Proposed Residential Development

5307-5335 Mt Lindsay Highway, Jimboomba

Flood Impact Analysis

Urban Construct (Qld) Pty Ltd

8 March 2019

Document Verification

Job Title **PROPOSED RESIDENTIAL DEVELOPMENT**

Job Number 21182

Document Title Flood Impact Analysis

Document Control

Date	Document	Revision No.	Issue	Author	Reviewer
06.07.18	Flood Impact Analysis	02	Final	J. McDonald	J. Ghobrial
08.03.19	Revised Flood Impact Analysis	03	DA RFI Issue	J. Nation	J. Ghobrial

Approval for Issue

Name	Signature	Date
James Nation		8 March 2019
John Ghobrial		8 March 2019

CONTENTS

APPENDICES

1 Introduction

ADG Engineers Pty Ltd (Aust) has been engaged by Urban Construct (QLD) Pty Ltd to undertake an assessment of the proposed residential development at 5307-5335 Mt Lindesay Highway, Jimboomba.

The objective of this report is to investigate the flood risk to the site from the adjacent Logan River and quantify any external impacts due to the development. The report will:

- calculate flood levels at the site due to flooding of Logan River and Henderson Creek;
- demonstrate the level of impact to upstream and downstream peak flood water levels as a result of the development proposal; and
- determine whether the development will cause any impacts to peak discharge and velocity.

1.1 Scope

The general approach and methodology employed to achieve the study objectives involved:

- Site inspection, compilation and review of available information;
- Review and interrogation of existing Logan City Council (LCC) *TUFLOW* flood model;
- Determine existing flood levels and depths of a range of AEP's;
- Modify the LCC *TUFLOW* model to reflect the proposed development;
- Determine post-development flood levels;
- Presentation of pre and post-development flood extents;
- Assess impacts of proposed development finished surface levels; and
- Identify key features of the flood model;
- Prepare a report.

1.2 Site Location & Land Titles

Table 1: Summary of Existing Land Titles

Street Address	5307 – 5335 Mt Lindesay Highway, Jimboomba
Title Details	Lot 1 RP859595, Lot 52 RP887426, Lot 51 RP887425
Total Site Area	181 ha

The site location map is shown in Figure 1.

Figure 1: Location Map

1.3 Existing Site Conditions

Logan River bounds the northern edge of the site, while Henderson Creek runs through the south of the site and along the eastern boundary. The site is currently occupied by Hills International College and Hills Golf Club.

1.4 Proposed Development

The western portion of the site is to be developed into 712 residential allotments. Access to the site will be provided from Johanna Street to the south-east of the site, and the existing school will be retained. The layout of the proposed development is illustrated on **Figure 2** below, with detailed drawings attached in **Appendix A**.

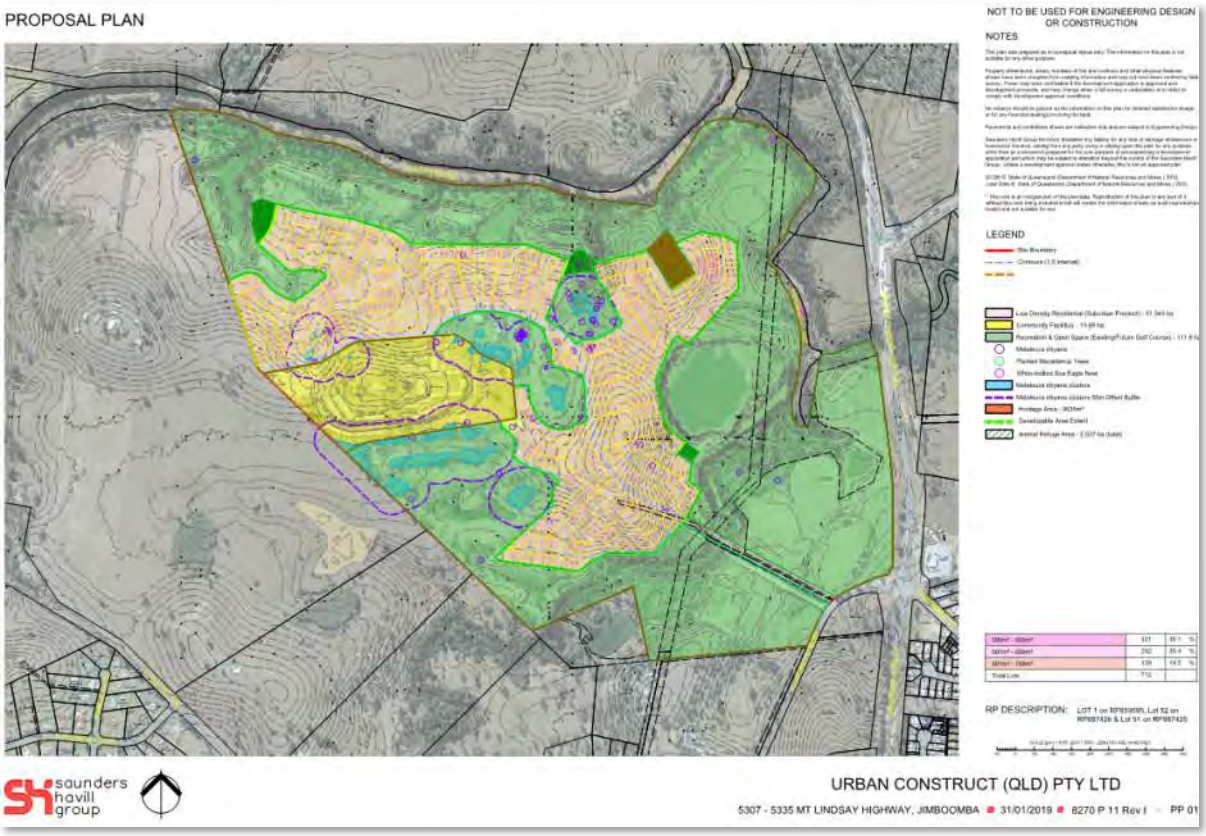

Figure 2: Proposed Layout

The Council flood overlay indicates that the site is subject to flooding from both Logan River and Henderson Creek, this extent is depicted in **Figure 3**.

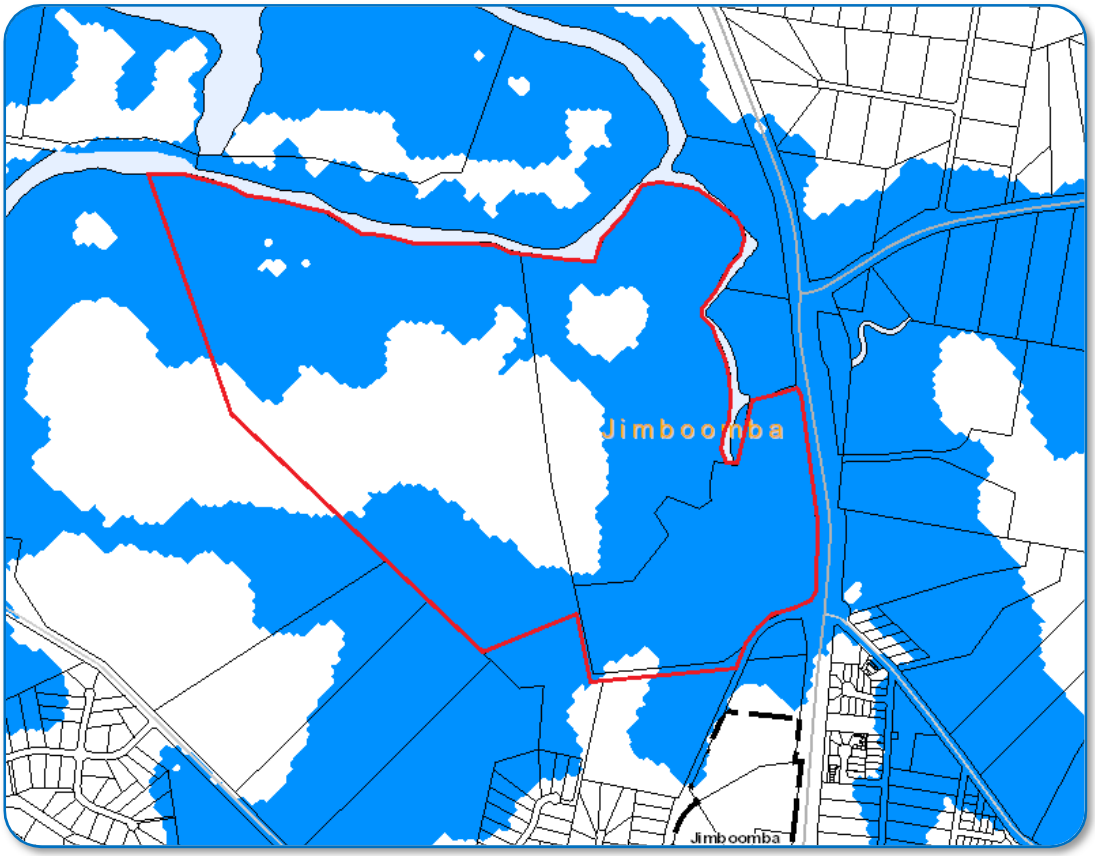

Figure 3: LCC Flood Overlay

2 Data Collection

A variety of data was collected and used as part of this FIA. The data and sources included:

- Existing *TUFLOW* model from LCC including topography and hydrology data; and
- Proposed topography for the site based on ADG earthworks surface tin for the proposed development areas.

3 Modelling Procedure

To achieve the desired development yield, significant earthworks are required to provide flood immunity to proposed lots and compensatory cut to maintain flood storage and conveyance. The defined flood level from the site as advised by Council is RL 28.0 m AHD and is governed by the regional 0.01 AEP flooding of Logan River. The proposed lots are to be filled above this minimum level.

To ensure no increase to peak flood levels external to the site, compensatory earthworks are proposed to maintain flood storage capacity and conveyance. These compensatory works are proposed to be undertaken above the 0.095 AEP flood level of RL 23.4 m AHD.

The pre and post-development *TUFLOW* modelling has been utilised to;

- quantify peak flood levels, depths and velocities at the development site for the 0.393, 0.095, and 0.01 AEP storm events;
- determine the extent of floodplain inundation; and
- determine whether the proposed development will cause any actionable nuisance on neighbouring properties.

4 2D Hydraulic Modelling

To simulate the impacts of the proposed earthworks, the Logan River TUFLOW model has been acquired from Logan City Council to use as the basis for assessment. This existing model has been utilised to represent the pre-development scenario and modified by the proposed earthworks design by ADG to represent the post-development scenario.

4.1 Model Extent

The extent of the Council *TUFLOW* model is from Cedar Grove Weir downstream to Chambers flat and has a grid size of 20m. For this investigation the model has been cut down to upstream of the Cusack Lane Bridge to approximately 1km downstream of the subject site. The grid size has also been reduced to 5m to increase the accuracy of the model. The model extent is illustrated in the *TUFLOW* model setup drawing depicted in **Figure 4** and included in **Appendix B**.

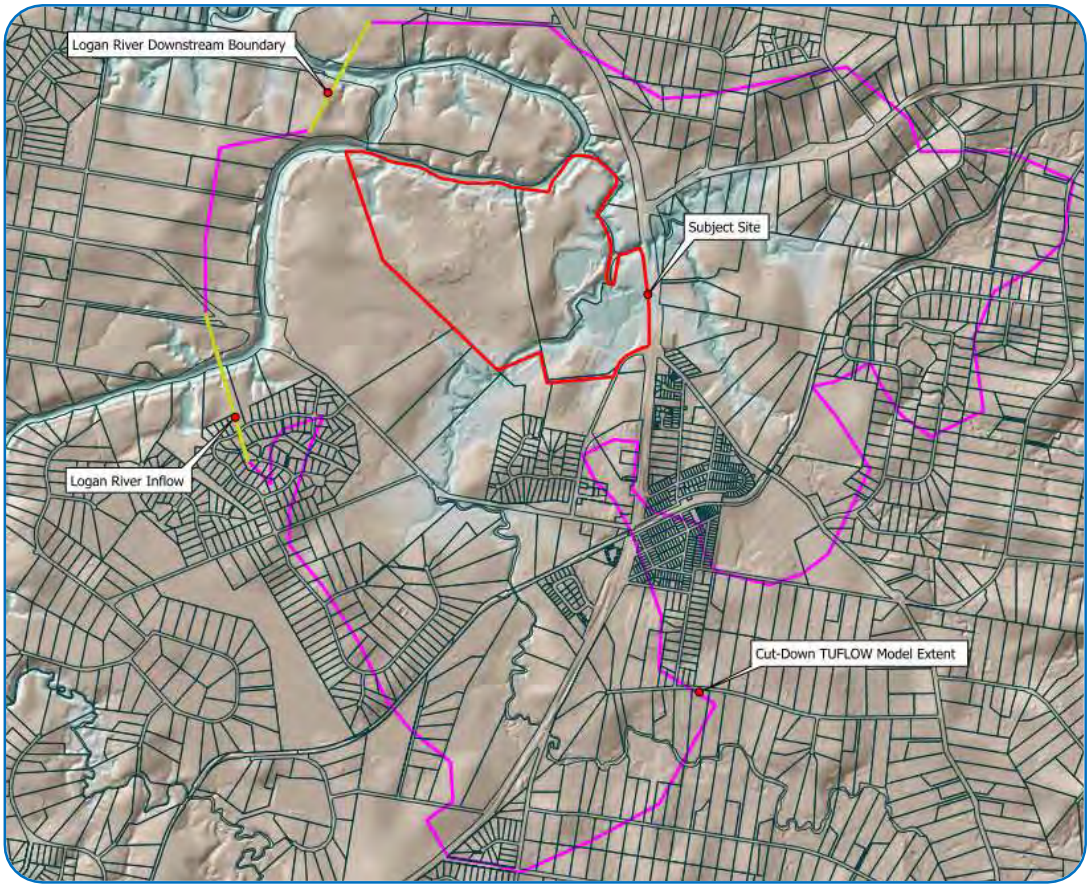

Figure 4: *TUFLOW* Model Extent

4.1.1 Downstream Boundary Condition

The downstream boundary condition for the model has been extracted from the Council *TUFLOW* model at an existing monitoring line and input as a Level vs Time relationship as displayed in **Figure 5** below.

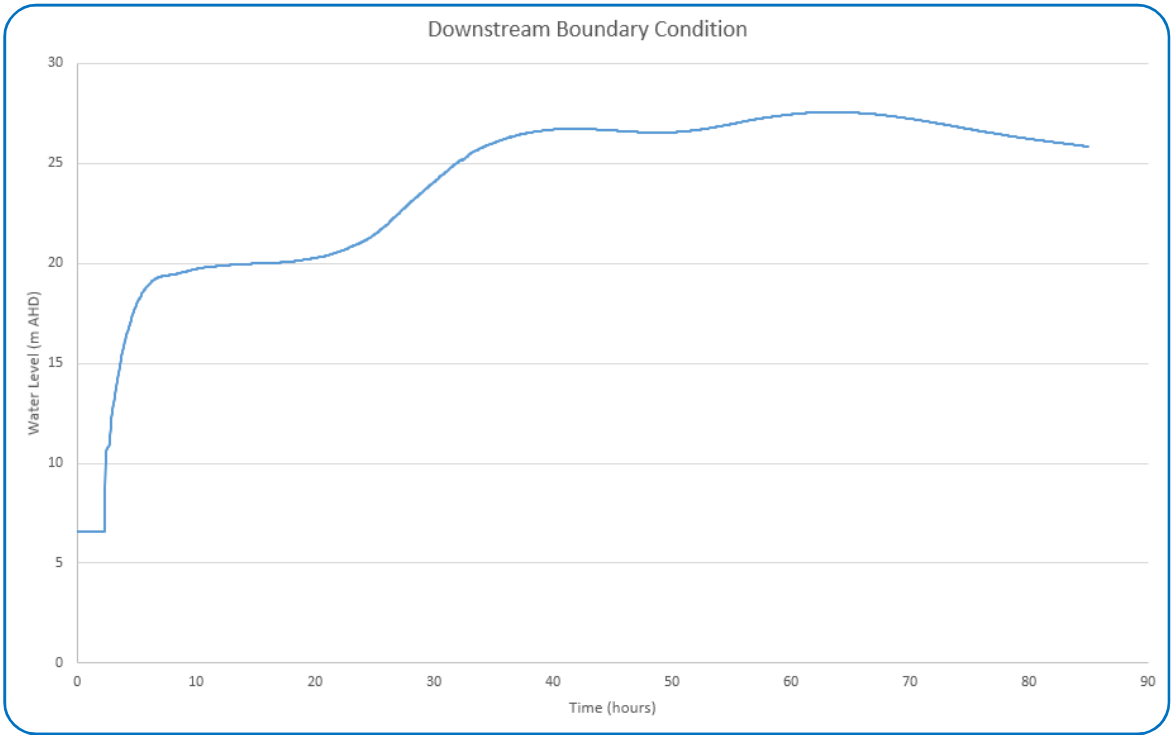

Figure 5: *TUFLOW* Downstream Boundary Condition (0.01 AEP)

4.1.2 Upstream Boundary Condition

The upstream boundary condition for the model has also been extracted from the Council *TUFLOW* model at an existing monitoring line and input as a Flow vs Time relationship. Additional local inflows into Henderson Creek have been retained from the Council model.

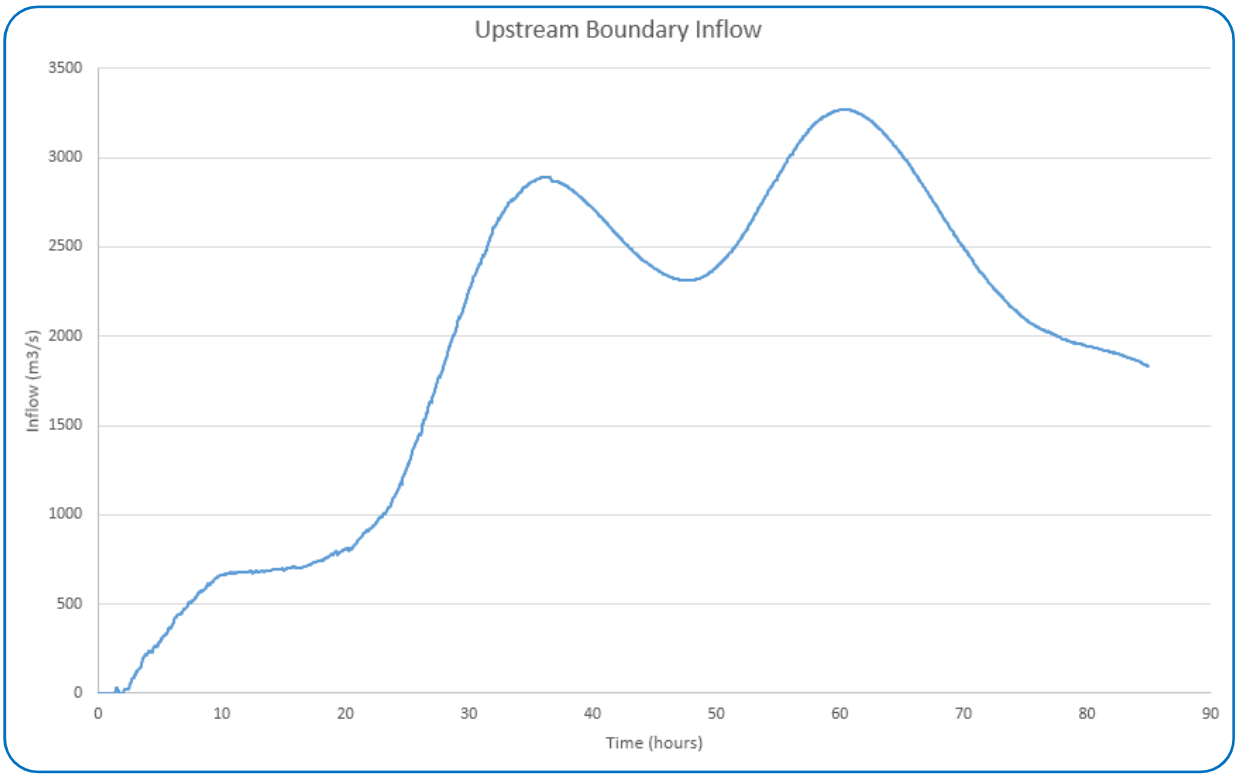

Figure 6: *TUFLOW* Upstream Inflow (0.01 AEP)

4.2 Existing Scenario Modelling Results

To ensure an accurate baseline for the flood analysis, the pre-development results from the cut down *TUFLOW* model were compared to the results from the original Council supplied *TUFLOW* model. The cut down model was found to produce almost identical results and as such was adopted as the base pre-development case. The critical storm duration for the 0.01 AEP is 72 hours, while the critical storm duration for the 0.393 and 0.095 AEPs is 30 hours.

The flooding behaviour of the area is dominated by flow from Logan River, with flow backing up into Henderson Creek during larger storm events. The 0.393 AEP event is largely contained within the creek and river banks with larger events breaking the banks and extending into the floodplain.

The following sections describe the pre-development modelling results in detail.

4.2.1 Pre-Development Peak Flood Levels

The expected pre-development peak flood levels for the site are listed in **Table 2** below for all modelled storm events.

Table 2: Pre-Development Peak Flood Levels

AEP	Peak Flood Level
0.393	17.12
0.095	23.39
0.01	27.94

An extract of the 0.01 AEP flood level results are depicted in **Figure 7, and** the 0.095 AEP flood level results in **Figure 8** below with full results for all modelled AEP's provided in **Appendix C**.

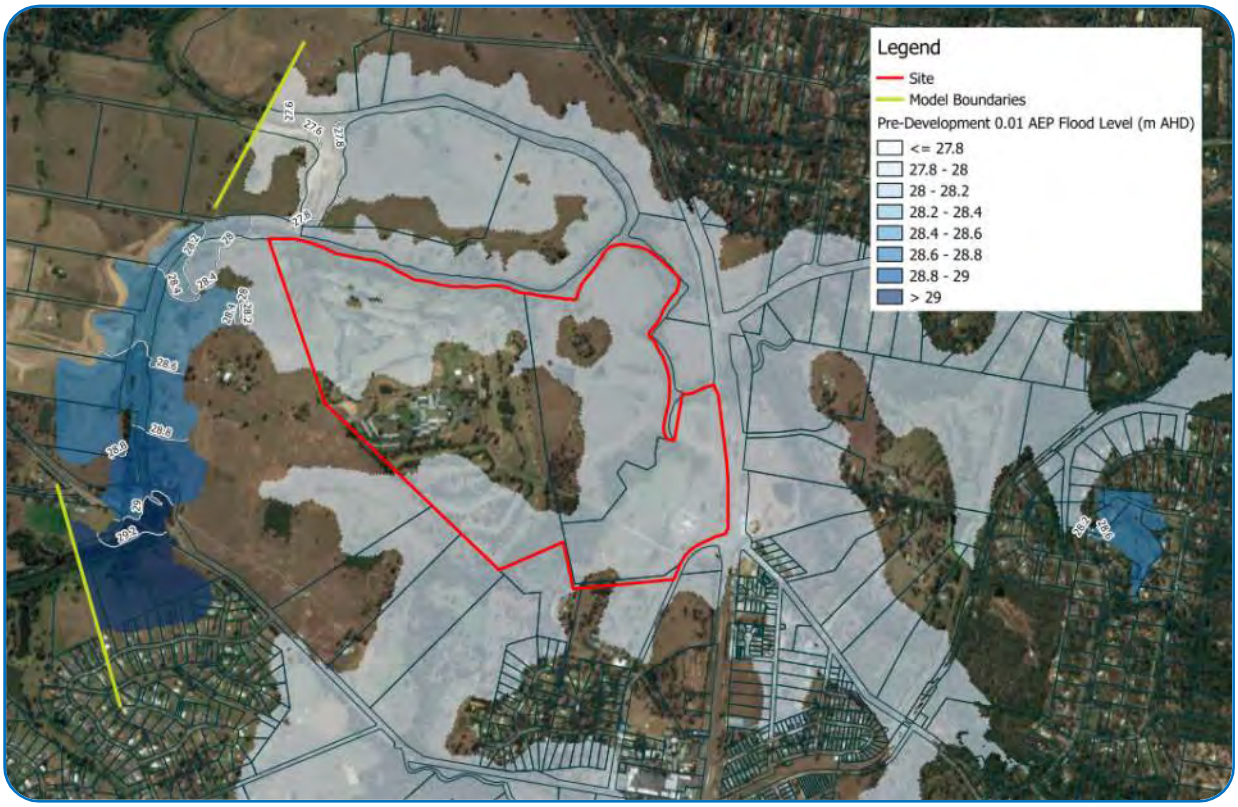

Figure 7: 0.01 AEP Pre-Development Peak Flood Levels

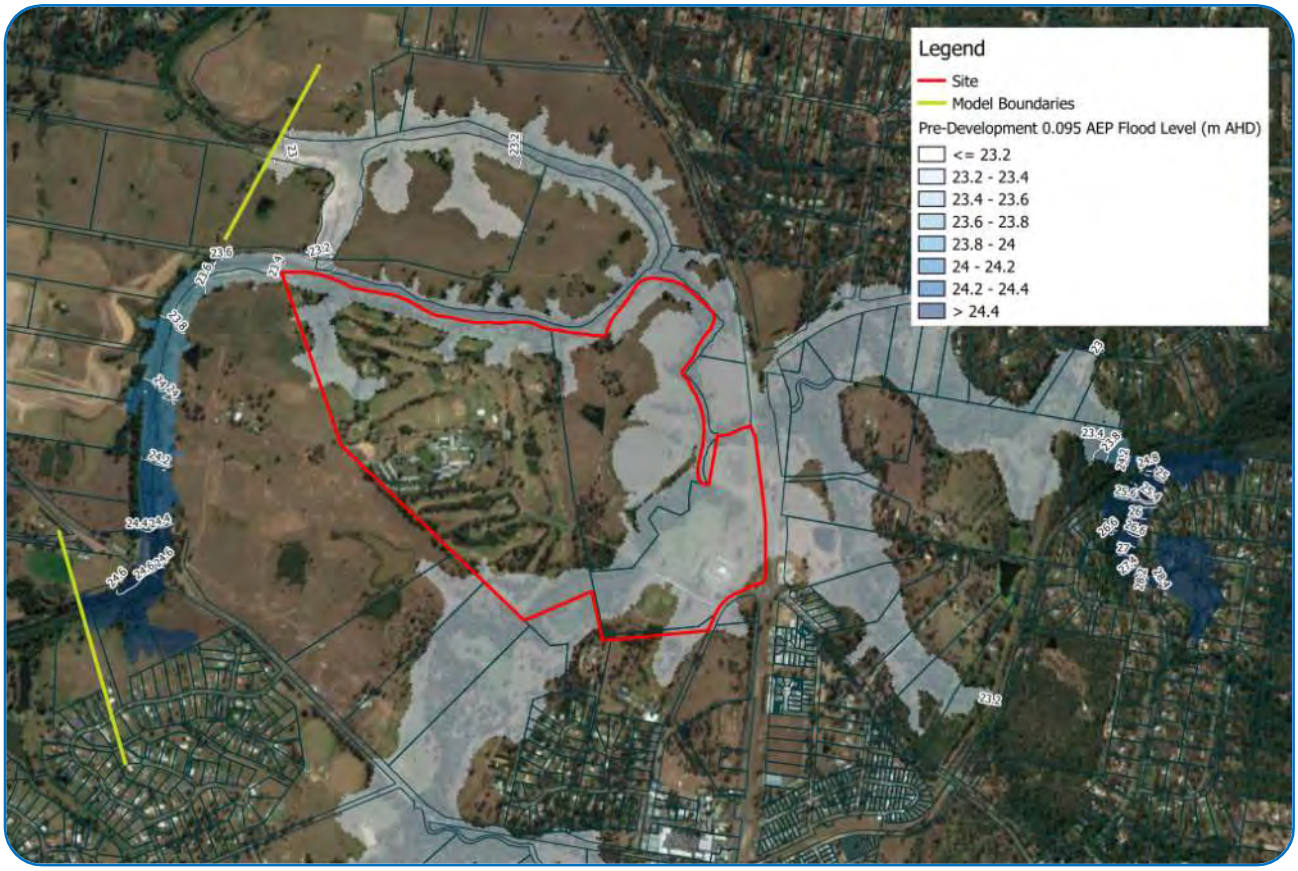

Figure 8: 0.095 AEP Pre-Development Peak Flood Levels

4.2.2 Pre-Development Peak Flood Depths

The expected flood depths adjacent to the site peak at approximately 19 m deep located within the main channel of Logan River, during the 0.01 AEP flood event. The expected peak flood depths for all modelled events are listed in **Table 3**.

Table 3: Pre-Development Peak Flood Depth

AEP	Peak Flood Depth
0.393	7.26
0.095	14.26
0.01	18.87

An extract of the 0.01 AEP flood depth results are depicted in **Figure 9** below with full results for all modelled AEP's provided in **Appendix C**.

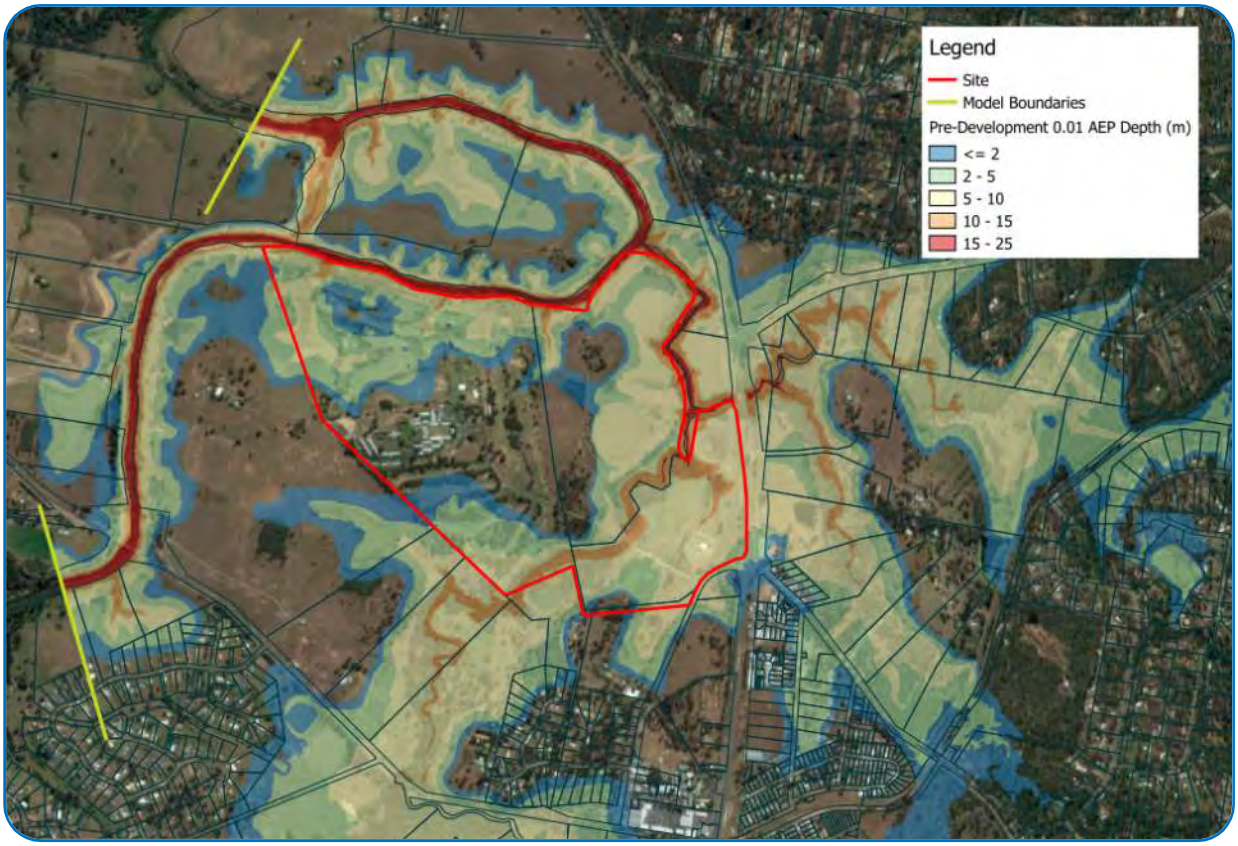

Figure 9: 0.01 AEP Pre-Development Peak Flood Depth

4.2.3 Pre-Development Peak Flood Velocity

The expected peak flood velocity adjacent to the site within Logan River is approximately 3.90 m/s during the 0.01 AEP flood event. The expected peak flood velocity for all modelled events are listed in **Table 4**.

Table 4: Pre-Development Peak Flood Velocity

AEP	Peak Flood Level
0.393	2.63
0.095	3.63
0.01	4.87

An extract of the 0.01 AEP flood depth results are depicted in **Figure 10** below with full results for all modelled AEP's provided in **Appendix C**. It is evident from the velocity plot that a large volume of flow in Logan River breaks out of the main channel to the north of the site shortcutting the oxbow bend in the river.

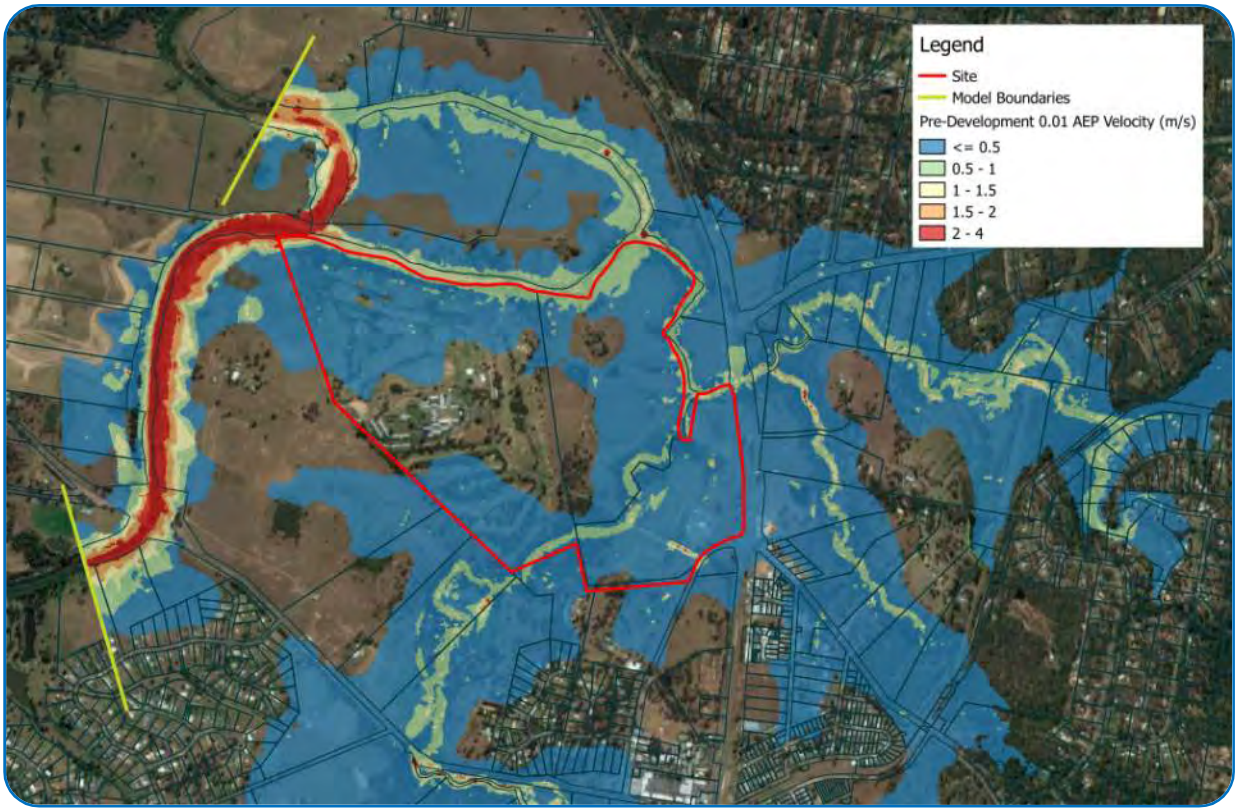

Figure 10: 0.01 AEP Pre-Development Peak Flood Velocity

4.3 Post-Developed Scenario

The post-development TUFLOW model builds upon the pre-development scenario with the addition of the proposed earthworks by ADG as depicted in Appendix B. These earthworks create a flood free pad for the development footprint and provide compensatory earthworks to maintain flood storage and conveyance. The compensatory works have been located above the 0.095 AEP flood level to protect existing stream embankments within Logan River.

The flooding behaviour of the post-development scenario is largely similar to the pre-development scenario. Storm events up to the 0.095 AEP within Logan River are unchanged to the pre-development scenario.

The following sections describe the post-development modelling results in detail.

4.3.1 Post-Development Peak Flood Levels

The expected post-development peak flood levels for the site are listed in **Table 5** below for all modelled storm events. These levels are identical to the pre-development scenario.

Table 5: Post-Development Peak Flood Levels

AEP	Peak Flood Level
0.393	17.12
0.095	23.39
0.01	27.94

An extract of the 0.01 AEP flood level results are depicted in **Figure 11** below with full results for all modelled AEP's provided in **Appendix D**.

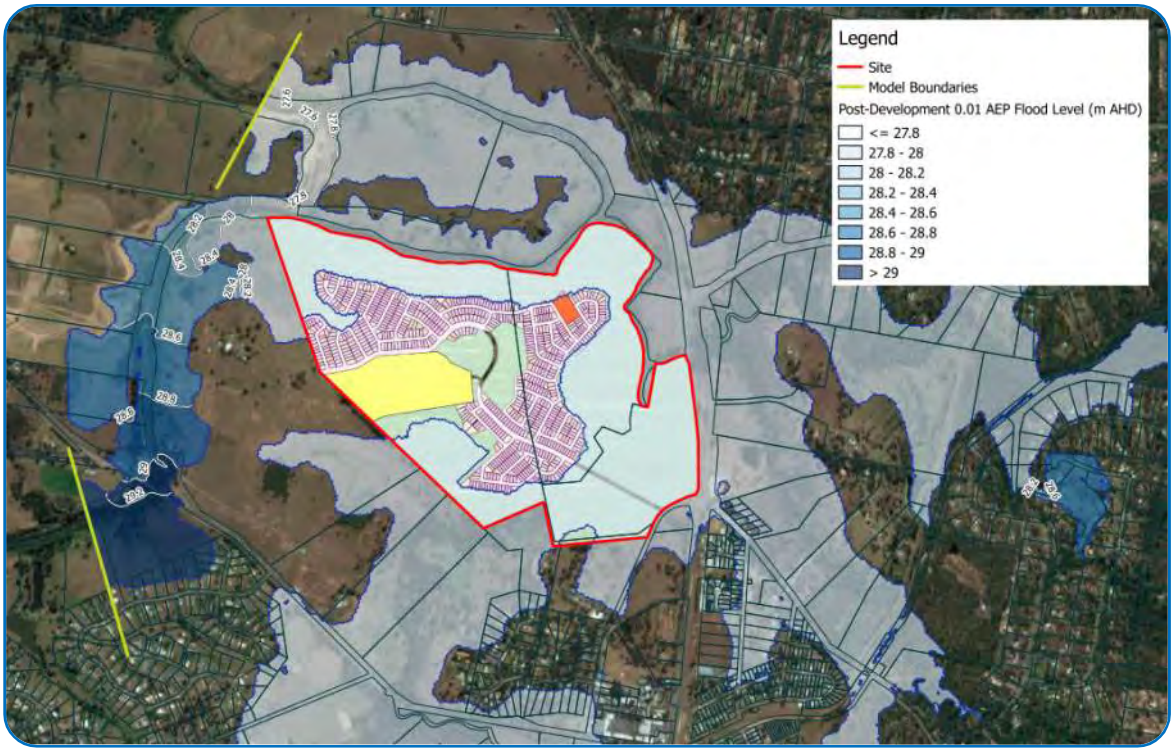

Figure 11: 0.01 AEP Pre-Development Peak Flood Levels

4.3.2 Post-Development Peak Flood Depths

The expected flood depths adjacent to the site peak at approximately 19 m deep located within the main channel of Logan River, during the 0.01 AEP post-development flood event. The expected peak flood depths for all modelled events are listed in **Table 6**. These depths are identical to the pre-development scenario.

Table 6: Pre-Development Peak Flood Depth

AEP	Peak Flood Depth
0.393	7.26
0.095	14.26
0.01	18.87

An extract of the 0.01 AEP flood depth results are depicted in **Figure 12** below with full results for all modelled AEP's provided in **Appendix D**.

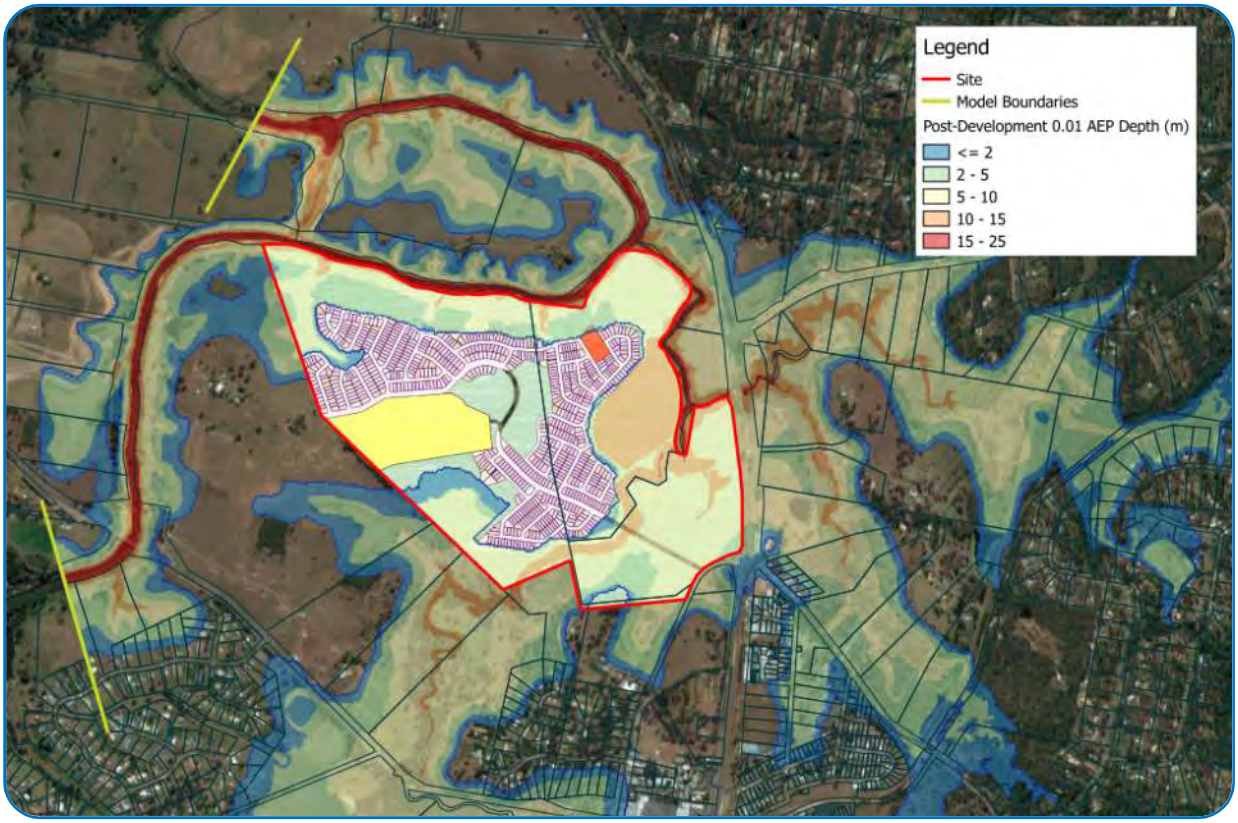

Figure 12: 0.01 AEP Post-Development Peak Flood Depth

4.3.3 Post-Development Peak Flood Velocity

The expected peak flood velocity adjacent to the site within Logan River is approximately 3.90 m/s during the 0.01 AEP flood event. The expected peak flood velocity for all modelled events are listed in **Table 7**. These velocities are identical to the pre-development scenario.

Table 7: Post-Development Peak Flood Velocity

AEP	Peak Flood Level
0.393	2.63

0.095	3.63
0.01	4.87

An extract of the 0.01 AEP flood depth results are depicted in **Figure 13** below with full results for all modelled AEP's provided in **Appendix D**.

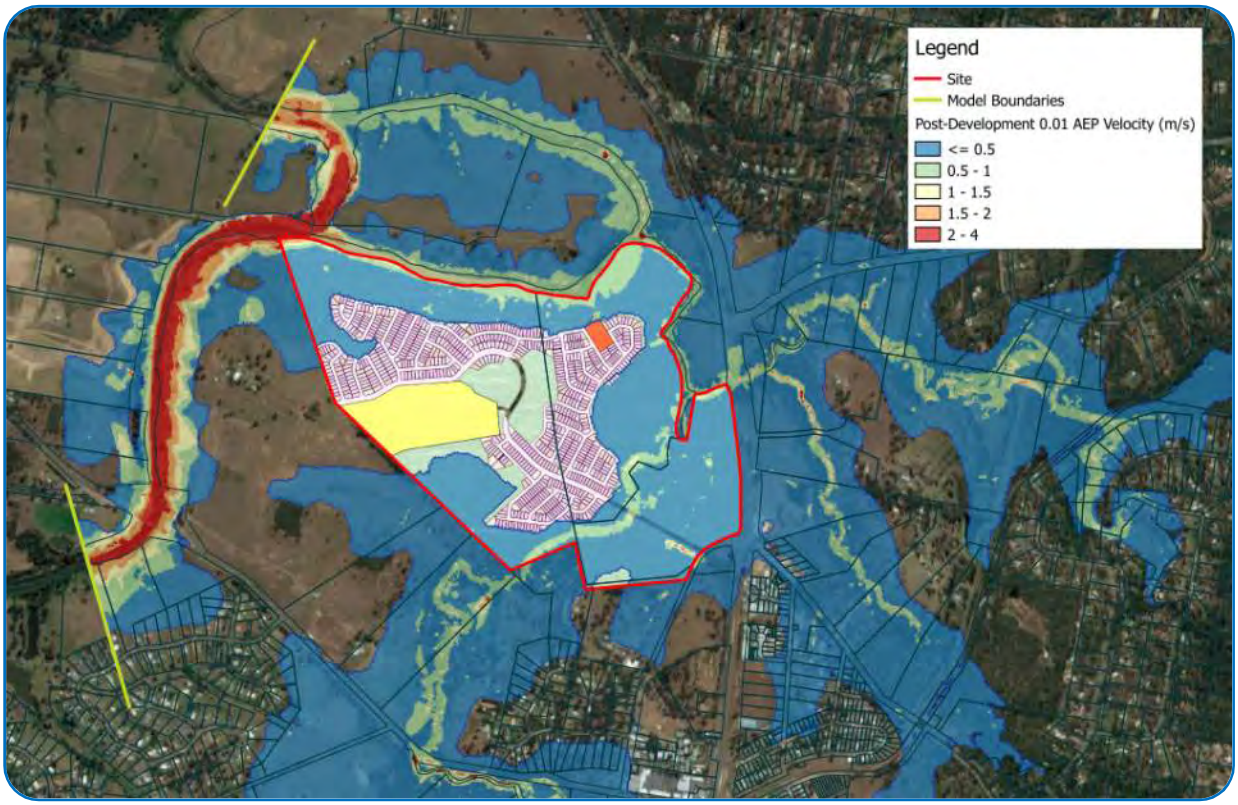

Figure 13: 0.01 AEP Post-Development Peak Flood Velocity

5 Impact Assessment

In order to illustrate the impacts of the proposed earthworks on flood levels external to the site, a spatial analysis of the pre and post-development results have been prepared. The 0.393 AEP, 0.095 AEP and the 0.01 AEP were analysed and the results are presented in **Appendix E**.

The results of the modelling indicate that the proposed earthworks will not impact on the level or extent of flood inundation or flood velocity within surrounding properties.

Figure 14 illustrates the expected extent of impact.

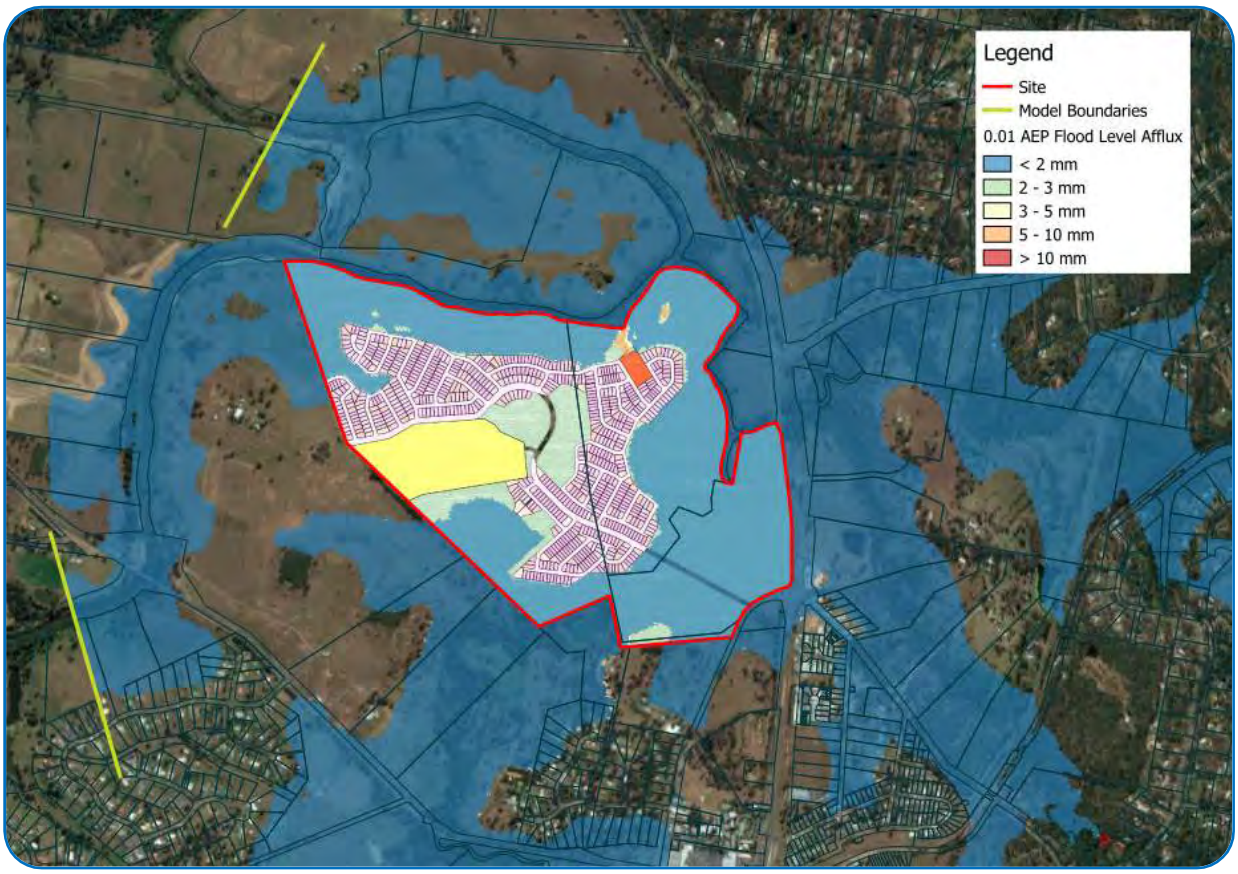

Figure 14: 0.01 AEP Flood Level Afflux Plot

The 0.01 AEP peak velocity impact was also analysed as illustrated in **Figure 15**. These results indicate that the proposed earthworks will not impact on the peak stream velocities external to the site.

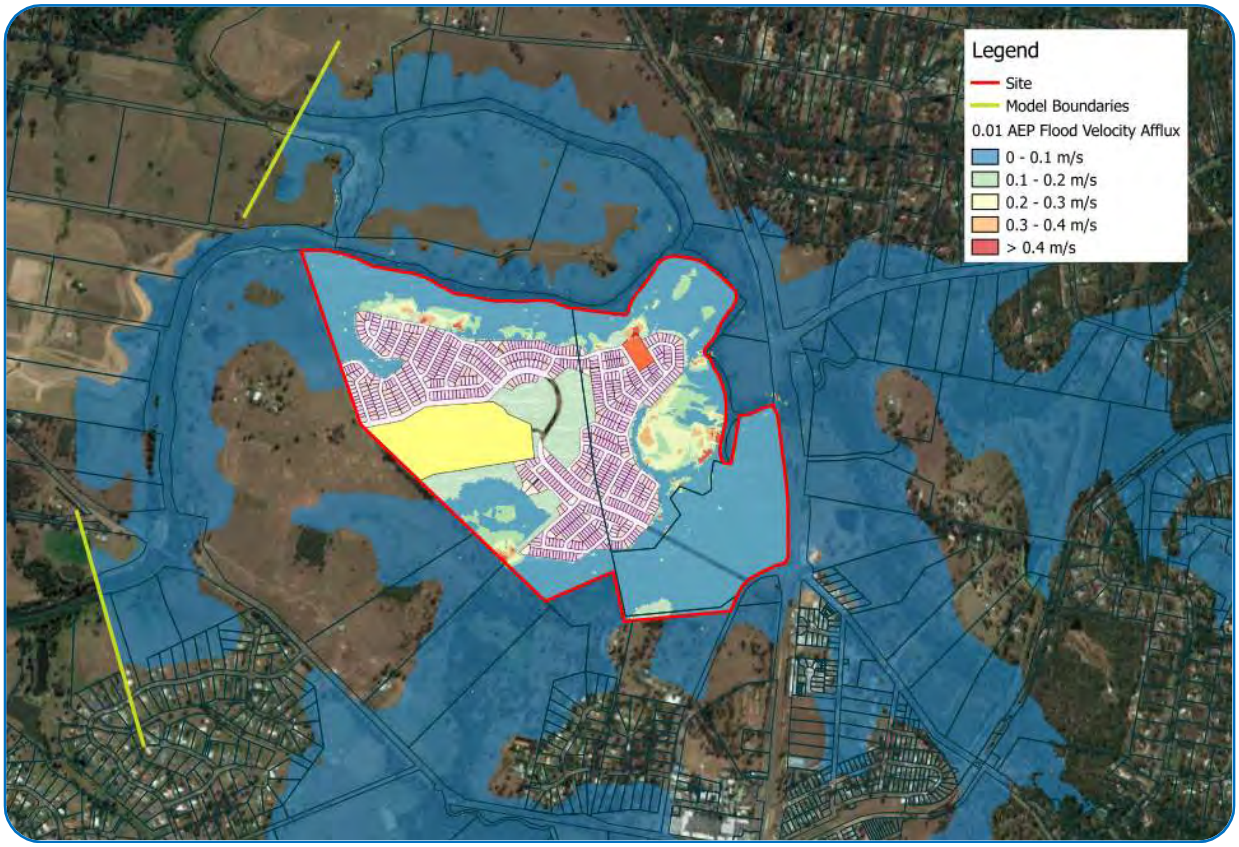

Figure 15: 0.01 AEP Flood Velocity Afflux Plot

7 Conclusions

The hydraulic behaviour of Logan River and Henderson Creek have been assessed based on the existing Logan City Council TUFLOW model. This model has been modified to represent the post-development earthworks and an assessment of the impacts undertaken.

The results of the modelling indicate:

- The 0.01 AEP flood level at the site is RL 27.94 m AHD;
- Flooding depths of up to 19 m are predicted adjacent to the site during the 0.01 AEP flood event within Logan River;
- The proposed earthworks provide flood immunity to the proposed lots;
- The compensatory earthworks proposed maintain flood storage volume and conveyance within major flowpaths;
- The proposed earthworks are not expected to increase peak flood levels or velocities external to the site for all modelled storm events; and
- There will be no impact on neighbouring properties during all modelled flood event.

This hydraulic impact assessment has demonstrated that the proposed development will not adversely affect neighbouring properties or materially change the flooding behaviour in the vicinity of the site.

Appendix A – Layout Drawing

PROPOSAL PLAN

NOT TO BE USED FOR ENGINEERING DESIGN OR CONSTRUCTION

NOTES

This plan was prepared as a conceptual layout only. The information on this plan is not suitable for any other purpose.

Property dimensions, areas, numbers of lots and contours and other physical features shown have been compiled from existing information and may not have been verified by field survey. These may need verification if the development application is approved and development proceeds, and may change when a full survey is undertaken or in order to comply with development approval conditions.

No reliance should be placed on the information on this plan for detailed subdivision design or for any financial dealings involving the land.

Pavements and centrelines shown are indicative only and are subject to Engineering Design.

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LEGEND

- Site Boundary
- Contours (1.0 interval)
- Low Density Residential (Suburban Precinct) - 51.343 ha
- Community Facilities - 13.69 ha
- Recreation & Open Space (Existing/Future Golf Course) - 111.8 ha
- Melaleuca irbyana
- Planted Macadamia Trees
- White-bellied Sea Eagle Nest
- Melaleuca irbyana clusters
- Melaleuca irbyana clusters 50m Offset Buffer
- Heritage Area - 9635m²
- Developable Area Extent
- Animal Refuge Area - 2.037 ha (total)

300m² - 500m²	321	45.1 %
501m² - 600m²	252	35.4 %
601m² - 799m²	139	19.5 %
Total Lots	712	

RP DESCRIPTION: LOT 1 on RP859595, Lot 52 on RP887426 & Lot 51 on RP887425

SCALE @A1 1:4000 @A3 1:8000 - LENGTHS ARE IN METRES

50 0 50 100 150 200 250 300 350 400 450

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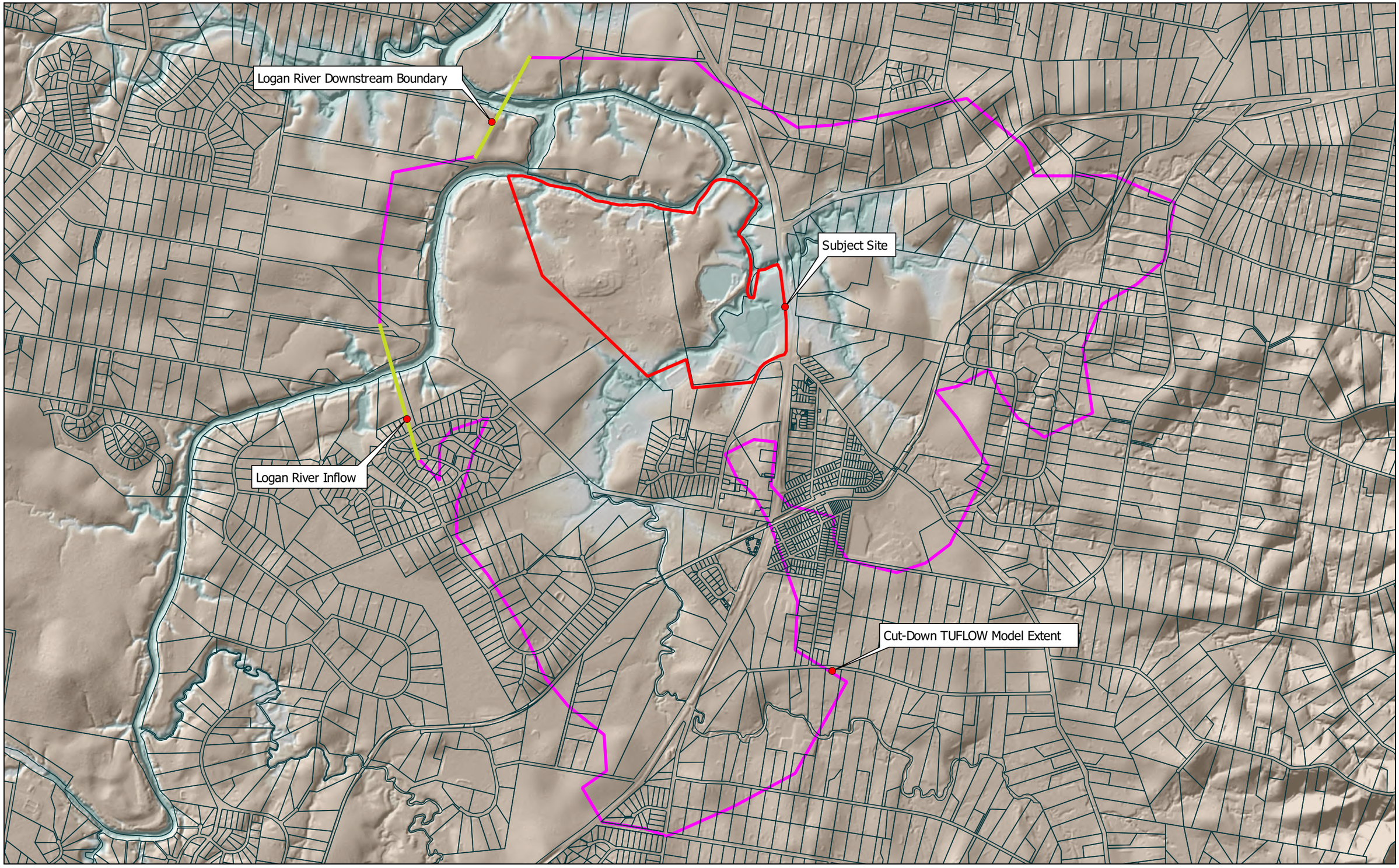
Appendix B – TUFLOW Model Layout



Rev	Date	Description	By	Chk
A	28.6.18	ORIGINAL ISSUE	JM	

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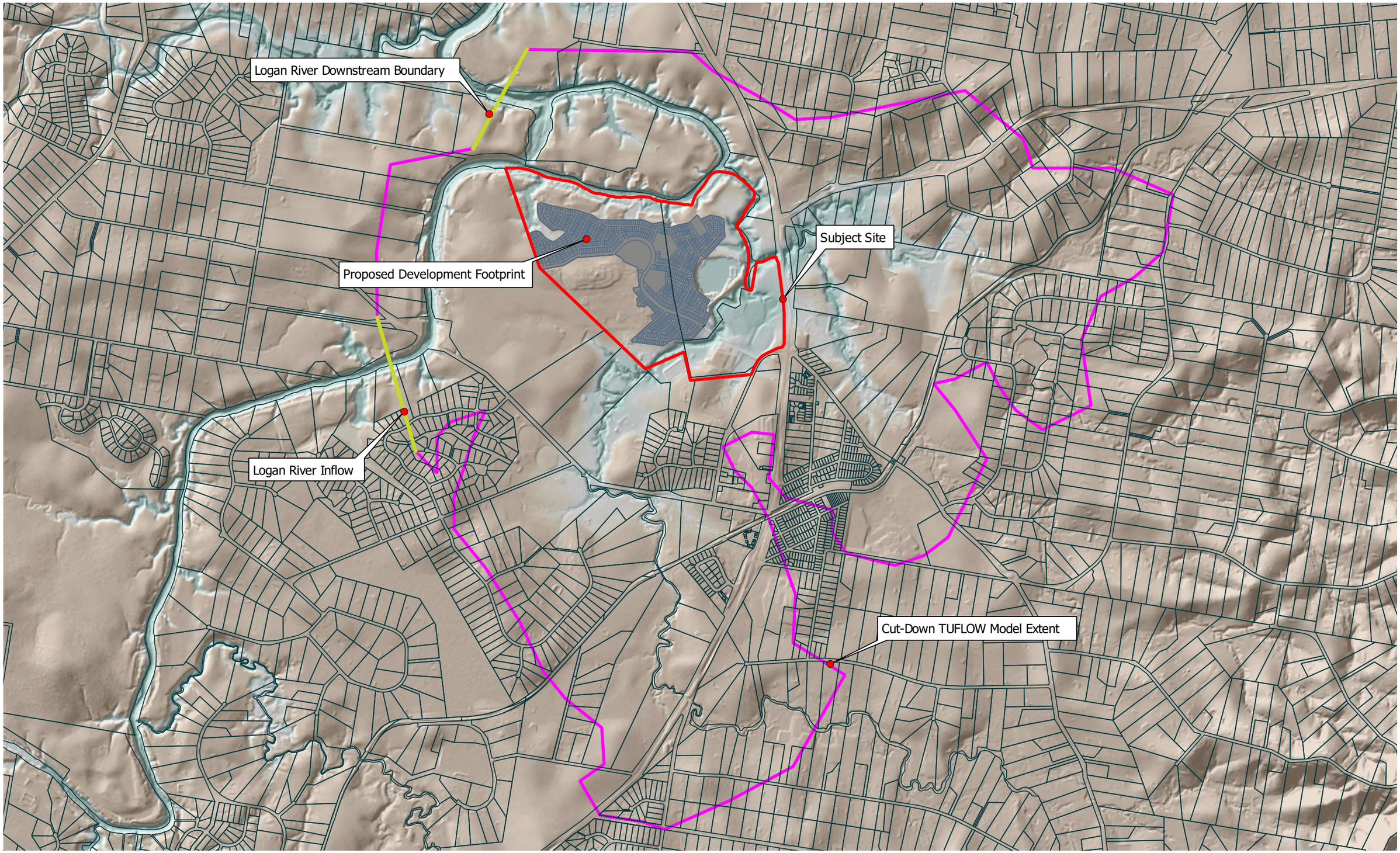
Client: URBAN CONSTRUCT (QLD) PTY LTD			
Project Name: PROPOSED RESIDENTIAL SUBDIVISION 5307 - 5336 MT LINDESAY HWY JIMBOOMBA QLD 4280			
Discipline: CIVIL			Status:
Designed By: JM	Checked By:		Approved By:
Project No.: 21182	Drawn By: JM		Scale at A1: 1:25,000
Title: PRE-DEVELOPMENT TUFLOW MODEL LAYOUT			
Drawing No.: C40			Revision:



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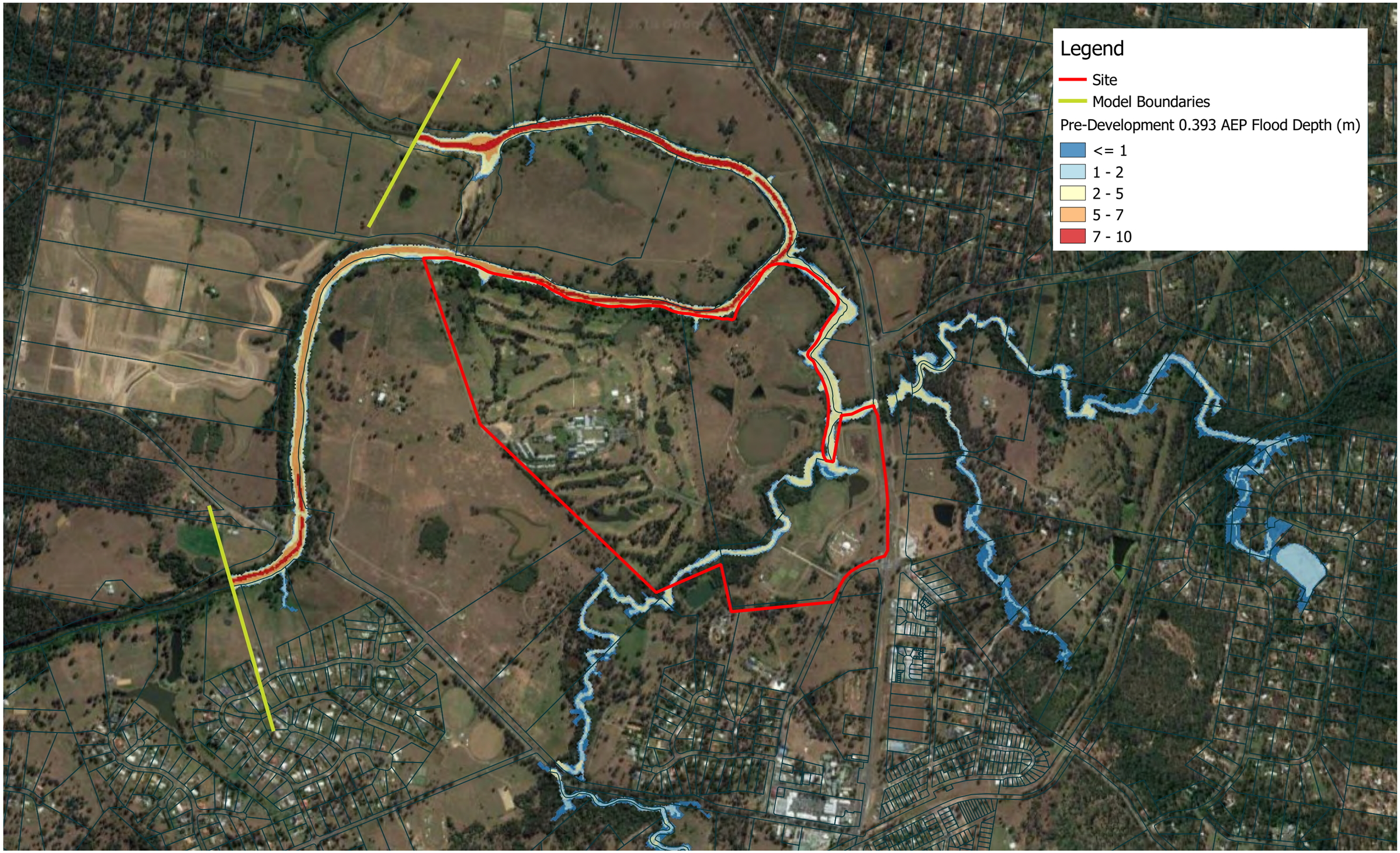
Client: URBAN CONSTRUCT (QLD) PTY LTD	Discipline: CIVIL		Status:
Project Name: PROPOSED RESIDENTIAL SUBDIVISION 5307 - 5336 MT LINDESAY HWY JIMBOOMBA QLD 4280	Designed By: JM	Checked By:	Approved By:
	Project No.: 21182	Drawn By: JM	Scale at A1: 1:25,000

Title	
POST-DEVELOPMENT TUFLOW MODEL LAYOUT	
Drawing No.: C41	Revision:

Appendix C – Pre-Development Results



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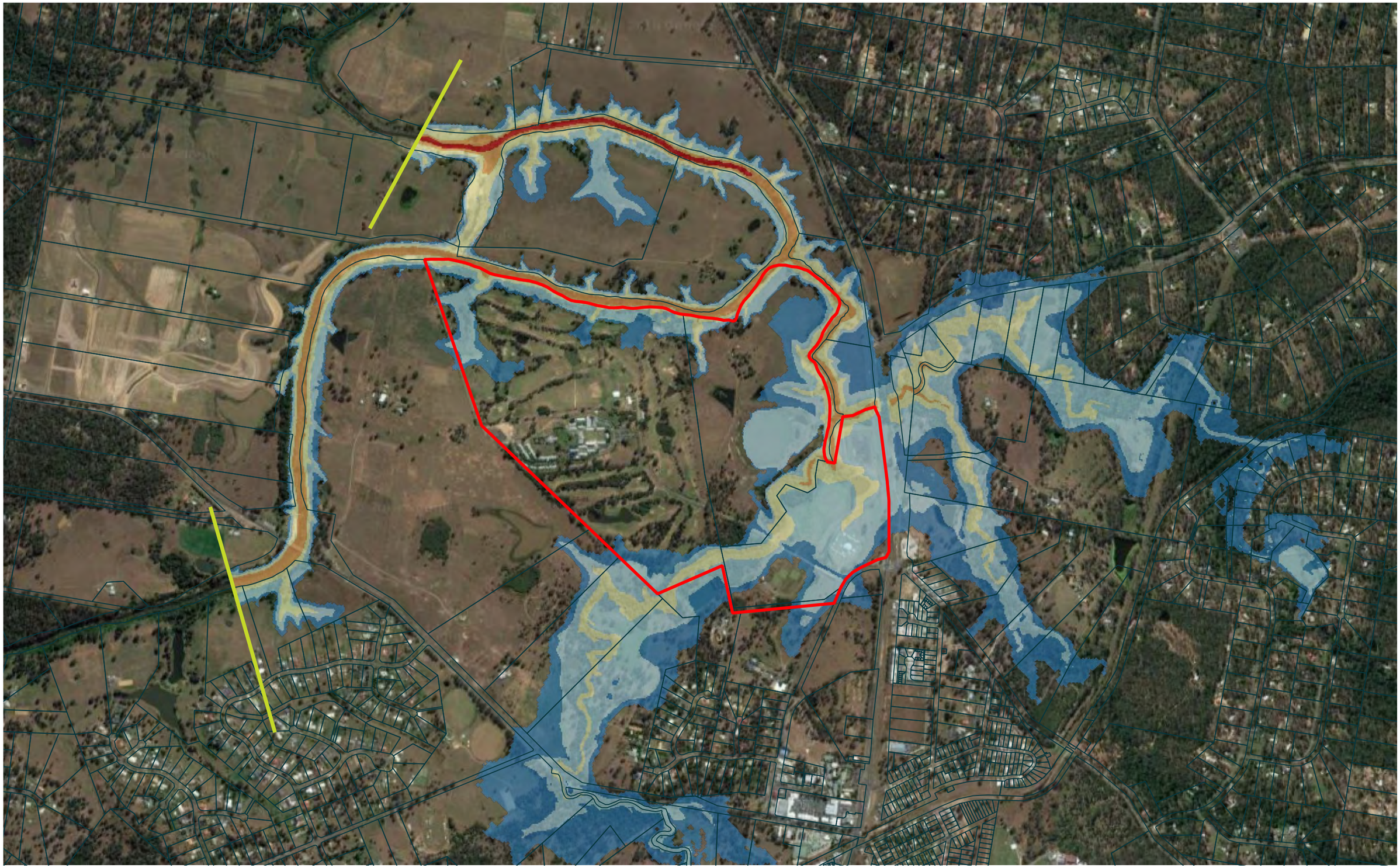
	Project No.: 21182	Drawn By: JM	Scale at A1: 1:15,000

Title: 0.393 AEP PRE-DEVELOPMENT PEAK FLOOD DEPTH

Drawing No.: C42

Revision:



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	Project No.: 21182	Drawn By: JM	Scale at A1: 1:15,000

Title: 0.095 AEP PRE-DEVELOPMENT PEAK FLOOD DEPTH

Drawing No.: C43

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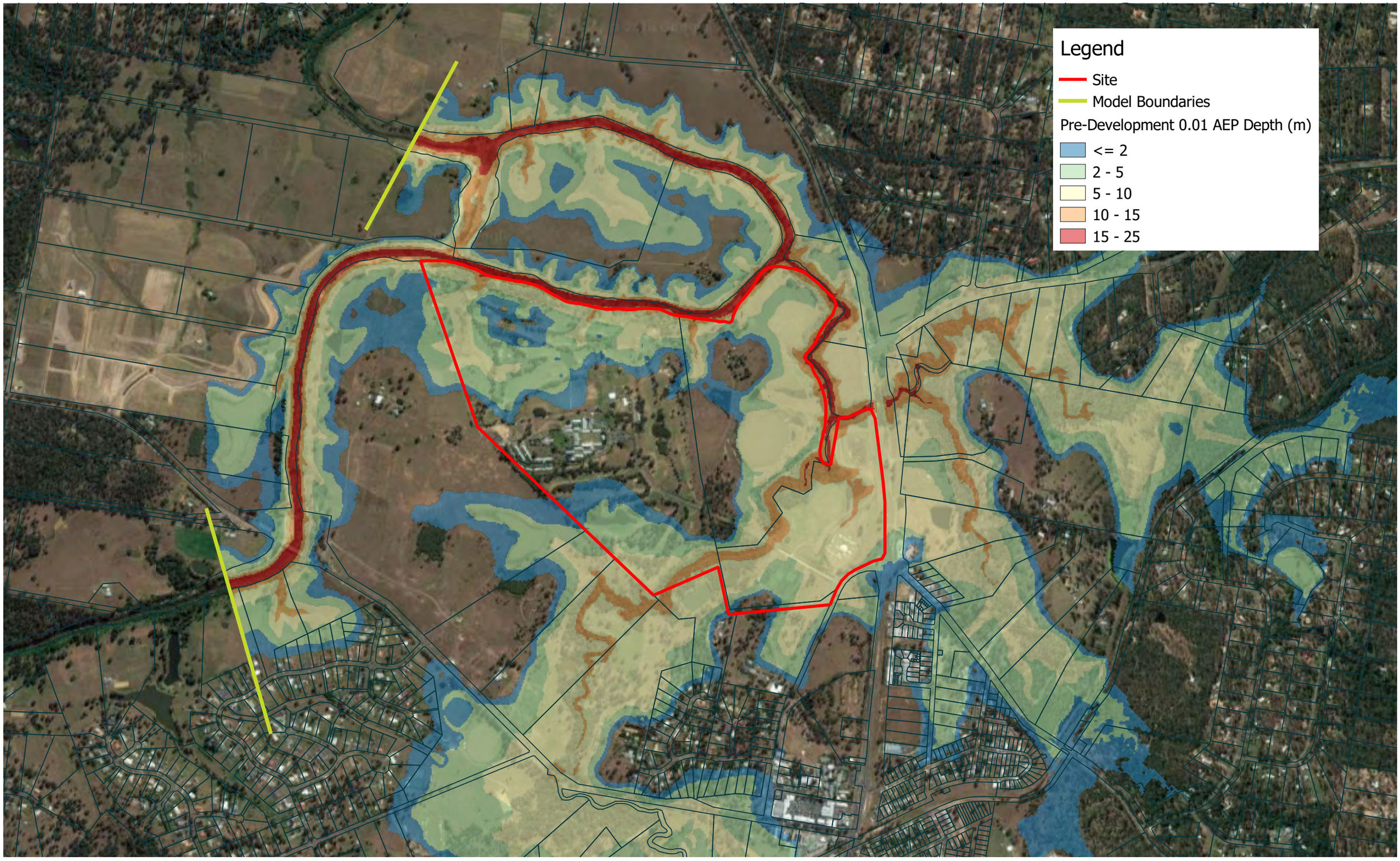

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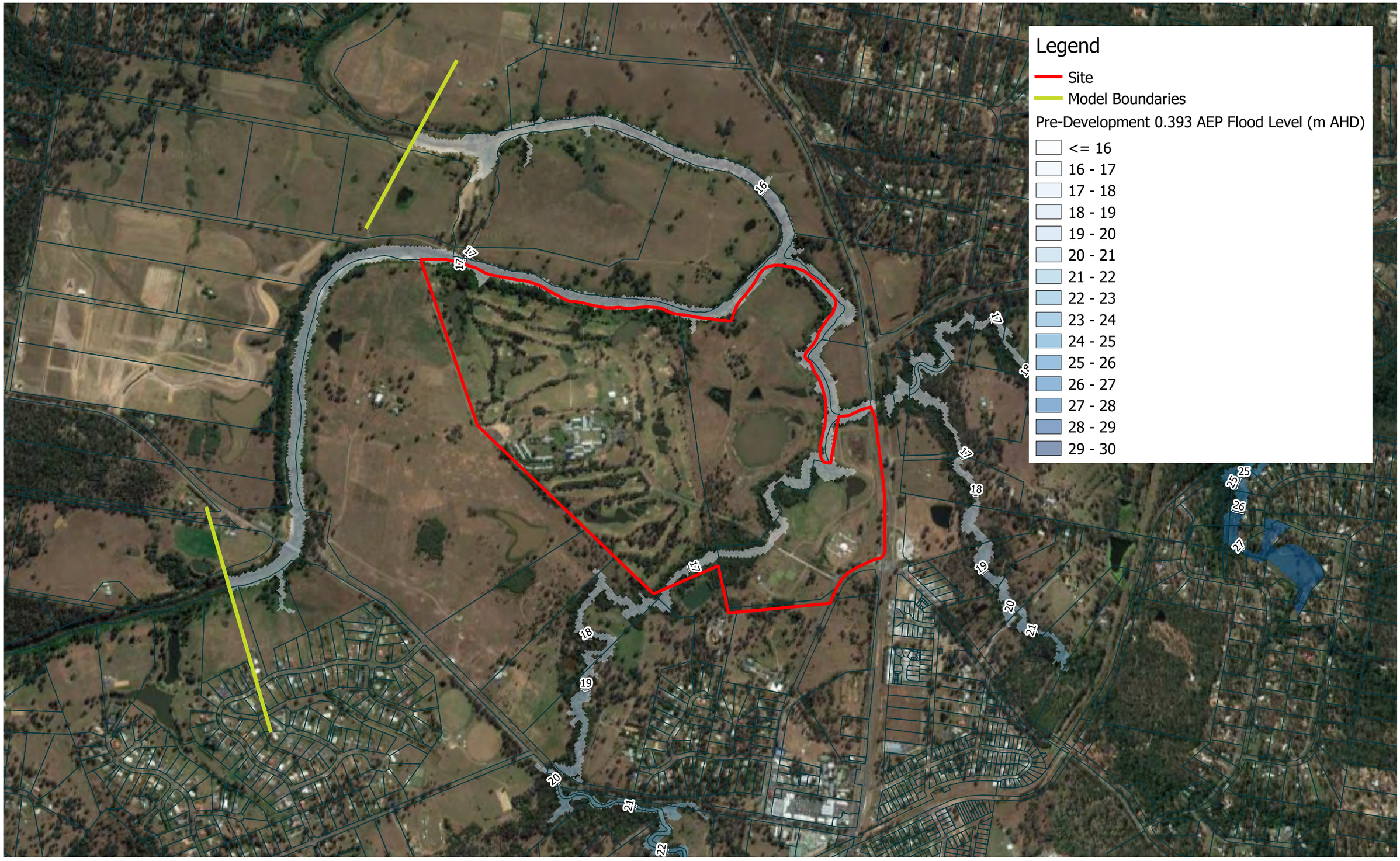
Client: URBAN CONSTRUCT (QLD) PTY LTD	Discipline: CIVIL		Status:
Project Name: PROPOSED RESIDENTIAL SUBDIVISION 5307 - 5336 MT LINDESAY HWY JIMBOOMBA QLD 4280	Designed By: JM	Checked By:	Approved By:
	Project No.: 21182	Drawn By: JM	Scale at A1: 1:15,000

Title	
0.01 AEP PRE-DEVELOPMENT PEAK FLOOD DEPTH	
Drawing No.: C44	Revision:



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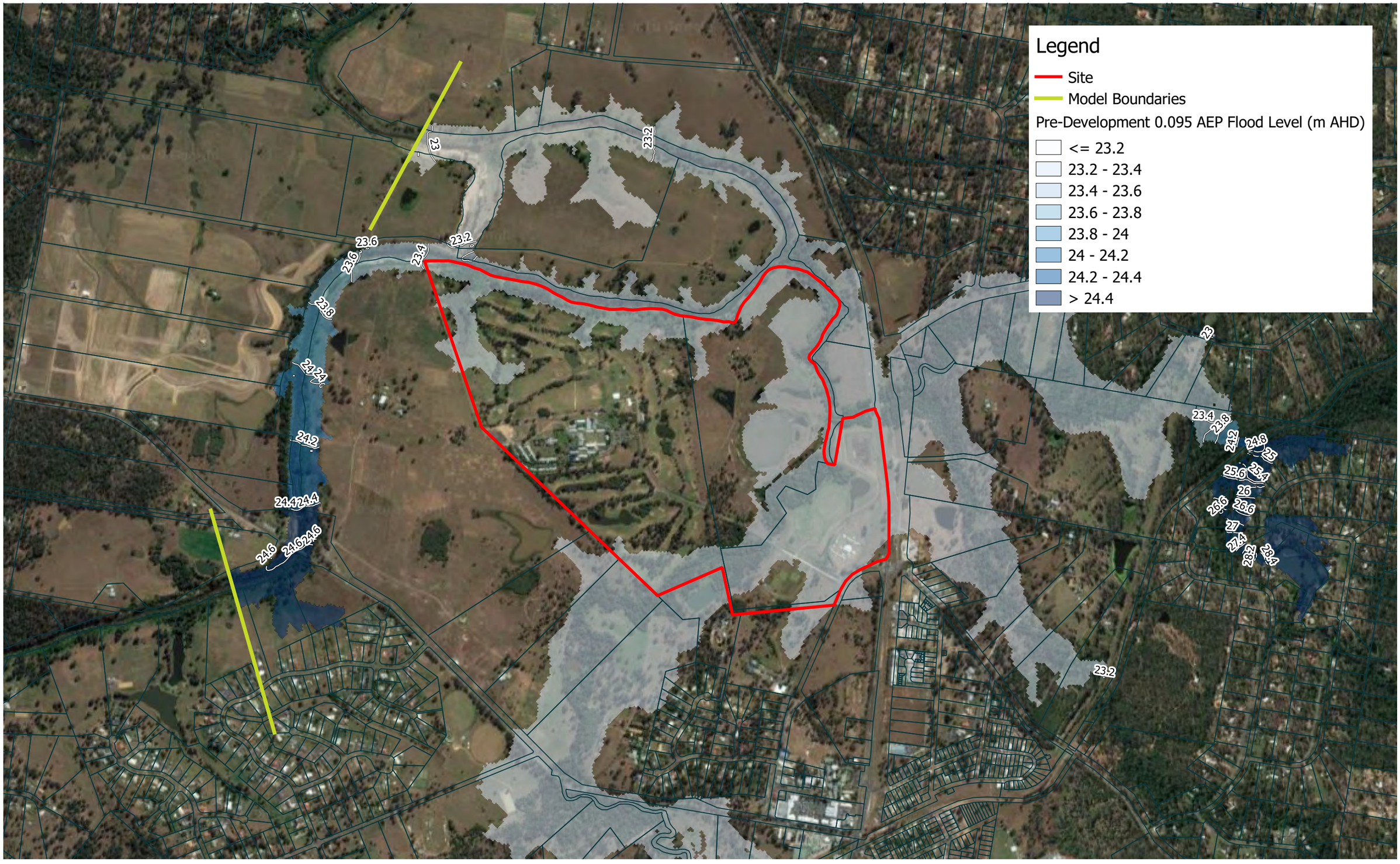
Discipline		Status
CIVIL		
Designed By	Checked By	Approved By
JM		
Project No.	Drawn By	Scale at A1
21182	JM	1:15,000

Title	
0.393 AEP PRE-DEVELOPMENT PEAK FLOOD LEVEL	
Drawing No.	Revision
C45	



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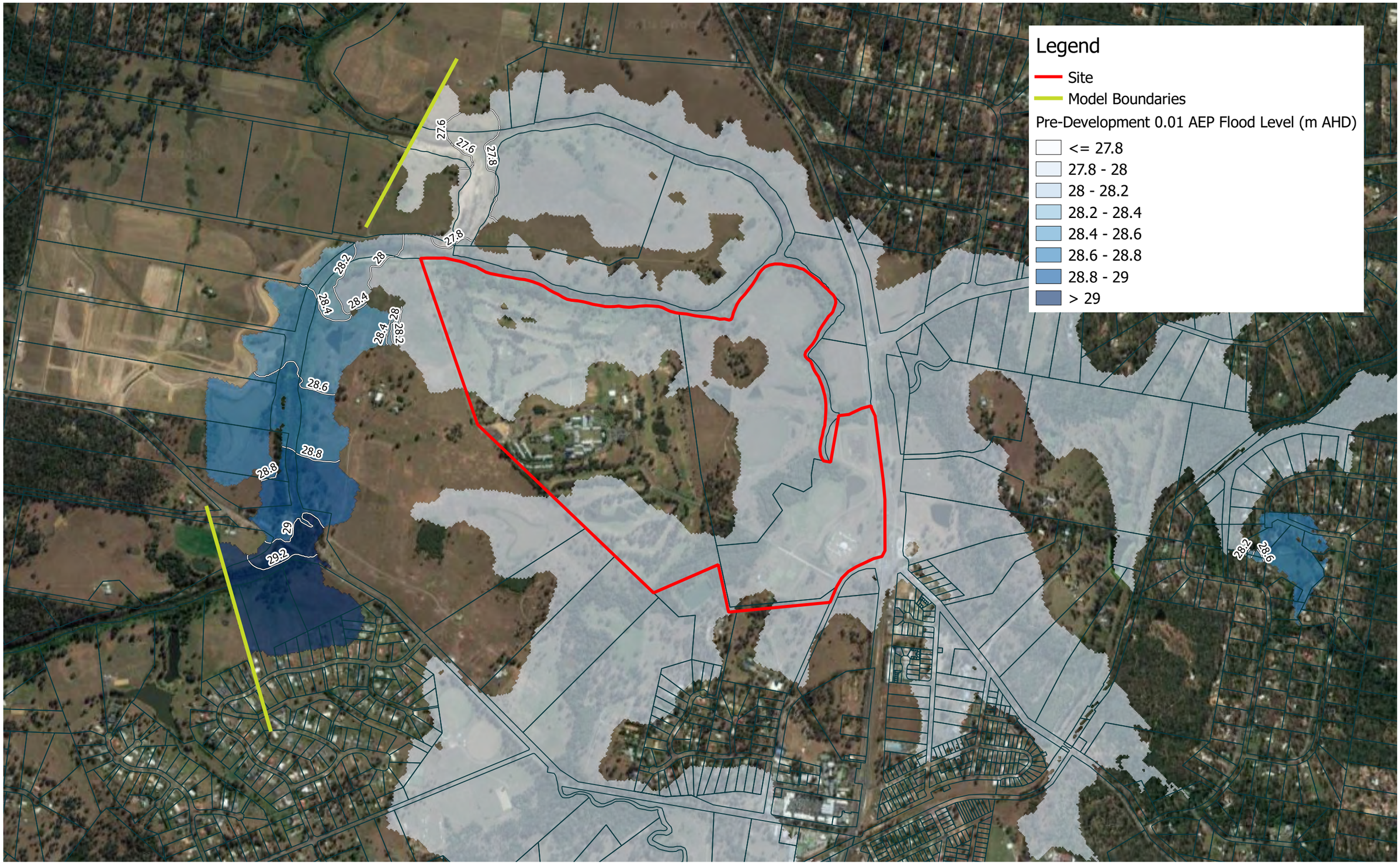
Discipline	CIVIL
Designed By	JM
Checked By	
Approved By	
Project No.	21182
Drawn By	JM
Scale at A1	1:15,000
Status	
Title	0.095 AEP PEAK FLOOD LEVEL
Drawing No.	C46
Revision	



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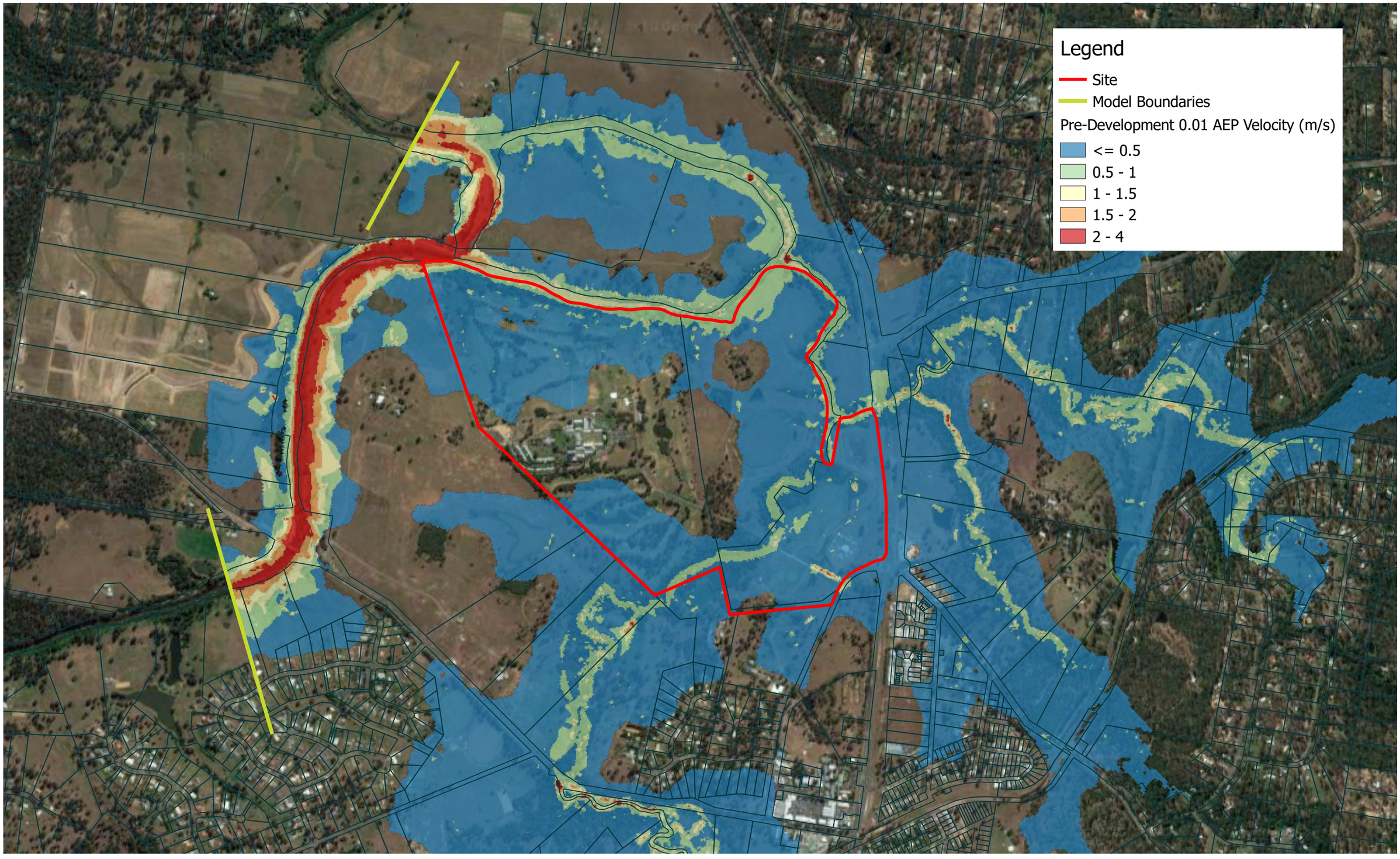
Project Name: PROPOSED RESIDENTIAL SUBDIVISION 5307 - 5336 MT LINDESAY HWY JIMBOOMBA QLD 4280	Designed By: JM	Checked By:	Approved By:
	Project No.: 21182	Drawn By: JM	Scale at A1: 1:15,000

Title	
0.01 AEP PRE-DEVELOPMENT PEAK FLOOD LEVEL	
Drawing No.: C47	Revision:



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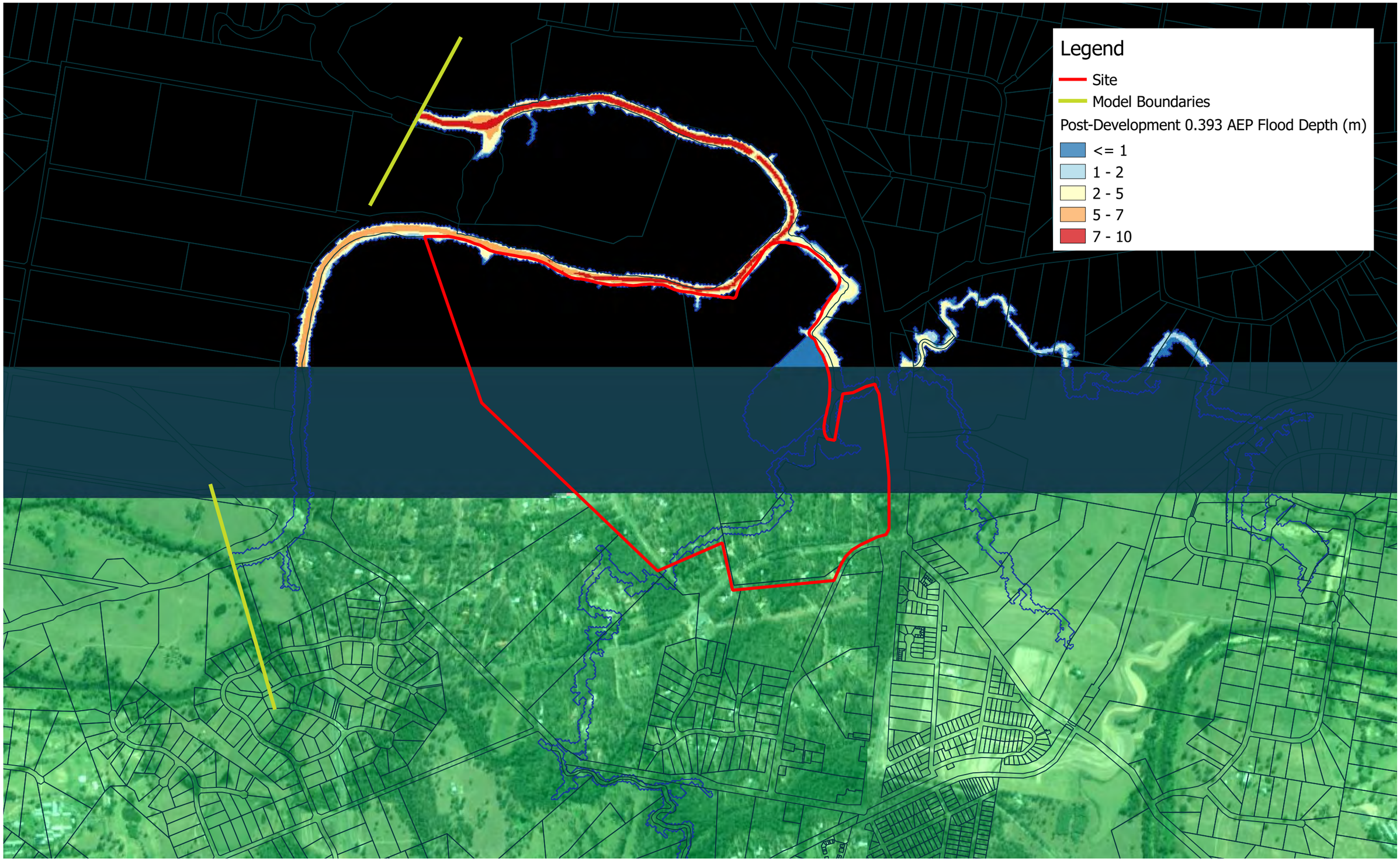
	Project No.: 21182	Drawn By: JM	Scale at A1: 1:15,000

Title: 0.01 AEP PRE-DEVELOPMENT PEAK VELOCITY

Drawing No.: C48

Revision:

Appendix D – Post-Development Results



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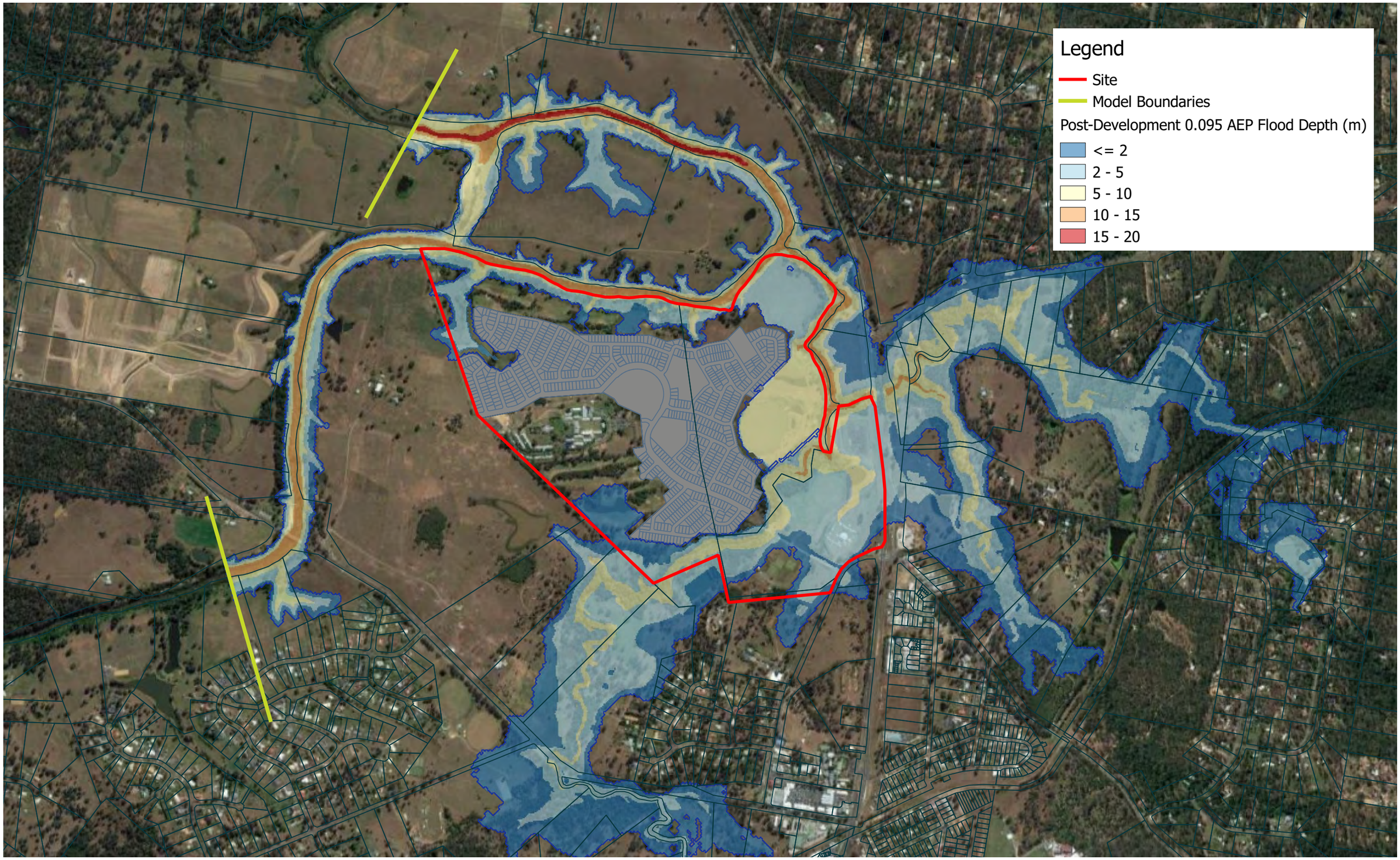
Discipline	CIVIL
Designed By	JM
Checked By	
Approved By	
Project No.	21182
Drawn By	JM
Scale at A1	1:15,000
Status	
Title	0.393 AEP POST-DEVELOPMENT PEAK FLOOD DEPTH
Drawing No.	C49
Revision	



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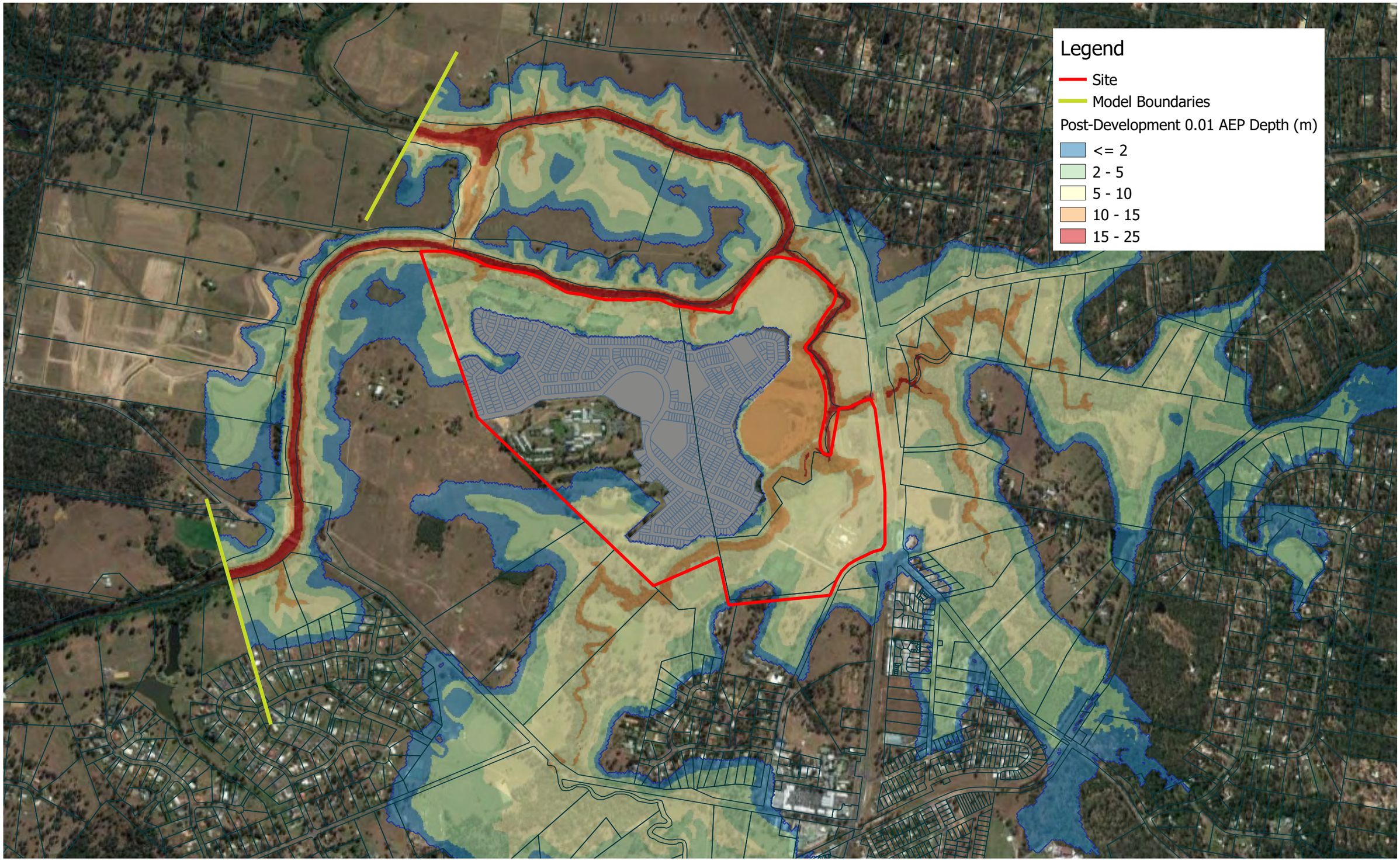
	Project No.: 21182	Drawn By: JM	Scale at A1: 1:15,000

Title	
0.095 AEP POST-DEVELOPMENT PEAK FLOOD DEPTH	
Drawing No.: C49	Revision:



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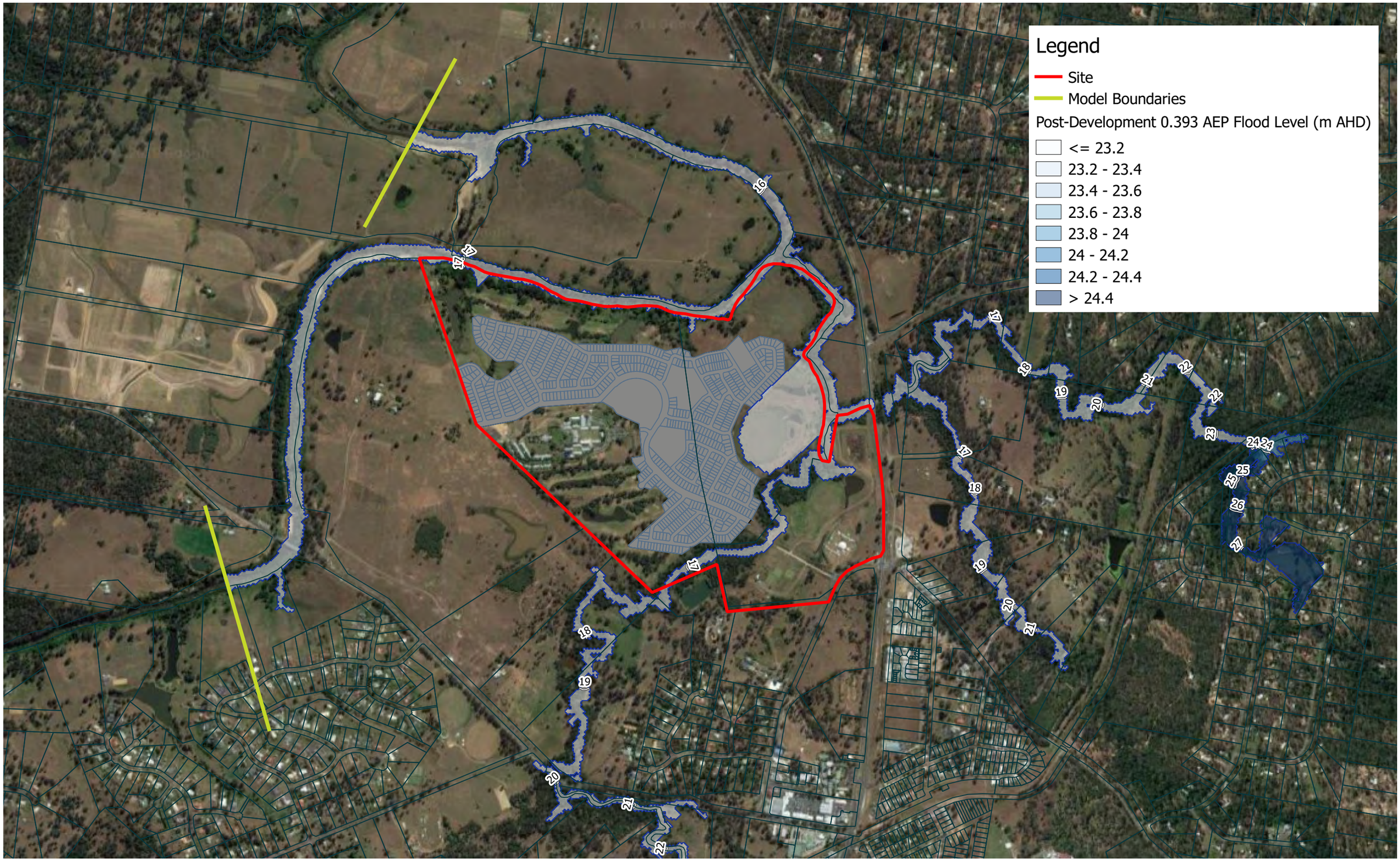
Title	
0.01 AEP POST-DEVELOPMENT PEAK FLOOD DEPTH	
Drawing No.: C51	Revision:



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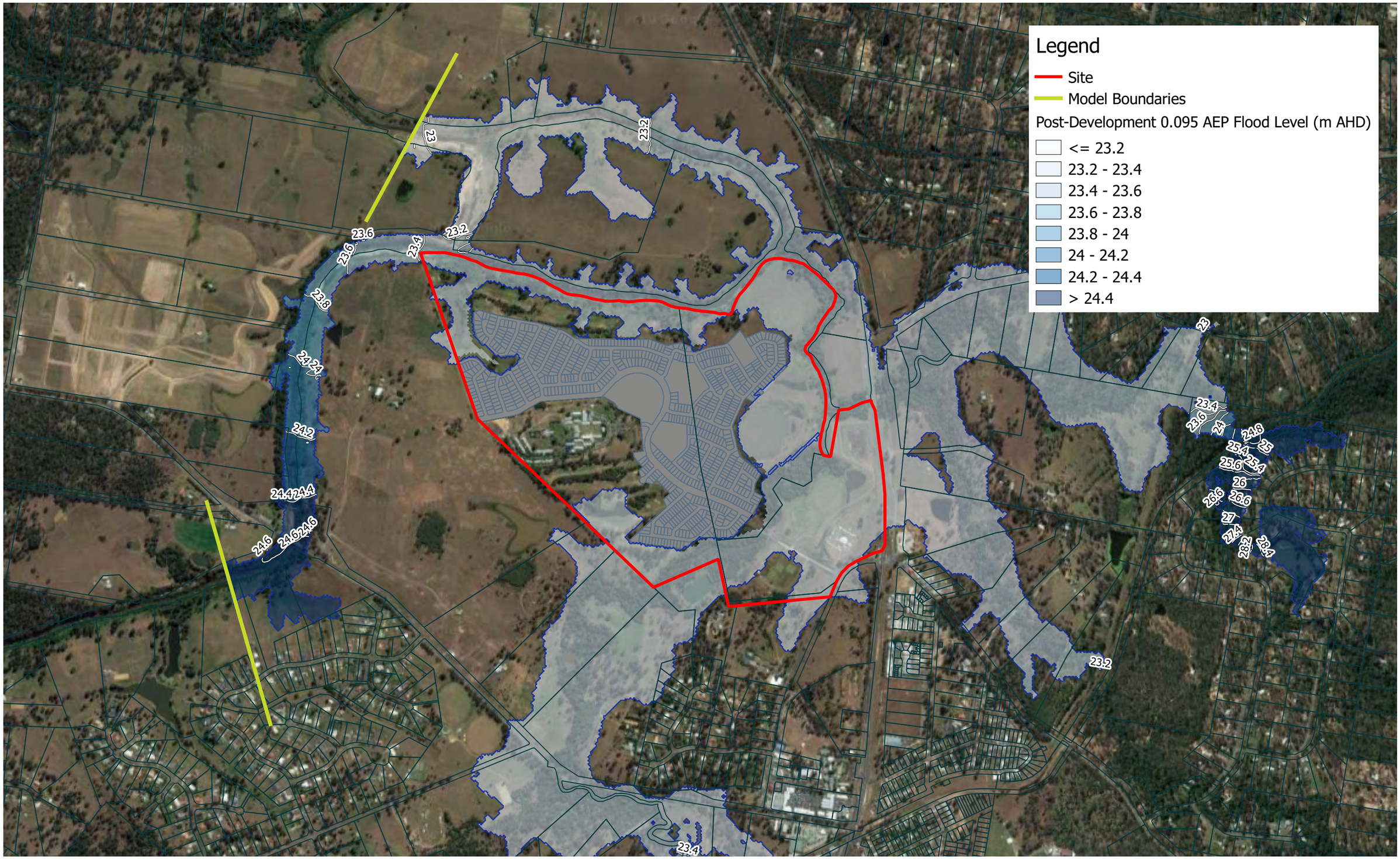
Title	
0.393 AEP POST-DEVELOPMENT PEAK FLOOD LEVEL	
Drawing No.: C52	Revision:



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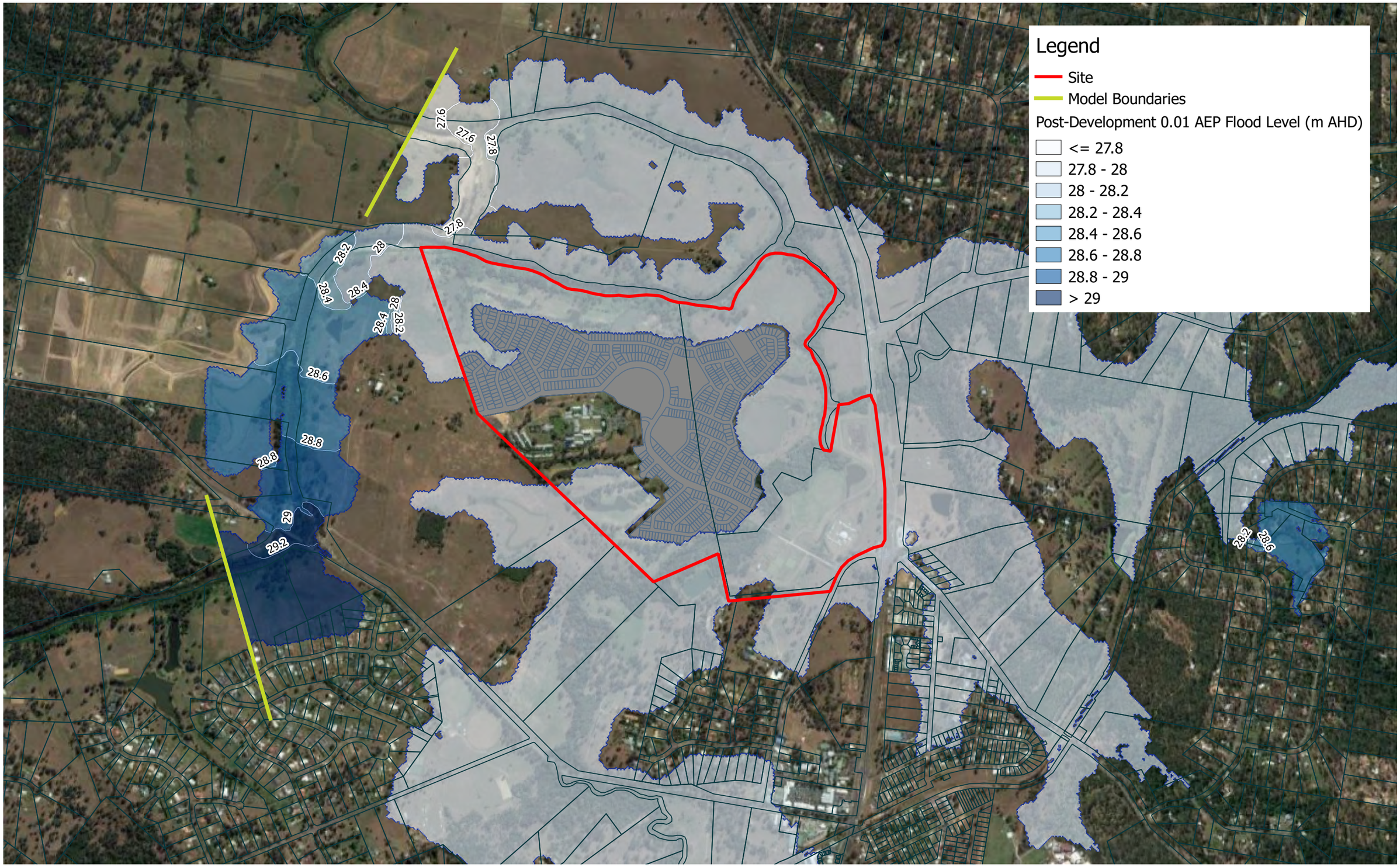
Title	
0.095 AEP POST-DEVELOPMENT PEAK FLOOD LEVELS	
Drawing No.: C53	Revision:



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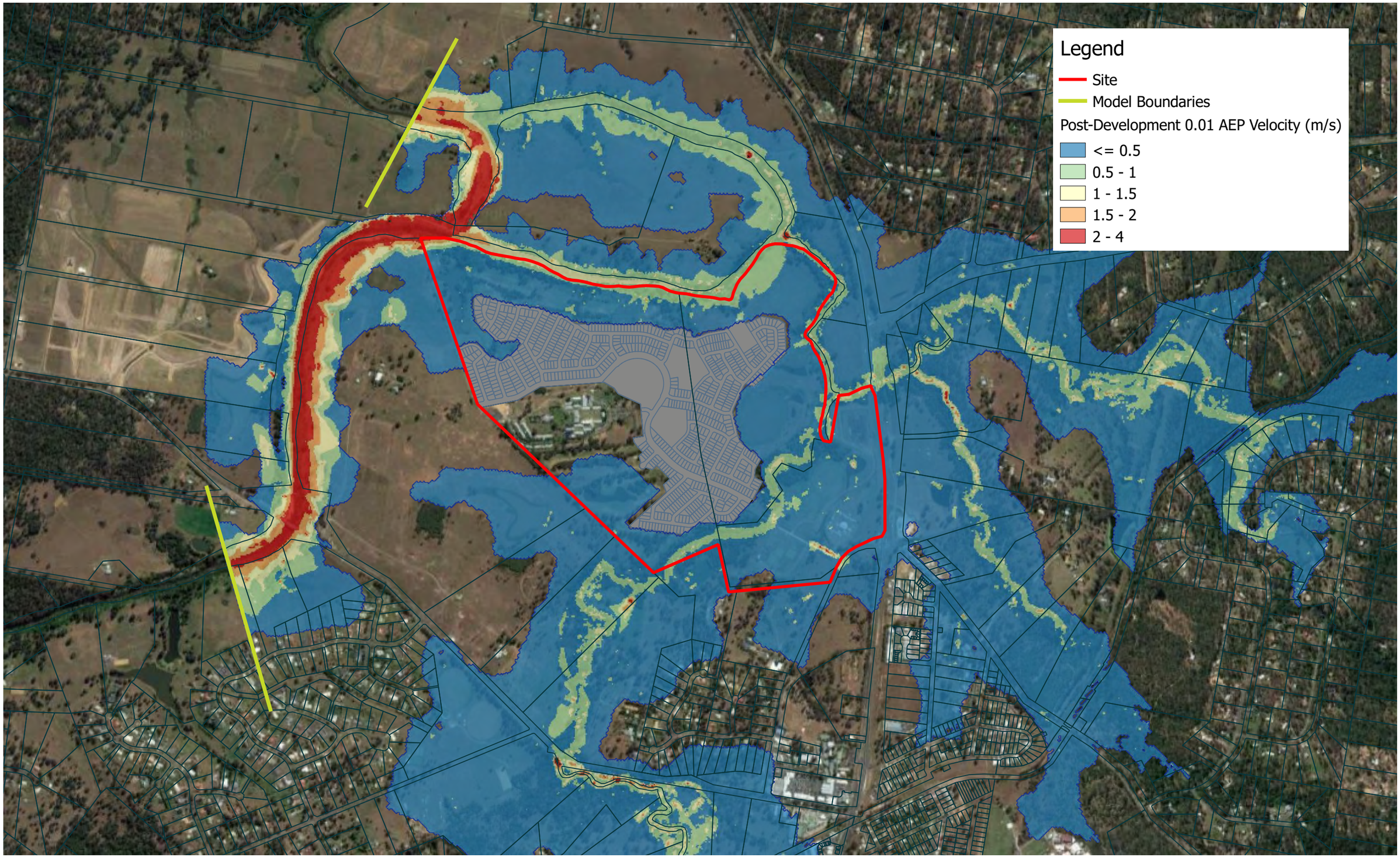
Title: 0.01 AEP POST-DEVELOPMENT PEAK FLOOD LEVEL

Drawing No.: C54

Revision:



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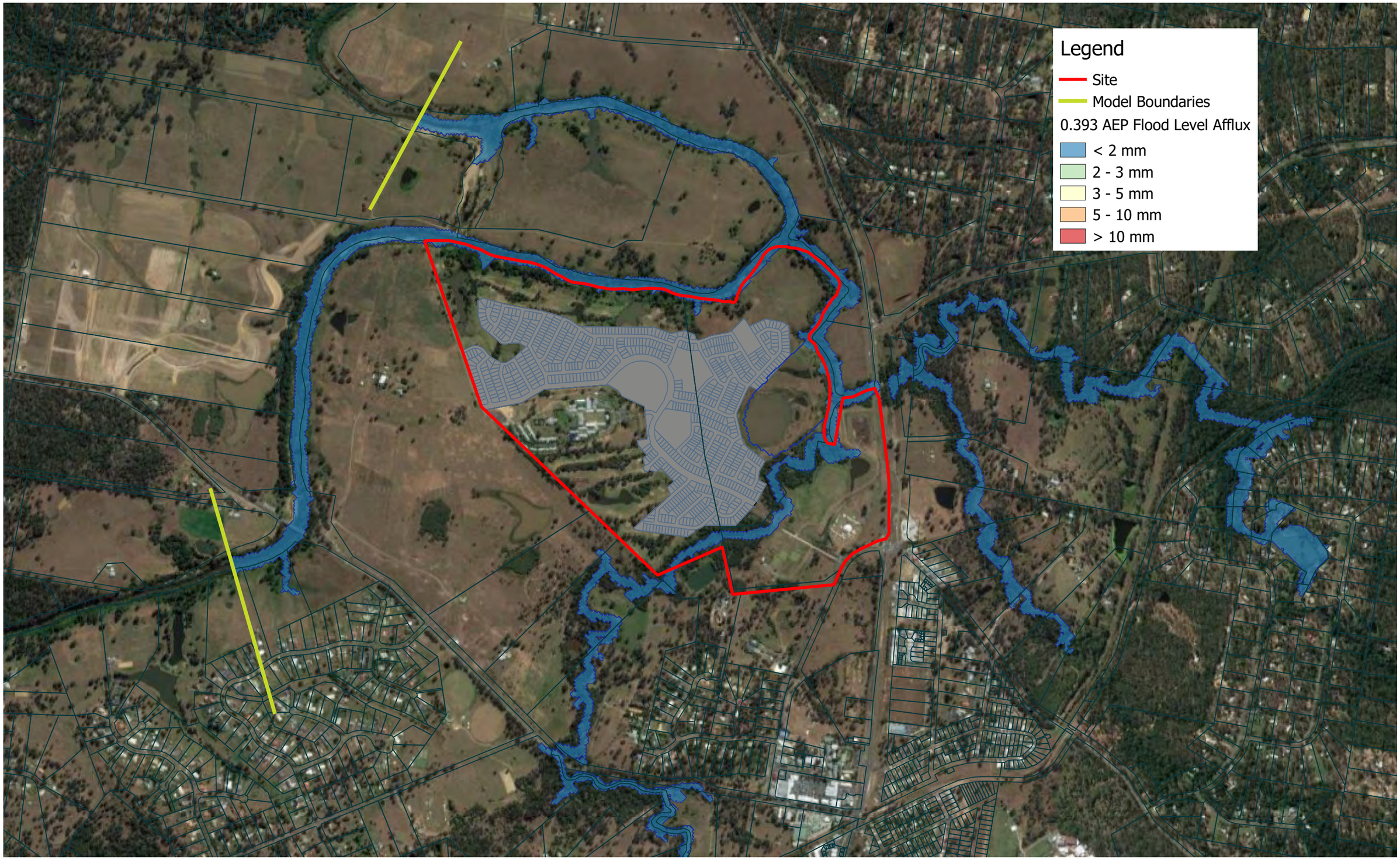
		Drawn By	JM
		Project No.	21182
		Status	
		Approved By	
		Scale at A1	1:15,000

Title	
0.01 AEP POST-DEVELOPMENT PEAK FLOOD VELOCITY	
Drawing No. C55	Revision

Appendix E – Impact Plots



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Discipline: CIVIL		Status:
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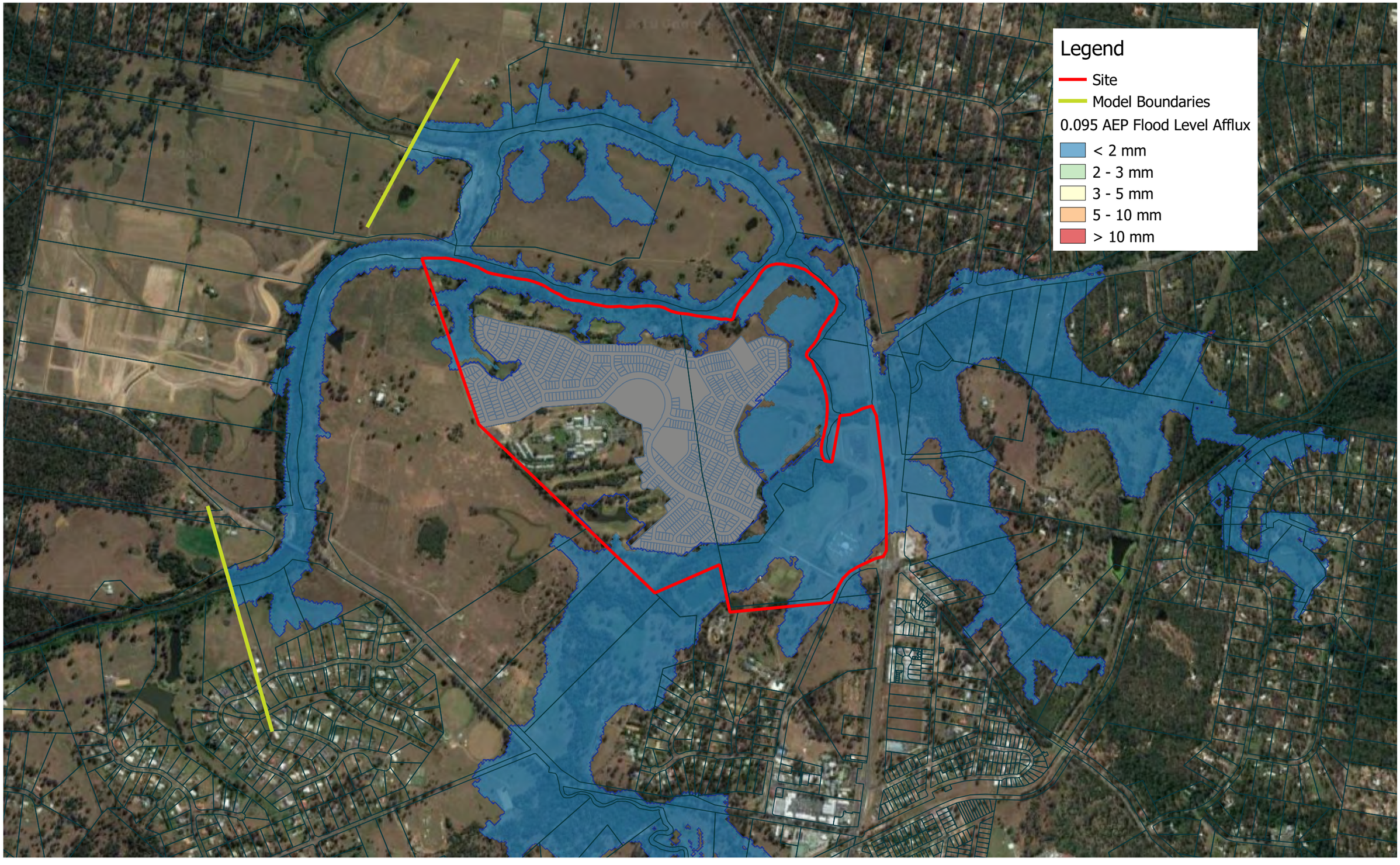
Project No.: 21182	Drawn By: JM	Scale at A1: 1:15,000

Title	0.393 AEP FLOOD LEVEL AFFLUX
Drawing No.	C56
Revision	



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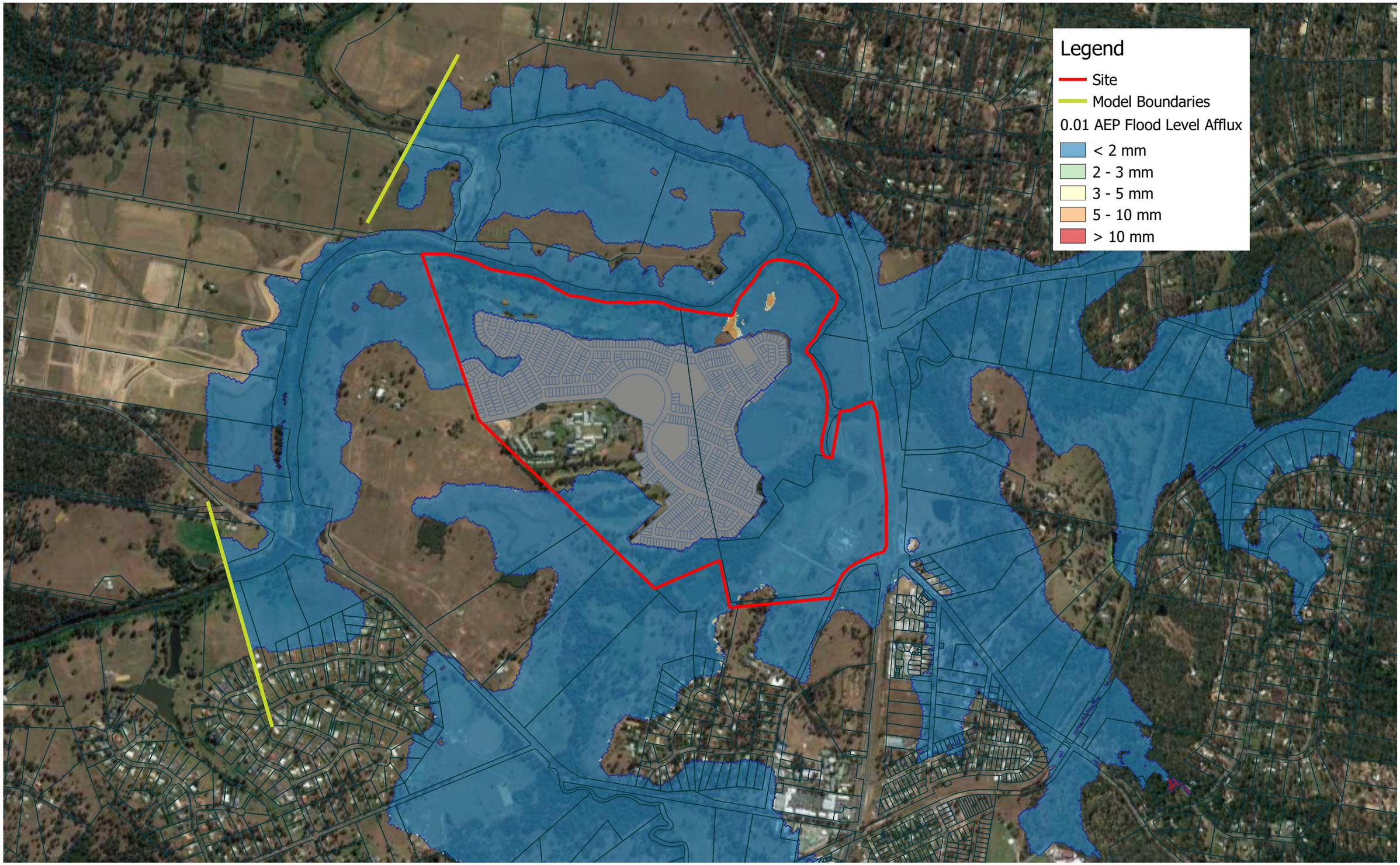
Title: 0.095 AEP FLOOD LEVEL IMPACT

Drawing No.: C57

Revision:



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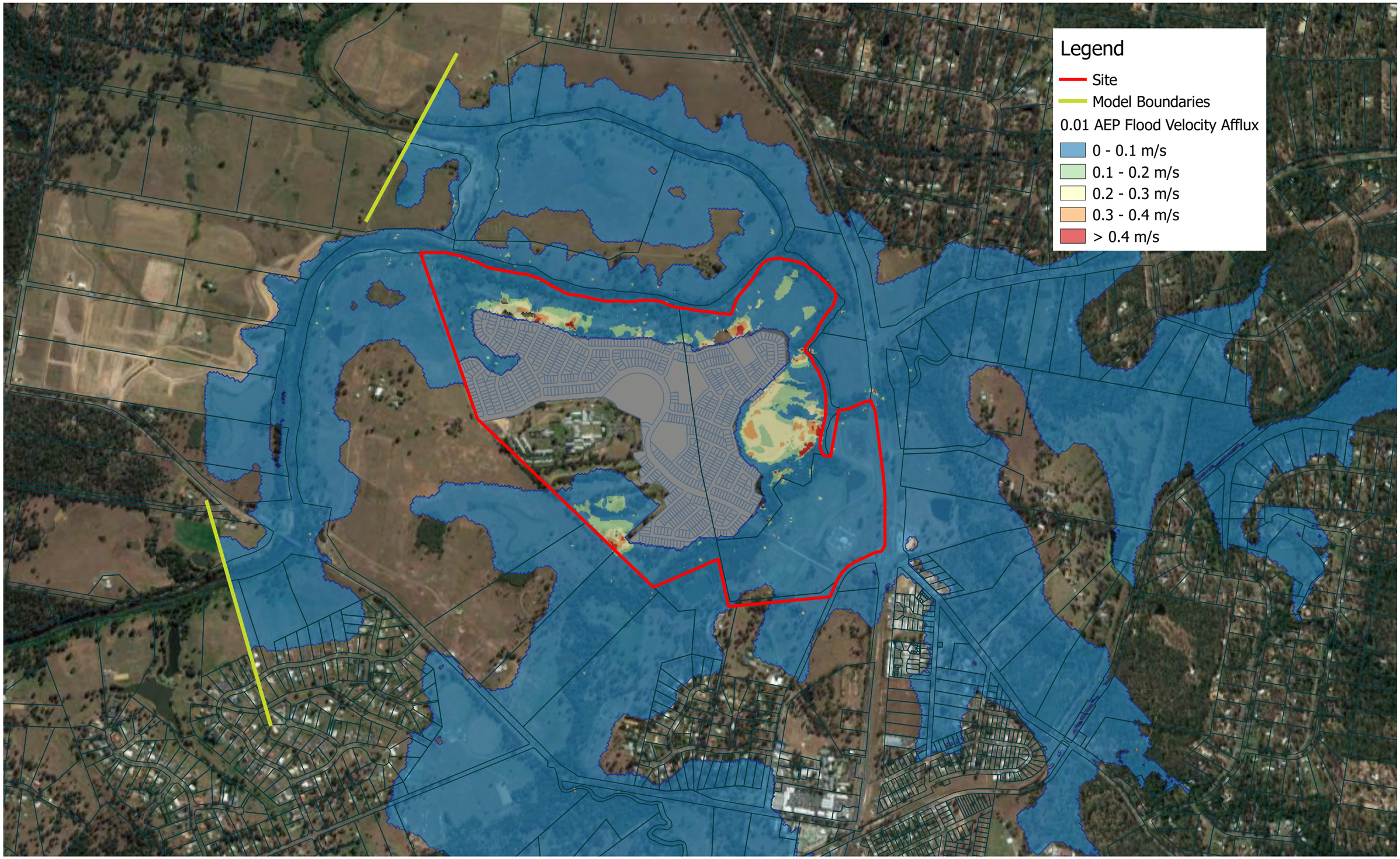
Title	
0.01 AEP FLOOD LEVEL IMPACT	
Drawing No.: C58	Revision:



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Title	
0.01 AEP FLOOD VELOCITY AFFLUX	
Drawing No.: C59	Revision:

Appendix F – Flood Code Response

Performance outcomes	Acceptable outcomes	Comments
For self-assessable and assessable development		
Risk to people and premises		
PO1 A building floor level of a habitable room has adequate allowance for the hydraulic gradient above the main floodway.	**AO1** A building has a finished habitable floor level a minimum of 500mm above the defined flood event.	The proposed earthworks provide a development footprint immune from the 0.01 AEP flood event. The proposed floor levels will need to be at RL28.50 m AHD minimum.
PO2 Development must not increase the level of risk of injury to life or risk of damage to property or adversely affect flood evacuation procedures.	**AO2** Development: (a) does not result in any of the following: (i) an increase in the number of people at risk from flooding up to and including the defined flood event; or (ii) an increase in the number of people that need evacuation up to and including the defined flood event; or (iii) an increase in the number of premises or infrastructure at risk from flooding up to and including the defined flood event; or (iv) existing flood warning times being reduced for flood events up to and including the defined flood event; or (v) an adverse impact on the ability of traffic to use evacuation routes or unreasonably increase traffic volumes on evacuation routes; or (b) is located entirely within a development envelope area approved by an earlier development approval.	The proposed earthworks provide a development footprint immune from the 0.01 AEP flood event. Flood free access to Johanna Street will need to be provided as part of the development.

For assessable development		
Risk to people and premises		
PO3 Development provides a development envelope area that is above the flood level during the defined flood event.	**AO3** Development provides a development envelope area above the flood level during the defined flood event with a minimum size and dimension specified in **Error! Reference source not found.**.**Error! Reference source not found.**	The proposed earthworks provide a development footprint immune from the 0.01 AEP flood event.
PO4 Public safety and the environment are not adversely affected by floodwater by: (a) locating a Medium impact industry or High impact industry to be able to function safely during and immediately after flood events; (b) safely storing hazardous materials.	**AO4** Development: (a) for a Medium impact industry or High impact industry is above the flood level specified in column 2 of **Error! Reference source not found.**; (b) involving the storage, sale or use of hazardous materials is located above the flood level during the defined flood event.	N/A
PO5 A car park other than a Parking station is only located below the flood level during the defined flood event where there is no increase in risk to: (a) pedestrian and vehicular safety; (b) a building or other structure. Note—Section 4.1–Guidelines for satisfying flood hazard overlay code in planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO5** No acceptable outcome provided.	N/A
PO6 Development for any of the uses identified in column 1 of **Error! Reference source not found.**, are able to function effectively during and immediately after flood events. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO6** Development for any of the uses identified in column 1 of **Error! Reference source not found.** is located above the flood level specified in column 2 of **Error! Reference source not found.**.	N/A

Performance outcomes	Acceptable outcomes	Comments
Flood storage and discharge capacity		
PO7 An existing floodway is protected and maintained to ensure there are no losses of conveyance capacity of waterways and storage so as not to adversely affect other premises, infrastructure and the environment. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO7** No acceptable outcome provided.	The proposed earthworks include no loss of floodplain storage and do not extend into major conveyance paths.
PO8 The natural conveyance of flood waters and natural overland flow paths are protected and maintained without adversely affecting adjoining premises. Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5—Infrastructure provides guidance to achieve this outcome.	**AO8** No acceptable outcome provided.	The proposed earthworks include no loss of floodplain storage and do not extend into major conveyance paths. This HIA has demonstrated that external properties will not be adversely affected.
PO9 Development (or development in combination with other development) for all flood events up to and including the defined flood event does not do any of the following: (a) cause or have the potential to cause damage; or (b) cause ponding of flood water; or (c) adversely affect the flood discharge capacity of the floodplain; or (d) decrease the flood resilience of properties and infrastructure; or (e) cause a cumulative increase in flood levels external to the premises. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO9** No acceptable outcome provided.	The proposed earthworks include no loss of floodplain storage and do not extend into major conveyance paths. This HIA has demonstrated that external properties will not be adversely affected.

Performance outcomes	Acceptable outcomes	Comments
PO10 Any loss of floodplain storage is compensated with compensatory storage or excavation that: (a) is of equal volume, creating a balance of cut to fill; (b) is free draining; (c) is located within the premises; (d) does not adversely affect the hydraulic conveyance capacity of the flood channel or floodplain; (e) is provided to the corresponding flood level; (f) is landscaped to provide visual amenity and erosion control; (g) is solely for the purpose of compensatory storage. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO10** No acceptable outcome provided.	The proposed earthworks include no loss of floodplain storage.
PO11 Development does not adversely change the following flood characteristics for all flood events up to and including the defined flood event: (a) peak flow; (b) flow of any part of the flood before the peak; (c) flood flow velocity; (d) level of flooding; (e) flood time to peak. Note—Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of planning scheme policy 5–Infrastructure Note—Section 4.1–Guidelines for satisfying flood hazard overlay of planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO11** No acceptable outcome provided.	This HIA has analysed the proposed earthworks and concluded that the existing flood characteristics of Logan River and Henderson Creek will not be adversely altered.
PO12 A stormwater quality improvement device is located to retain existing flood plain storage	**AO12** A stormwater quality improvement high flow outlet device is located:	The high flow outlets of stormwater quality improvement devices is located above the regional 0.02 AEP flood level. See separate Conceptual

Performance outcomes	Acceptable outcomes	Comments
capacity and ensure functionality of the stormwater quality improvement device.	(a) above the five percent AEP flood event caused by local flooding; (b) above the two percent AEP flood event caused by regional flooding.	Stormwater Management Plan.
PO13 A stormwater quantity management device is located to retain existing flood plain storage capacity and ensure functionality of the stormwater quantity management device.	**AO13** A stormwater quantity management high flow outlet device is located above the two percent AEP flood event.	The high flow outlets of stormwater quantity devices is located above the regional 0.02 AEP flood level. See separate Conceptual Stormwater Management Plan.
Filling and excavation		
PO14 Filling and excavation is carried out above the flood level of the 10 percent AEP event to protect in stream and banks of a waterway and wetland. Note—Section 4.1–Guidelines for satisfying flood hazard overlay code in planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO14.1** Earthworks are limited to areas where: (a) flooding is predominately due to backflow; (b) the peak depth average velocity is less than the maximum permissible velocity for considerable bare earth channels (typically 0.5m/sec) in accordance with Table 9.0.5.3 of the Queensland Urban Drainage Manual; (c) the cut/fill batter is not steeper than 1V:4H and the exposed earth surface is landscaped with erosion resistant vegetation cover.	The earthworks are largely confined to areas above the 0.095 AEP flood level. An existing lake located in the backwater controlled section of Henderson Creek has been lowered to below this level.
	AO14.2 A filling and excavation plan is provided in accordance with section 2.2.2 of planning scheme policy 5–Infrastructure.	See separate ADG earthworks drawings.
Access		
PO15 Development provides vehicular access to a road network that is sufficient to enable safe access and egress. Note—Section 4.1–Guidelines for satisfying flood hazard overlay code in planning scheme policy 5–Infrastructure provides guidance to achieve this outcome.	**AO15** Development provides vehicular access to a road that is: (a) above the flood level during the defined flood event; or (b) below the flood level during the defined flood event where the road: (i) has a low flood hazard; (ii) remains trafficable until another road	The development will need to provide flood immune access to Johanna Street

Performance outcomes	Acceptable outcomes	Comments
	access to the development becomes trafficable; (iii) directly connects to a road that is above the defined flood event that provides access to the road network.	
PO16 Development provides an access area to a building or fill area on which a building is to be constructed where the access is located on land classified as a low flood hazard in the defined flood event.	**AO16** Development provides access to a building or fill area that has: (a) a maximum depth of inundation of 300 mm during all flood events up to and including the defined flood event; (b) a maximum distance of inundation of 200 metres during all flood events up to and including the defined flood event; (c) a depth multiplied velocity product of less than or equal to $0.4m^2/s$. Note—Velocity in flood waters is measured as the average velocity over a column of water.	The prosed earthworks provide a development footprint above the 0.01 AEP flood level.

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