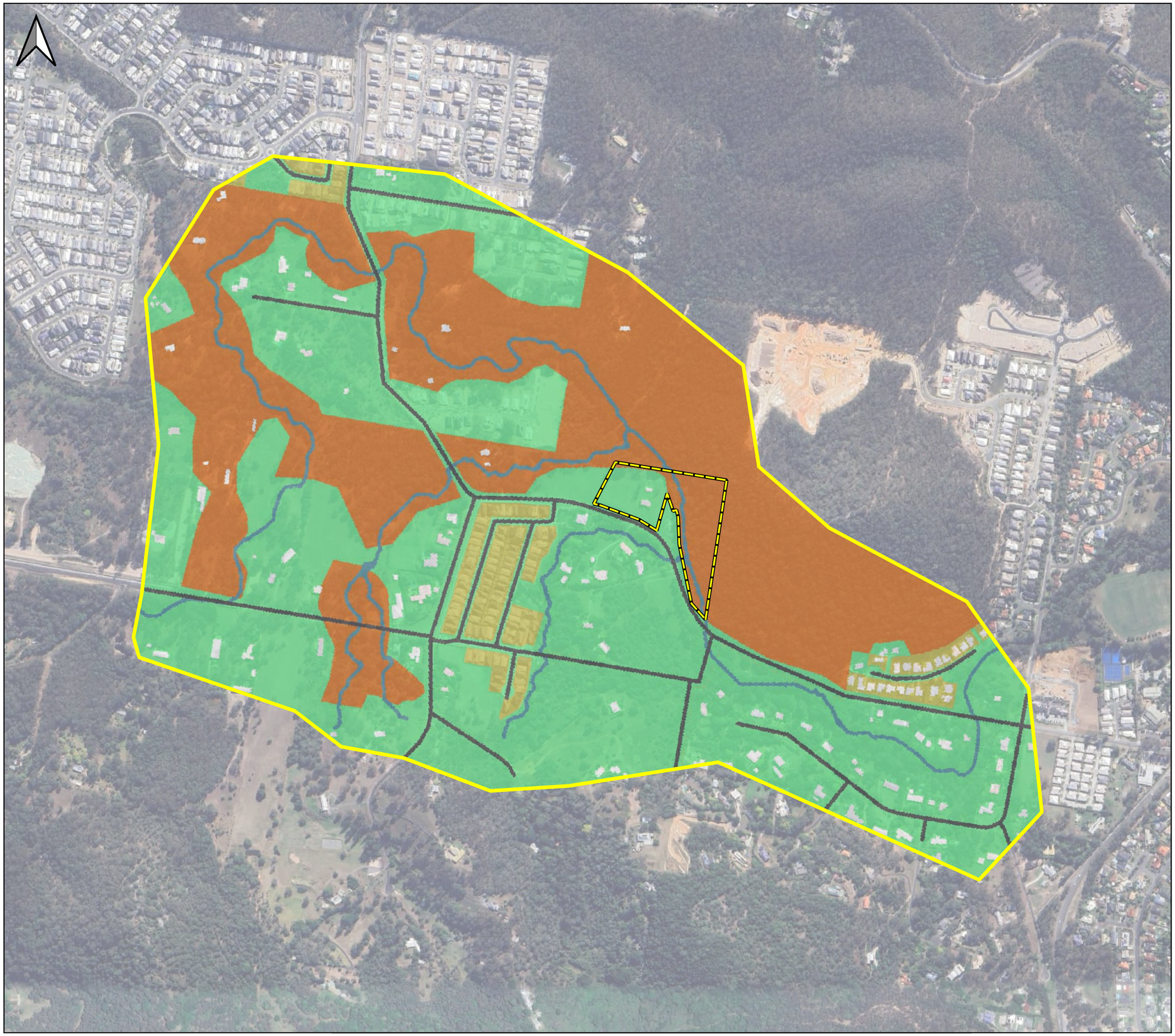

Legend

- Model Boundary
- Site

Mannings 'n' - Material

Band 1 (Gray)

- 0.022 - Roads
- 0.050 - Middle of Channel
- 0.060 - Sparse Scrub
- 0.080 - Urban Areas
- 0.100 - Desne Vegetation
- 0.300 - Buildings

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

TUFLOW Materials

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix D.03

Date: 01/04/2024

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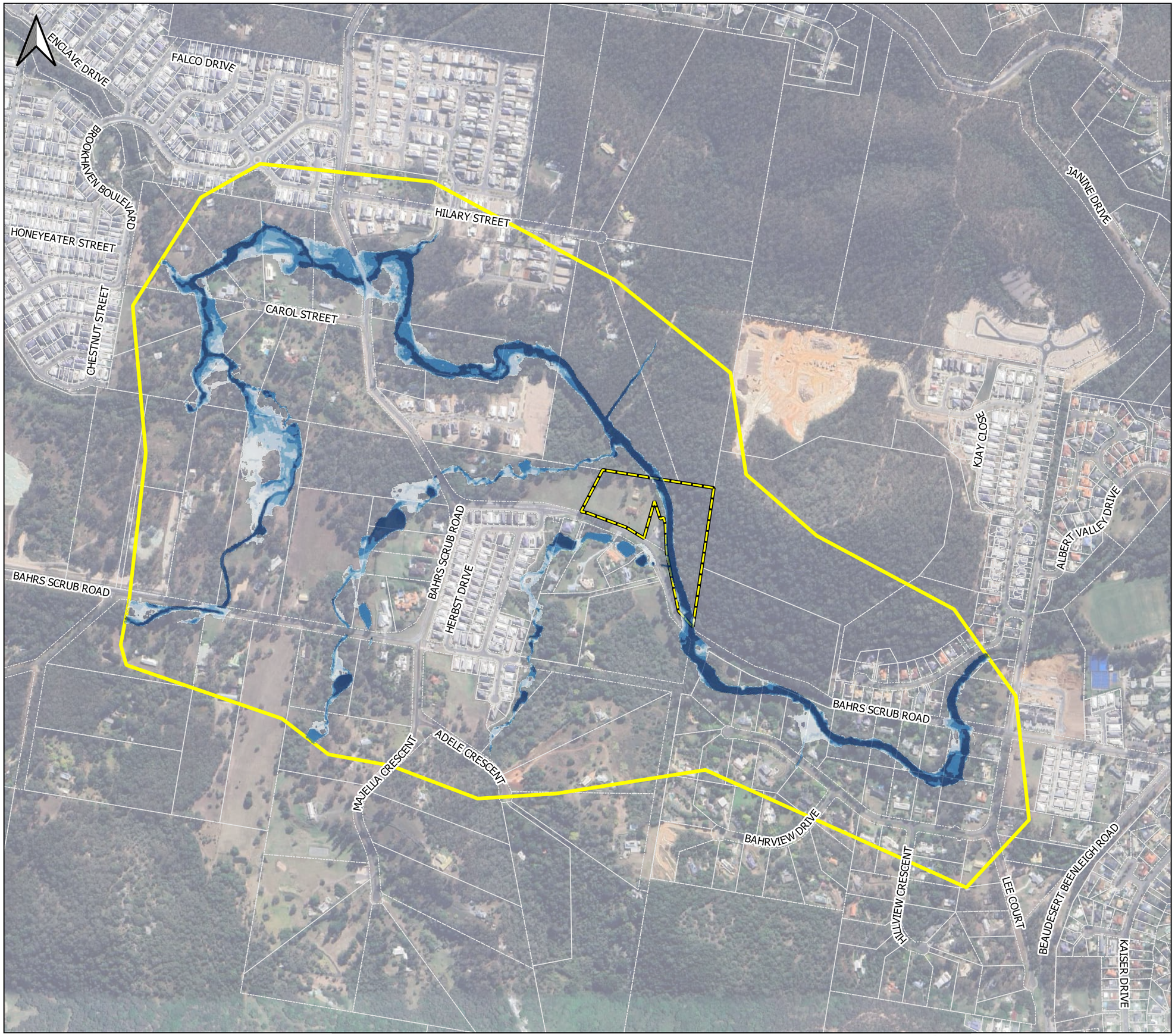
APPENDIX E TUFLOW MAPPING



Legend

- Cadastre
- Model Boundary
- Site

Existing 50% AEP Depth (m)

Band 1

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- > 1

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 50% AEP Depth

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number: 10080

Rev: A

Appendix E.01

Date: 01/04/2024

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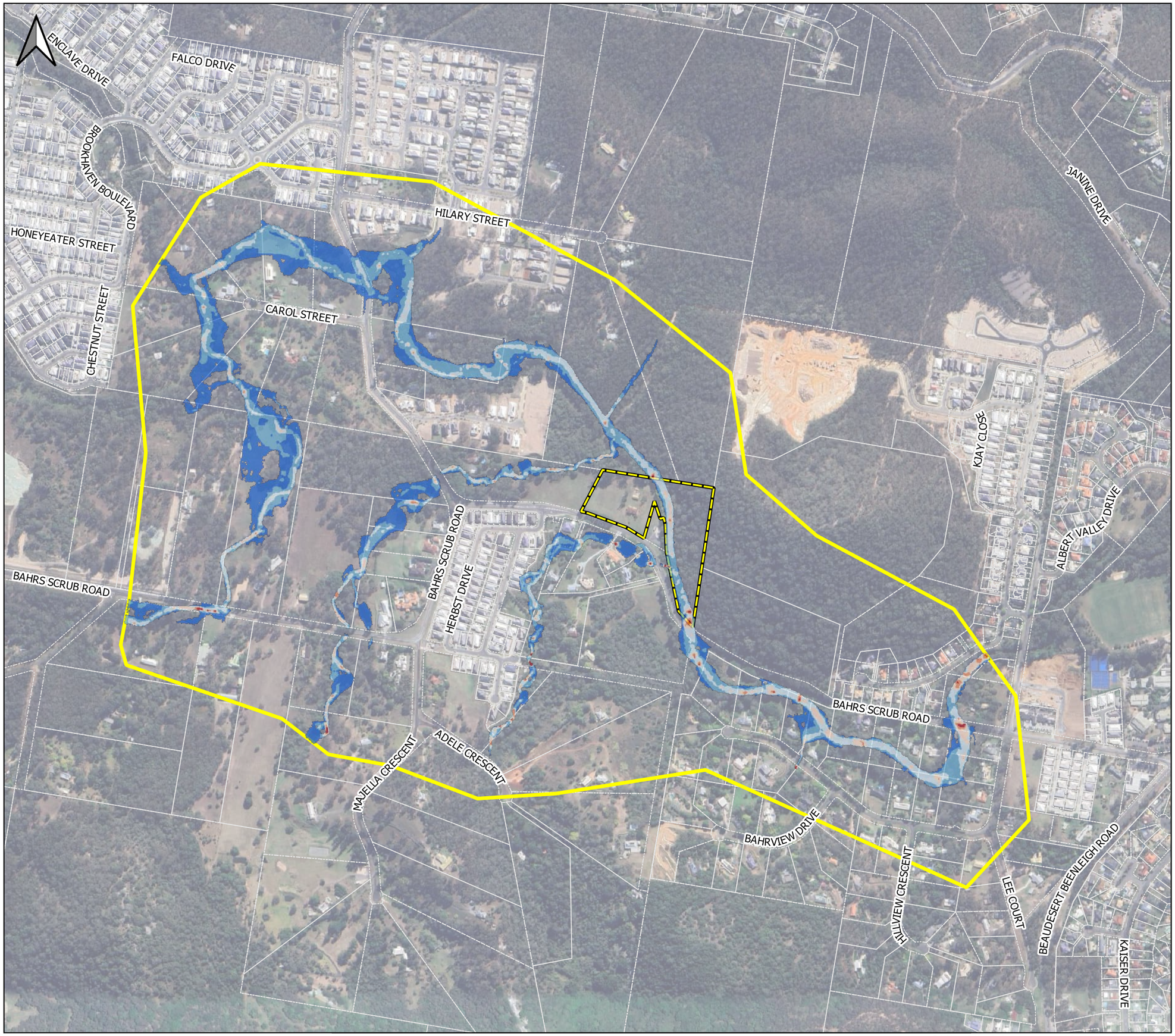

Legend

- Cadastre
- Model Boundary
- Site

Existing 50% AEP Velocity (m/s)

Band 1

- <= 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- > 2.5

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 50% AEP Velocity

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix E.02

Date: 01/04/2024

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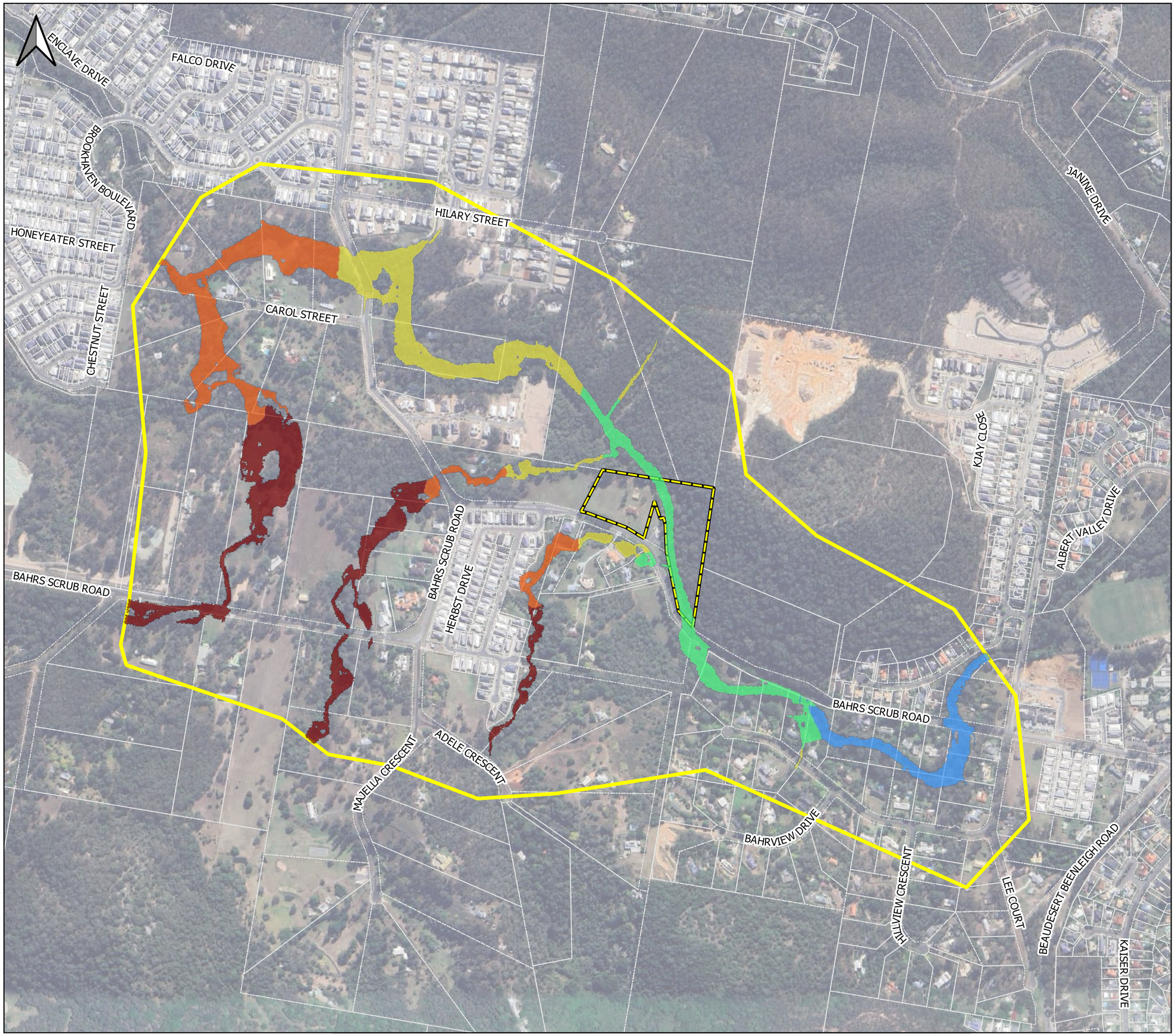


Legend

- Cadastre
- Model Boundary
- Site

Existing 50% AEP WSL (mAHD)

Band 1

- <= 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- > 30

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 50% AEP Water Surface Level

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

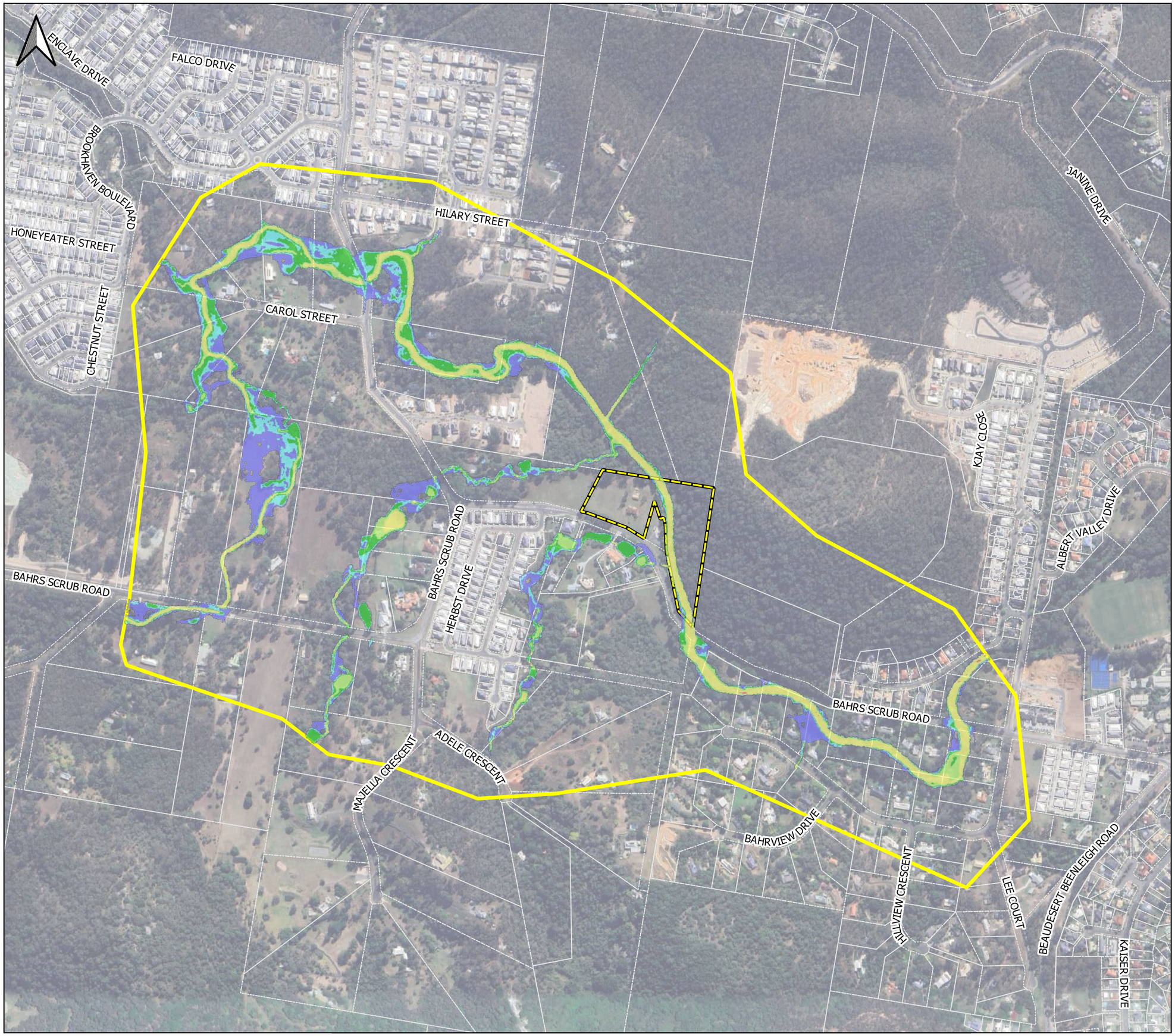
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix E.03

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 50% AEP Hazard

- Band 1
- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Project Name:

Bahrs Scrub Road Flood Assessment

Title:

Existing 50% AEP Hazard

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number: **10080**

Rev: **A**

Appendix E.04

Date: 01/04/2024

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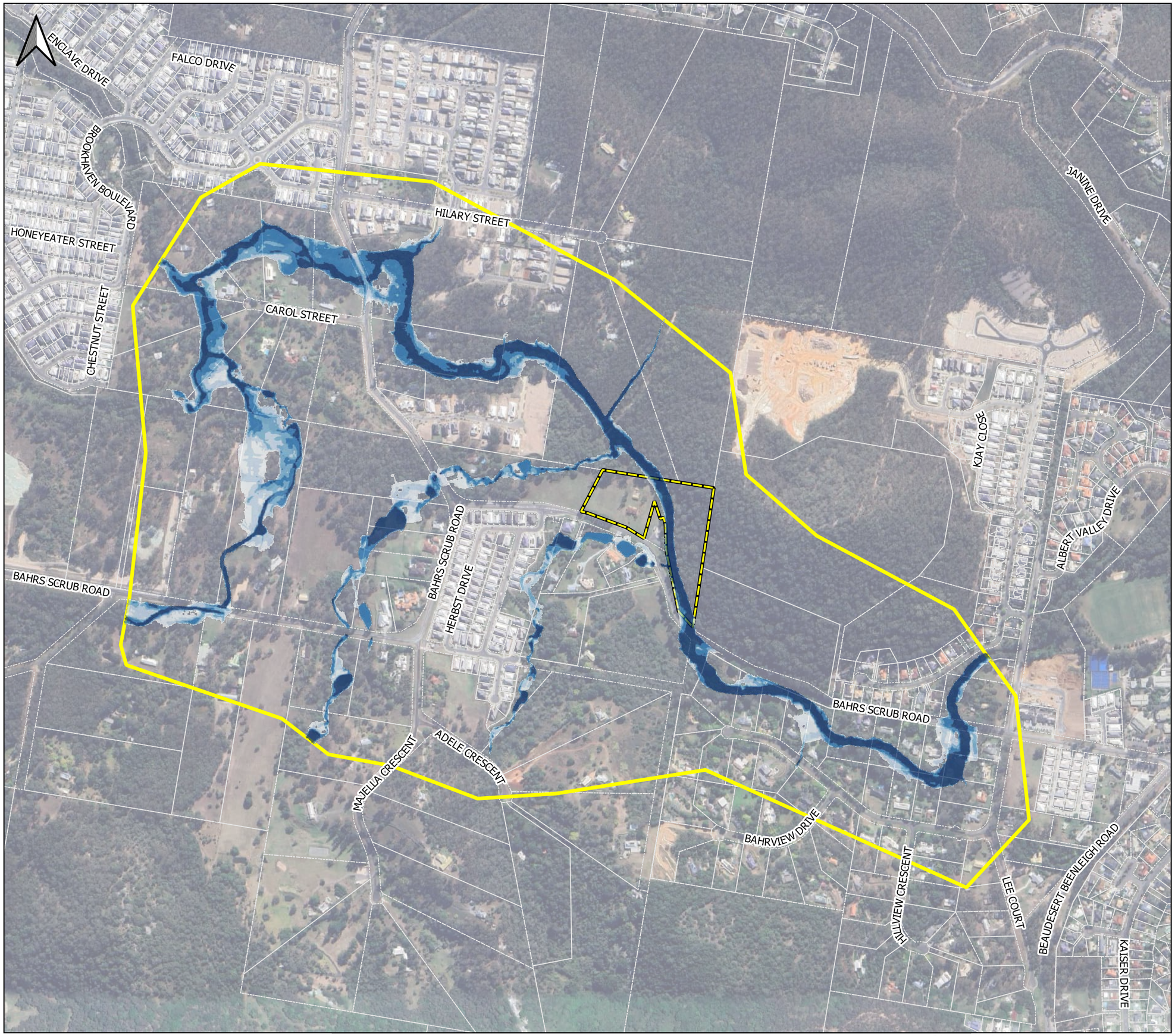

Legend

- Cadastre
- Model Boundary
- Site

Existing 20% AEP Depth (m)

Band 1

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- > 1

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 20% AEP Depth

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number: 10080

Rev: A

Appendix E.05

Date: 01/04/2024

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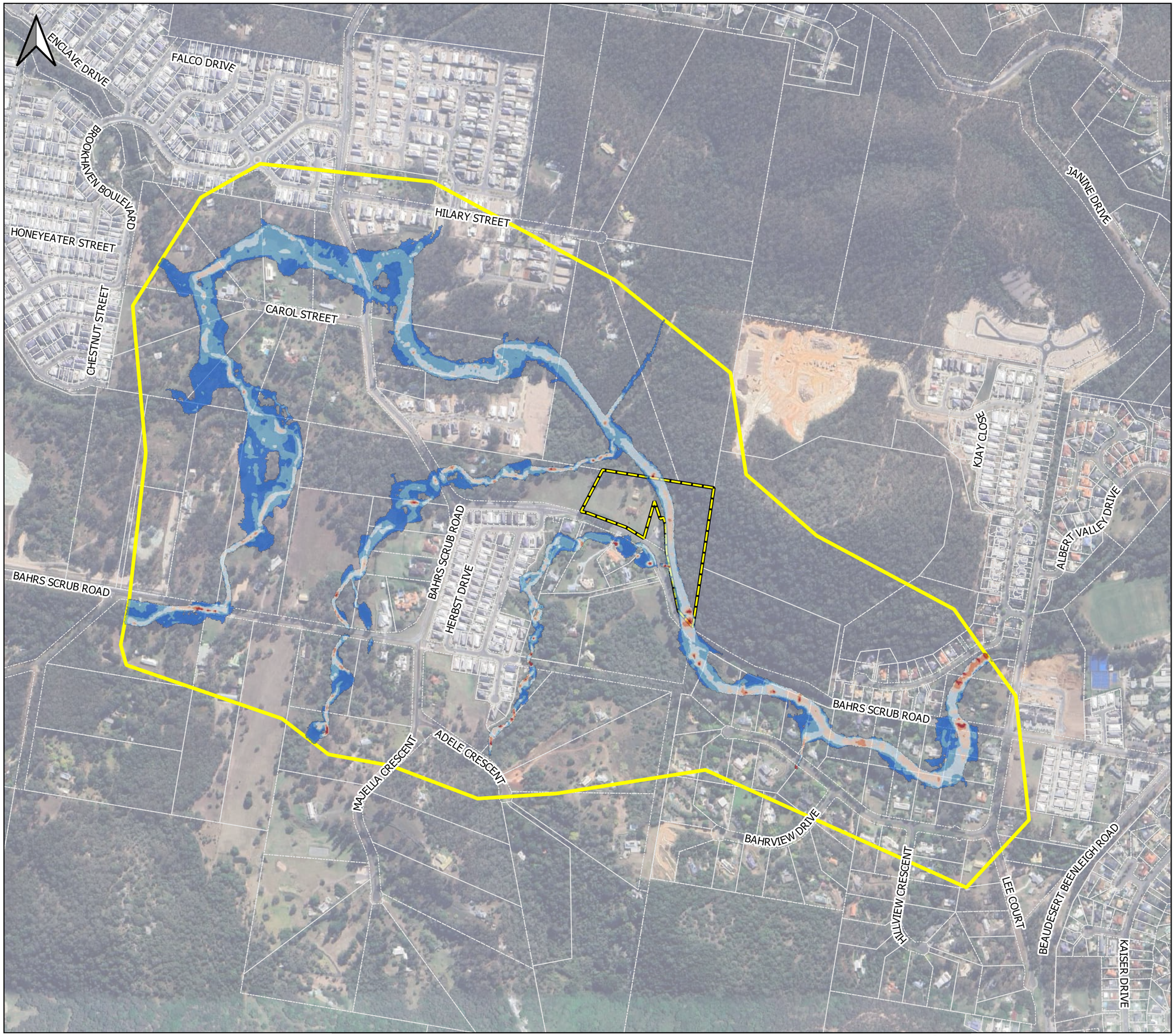

Legend

- Cadastre
- Model Boundary
- Site

Existing 20% AEP Velocity (m/s)

Band 1

- <= 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- > 2.5

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 20% AEP Velocity

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number: 10080

Rev: A

Appendix E.06

Date: 01/04/2024

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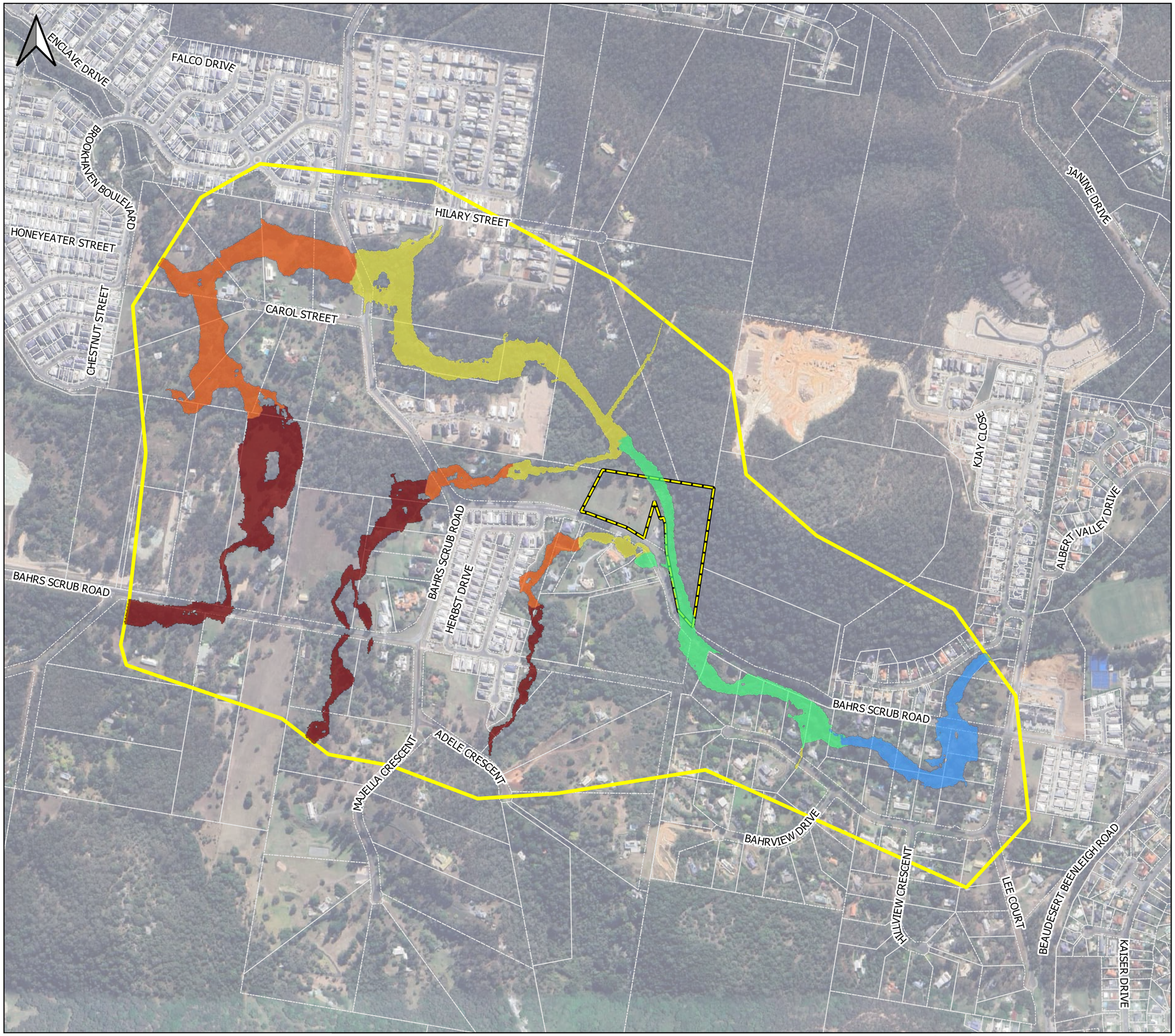

Legend

- Cadastre
- Model Boundary
- Site

Existing 20% AEP WSL (mAHD)

Band 1

- <= 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- > 30

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 20% AEP Water Surface Level

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix E.07

Date: 01/04/2024

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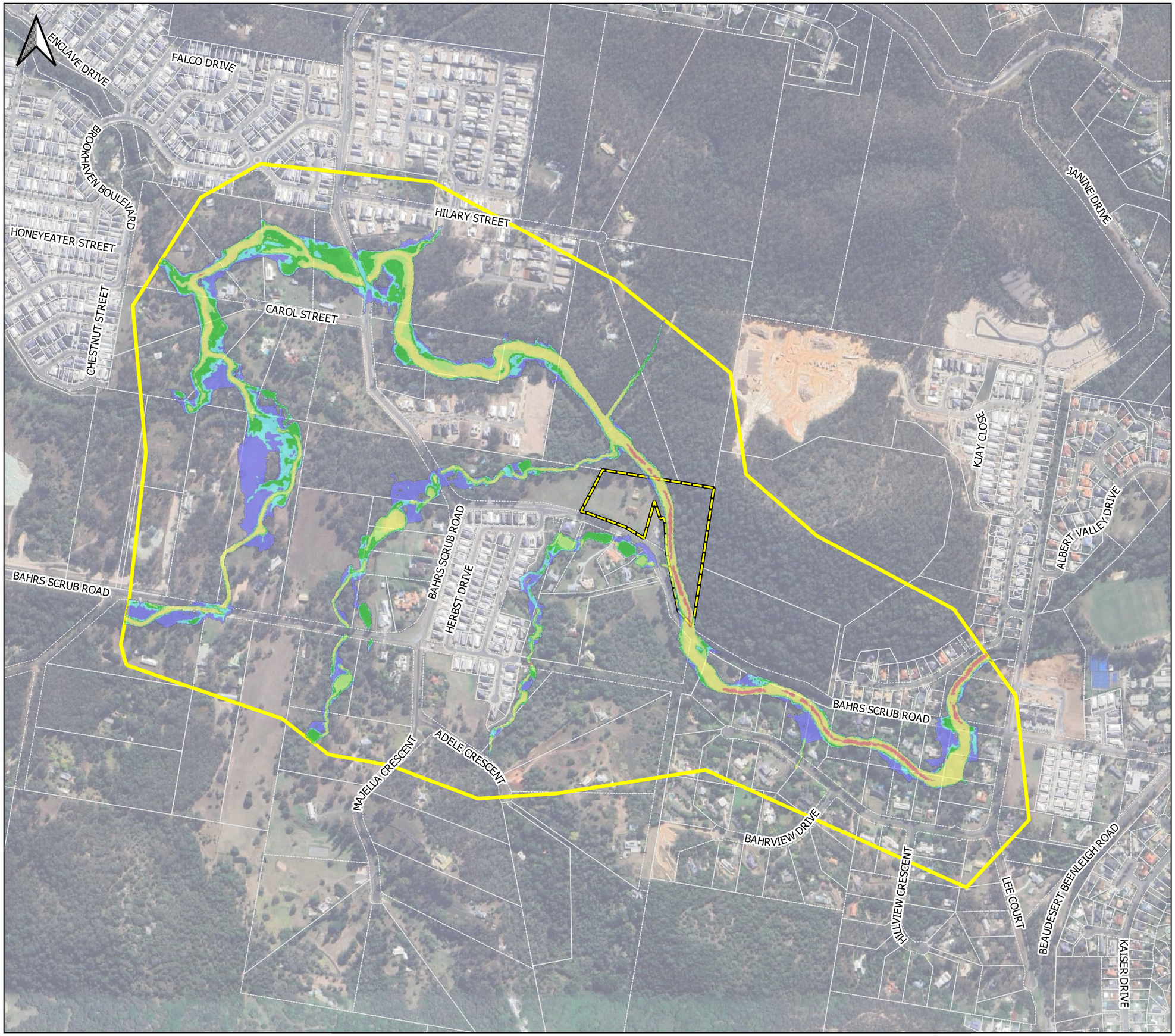


Legend

- Cadastre
- Model Boundary
- Site

Existing 20% AEP Hazard

- Band 1
- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Project Name:

Bahrs Scrub Road Flood Assessment

Title:

Existing 20% AEP Hazard

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

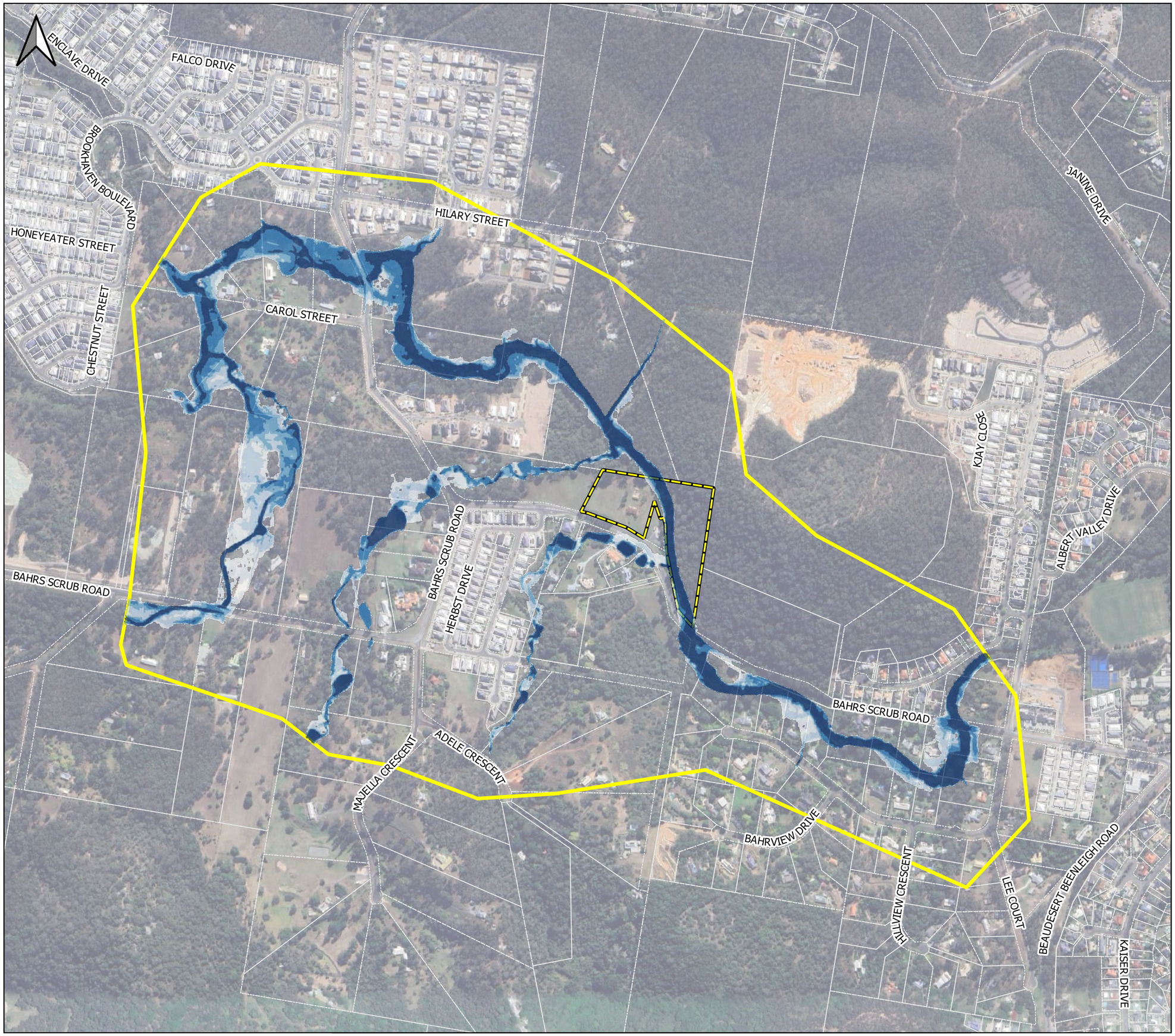
Project Number: **10080**

Rev: **A**

Appendix E.08

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 10% AEP Depth (m)

Band 1

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- > 1

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 10% AEP Depth

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number: 10080

Rev: A

Appendix E.09

Date: 01/04/2024

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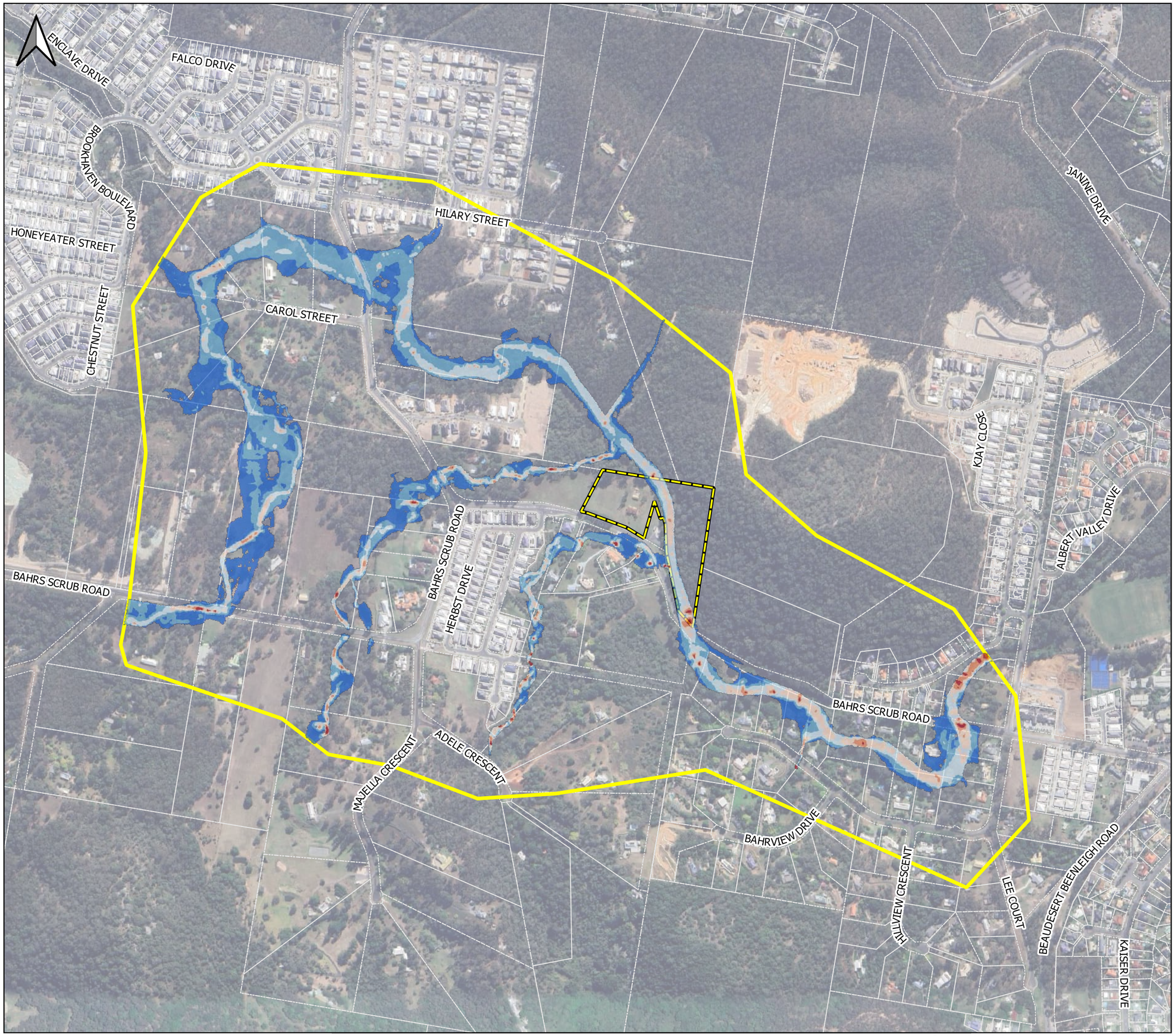

Legend

- Cadastre
- Model Boundary
- Site

Existing 10% AEP Velocity (m/s)

Band 1

- <= 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- > 2.5

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 10% AEP Velocity

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number: 10080

Rev: A

Appendix E.10

Date: 01/04/2024

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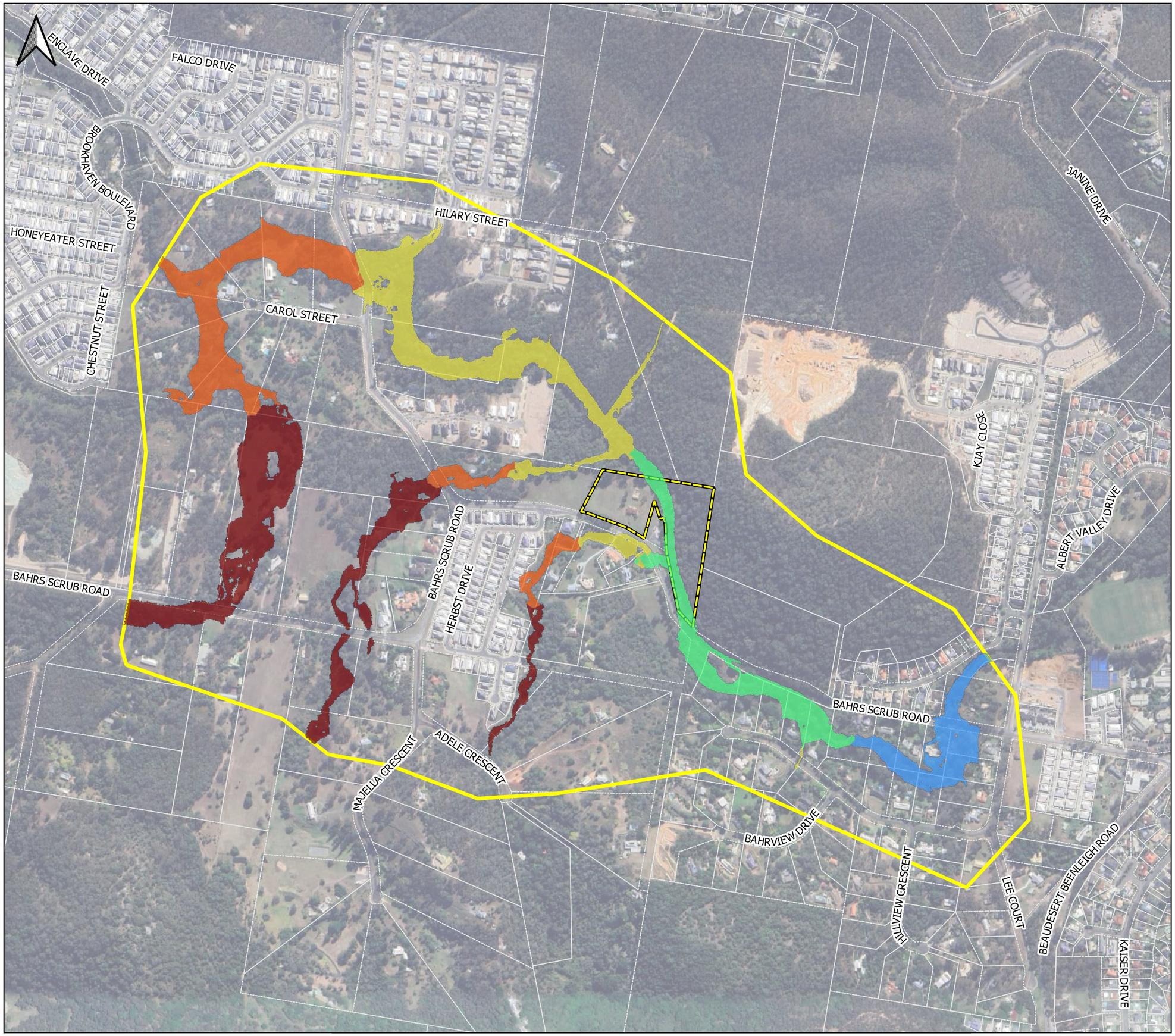


Legend

- Cadastre
- Model Boundary
- Site

Existing 10% AEP WSL (mAHD)

Band 1

- <= 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- > 30

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 10% AEP Water Surface Level

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

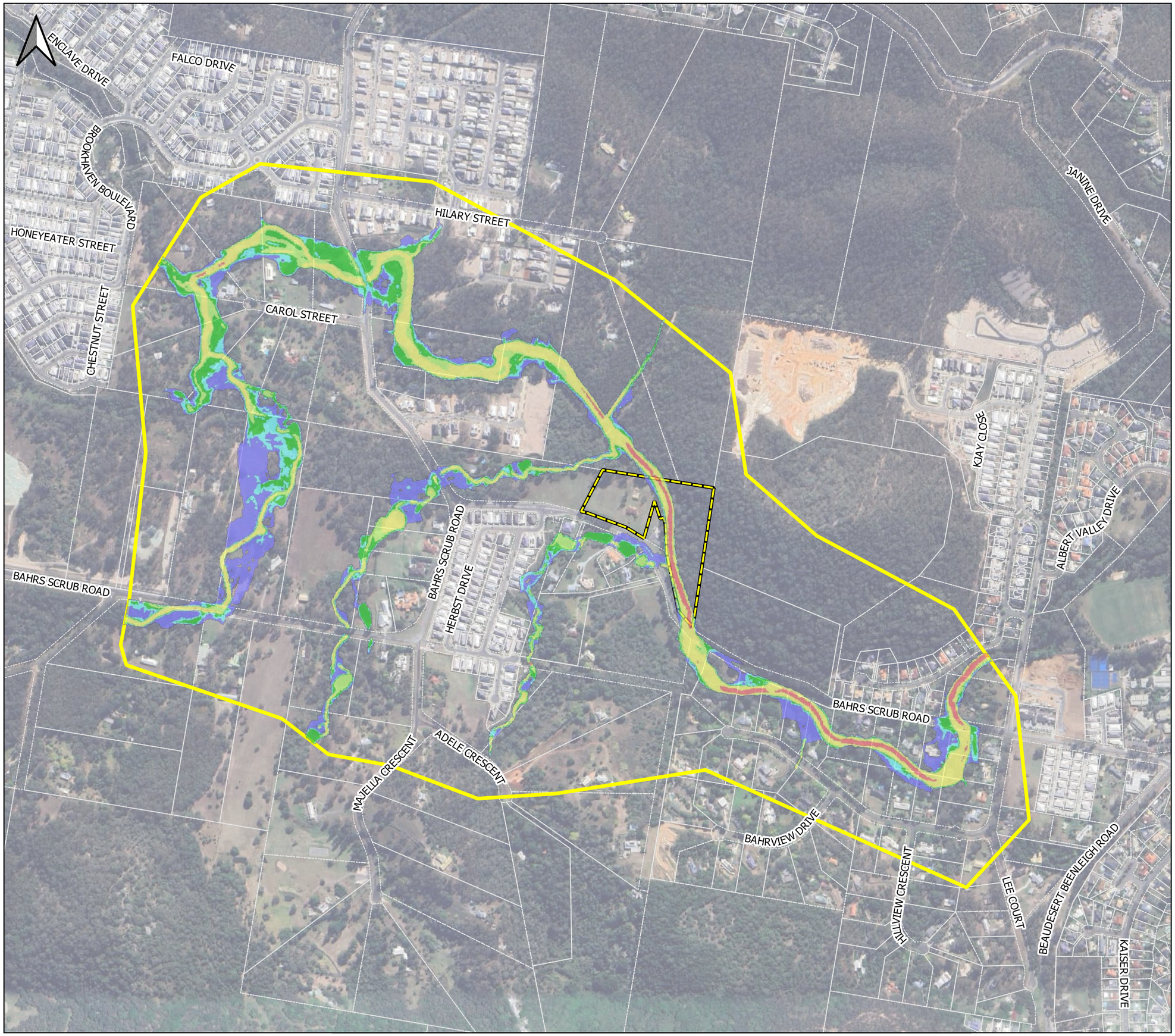
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix E.11

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 10% AEP Hazard

Band 1

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Project Name:

Bahrs Scrub Road Flood Assessment

Title:

Existing 10% AEP Hazard

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

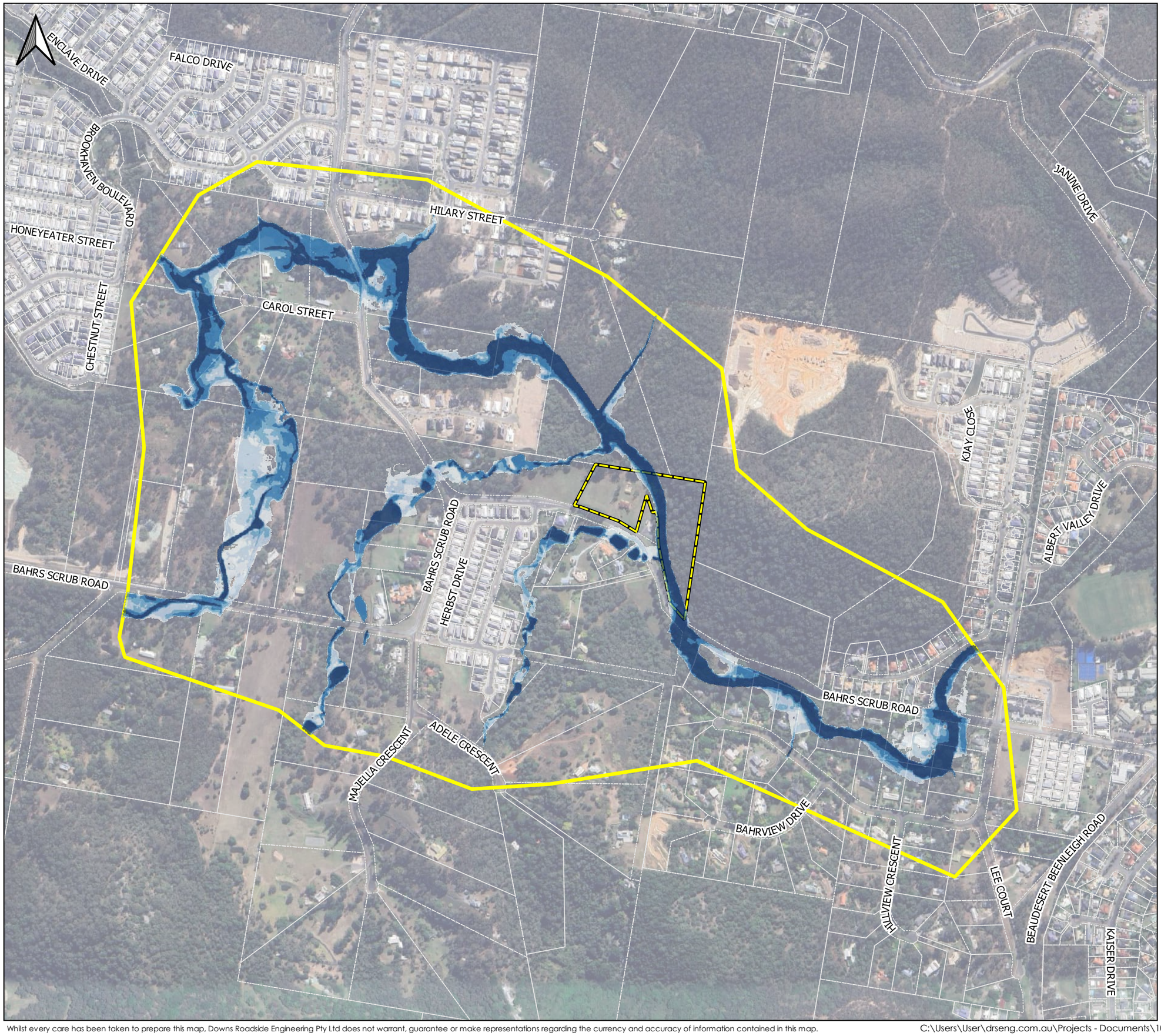
Project Number: **10080**

Rev: **A**

Appendix E.12

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 5% AEP Depth (m)

Band 1

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- > 1

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 5% AEP Depth

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

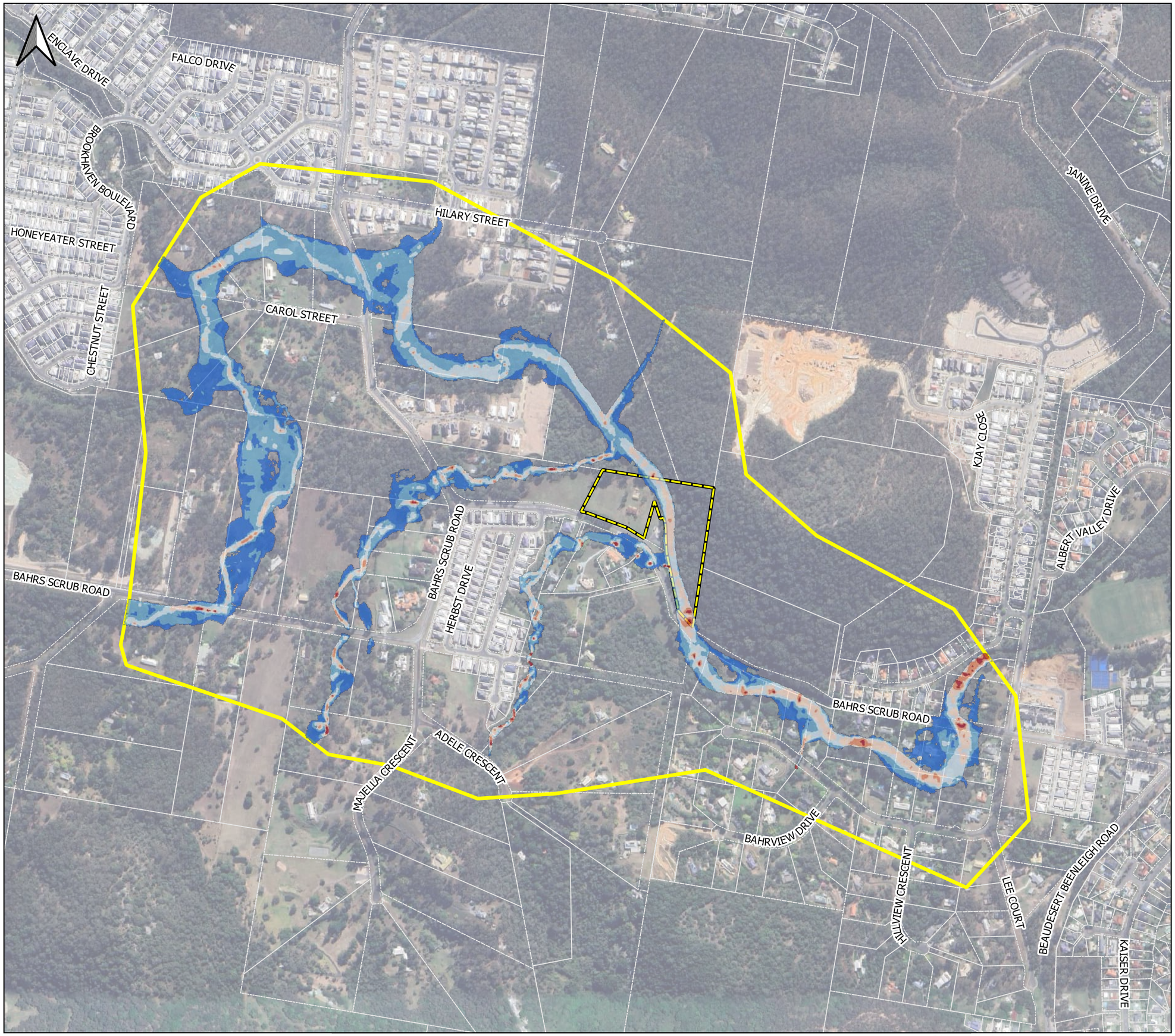
Project Number: 10080

Rev: A

Appendix E.13

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 5% AEP Velocity (m/s)

Band 1

- <= 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- > 2.5

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 5% AEP Velocity

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

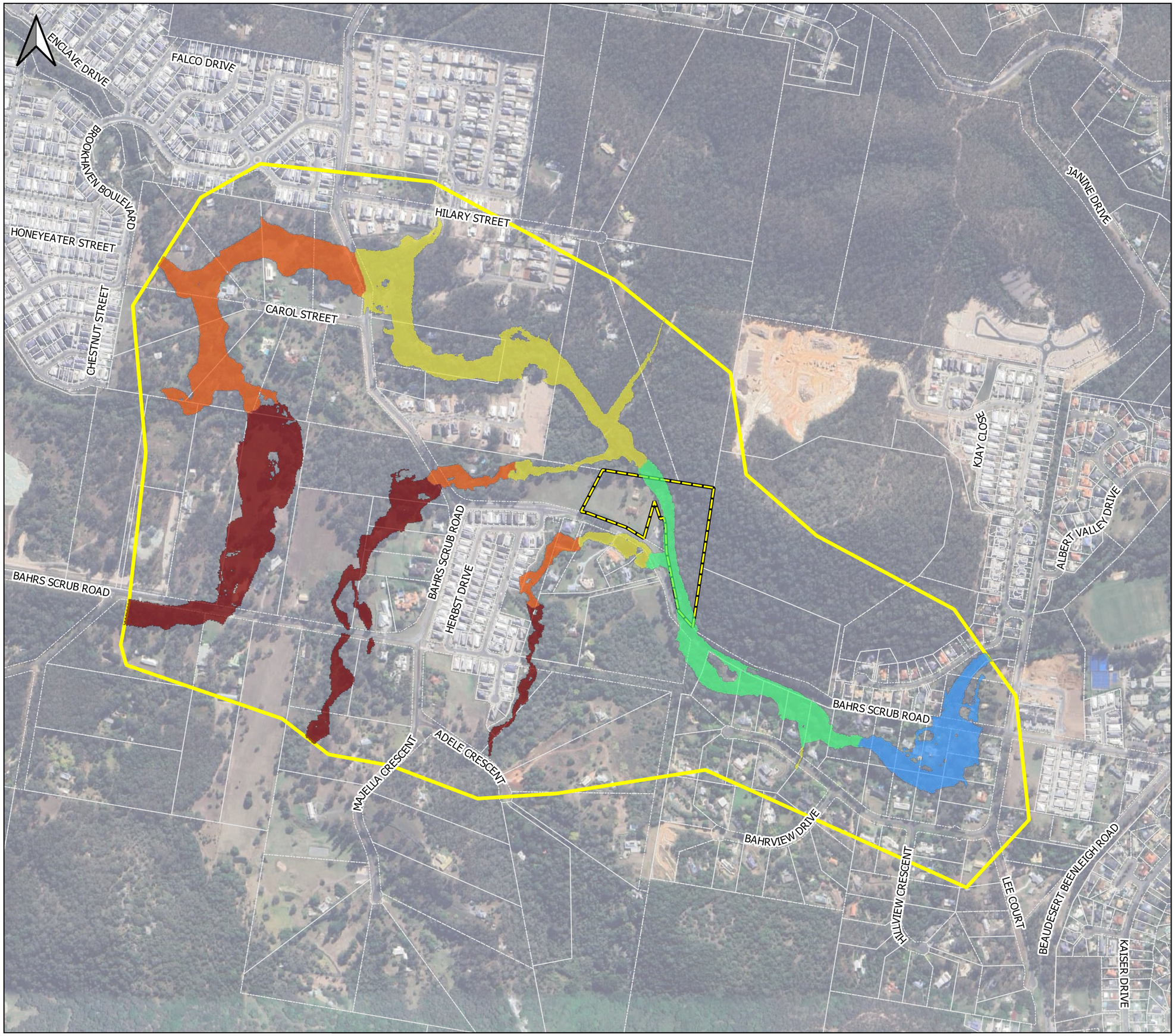
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix E.14

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 5% AEP WSL (mAHD)

Band 1

- <= 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- > 30

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 5% AEP Water Surface Level

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

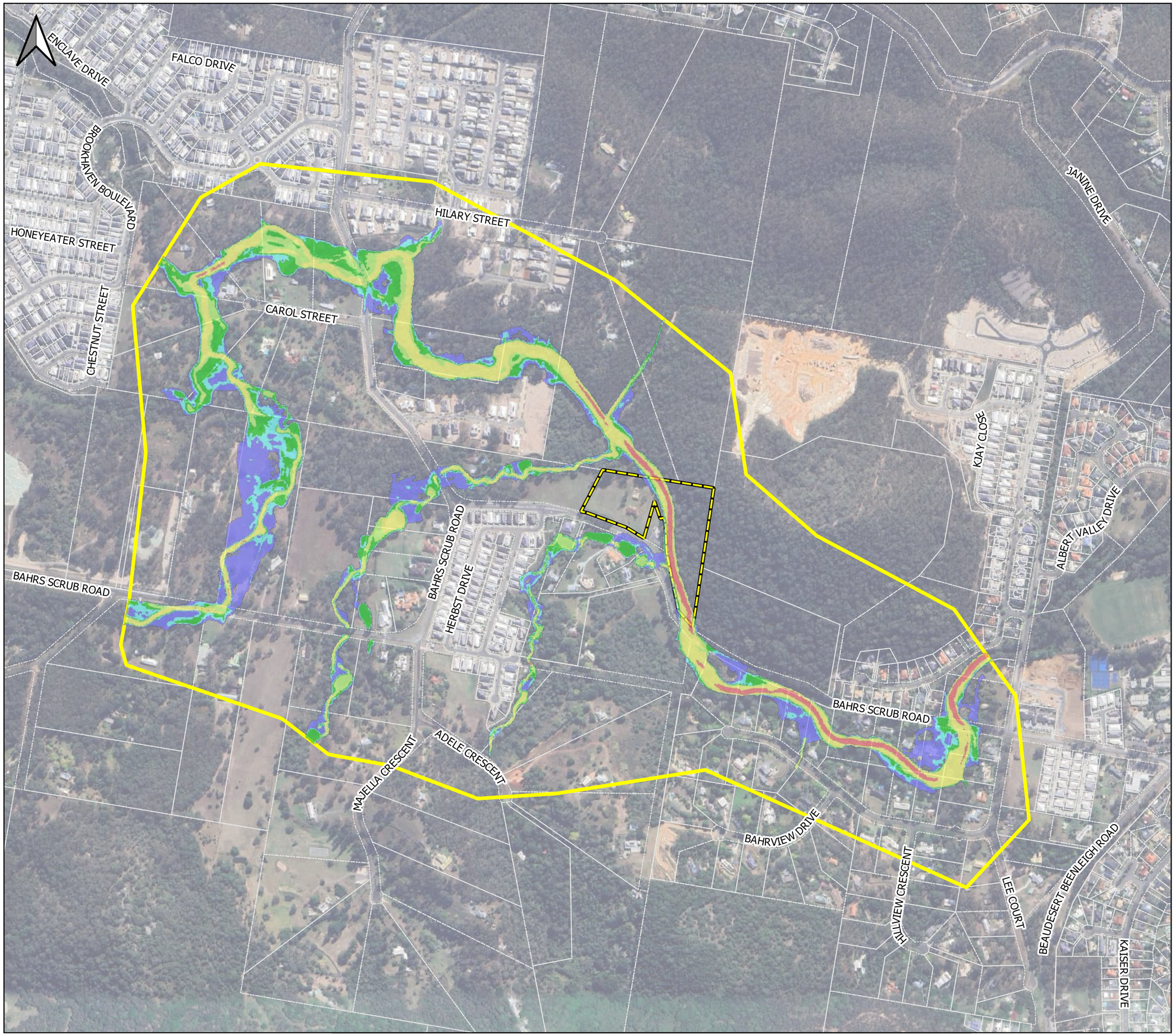
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix E.15

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 5% AEP Hazard

- Band 1
- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Project Name:

Bahrs Scrub Road Flood Assessment

Title:

Existing 5% AEP Hazard

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

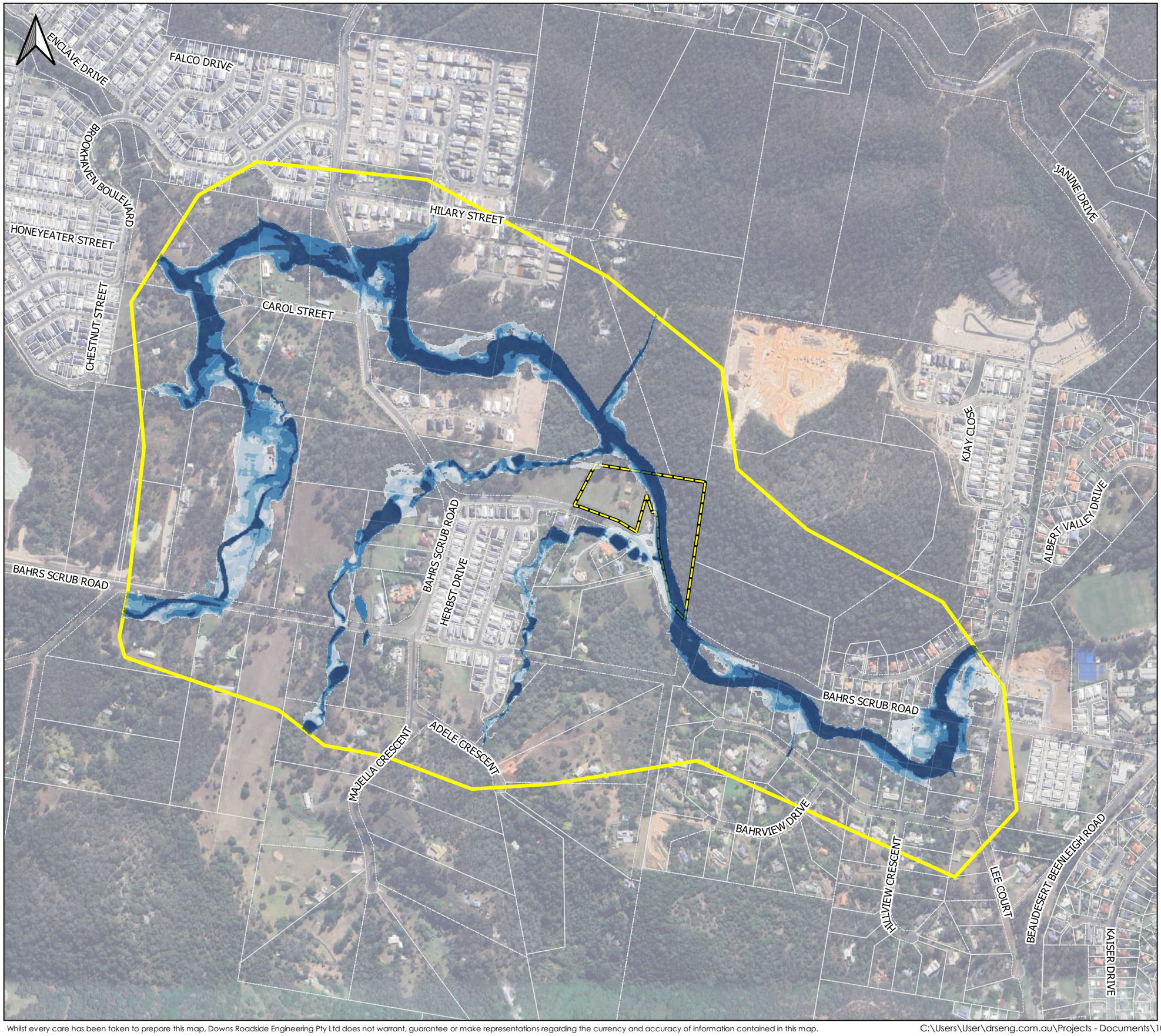
Project Number: **10080**

Rev: **A**

Appendix E.16

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 2% AEP Depth (m)

Band 1

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- > 1

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 2% AEP Depth

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

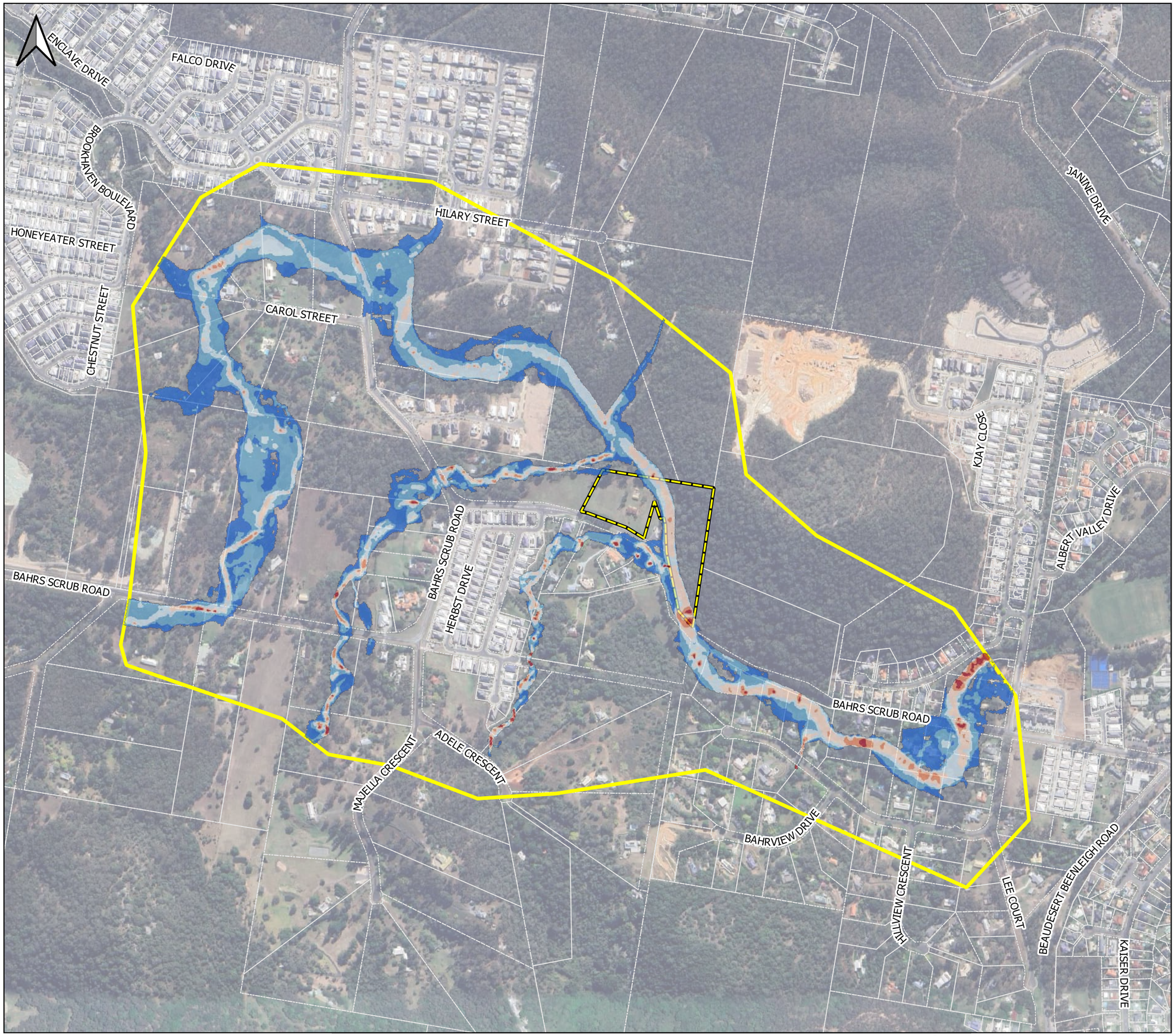
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix E.17

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 2% AEP Velocity (m/s)

Band 1

- <= 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- > 2.5

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 2% AEP Velocity

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

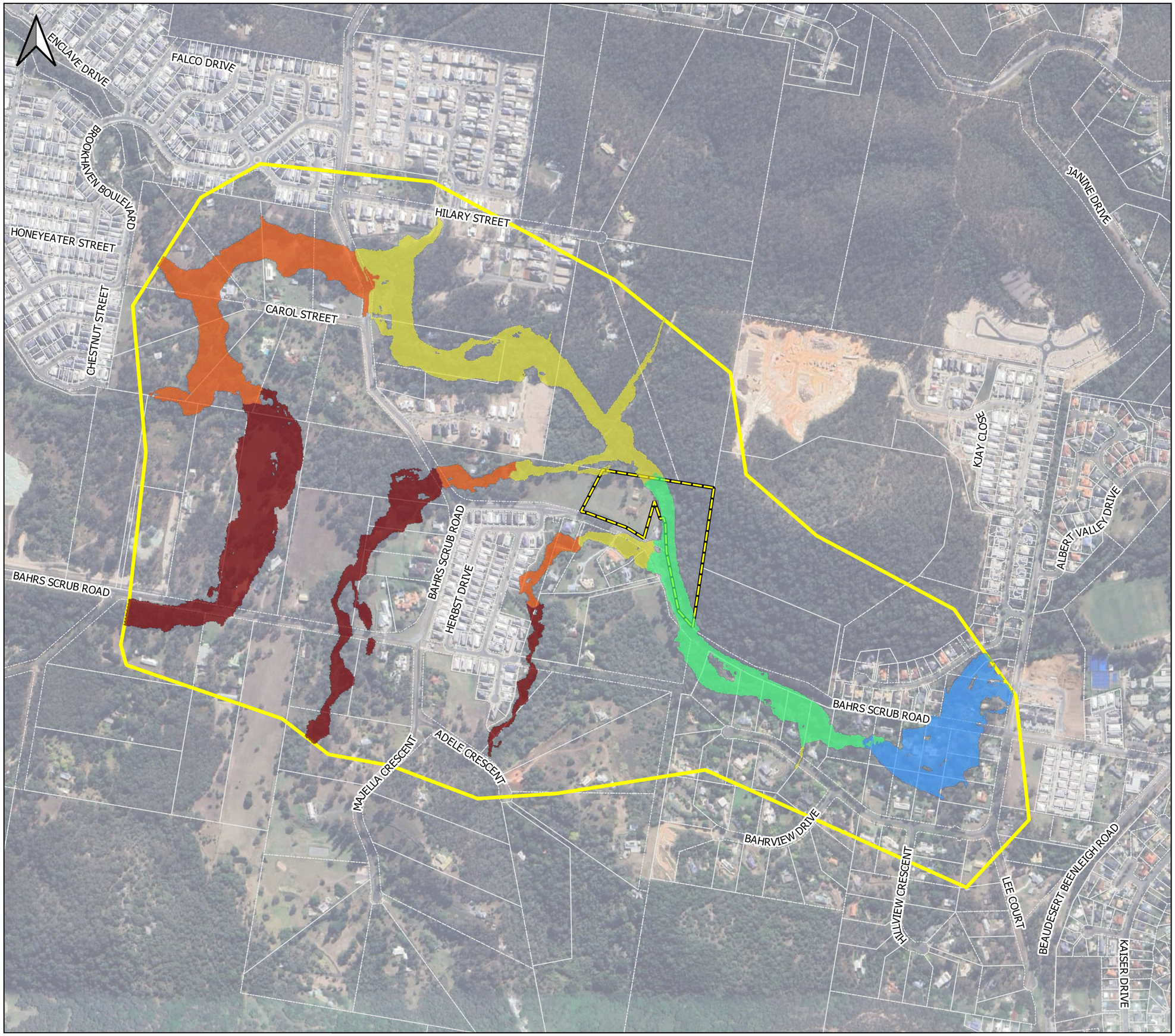
Project Number: 10080

Rev: A

Appendix E.18

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 2% AEP WSL (mAHD)

Band 1

- <= 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- > 30

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 2% AEP Water Surface Level

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

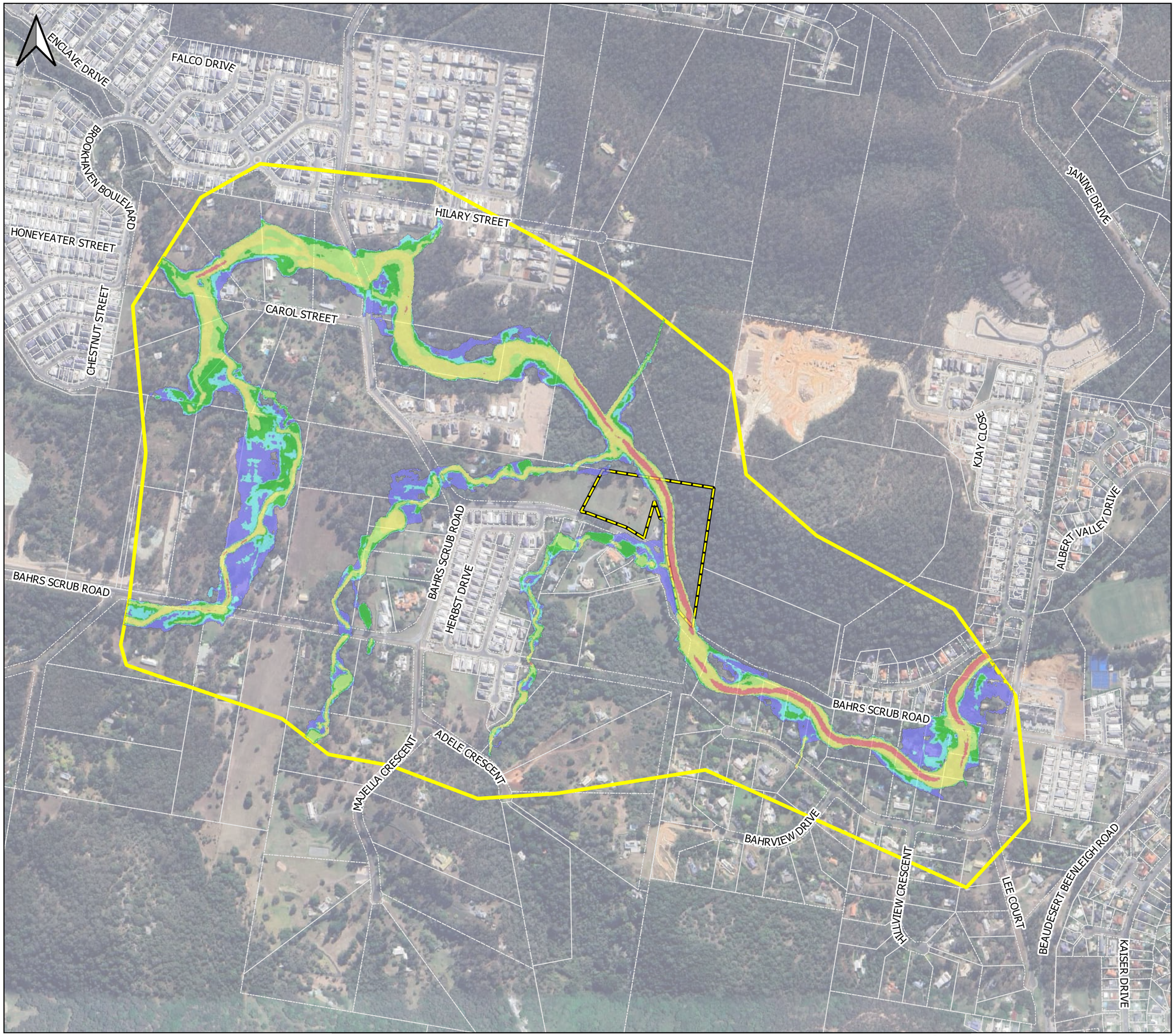
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix E.19

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 2% AEP Hazard

Band 1

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Project Name:

Bahrs Scrub Road Flood Assessment

Title:

Existing 2% AEP Hazard

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

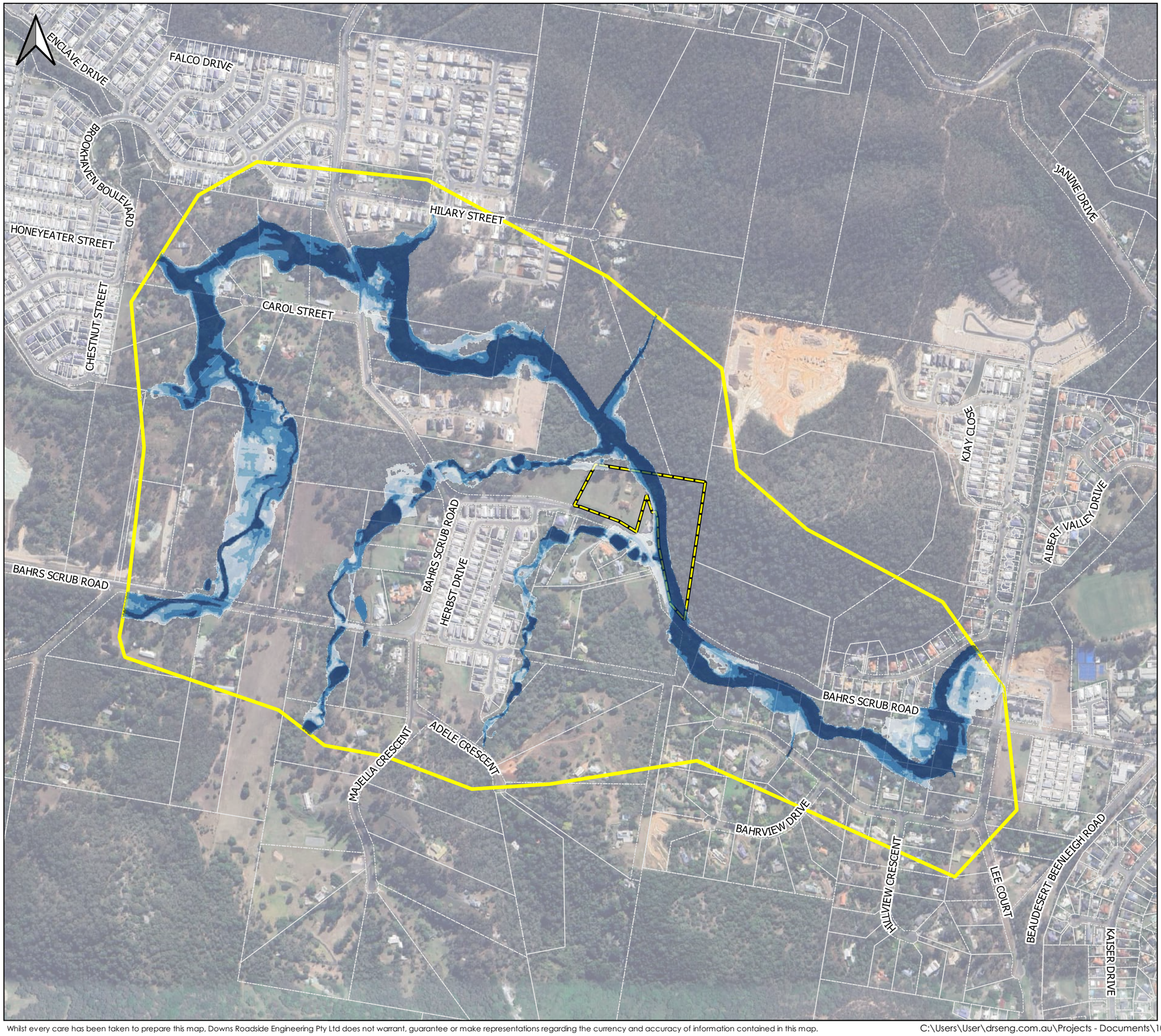
Project Number: **10080**

Rev: **A**

Appendix E.20

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 1% AEP Depth (m)

Band 1

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- > 1

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 1% AEP Depth

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

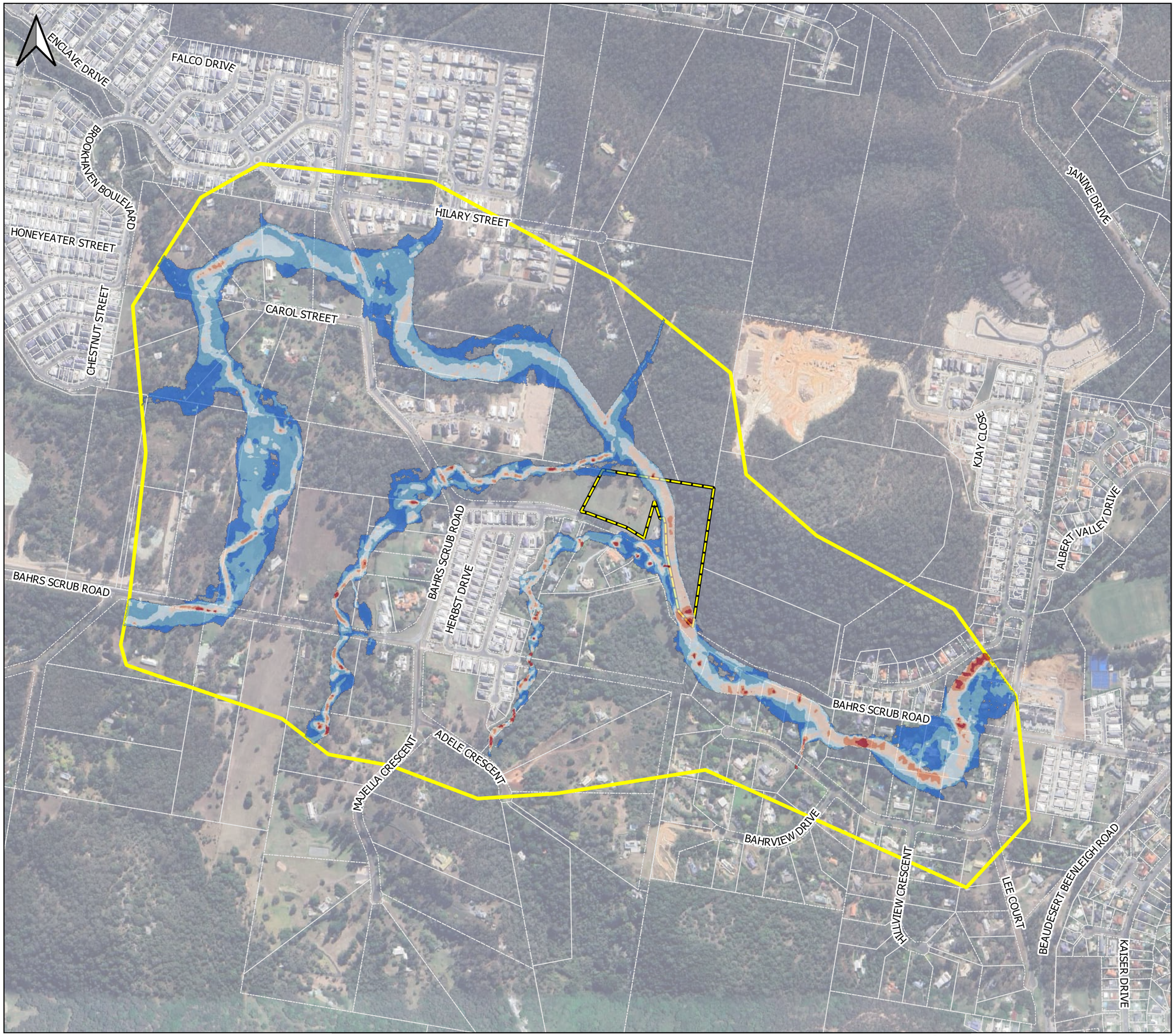
Project Number: 10080

Rev: A

Appendix E.21

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 1% AEP Velocity (m/s)

Band 1

- <= 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- > 2.5

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 1% AEP Velocity

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

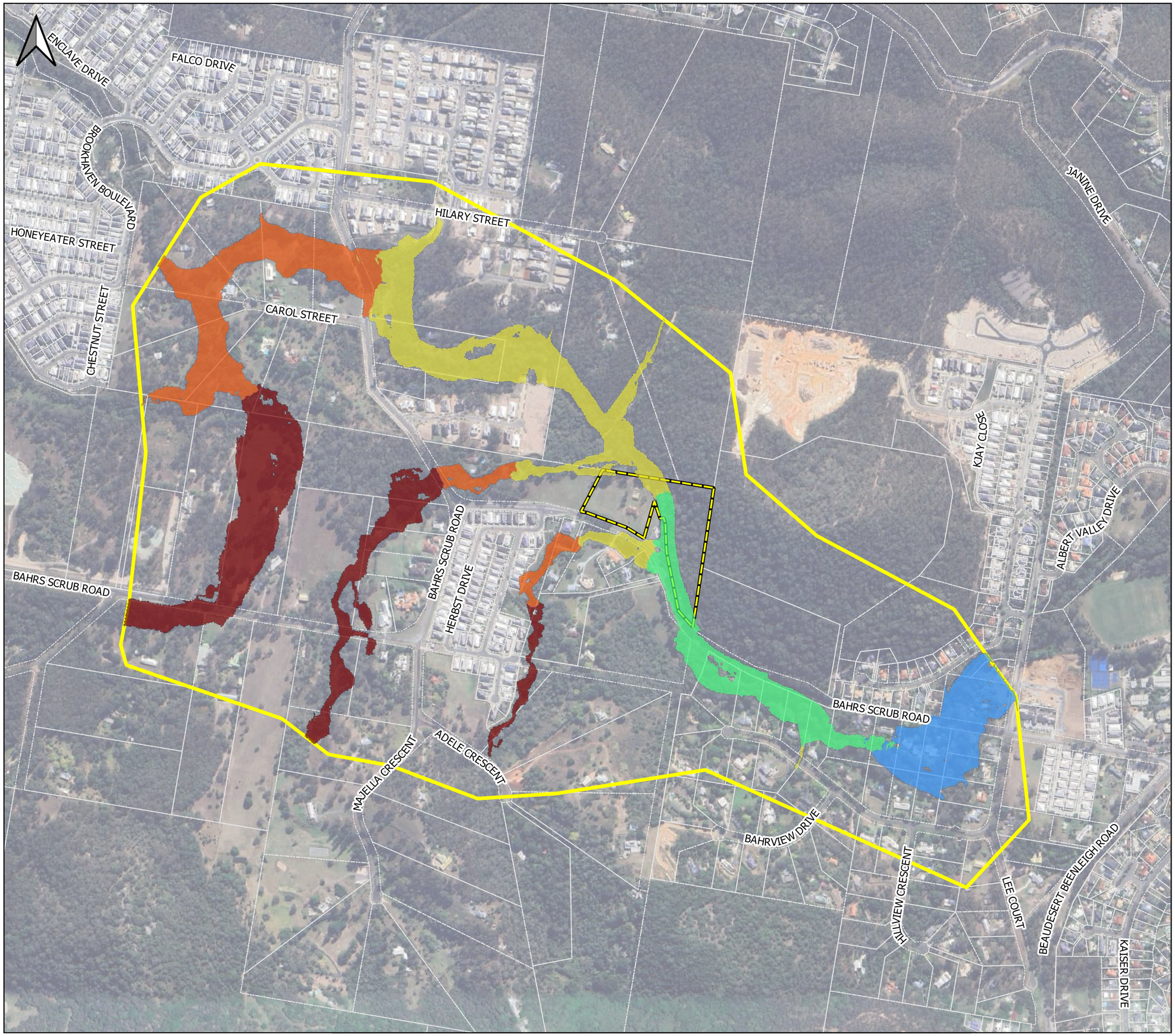
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix E.22

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 1% AEP WSL (mAHD)

Band 1

- <= 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- > 30

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 1% AEP Water Surface Level

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

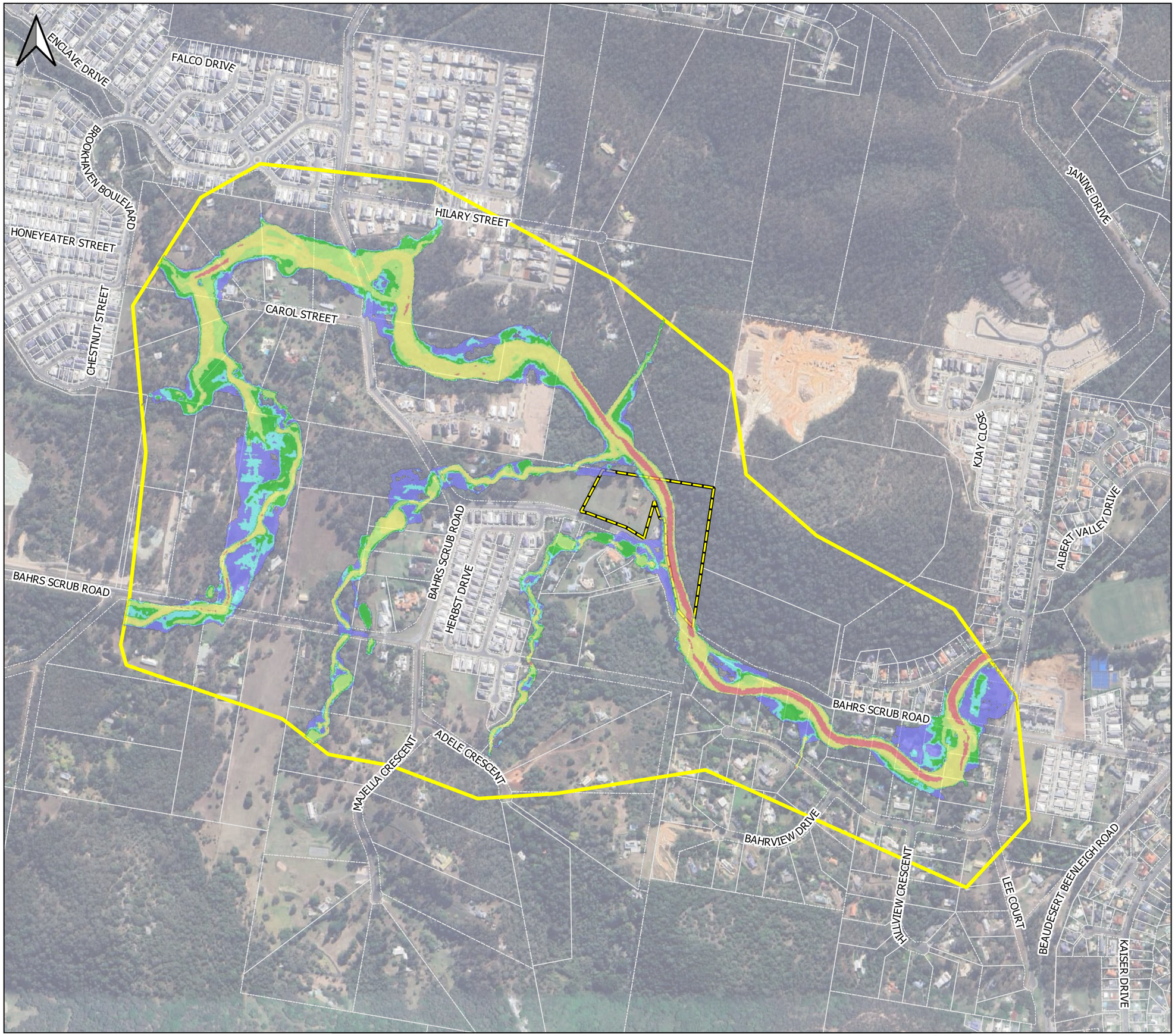
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix E.23

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 1% AEP Hazard

Band 1

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Project Name:

Bahrs Scrub Road Flood Assessment

Title:

Existing 1% AEP Hazard

Scale (at A3)
1:7,500

0 100 200 300 400

Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

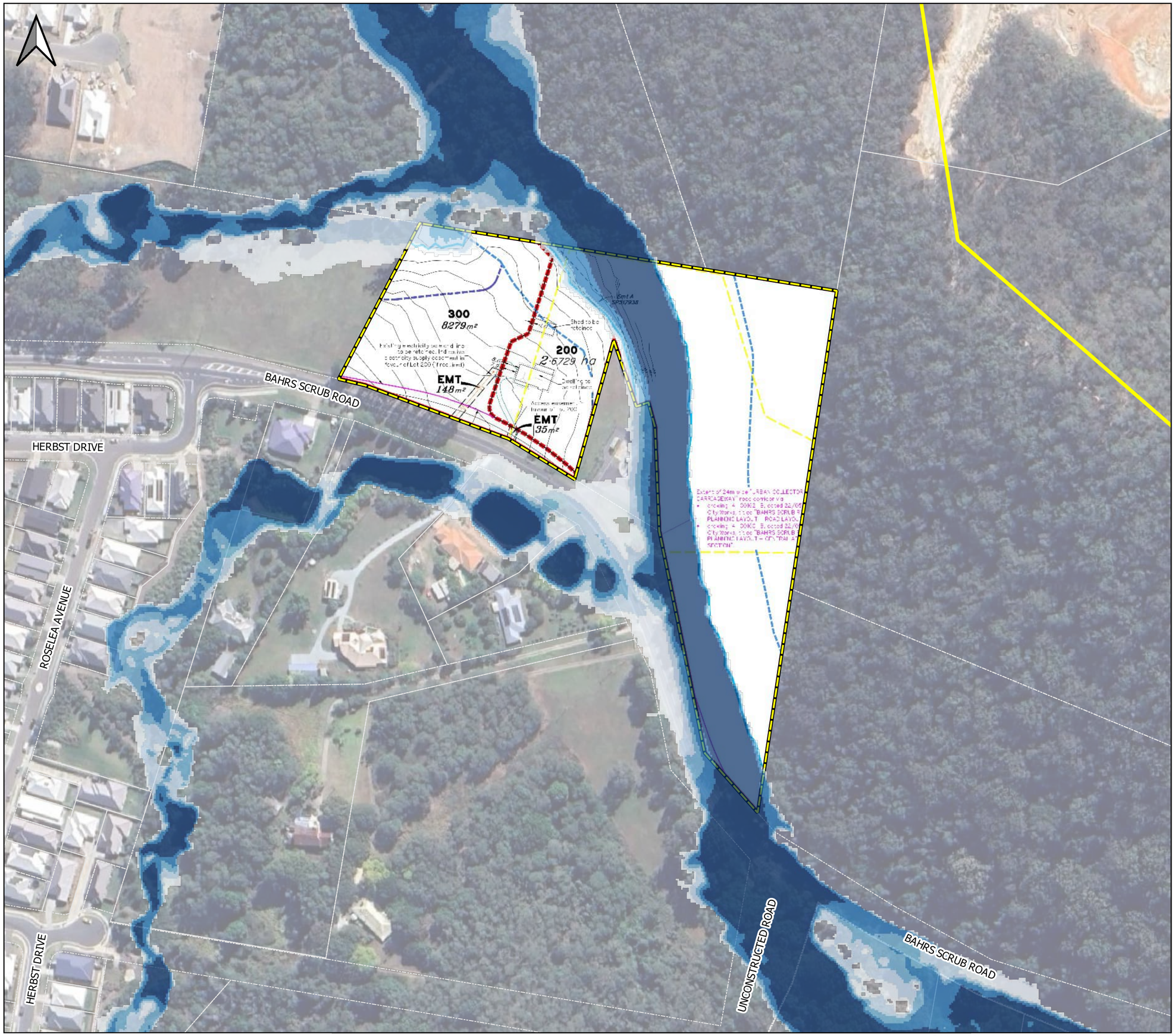
Project Number: **10080**

Rev: **A**

Appendix E.24

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 1% AEP + CC Depth (m)

Band 1

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- > 1

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 1% AEP + Climate Change Depth

Scale (at A3)
1:2,000
0 10 20 30 40
Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

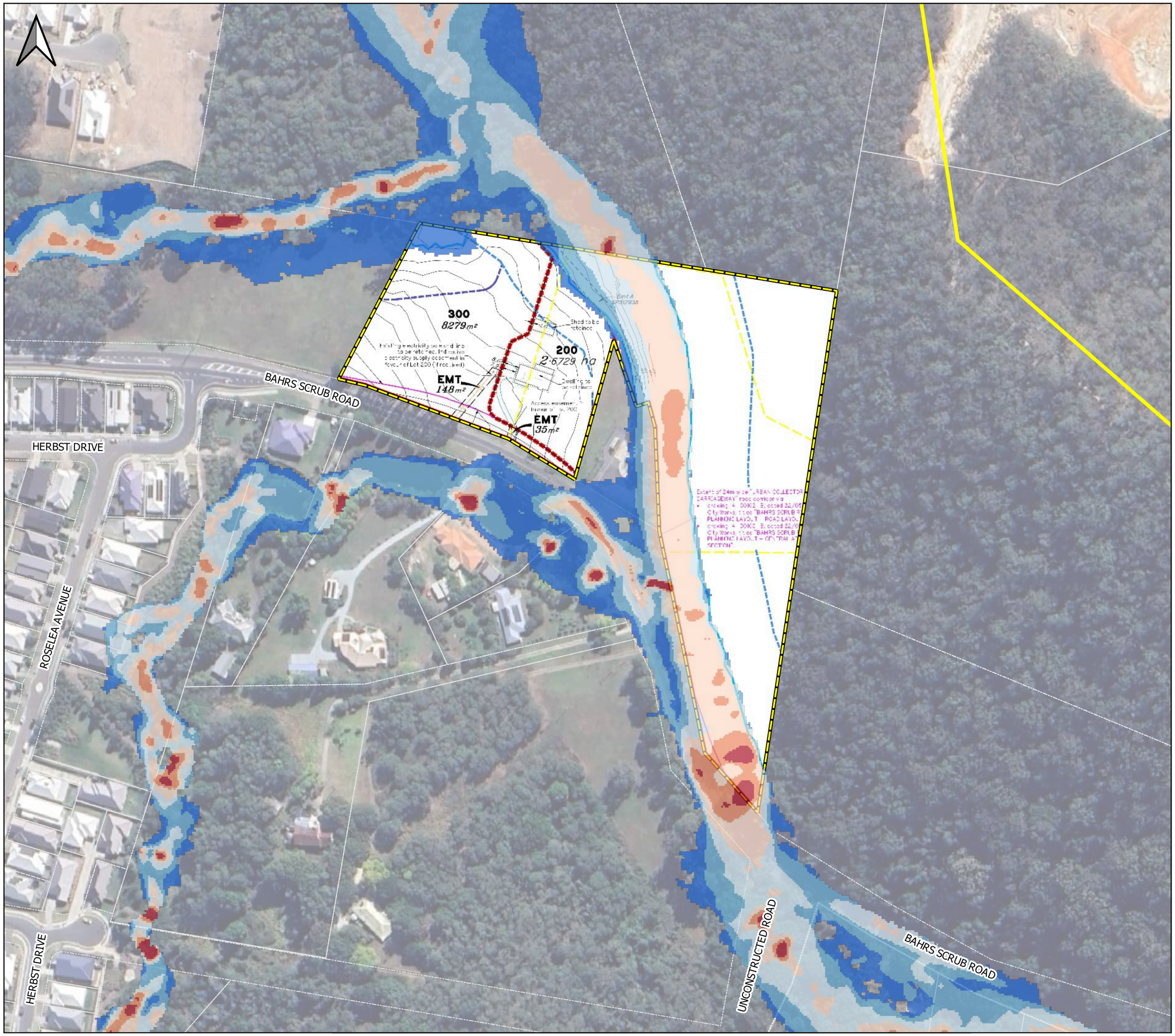
DOWNS ROADSIDE ENGINEERING

Project Number: 10080
Rev: A

Appendix E.25

Date: 02/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 1% AEP + CC Velocity (m/s)

Band 1

- <= 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- > 2.5

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 1% AEP + Climate Change Velocity

Scale (at A3)
1:2,000
0 10 20 30 40
Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

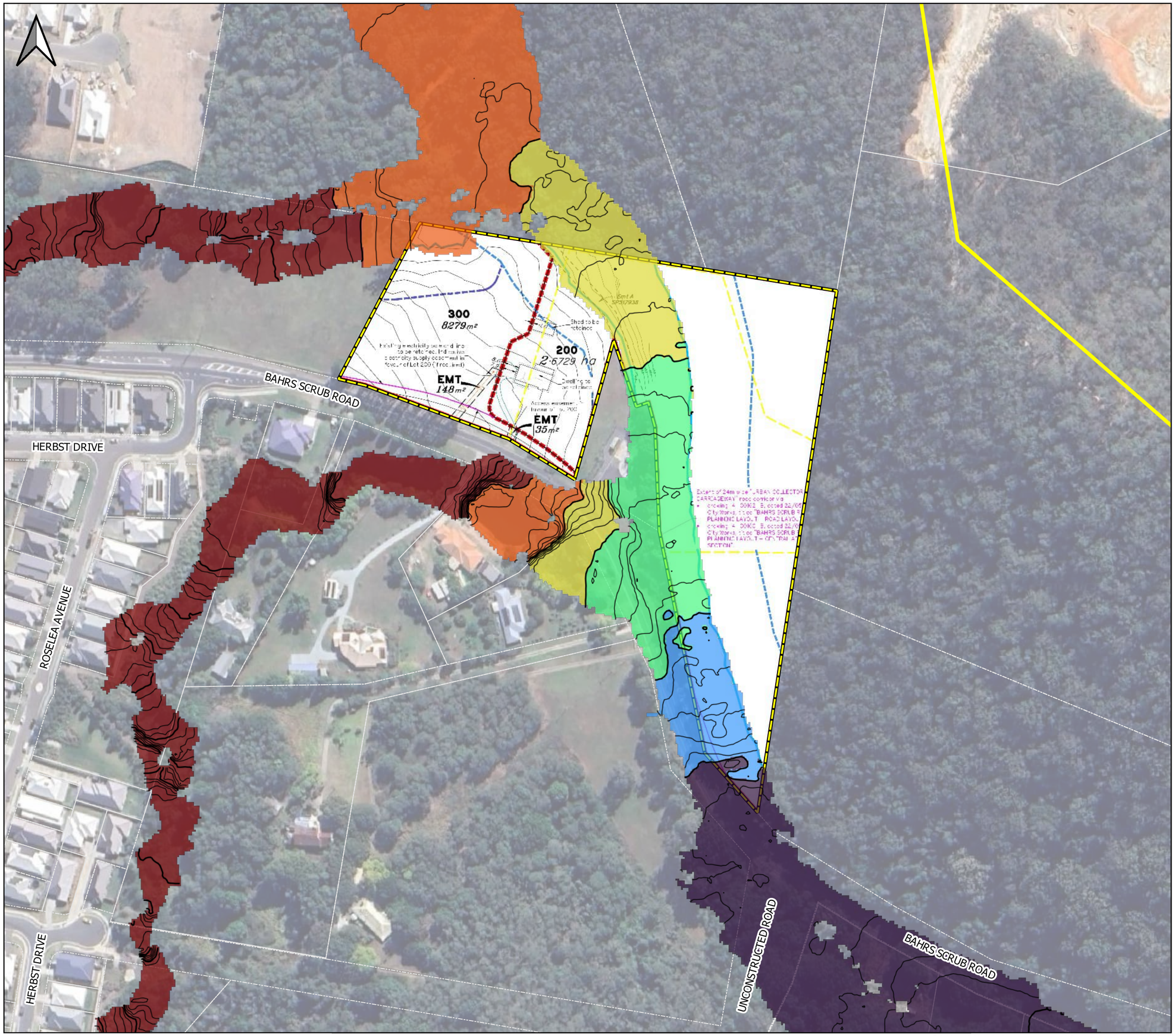
DOWNS ROADSIDE ENGINEERING

Project Number: 10080
Rev: A

Appendix E.26

Date: 02/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 1% AEP + CC WSL (mAHD)

Band 1

- <= 18
- 18 - 19
- 19 - 20
- 20 - 21
- 21 - 22
- > 22

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Existing 1% AEP + Climate Change
Water Surface Level

Scale (at A3)
1:2,000
0 10 20 30 40
Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

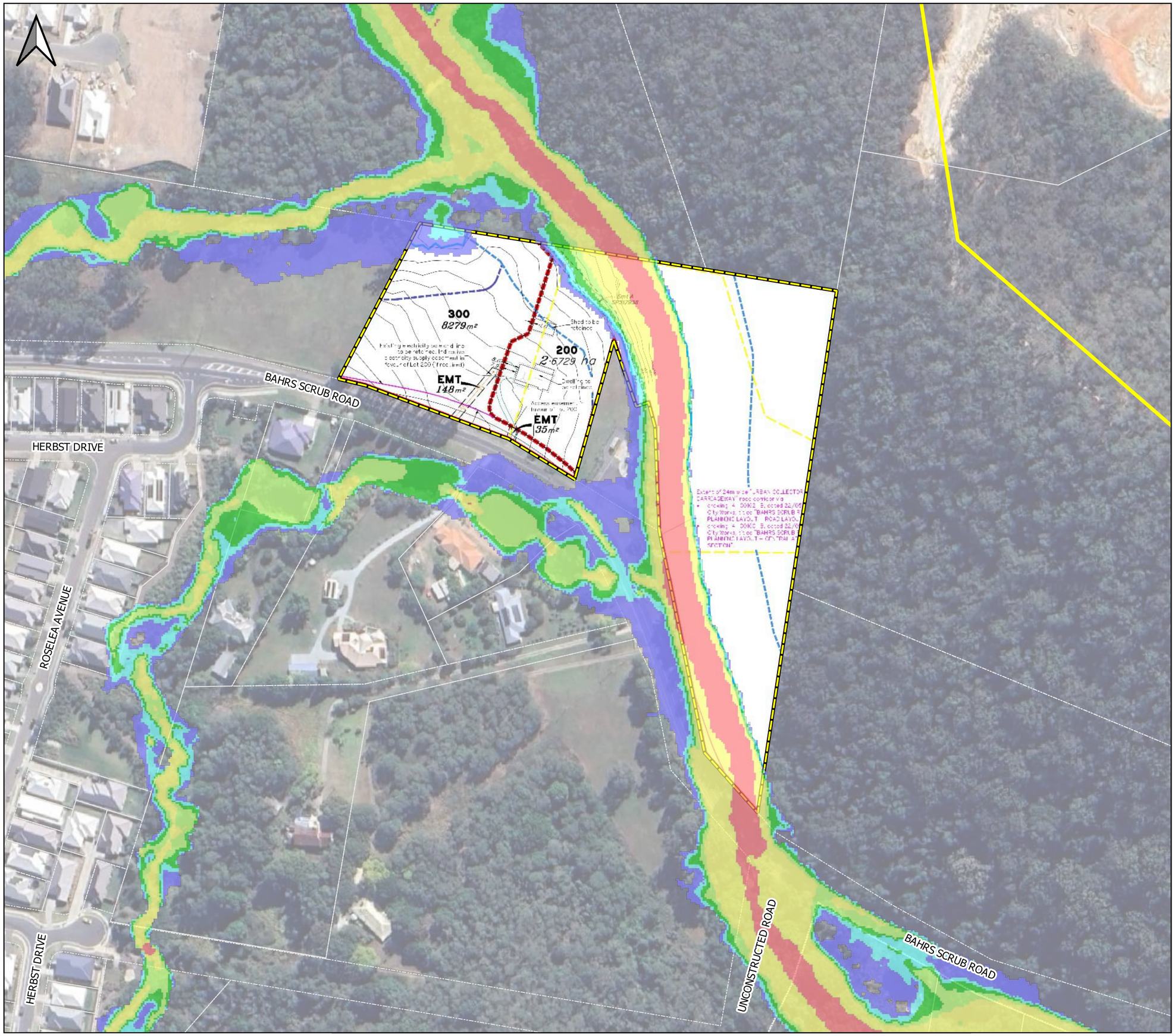
DOWNS ROADSIDE ENGINEERING

Project Number: 10080 | Rev: A

Appendix E.27

Date: 02/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Existing 1% AEP + CC Hazard

Band 1

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Project Name:

Bahrs Scrub Road Flood Assessment

Title:

Existing 1% AEP + Climate Change Hazard

Scale (at A3)
1:2,000
0 10 20 30 40
Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

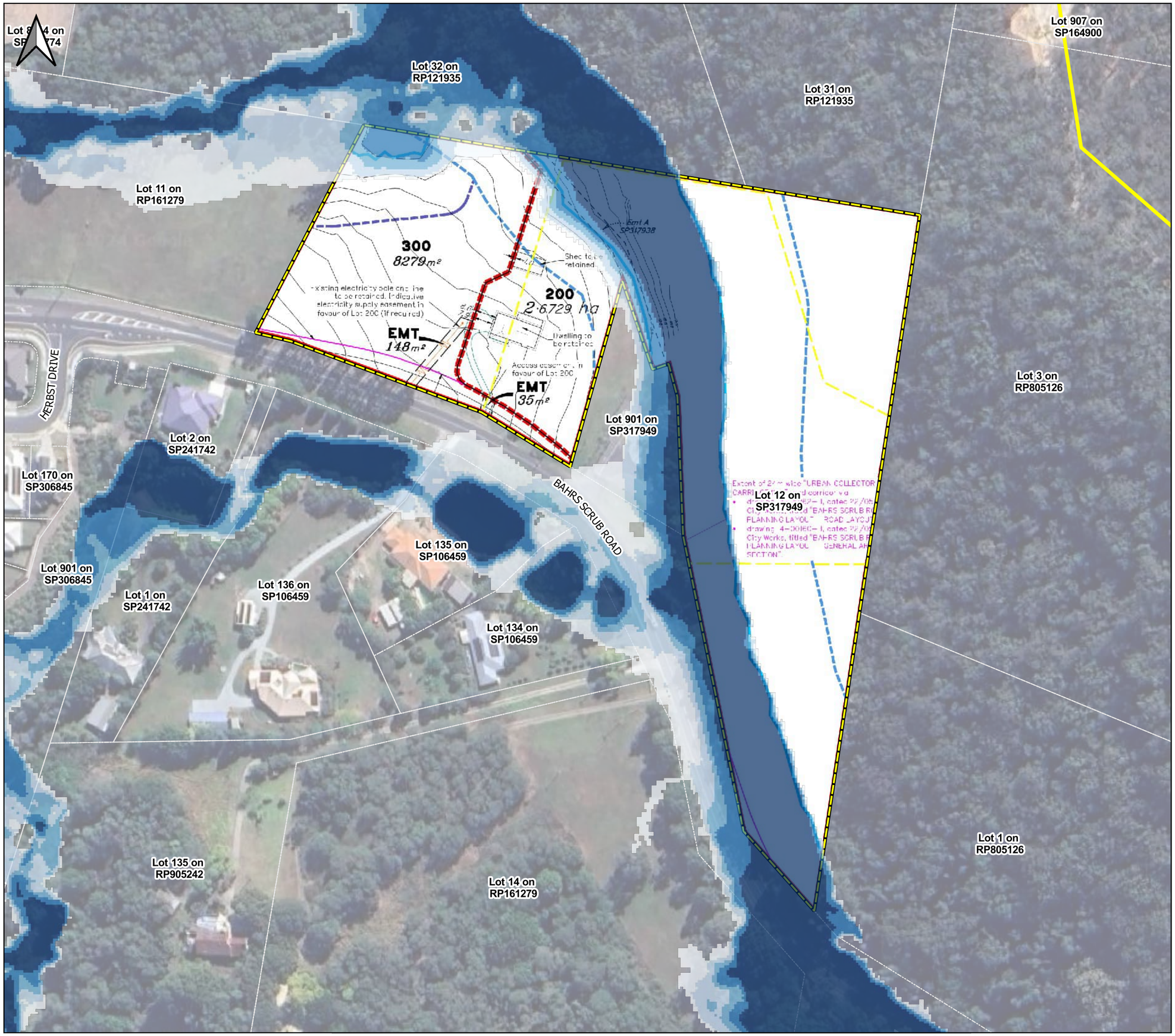
Project Number:	Rev:
10080	**A**

Appendix E.28

Date: 02/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz

APPENDIX F TUFLOW MAPPING SENSITIVITY



Legend

- Cadastre
- Model Boundary
- Site

Sensitivity 1% AEP + CC Depth (m)

Band 1

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- > 1

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Sensitivity 1% AEP + Climate Change Depth

Scale (at A3)
1:1,500
0 10 20 30 40
Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

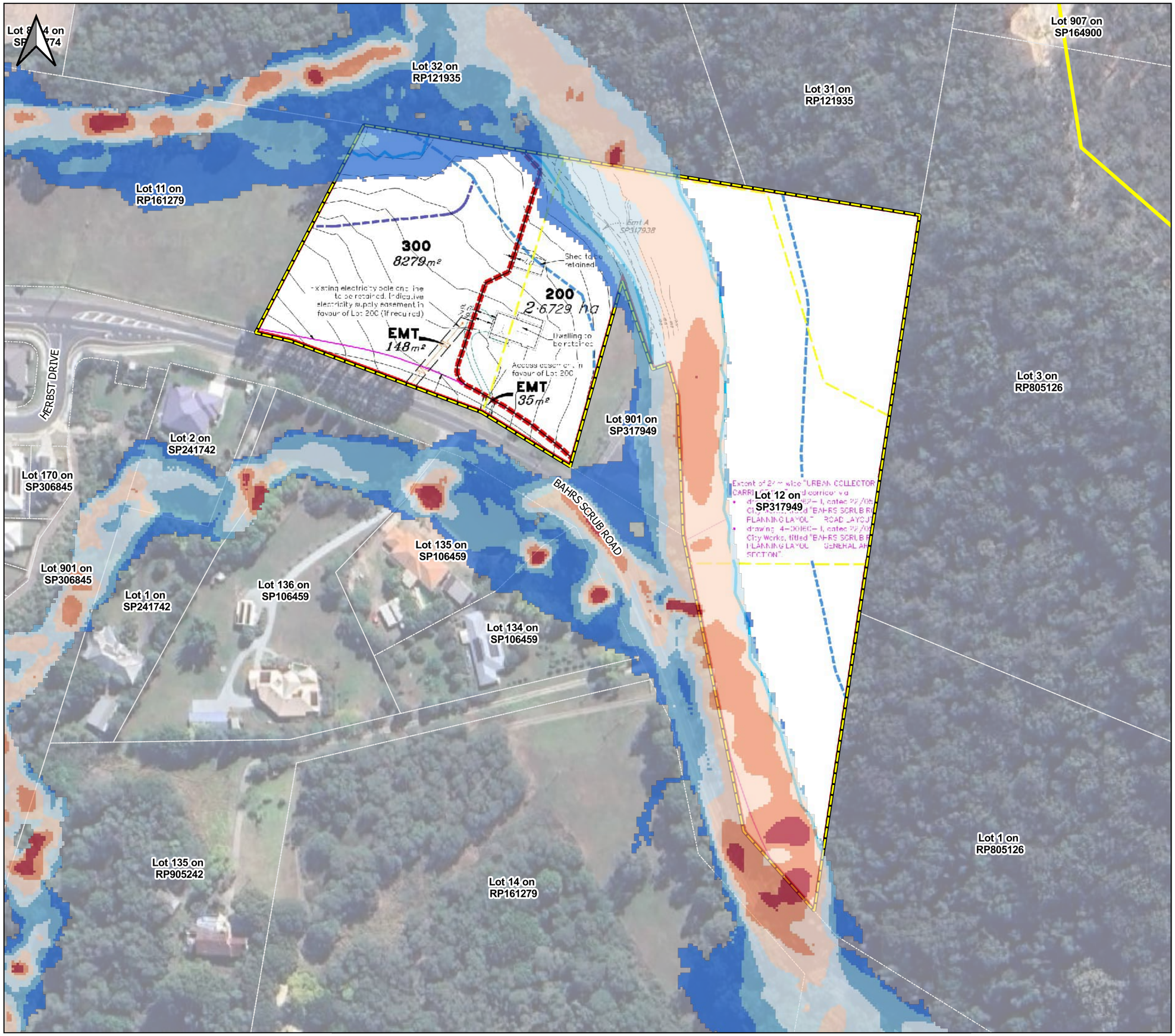
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix F.01

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Sensitivity 1% AEP + CC Velocity (m/s)

Band 1

- <= 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- > 2.5

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Sensitivity 1% AEP + Climate Change Velocity

Scale (at A3)
1:1,500
0 10 20 30 40
Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

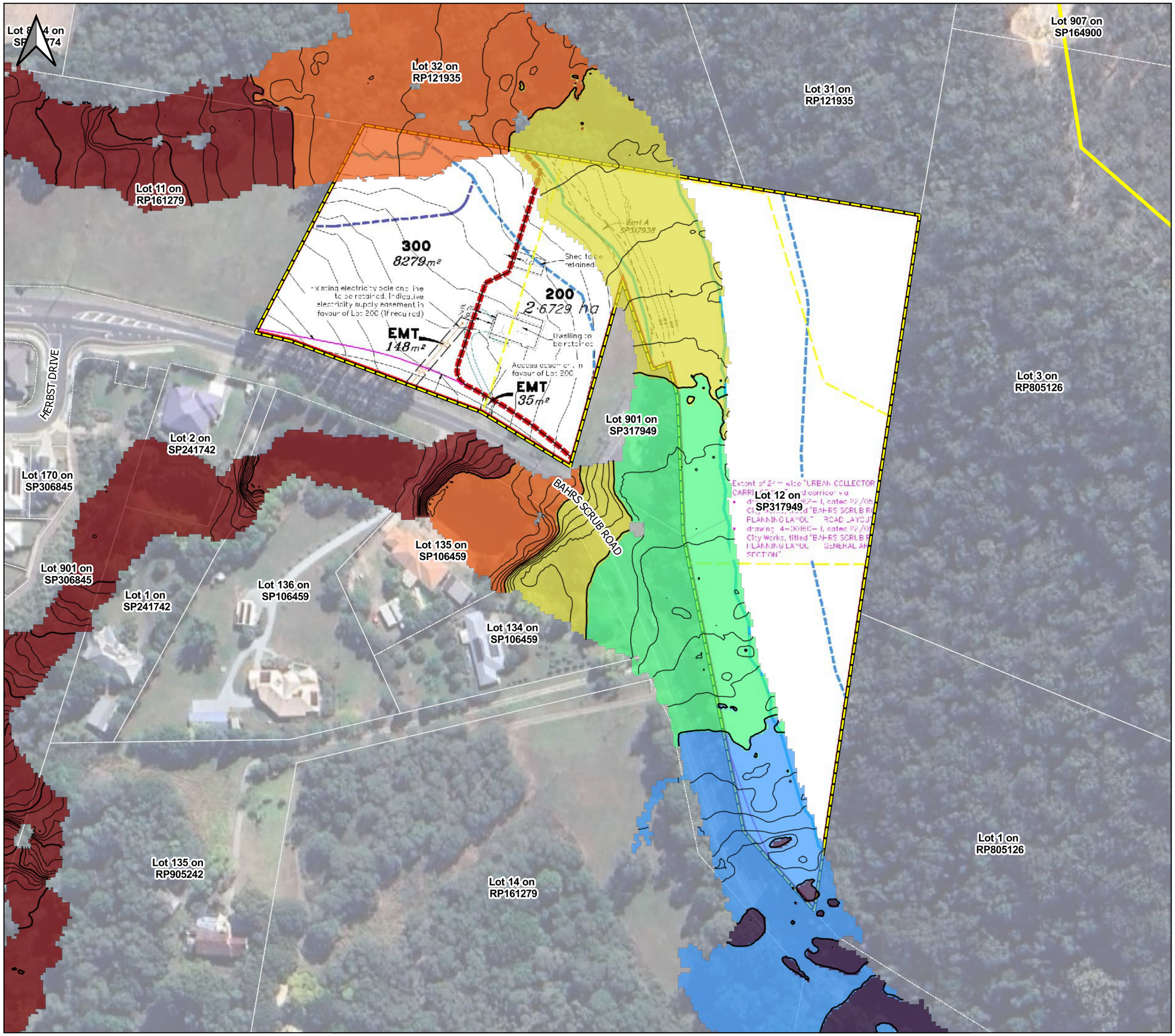
DOWNS ROADSIDE ENGINEERING

Project Number:	Rev:
10080	A

Appendix F.02

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Sensitivity 1% AEP + CC WSL (mAHD)

Band 1

- <= 18
- 18 - 19
- 19 - 20
- 20 - 21
- 21 - 22
- > 22

Project Name:

Bahrs Scrub Road
Flood Assessment

Title:

Sensitivity 1% AEP + Climate Change Water Surface Level

Scale (at A3)
1:1,500
0 10 20 30 40
Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

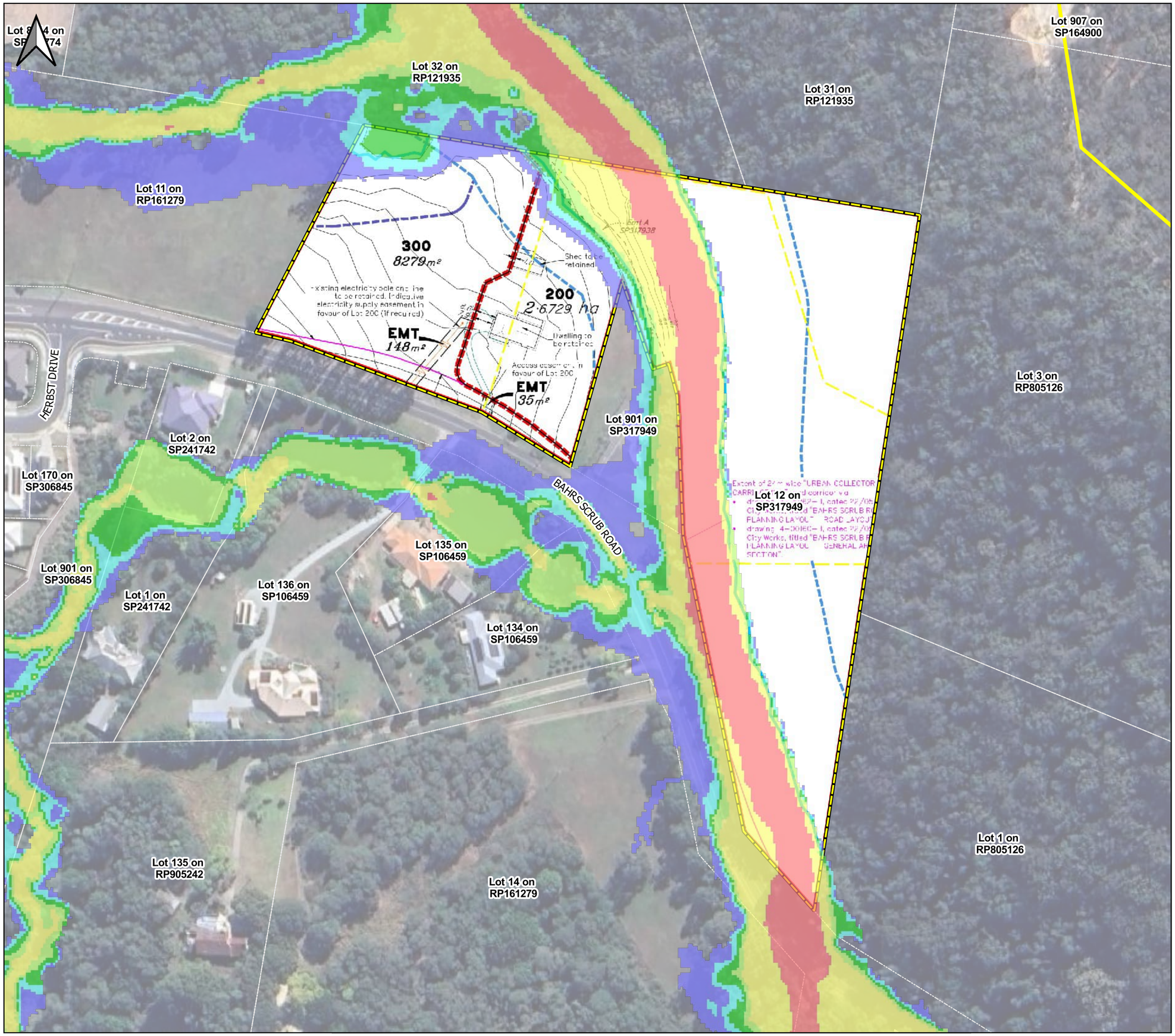
DOWNS ROADSIDE ENGINEERING

Project Number: 10080
Rev: A

Appendix F.03

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz



Legend

- Cadastre
- Model Boundary
- Site

Sensitivity 1% AEP + CC Hazard

Band 1

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Project Name:

Bahrs Scrub Road Flood Assessment

Title:

Sensitivity 1% AEP + Climate Change Hazard

Scale (at A3)
1:1,500
0 10 20 30 40
Metres
Geocentric Datum of Australia 1994
Map Grid of Australia Zone 56

DOWNS ROADSIDE ENGINEERING

Project Number: **10080**
Rev: **A**

Appendix F.04

Date: 01/04/2024

C:\Users\User\drseng.com.au\Projects - Documents\10080-DTS-BahrsScrubRdFRA\4 Design\GIS\Maps\10080_Mapping_V2.qgz

APPENDIX G RESPONSES TLPI AO/PO 5, 7, 17 & 18

Table 12 – Logan City Council TLPI 2023

Performance Outcomes	Acceptable Outcomes	Response
PO5 Development provides a development envelope area that is: a. above the flood level during the defined flood event; b. of an area and dimensions to accommodate the activities associated with the intended use.	**AO5** Development provides a development envelope area above the flood level during the defined flood event with a minimum size and dimension specified in Table 8.2.5.3.4 - Development envelope area.	**Complies** - This proposed development has a developable footprint of approximately 4250m² on the eastern lot and 8030m² on the western lot. Water surface level mapping has been provided for all modelled events and can be seen in **Appendix E** and **Appendix F**.
PO7 Reconfiguring a lot involving a development envelope area located in a Flood investigation area identified on Flood hazard overlay map OM-05.01 is limited to: a. the realignment of boundaries where the development envelope area is located outside a High flow area identified on Flood hazard overlay map OM-05.02; or b. the development is demonstrated to be compatible with the level of flood risk, including delivering the relevant outcomes for a: i. High flood risk area; j. Moderate flood risk area; k. iii. Low flood risk area, Very low flood risk area and High flood island where involving a vulnerable use or essential community infrastructure activities.	**AO7** Each lot has a development envelope area located outside of a Flood investigation area identified on Flood hazard overlay map OM-05.01.	**Complies** - This proposed development has a developable footprint of approximately 4250m² on the eastern lot and 8030m² on the western lot. Water surface level mapping has been provided for all modelled events and can be seen in **Appendix E** and **Appendix F.**

Performance Outcomes	Acceptable Outcomes	Response
Note - Planning scheme policy 10 - Flood provides guidelines on how to prepare a detailed localised flood risk assessment to assist with achieving Performance Outcome 7(b). It also includes guidance on how to demonstrate compliance with this performance outcome.		
PO17 Development where involving an accommodation land use or residential activities has a low flood hazard vehicle route to a suitable flood-free area that contains local goods and services to serve the daily needs of people. *Note - Planning scheme policy 10 - Flood provides guidance on achieving this performance outcome.*	**AO17** During the defined flood event, development for an accommodation land use or residential activities has: a. flood-free vehicle access to a road above the flood level; b. a flood-free vehicle route that leads to a suitable flood-free area that contains local goods and services to serve the daily needs of people.	Refer **Section 5.4** of FRA.
PO18 Development has a low flood hazard vehicle or pedestrian route from dwellings to a flood-free or low flood hazard road.	**AO18** Development has a flood-free vehicle or pedestrian route from onsite dwellings to the flood-free road. *Editor's note - Figure 8.2.5.3.1 - Compliant dwelling with flood- free evacuation route illustrates an example of a development complying with this Acceptable Outcome. Figure 8.2.5.3.2 - Non-compliant dwelling with no flood-free evacuation route illustrates an example of a development that does not comply with this acceptable outcome.*	**Complies** – Flood free access is available to Bahrs Scrub Road as demonstrated in **Appendix E**.