

Flood Impact Assessment

Aspect Industrial Estate (AIE)

AWE200083

Prepared for
Mirvac

24 February 2021



Contact Information

Cardno (NSW/ACT) Pty Ltd

ABN 95 001 145 035

Level 9, The Forum
203 Pacific Highway St Leonards NSW 2065

Telephone: 61 2 9496 7700

Facsimile: 61 2 9439 5170

International: 61 2 9496 7700

sydney@cardno.com.au

www.cardno.com

Document Information

Prepared for Mirvac
Project Name Aspect Industrial Estate
File Reference AWE200083 AIE FIA Rpt
24Feb21.docx
Job Reference AWE200083
Date 24 February 2021

Document Control

Version	Date	Description of Revision	Prepared By	Prepared (Signature)	Reviewed By	Reviewed (Signature)
1	19/11/19	Draft Final	VJ, MS, BCP	<i>Brett C. Phillips</i>	BCP	
2	15/5/20	Final	BCP	<i>Brett C. Phillips</i>	BCP	<i>Brett C. Phillips</i>
3	22/7/20	Final	BCP	<i>Brett C. Phillips</i>	BCP	<i>Brett C. Phillips</i>
4	14/10/20	Final	BCP	<i>Brett C. Phillips</i>	BCP	<i>Brett C. Phillips</i>
5	24/2/21	Updated Final	BCP	<i>Brett C. Phillips</i>	BCP	<i>Brett C. Phillips</i>

Version	Reason for Issue	Approved for Release By	Approved (Signature)	Approved Release Date
1	Draft Final Report	BCP	<i>Brett C. Phillips</i>	19/11/19
2	Final Report	BCP	<i>Brett C. Phillips</i>	15/5/20
3	Final Report includes update of SEPP (WSEA)	BCP	<i>Brett C. Phillips</i>	22/7/20
4	Final Report includes Stage 1 assessment	BCP	<i>Brett C. Phillips</i>	14/10/20
5	Final Report with Stage 1 & Final Masterplan assessments	BCP	<i>Brett C. Phillips</i>	24/2/21

Document Reference:

Y:\2304\Projects_AWE\FY20\0083_Aspect_Industrial_Estate\4_ISSUED_DOCS\2_Report\210223_FIA_Rpt_Final_v5\AWE200083 AIE FIA Rpt 24Feb21.docx

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Executive Summary

The purpose of this report is to assess the impact of Stage 1 development which it is proposed to undertake in the Aspect Industrial Estate as well as the Final Masterplan. This report addresses the relevant SEARs considerations

The Aspect Industrial Estate Masterplan has evolved in response to considerations raised by DPIE.

The details of the preliminary Masterplan are given in Figure A.1. The preliminary masterplan responded to the flooding risks by separating upstream runoff from local internal runoff and conveying upstream runoff to the existing Mamre Road crossing in all events up to the 100 yr ARI event while directing all runoff from within the industrial estate to a dual purpose basin in order to mitigate the impacts of development on the rate of runoff in all events up to the 100 yr ARI event and to mitigate impacts on stormwater quality.

In response to considerations raised by DPIE the preliminary masterplan was modified to extend the riparian corridor upstream along the northern and northeastern boundary to the point at which upstream runoff enters the site from the eastern drainage line as part of the final masterplan. This corridor would comprise a swale vegetated with structured communities to convey external runoff entering the site from the south and the east around the outer boundary of the site and own to the Mamre Road crossing. The concept details of the final masterplan are given in Figure 2.

It is proposed to stage the development of the industrial estate. The concept details of the Stage 1 development of the Aspect Industrial Estate are given in Figure 5.

The Stage 1 development responds to the flooding risks by also separating upstream runoff from local internal runoff and implementing the following measures:

- (i) Capturing upstream runoff just inside the southern site boundary and conveying this via a swale to the head of the extended riparian corridor which conveys the combined upstream runoff from the southern and eastern drainage lines to the existing Mamre Road crossing in all events up to the 100 yr ARI event; and
- (ii) Directing all runoff from within the Stage 1 development to a dual purpose basin in order to mitigate the impacts on the rate of runoff in all events up to the 100 yr ARI event and to mitigate impacts on stormwater quality. The basin has been sized on the ultimate conditions when all stages of development of the industrial estate have been completed ie. it is planned to construct the full basin under Stage 1.

The flood impact assessment was informed by the assessment of design flood levels, velocities and hazards under Benchmark conditions as described in Cardno, 2020.

Hydrology

The hydrological assessments were undertaken in three phases.

In the Phase 1 the hydrological model of benchmark conditions was modified to represent the preliminary Masterplan Conditions without a Basin and with a Basin. The Preliminary Masterplan is considered slightly conservative in comparison to the Final Masterplan due to the changes in the development footprints to accommodate the extended riparian corridor in the Final Masterplan.

The Phase 1 hydrological assessments are described in **Appendix A**.

Based on the ARR1987 assessment which targeted the 2yr ARI (12 hour) and 100 yr ARI (2 hour) peak flows under benchmark condition, the Site Storage Requirements (SSR) and Permissible Site Discharge (PSD) for 2 yr ARI and 100 yr ARI events were determined for Aspect Industrial Estate. These SSR and PSD values are summarised in Table A.2.

The 2020 Mamre Road Flood, Riparian Corridor and Integrated Water Cycle Management Strategy prepared by Sydney Water includes recommended Site Storage Requirements (SSR) and Permissible Site Discharges (PSD) in 50% AEP and 1% AEP for on-site detention / basins.

As discussed in Appendix A.3, it is concluded that the SSR and PSD values for Aspect Industrial Estate in 2 yr ARI and 100 yr ARI events are comparable to the SSR and PSD values recommended by Sydney Water, 2020.

In the Phase 2 the hydrological model of benchmark conditions was modified to represent Stage 1 Conditions with a basin (sized based on the preliminary Masterplan Conditions to meet a target at Mamre Road of not exceeding the following peak flows - 2 yr ARI (12 hr) & 100 yr ARI (2 hr)– refer Appendix A).

In the Phase 3 the hydrological model of benchmark conditions was modified to represent Final Masterplan Conditions with a basin sized by AT&L to meet target at Mamre Road of not exceeding the following peak flows - 2 yr ARI (36 hr) & 100 yr ARI (36 hr).

Stage 1 Conditions with a Basin

Based on the basin assessment undertaken under preliminary Masterplan conditions, the results of the ARR1987 hydrological modelling of Stage 1 Conditions with an (ultimate) Basin are summarised in **Attachment B7**.

Future Masterplan Conditions with a Basin

Based on the modified basin assessment under Final Masterplan conditions, the results of the ARR1987 hydrological modelling of Final Masterplan Conditions without a Basin and with a Basin are summarised in **Attachments B8** and **B9** respectively.

Stream Erosion Index

The SEI has been assessed at Mamre Road under preliminary Masterplan Conditions without a Basin and with a Basin based on continuous (6 minute) MUSIC modelling. It was calculated that the SEI under preliminary Masterplan Conditions without a Basin and with a Basin would be 5.65 and 1.0 respectively. It is concluded that this demonstrates the impact uncontrolled development can have on the SEI and the effectiveness of a basin which includes a control on frequent flows is able to manage the adverse impacts of development on stream forming flows.

Hydraulics

Stage 1 Conditions

The assessment of flooding under Stage 1 Conditions was undertaken by modifying the local TUFLOW model of Benchmark Conditions described in Cardno, 2019 to represent the planned Stage 1 earthworks and development.

For assessment purposes, the Scenario 2 conditions were adopted to maintain compatibility with the 2015 South Creek flooding assessments which were based on ARR1987.

Inflows to the TUFLOW model were exported from the hydrological model and input at the locations of the subcatchment outlets (nodes). Inflows to the TUFLOW model were exported from the hydrological model and input at the locations of the subcatchment outlets (nodes). Internal drainage lines and the basin were not explicitly modelled rather the outflow from the basin was input just downstream of the basin. For detailed basin outflows for various storm events, refer to the Civil Engineering report. The downstream boundary condition was a free outfall. The flood extent in South Creek was overlaid the results of the local TUFLOW model to identify where mainstream flooding takes over from overland flows.

The TUFLOW floodplain model was run for the critical storm burst durations for the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events.

Flood levels and extent, depths, velocities and hazards under Stage 1 Conditions are plotted for each of these events.

Final Masterplan Conditions

The assessment of flooding under Final Masterplan Conditions was undertaken by modifying the local TUFLOW model of Benchmark Conditions described in Cardno, 2020 to represent the planned Final Masterplan earthworks and development.

The Stage 1 modelling approach was also applied to the modelling of the Final Masterplan.

The TUFLOW floodplain model was run for the critical storm burst durations for the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events.

Flood levels and extent, depths, velocities and hazards under Stage 1 Conditions are plotted for each of these events.

Flood Impact Assessment

Under both Stage 1 Conditions and Final Masterplan Conditions, flood level difference plots disclose negligible adverse impacts on flood level downstream of Mamre Road in the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events. In a PMF greater decreases in the flood levels are experienced downstream of Mamre Road.

Under both Stage 1 Conditions and Final Masterplan Conditions, , flood velocity difference plots disclose negligible adverse impacts of Stage 1 development on flood velocities downstream of Mamre Road in the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events. In a PMF modest increases in the flood velocities are experienced downstream of Mamre Road.

Planning Considerations

The site is located within the Mamre Road Precinct (MRP) which was rezoned on 12 June 2020.

The State Environmental Planning Policy (Western Sydney Employment Area) 2009 (SEPP (WSEA)) was also amended and the Mamre Road Structure Plan was introduced.

While the WSEA Maps do not include a map of flood prone land and the site is located outside Council's Flood Planning Area as defined under Penrith LEP 2010, Council has undertaken overland flow flood mapping which covers the site. Given the mapping of overland flow flooding through the site it is considered that development is occurring on flood prone lands for the purpose of the SEPP (WSEA).

The relevant primary considerations are set out in Clause 33I Development on flood prone land under Part 6 Miscellaneous provisions of the SEPP (WSEA). It is concluded that the proposed development including Stage 1 and the Final Masterplan addresses all of the considerations set out under Clause 33I Development on flood prone land.

Related considerations are set out in 33L Stormwater, water quality and water sensitive design under Part 6 Miscellaneous provisions. How the proposed Stage 1 development addresses each of the considerations detailed under 33L is detailed in the related 2020 Stormwater Management Report prepared by AT&L.

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1 Introduction

Aspect Industrial Estate (the site) is legally described as Lots 54 – 58 in DP 259135, with an area of approximately 56.3 hectares (ha). The site is located east of Mamre Road, Kemps Creek within the Penrith Local Government Area (LGA).

The site has approximately 950 m of direct frontage to Mamre Road with a proposed intersection providing vehicular access via Mamre Road to the M4 Motorway and Great Western Highway to the north and Elizabeth Drive to the south.

The site is located approximately 4km north-west of the future Western Sydney Nancy-Bird Walton Airport, 13km south-east of the Penrith CBD and 40km west of the Sydney CBD.

The Department of Planning, Industry and Environment (DPIE) rezoned Mamre Road Precinct, including the site, in June 2020 under the *State Environmental Planning Policy (Western Sydney Employment Area) 2009* (WSEA SEPP). The rezoning of this precinct responds to the demand for industrial land in Western Sydney. The site primarily zoned IN1 General Industrial with a small sliver of land zoned E2 Environmental Conservation.

1.1 Purpose of this Report

Consistent with the above, this report has been prepared to support a Development Application under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the purpose of:

- A Masterplan for the site comprising 11 industrial buildings, internal road network layout, building locations, gross floor area (GFA), car parking, concept landscaping, building heights, setbacks and built form parameters.
- Stage 1 development of the site including:
 - The demolition, removal of existing rural structures and remediation works;
 - Heritage salvage works (if applicable);
 - Clearing of existing vegetation on the subject site and associated dam dewatering and decommissioning;
 - Realignment of existing creek and E2 Environmental Conservation zone;
 - Onsite bulk earthworks including any required ground dewatering;
 - The importation, placement and compaction of spoil material, consisting of:
 - Virgin Excavated Natural material (VENM) within the meaning of the POEO Act; and/or
 - Excavated Natural material (ENM) within the meaning of the NSW Environmental Protection Authority's (EPA) Resource Recovery Exemption under Part 9, Clauses 91 and 92 of the POEO (Waste) Regulation 2014 – The Excavated Natural Material Order 2014; and/or
 - Materials covered by a specific NSW EPA Resource Recovery Order and Exemption which are suitable for their proposed use.

- Boundary retaining walls;
- Catchment level stormwater infrastructure, trunk services connections, utilities, roads and access infrastructure (signalised intersection with Mamre Road) associated with Stage 1;
- Construction, fit out and 24 hours a day/ 7 days per week use of warehouse and distribution centre within Stage 1;
- Detailed on lot earthworks, stormwater, services and utility infrastructure associated with the construction of warehouse and distribution centre within Stage 1;
- Boundary stormwater management, fencing and landscaping; and
- Staged subdivision of Stage 1.

The Secretary's Environmental Assessment Requirements (SEARs) have been issued in respect of the proposal.

The purpose of this report is to assess the impact of Stage 1 development which it is proposed to undertake in the Aspect Industrial Estate as well as the Final Masterplan. This report addresses the relevant SEARs considerations.

The flood impact assessment was informed by the assessment of design flood levels, velocities and hazards under Benchmark conditions as described in Cardno, 2020 (refer **Section 1.4**).

1.2 Location

The location of the Aspect Industrial Estate is indicated in **Figure 1**.

1.3 Aspect Industrial Estate Masterplan and Staging

The Aspect Industrial Estate Masterplan has evolved in response to considerations raised by DPIE.

The details of the preliminary Masterplan are given in **Figure A.1**. The preliminary masterplan responded to the flooding risks by separating upstream runoff from local internal runoff and conveying upstream runoff to the existing Mamre Road crossing in all events up to the 100 yr ARI event while directing all runoff from within the industrial estate to a dual purpose basin in order to mitigate the impacts of development on the rate of runoff in all events up to the 100 yr ARI event and to mitigate impacts on stormwater quality.

In response to considerations raised by DPIE the preliminary masterplan was modified to extend the riparian corridor upstream along the northern and northeastern boundary to the point at which upstream runoff enters the site from the eastern drainage line as part of the final masterplan. This corridor would comprise a swale vegetated with structured communities to convey external runoff entering the site from the south and the east around the outer boundary of the site and own to the Mamre Road crossing. The concept details of the final masterplan are given in **Figure 2**.

It is proposed to stage the development of the industrial estate. The concept details of the Stage 1 development of the Aspect Industrial Estate are given in **Figure 5**.

The Stage 1 development responds to the flooding risks by separating upstream runoff from local internal runoff and implementing the following measures:

- (i) Capturing upstream runoff just inside the southern site boundary and conveying this via a swale to the head of the extended riparian corridor which conveys the combined upstream runoff from the southern and eastern drainage lines to the existing Mamre Road crossing in all events up to the 100 yr ARI event; and
- (ii) Directing all runoff from within the Stage 1 development to a dual purpose basin in order to mitigate the impacts on the rate of runoff in all events up to the 100 yr ARI event and to mitigate impacts on stormwater quality. The basin has been sized on the masterplan conditions when all stages of development of the industrial estate have been completed ie. it is planned to construct the full basin under Stage 1.

1.4 2020 Flood Risk Assessment

The purpose of this report is to provide a high-level understanding of the opportunities and constraints of the site due to flooding and to inform the development of a stormwater strategy/management plan for the Aspect Industrial Estate based on an assessment of flooding under Pre-development conditions.

1.3.1 Hydrology

Hydrological modelling of the South Creek catchment was undertaken in 2015 at the catchment scale using XP-RAFTS. The hydrological model assembled by Worley Parsons in 2015 was based on ARR1987 IFD. The local catchment is located within the larger South Creek subcatchment 1.17.

It should be noted that the 2015 study identified the critical storm burst duration for South Creek downstream of Bringelly Road to be 36 hours. While any future development would be expected to have an adverse impact of peak flows in short duration storm bursts it is likely that any future development will have minimal or nil adverse or beneficial impact on peak flows in a 36 hour storm due to the duration of the storm and timing effects due to runoff from impervious areas occurring more rapidly than runoff from pervious areas.

A local hydrological model was created to assess runoff under benchmark conditions and to facilitate the assessment of impacts of proposed development.

An issue which was considered was whether the airspace in existing farms dams is to be included in the benchmark conditions. An initial assessment was undertaken of the regional significance or otherwise of the farm dams based on criteria formulated in the upper South Creek catchment.

It was concluded that:

- (i) The combined capacity in 8 farm dams within the local catchment is just under the criterion for classification as a regional farm dam system; and on this basis;
- (ii) the farm dams have been ignored when assessing "Benchmark Conditions".

Hydrological assessments were undertaken using both ARR1987 and ARR2019.

Design rainfall and storm burst patterns were obtained from ARR1987 for 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events.

The Probable Maximum Precipitation (PMP) was estimated using The Estimation of Probable Maximum Precipitation in Australia: Generalised Short – Duration Method (Bureau of Meteorology, 2003). The PMP depths were obtained for ellipses A and were applied to each subcatchment in the local model.

For the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events the adopted initial rainfall loss = 15 mm and continuing rainfall loss = 1.5 mm/h. For the PMF the adopted rainfall losses were an initial loss = 1 mm and a continuing loss = 0 mm/h.

Design rainfall and storm burst patterns were obtained from ARR2019 were obtained from the ARR Data Hub for 50%, 20%, 1%, 0.5% and 0.2% AEP events.

For the for 50%, 20%, 1%, 0.5% and 0.2% AEP events the adopted initial burst rainfall loss (IL) varied while a constant continuing rainfall loss (CL) = 2.3 mm/h was adopted. The adopted average initial burst losses were as follows.

AEP	Burst IL (mm)	CL (mm/h)
50%	28.5	2.3
20%	16	2.3
10%	14	2.3
5%	13.5	2.3
2%	12	2.3
1%	10	2.3
0.5%	10	2.3
0.2%	10	2.3

The peak flows estimated at the Mamre Road crossing for the various events are summarised in **Table 1**.

Table 1 Summary of Estimated Peak Flows at Mamre Road Crossing

ARI (yrs)	ARR1987 Hydrology			ARR2019 Hydrology		
	Peak Flow (m3/s)	Critical Duration (hrs)	AEP	Peak Flow (m3/s)	Critical Duration (hrs)	
2	6.31	9	50%	3.23	6	
5	9.09	4.5	20%	7.73	2	
100	21.0	2	1%	23.3	0.75	
200	24.4	2	0.50%	26.2	0.75	
500	29.2	2	0.20%	30.9	0.75	
PMF	162	0.75	PMF	162	0.75	

It should be noted, as discussed in **Section 1.5**, that 2 yr ARI equates to 39% AEP while 5 yr ARI equates to 18% AEP.

It was noted that the:

- Critical storm burst durations for ARR2019 storm burst are all shorter than the critical storm burst durations for ARR1987 storm burst;
- The 1% AEP peak flow at Mamre Road under ARR2019 is around 11% higher than the estimated 100 yr ARI peak flow at Mamre Road under ARR1987.

It was also of interest to compare the estimated peak flows at Mamre Road under ARR1987 with the estimated peak flows in South Creek in the vicinity of the local catchment at Node 1.17 (refer Figure 10 in Cardno, 2020). The estimated peak flows at Node 1.17 are summarised in **Table 2**.

Table 2 Comparison of Estimated Peak Flows at Mamre Road and in South Creek at Node 1.17

Event	Mamre Road			South Creek (Node 1.17)		
	Storm Burst			Storm Burst		
	2 hrs	9 hrs	36 hrs	2 hrs	9 hrs	36 hrs
2 yr ARI	5.3	6.3	3.8	13.6	151	305
100 yr ARI	20.9	14.8	9.0	360	774	956

1.3.2 Hydraulics

A local TUFLOW model of the drainage lines through the site was assembled.

The Digital Elevation Model (DEM) was created by combining detailed survey and ALS data external to the site. Based on the assessment of the combined impact of the farm dams in the Mamre Road local catchment discussed in Section 3.1, the farm dams were removed from the DEM by interpolating the terrain through each of the farm dams.

The roughness zones for the floodplain are mapped in Figure 13 of Cardno, 2020.

From the detailed survey it was determined that the crossing under Mamre Road is 3 x 1.85 m x 0.77 m culverts. For assessment purposes it was assumed that this crossing would be partially blocked and that only two of the three culverts would convey floodwaters.

Hydraulic assessments were undertaken using flows estimated using both ARR1987 and ARR2019. Inflows to the TUFLOW model were exported from the hydrological model and input at the locations of the subcatchment outlets (nodes). For assessment purposes, the Scenario 2 conditions were adopted to maintain compatibility with the 2015 South Creek flooding assessments which were based on ARR1987.

The downstream boundary condition was a free outfall. The flood extent in South Creek was overlaid over the results of the local TUFLOW model to identify where mainstream flooding takes over from overland flows.

The TUFLOW floodplain model was run for the critical storm burst durations for the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events.

Flood levels and extent, depths, velocities and hazards under Benchmark Conditions are plotted for each of these events.

1.5 Approach

The approach adopted to the hydrological and hydraulic assessments is outlined as follows.

1.4.1 Hydrology

The hydrological model assembled by Worley Parsons in 2015 was based on ARR1987 IFD. 100 yr ARI runoff in the upper South Creek catchment south of Bringelly Road has been assessed previously for 2 hour, 9 hour and 36 hour storm bursts. An assessment of the sensitivity of 100 yr ARI peak runoff to storm burst rainfall losses has also been undertaken.

It should be noted that the 2015 study identified the critical storm burst duration for South Creek downstream of Bringelly Road to be 36 hours. While any future development would be expected to have an adverse impact of peak flows in short duration storm bursts it is likely that any future development will have minimal or nil adverse or beneficial impact on peak flows in a 36 hour storm due to the duration of the storm and timing effects due to runoff from impervious areas occurring more rapidly than runoff from pervious areas.

A local hydrological model was created to assess runoff under benchmark conditions and to facilitate the assessment of impacts of proposed Stage 1 development and the Final Masterplan.

An additional assessment was undertaken using ARR2019 IFD and burst losses.

1.4.2 Hydraulics

Given that the proposed development is located in a local catchment which drains to South Creek and is located beyond the extent of the South Creek floodplain model, a local 1D/2D floodplain model was assembled to assess flooding under benchmark conditions and to facilitate the assessment of impacts of proposed development.

1.6 Terminology

Book 1, Chapter 2, Section 2.2.5. Adopted Terminology in Australian Rainfall & Runoff, 2016 describes the adopted terminology as follows:

To achieve the desired clarity of meaning, technical correctness, practicality and acceptability, the National Committee on Water Engineering has decided to adopt the terms shown in Figure 1.2.1 and the suggested frequency indicators.

Navy outline indicates preferred terminology. Shading indicates acceptable terminology which is depends on the typical use. For example, in floodplain management 0.5% AEP might be used while in dam design this event would be described as a 1 in 200 AEP.

As shown in the third column of Figure 1.2.1, the term Annual Exceedance Probability (AEP) expresses the probability of an event being equalled or exceeded in any year in percentage terms, for example, the 1% AEP design flood discharge. There will be situations where the use of percentage probability is not practicable; extreme flood probabilities associated with dam spillways are one example of a situation where percentage probability is not appropriate. In these cases, it is recommended that the probability be expressed as 1 in X AEP where 100/X would be the equivalent percentage probability.

Frequency Descriptor	EY	AEP (%)	AEP	ARI
			(1 in x)	
Very Frequent	12			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.5
	1	63.21	1.58	1
Frequent	0.69	50	2	1.44
	0.5	39.35	2.54	2
	0.22	20	5	4.48
	0.2	18.13	5.52	5
	0.11	10	10	9.49
Rare	0.05	5	20	20
	0.02	2	50	50
	0.01	1	100	100
	0.005	0.5	200	200
Very Rare	0.002	0.2	500	500
	0.001	0.1	1000	1000
	0.0005	0.05	2000	2000
	0.0002	0.02	5000	5000
Extreme			PMP/	
			PMPDF	

Figure 1.2.1. Australian Rainfall and Runoff Preferred Terminology

For events more frequent than 50% AEP, expressing frequency in terms of annual exceedance probability is not meaningful and misleading, as probability is constrained to a maximum value of 1.0 or 100%. Furthermore, where strong seasonality is experienced, a recurrence interval approach would also be misleading.

An example of strong seasonality is where the rainfall occurs predominately during the Summer or Winter period and as a consequence flood flows are more likely to occur during that period. Accordingly, when strong seasonality exists, calculating a design flood flow with a 3 month recurrence interval is of limited value as the expectation of the time period between occurrences will not be consistent throughout the year. For example, a flow with the magnitude of a 3 month recurrence interval would be expected to occur or be exceeded 4 times a year; however, in situations where there is strong seasonality in the rainfall, all of the occurrences are likely to occur in the dominant season.

Consequently, events more frequent than 50% AEP should be expressed as X Exceedances per Year (EY). For example, 2 EY is equivalent to a design event with a 6 month recurrence interval when there is no seasonality in flood occurrence.

The terminology adopted herein depends on the edition of Australian Rainfall and Runoff provide the IFD data. In the case of assessments based on ARR1987 the ARI terminology was adopted for design floods. In the case of assessments based on ARR2019 the AEP terminology was adopted for design floods.

2 Hydrology

Hydrological modelling of the local Mamre Road catchment under Benchmark Conditions is outlined in Section 1.3.1 and described in detail in Cardno, 2020.

The hydrological assessments were undertaken in three phases.

In the Phase 1 the hydrological model of benchmark conditions was modified to represent the preliminary Masterplan Conditions without a Basin and with a Basin. The subcatchment boundaries and the link-node layout of the local XP-RAFTS model are given in **Figure A.2**. It should be noted that the diversion of upstream runoff around the site was included in both the preliminary Masterplan Conditions without a Basin and with a Basin. The model layout also included provision for upstream catchment flows greater than the 100 yr ARI peak flow to spill through the industrial estate once the capacity of the diversion scheme is exceeded.

The Phase 1 hydrological assessments are described in **Appendix A**.

In the Phase 2 the hydrological model of benchmark conditions was modified to represent Stage 1 Conditions with a basin (sized based on the preliminary Masterplan Conditions to meet a target at Mamre Road of not exceeding the following peak flows - 2 yr ARI (12 hr) & 100 yr ARI (2 hr) – refer Appendix A. The subcatchment boundaries and the link-node layout of the local XP-RAFTS model are given in **Figure 6**.

In the Phase 3 the hydrological model of benchmark conditions was modified to represent Final Masterplan Conditions with a basin sized by AT&L to meet target at Mamre Road of not exceeding the following peak flows - 2 yr ARI (36 hr) & 100 yr ARI (36 hr). These modified basin properties are as follows:

ARR	Basin Footprint (m ²)	Max 100 yr ARI Depth (m)	100 yr ARI Basin Volume (m ³)	Max 2 yr ARI Depth (m)	2 yr ARI Basin Volume (m ³)	Primary Outlet	Secondary Spillway Width (m)	Crest Level (m)	Indicative Embankment Crest Level above Primary Outlet IL (m)
Basin sized to meet target at Mamre Road - 2 yr ARI (36 hr) & 100 yr ARI (36 hrhr)									
1987	8825	4.01	35,418	1.85	16,328	1 x 0.63m diam RCP	3.6	4	4.2

The subcatchment boundaries and the link-node layout of the local XP-RAFTS model are given in **Figure 3**.

2.1 Stage 1 Conditions with a Basin

Based on the basin assessment undertaken under preliminary Masterplan conditions, the results of the ARR1987 hydrological modelling of Stage 1 Conditions with an (ultimate) Basin are summarised in **Attachment B7**.

2.2 Final Masterplan Conditions with a Basin

Based on the modified basin assessment under Final Masterplan conditions, the results of the ARR1987 hydrological modelling of Final Masterplan Conditions without a Basin and with a Basin are summarised in **Attachments B8** and **B9** respectively.

2.3 Stream Erosion Index

Given the mapping of a watercourse and a riparian buffer zone it is anticipated that the Stream Erosion Index will be of interest to Council. Council typically requires:

An assessment to show that the post development duration of stream forming flows is no greater than 3.5 times the pre-developed duration of stream forming flows.

This is interpreted to be a requirement that the Stream Erosion Index (SEI) be no greater than 3.5.

The stream erosion index is a value that can describe the impact of development on a watercourse in terms of erosion potential. It is defined as the number of occasions the Developed Conditions flow exceeds the 'stream forming flow', divided the number of occasions the Benchmark Conditions flow exceeds the 'stream forming flow'.

Stream forming flow is defined as 50% of the 2 year ARI flow under Benchmark Conditions.

The SEI has been assessed at Mamre Road under preliminary Masterplan Conditions without a Basin and Ultimate Conditions with a Basin based on continuous (6 minute) MUSIC modelling. It was calculated that the SEI under preliminary Masterplan Conditions without a Basin and with a Basin would be 5.65 and 1.0 respectively. It is concluded that this demonstrates the impact uncontrolled development can have on the SEI and the effectiveness of a basin which includes a control on frequent flows is able to manage the adverse impacts of development on stream forming flows.

3 Flooding Assessment

The assessments of flooding under Stage 1 Conditions and the Final Masterplan Conditions are outlined as follows.

3.1 Stage 1 Conditions with a Basin

3.1.1 Stage 1 Model

The assessment of flooding under Stage 1 Conditions was undertaken by modifying the local TUFLOW model of Benchmark Conditions described in Cardno, 2020 to represent the planned earthworks and development as follows.

The DEM as updated based on the proposed platform levels, proposed roadworks and swales under Stage 1 Conditions (see **Figure 5**).

The basin size was based on the preliminary Masterplan Conditions to meet a target at Mamre Road of not exceeding the following peak flows - 2 yr ARI (12 hr) & 100 yr ARI (2 hr) – refer Appendix A for size and outlet details.

The adopted roughness zones under Stage 1 Conditions are mapped in **Figure 7**.

The swale diversion system was included in the model.

From the detailed survey it was determined previously that the crossing under Mamre Road is 3 x 1.85 m x 0.77 m culverts. For assessment purposes it was assumed that this crossing would be partially blocked and that only two of the three culverts would convey floodwaters.

For assessment purposes, the Scenario 2 inflows were adopted to maintain compatibility with the 2015 South Creek flooding assessments which were based on ARR1987.

Inflows to the TUFLOW model were exported from the hydrological model and input at the locations of the subcatchment outlets (nodes). Internal drainage lines and the basin were not explicitly modelled rather the outflow from the basin was input just downstream of the basin.

The downstream boundary condition was a free outfall. The flood extent in South Creek was overlaid over the results of the local TUFLOW model to identify where mainstream flooding takes over from overland flow flooding.

3.1.2 Results

The TUFLOW floodplain model was run for the critical storm burst durations for the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events.

2 yr ARI

The estimated 2 year ARI flood levels and extent, depths and velocities and provisional flood hazard under Stage 1 Conditions are plotted in **Figures 8, 9, 10 and 11** respectively.

5 yr ARI

The estimated 5 year ARI flood levels and extent, depths, velocities and hazards under Stage 1

Conditions are plotted in **Figures 14, 15, 16 and 17** respectively.

100 yr ARI

The estimated 100 year ARI flood levels and extent, depths, velocities and hazards under Stage 1 Conditions are plotted in **Figures 20, 21, 22 and 23** respectively.

200 yr ARI

The estimated 200 year ARI flood levels and extent, depths, velocities and hazards under Stage 1 Conditions are plotted in **Figures 26, 27, 28 and 29** respectively.

500 yr ARI

The estimated 500 year ARI flood levels and extent, depths, velocities and hazards under Stage 1 Conditions are plotted in **Figures 32, 33, 34 and 35** respectively.

PMF

The estimated PMF flood levels and extent, depths, velocities and hazards under Stage 1 Conditions are plotted in **Figures 38, 39, 40 and 41** respectively.

3.2 Final Masterplan Conditions with a Basin

3.2.1 Final Masterplan Model

The assessment of flooding under Final Masterplan Conditions was undertaken by modifying the local TUFLOW model of Benchmark Conditions described in Cardno, 2020 to represent the planned earthworks and development as follows.

The DEM as updated based on the proposed platform levels, proposed roadworks and swales under Final Masterplan Conditions (see **Figure 2**).

The basin was sized by AT&L to meet a target at Mamre Road of not exceeding the following peak flows - 2 yr ARI (36 hr) & 100 yr ARI (36 hr).

The adopted roughness zones under Stage 1 Conditions are mapped in **Figure 4**.

The swale diversion system was included in the model. Likewise, the 1500 mm diameter trunk drainage pipe (which is separate from the internal drainage) which conveys runoff from the catchment area south east of the estate through the east to the head of the riparian swale on the eastern boundary of the estate is included.

As for Stage 1 Conditions it was assumed that the Mamre Road crossing would be partially blocked and that only two of the three culverts would convey floodwaters.

For assessment purposes, the Scenario 2 inflows were adopted.

Inflows to the TUFLOW model were exported from the hydrological model and input at the locations of the subcatchment outlets (nodes). Internal drainage lines and the basin were not explicitly modelled rather the outflow from the basin was input just downstream of the basin.

The downstream boundary condition was a free outfall. The flood extent in South Creek was overlaid over the results of the local TUFLOW model to identify where mainstream flooding takes over from overland flow flooding.

3.2.2 Results

The TUFLOW floodplain model was run for the critical storm burst durations for the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events.

2 yr ARI

The estimated 2 year ARI flood levels and extent, depths and velocities and provisional flood hazard under Final Masterplan Conditions are plotted in **Figures 44, 45, 46** and **47** respectively.

5 yr ARI

The estimated 5 year ARI flood levels and extent, depths, velocities and hazards under Final Masterplan Conditions are plotted in **Figures 50, 51, 52** and **53** respectively.

100 yr ARI

The estimated 100 year ARI flood levels and extent, depths, velocities and hazards under Final Masterplan Conditions are plotted in **Figures 56, 57, 58** and **59** respectively.

200 yr ARI

The estimated 200 year ARI flood levels and extent, depths, velocities and hazards under Final Masterplan Conditions are plotted in **Figures 62, 63, 64** and **65** respectively.

500 yr ARI

The estimated 500 year ARI flood levels and extent, depths, velocities and hazards under Final Masterplan Conditions are plotted in **Figures 68, 69, 70** and **71** respectively.

PMF

The estimated PMF flood levels and extent, depths, velocities and hazards under Final Masterplan Conditions are plotted in **Figures 74, 75, 76** and **77** respectively.

4 Flood Impact Assessment

The impacts of Stage 1 of the proposed Aspect Industrial Estate and of the Final Masterplan are described as follows.

4.1 Flood Level Impacts

4.1.1 Stage 1 Conditions

The estimated impact of Stage 1 of the proposed Aspect Industrial Estate on 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI flood levels and PMF levels (in comparison to Benchmark Conditions) are plotted in **Figures 12, 18, 24, 30, 36** and **42** respectively.

These Figures disclose negligible adverse impacts on flood level downstream of Mamre Road in the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events. In a PMF greater decreases in the flood levels are experienced downstream of Mamre Road.

4.1.2 Final Masterplan Model

The estimated impact of the Final Masterplan on 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI flood levels and PMF levels (in comparison to Benchmark Conditions) are plotted in **Figures 48, 54, 60, 66, 72** and **78** respectively.

These Figures disclose negligible adverse impacts on flood level downstream of Mamre Road in the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events. In a PMF modest increases in the flood levels are experienced downstream of Mamre Road.

4.2 Flood Velocity Impacts

4.2.1 Stage 1 Conditions

The estimated impact of Stage 1 of the Aspect Industrial Estate on 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI flood velocities and PMF velocities (in comparison to Benchmark Conditions) are plotted in **Figures 13, 19, 25, 31, 37** and **43** respectively.

These Figures disclose negligible adverse impacts on flood velocities downstream of Mamre Road in the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events. In a PMF modest increases in the flood velocities are experienced downstream of Mamre Road.

4.2.2 Final Masterplan Model

The estimated impact of the Final Masterplan on 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI flood velocities and PMF velocities (in comparison to Benchmark Conditions) are plotted in **Figures 49, 55, 61, 67, 73** and **79** respectively.

These Figures disclose negligible adverse impacts on flood velocities downstream of Mamre Road in the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events. In a PMF modest increases in the flood velocities are experienced downstream of Mamre Road.

5 Planning Considerations

The site is located within the Mamre Road Precinct (MRP) which was rezoned on 12 June 2020.

The State Environmental Planning Policy (Western Sydney Employment Area) 2009 (SEPP (WSEA)) was also amended and the Mamre Road Structure Plan was introduced.

The aims of the SEPP (WSEA) are set out in Part 1 Preliminary as follows:

3 Aims of Policy

- (1) *This Policy aims to protect and enhance the land to which this Policy applies (the Western Sydney Employment Area) for employment purposes.*
- (2) *The particular aims of this Policy are as follows—*
 - (a) *to promote economic development and the creation of employment in the Western Sydney Employment Area by providing for development including major warehousing, distribution, freight transport, industrial, high technology and research facilities,*
 - (b) *to provide for the co-ordinated planning and development of land in the Western Sydney Employment Area,*
 - (c) *to rezone land for employment, environmental conservation or recreation purposes,*
 - (d) *to improve certainty and regulatory efficiency by providing a consistent planning regime for future development and infrastructure provision in the Western Sydney Employment Area,*
 - (e) *to ensure that development occurs in a logical, environmentally sensitive and cost-effective manner and only after a development control plan (including specific development controls) has been prepared for the land concerned,*
 - (f) *to conserve and rehabilitate areas that have a high biodiversity or heritage or cultural value, in particular areas of remnant vegetation.*

The relevant primary considerations are set out in 33I Development on flood prone land under Part 6 Miscellaneous provisions. How the proposed Stage 1 development and the Final Masterplan address each of these considerations is outlined as follows:

33I Development on flood prone land

- (1) *This clause applies to development requiring consent that is carried out on flood prone land.*

The SEPP (WSEA) defines **flood prone land** means land impacted up to the level of the probable maximum flood and identified in a map adopted by the relevant council or published by the Government.

It is noted that while the 2020 WSEA Maps includes a map of 1 in 100 AEP Flood Extent it does not include a map titled flood prone land.

The Penrith LEP 2010 also includes Flood Planning Land Maps defining the Flood Planning Area (FPA) (refer **Figure 3** in the companion Flood Risk Assessment prepared by Cardno, 2020). It appears that these maps have been prepared based on the 'Flood Study Report South Creek' (NSW Department of Water Resources, 1990) and/or 'South Creek Floodplain Management Study' (Willing & Partners, 1991). It is noted that the site is located outside Council's Flood Planning Area.

Chapter C3 Water Management of the Penrith Development Control Plan (DCP) 2014 outlines the controls on flooding constraints on developments in Chapter 3.5. As stated in Chapter 3.5:

13 Overland Flow Flooding

- a) *Council has undertaken a Penrith Overland Flow Flood 'Overview' Study. Consideration must be given to the impact on any overland flow path.*

The mapped extents of overland flow flooding through the site under existing conditions are given in **Figure 9** in the companion Flood Risk Assessment prepared by Cardno, 2020.

Given the mapping of overland flow flooding through the site, it is considered that development is occurring on flood prone lands for the purpose of the SEPP (WSEA).

- (2) *Consent is not to be granted to the carrying out of development to which this clause applies unless the consent authority has taken into consideration whether or not*
 - (a) *the development will adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and*

Flood Level Impacts

The estimated impact of Stage 1 of the proposed Aspect Industrial Estate on 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI flood levels and PMF levels (in comparison to Benchmark Conditions) are plotted in **Figures 12, 18, 24, 30, 36 and 42** respectively.

The estimated impact of the Final Masterplan on 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI flood levels and PMF levels (in comparison to Benchmark Conditions) are plotted in **Figures 48, 54, 60, 66, 72 and 78** respectively.

All these Figures disclose negligible adverse impacts on flood level downstream of Mamre Road in the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events. In a PMF greater decreases in the flood levels are experienced downstream of Mamre Road.

Flood Velocity Impacts

The estimated impact of Stage 1 of the Aspect Industrial Estate on 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI flood velocities and PMF velocities (in comparison to Benchmark Conditions) are plotted in **Figures 13, 19, 25, 31, 37 and 43** respectively.

The estimated impact of the Final Masterplan on 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI flood velocities and PMF velocities (in comparison to Benchmark Conditions) are plotted in **Figures 49, 55, 61, 67, 73 and 79** respectively.

All these Figures disclose negligible adverse impacts on flood velocities downstream of Mamre Road in the 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events. In a PMF modest increases in the flood velocities are experienced downstream of Mamre Road.

- (b) *the development will alter flow distributions and velocities to the detriment of other properties or the environment of the floodplain, and*

The impacts on flood levels and velocities are summarised under (a) above.

The Stream Erosion Index (SEI) was at Mamre Road under preliminary Masterplan Conditions without a Basin and with a Basin based on continuous (6 minute) MUSIC modelling.

It was calculated that the SEI under preliminary Masterplan Conditions without a Basin and with a Basin would be 5.65 and 1.0 respectively. It is concluded that this demonstrates the effectiveness of a basin which includes a control on frequent flows to manage the adverse impacts of development on downstream stream forming flows.

The 2020 Mamre Road Flood, Riparian Corridor and Integrated Water Cycle Management Strategy prepared by Sydney Water includes recommended Site Storage Requirements (SSR) and Permissible Site Discharges (PSD) in 50% AEP and 1% AEP for on-site detention / basins.

As discussed in Appendix A.3, it is concluded that the SSR and PSD values for Aspect Industrial Estate in 2 yr ARI and 100 yr ARI events are comparable to the SSR and PSD values recommended by Sydney Water, 2020.

It is planned to construct the full basin under Stage 1.

- (c) *the development will enable safe occupation of the flood prone land, and*

The flood hazards experienced in the Aspect Industrial Estate under Stage 1 Conditions in 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI floods and PMF are plotted in **Figures 11, 17, 23, 29, 35 and 41** respectively.

The flood hazards experienced in the Aspect Industrial Estate under the Final Masterplan in 2 yr ARI, 5 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI floods and PMF are plotted in **Figures 47, 53, 59, 65, 71 and 77** respectively.

These Figures disclose that there would be:

- Nil flood hazard experienced in the developed areas of the Estate in the 2 yr ARI, 5 yr ARI and 100 yr ARI floods;
- In the 200 yr ARI and 500 yr ARI floods a zone of low flood hazard would be present in a corridor along the northern boundary which conveys overland flows around the industrial development; and
- In the PMF the industrial development would be exposed to low hazard overland flows while the internal roads and the northern corridor would experience high hazard overland flows. It is noted that the Annual Exceedance Probability (AEP) of the PMF is around 0.0001% to 0.00001% AEP (1,000,000 to 10,000,000 yr ARI).

- (d) *the development will detrimentally affect the floodplain environment or cause avoidable erosion, siltation, salinity, destruction of riparian vegetation or a reduction in the stability of the riverbank/watercourse, and*

The Stream Erosion Index (SEI) has been assessed at Mamre Road under preliminary Masterplan Conditions without a Basin and Ultimate Conditions with a Basin based on continuous (6 minute) MUSIC modelling. It was calculated that the SEI under Ultimate Conditions without a Basin and Ultimate Conditions with a Basin would be 5.65 and 1.0 respectively. It is concluded that this demonstrates the effectiveness of a basin which includes a control on frequent flows to manage the adverse impacts of development on downstream stream forming flows and would maintain the stability of the watercourse downstream of Mamre Road.

The basin has been sized on the masterplan conditions when all stages of development of the industrial estate have been completed. It is planned to construct the full basin under Stage 1.

- (e) *the development will be likely to result in unsustainable social and economic costs to the flood affected community or general community, as a consequence of flooding, and*

The development will not result in unsustainable social and economic costs to the general community.

The Stage 1 industrial development and Final Masterplan development would be exposed only to potential flood risks and damages in extreme floods. In the PMF, the industrial development would be exposed to low hazard overland flows while some undeveloped areas and the riparian corridor would experience high hazard overland flows. It is noted that the Annual Exceedance Probability (AEP) of the PMF is around 0.0001% to 0.00001% AEP (1,000,000 yr ARI to 10,000,000 yr ARI).

- (f) *the development is compatible with the flow conveyance function of the floodway, and*

The development responds to the overland flows which enter the site from the upstream catchment. These flows are captured and conveyed safely through the site in all events up to the 500 yr ARI flood. In a PMF, upstream overlands flows are conveyed through the site both by the drainage system and as overland flows.

- (g) *the development is compatible with the flood hazard, and*

The flood hazards are summarised in (c) above. The development responds to the overland flows which enter the site from the upstream catchment and is compatible with the resultant flood hazard

- (h) *in the case of development consisting of the excavation or filling of land, the development—*

- (i) *will detrimentally affect the existing drainage patterns and soil stability in the locality, and*

The Stream Erosion Index (SEI) has been assessed at Mamre Road under preliminary Masterplan Conditions with a Basin based on continuous (6 minute) MUSIC modelling. It was calculated that the SEI under Ultimate Conditions with a Basin would be 1.0 which demonstrates the basin which includes a control on frequent flows would maintain the stability of the watercourse downstream of Mamre Road.

The basin has been sized on the conditions when all stages of development of the industrial estate have been completed. It is planned to construct the full basin under Stage 1.

- (ii) *will adversely impact or alter flood behaviour.*

The impacts on flood levels and velocities are summarised under (a) above.

Related considerations are set out in 33L Stormwater, water quality and water sensitive design under Part 6 Miscellaneous provisions.

33L Stormwater, water quality and water sensitive design

- (I) *The objective of this clause is to avoid or minimise the adverse impacts of stormwater on the land on which development is to be carried out, adjoining properties, riparian land, native bushland, waterways, groundwater dependent ecosystems and groundwater systems.*

How the proposed Stage 1 development and the Final Masterplan addresses each of the considerations detailed under 33L is detailed in the related 2020 Stormwater Management Report prepared by AT&L.

6 References

Cardno (2020) "Flood Risk Assessment, Aspect Industrial Estate (AIE)", *Final Report*, Version 4, prepared for Mirvac, 22 pp + Apps.

NSW Government (2005). *Floodplain Development Manual, The management of flood liable land*, April, 29 pp + Apps

Sydney Water (2020) "Mamre Road Flood, Riparian Corridor and Integrated Water Cycle Management Strategy", *Final Report*, October, 61 pp + Apps

Worley Parsons (2015) "Updated South Creek Flood Study", *Final Report*, 2 Vols, prepared for Penrith City Council, acting in association with Liverpool, Blacktown and Fairfield City Councils, 74 pp + Apps.



Source: Nearmap accessed 12 November 2019

Figure 1 Location of Aspect Industrial Estate

OVERALL DEVELOPMENT DATA	
Total Site Area	652,213 m ²
Perimeter Site Area	644,209 m ²
Access Roads Area	43,489 m ²
Future Reserve Area	23,100 m ²
Creek Riparian Area	29,613 m ²
Rippled Riparian Area	3,958 m ²
Basin Lot Area	17,207 m ²
Total Buildingable Area	446,667 m ²
Total Office Area incl. excl. office	11,510 m ²
Total Warehouse Area	238,030 m ²
Cafe	122 m ²
Total Building Area	251,162 m ²
Restriction on User Area	4,813 m ²

WAREHOUSE 1	
Site Area	58,156 m ²
Offices	1,440 m ²
Warehouses	30,000 m ²
Dock Office	200 m ²
Cafe	122 m ²
Total GFA	36,842 m ²
Carparks Provided	233

WAREHOUSE 2	
Site Area	41,945 m ²
Offices	1,500 m ²
Warehouses	34,484 m ²
Dock Office	200 m ²
Total GFA	20,595 m ²
Carparks Provided	144

WAREHOUSE 3	
Site Area	42,882 m ²
Offices	700 m ²
Warehouses	20,735 m ²
Dock Office	100 m ²
Total GFA	21,535 m ²
Carparks Provided	89

WAREHOUSE 4	
Site Area	41,044 m ²
Offices	750 m ²
Warehouses	18,235 m ²
Dock Office	100 m ²
Total GFA	19,085 m ²
Carparks Provided	90

WAREHOUSE 5	
Site Area	28,382 m ²
Offices	650 m ²
Warehouses	12,125 m ²
Dock Office	100 m ²
Total GFA	12,990 m ²
Carparks Provided	80

WAREHOUSE 6	
Site Area	37,845 m ²
Offices	750 m ²
Warehouses	22,740 m ²
Dock Office	100 m ²
Total GFA	23,590 m ²
Carparks Provided	100

WAREHOUSE 7	
Site Area	37,947 m ²
Offices	750 m ²
Warehouses	21,610 m ²
Dock Office	100 m ²
Total GFA	22,490 m ²
Carparks Provided	100

WAREHOUSE 8	
Site Area	50,786 m ²
Offices	1,300 m ²
Warehouses	24,825 m ²
Dock Office	200 m ²
Total GFA	30,020 m ²
Carparks Provided	175

WAREHOUSE 9	
Site Area	36,571 m ²
Offices	750 m ²
Warehouses	17,720 m ²
Dock Office	100 m ²
Total GFA	18,370 m ²
Carparks Provided	95

WAREHOUSE 10	
Site Area	33,421 m ²
Offices	750 m ²
Warehouses	17,325 m ²
Dock Office	100 m ²
Total GFA	18,375 m ²
Carparks Provided	87

WAREHOUSE 11	
Site Area	38,649 m ²
Offices	750 m ²
Warehouses	20,525 m ²
Dock Office	100 m ²
Total GFA	21,190 m ²
Carparks Provided	90

*Areas are measured in itum
Mamre Rd boundary in red
**All areas subject to survey



Figure 2 Aspect Industrial Estate Final Masterplan



Figure 3 Local Subcatchment Boundaries in AIE XP-RAFTS model under Final Masterplan Conditions

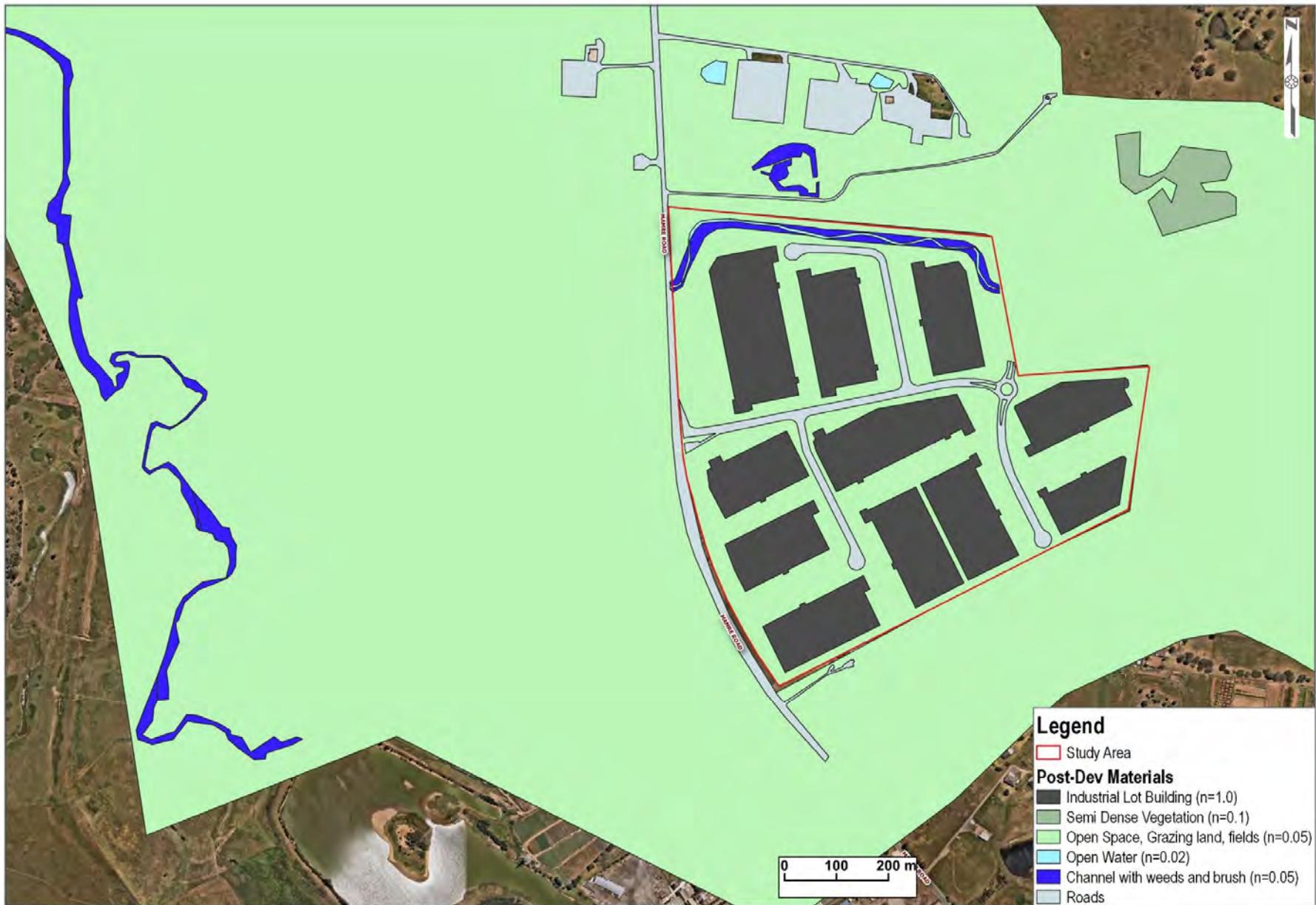


Figure 4 Adopted Roughness Zones under Final Masterplan Conditions



OVERALL DEVELOPMENT DATA

Total Site Area	88,213 m ²
Basin Boundary Site Area	54,693 m ²
Access Roads Area	22,873 m ²
Creek Riparian Area	20,616 m ²
Recreational Area	3,131 m ²
Basin Lot Area	17,290 m ²
Total Developable Area	44,536 m ²
Restriction on User Area	4,613 m ²

WAREHOUSE 1

Site Area	58,156 m ²
Offices	1,460 m ²
Warehouses	35,260 m ²
Display Offices	2,020 m ²
Cafe	122 m ²
Total GFA	38,842 m ²
Carpark Provided	233

WAREHOUSE 3

Site Area	42,882 m ²
Offices	700 m ²
Warehouses	20,785 m ²
Display Offices	103 m ²
Total GFA	21,588 m ²
Carpark Provided	89



Mirvac Design

Level 2, 220 George Street
Sydney NSW 2000
T 02 8500 0200
F 02 8500 0203
E info@sba.com.au
W www.sba.com.au
Architects / Planners / Interior Designers
ABN 78 003 399 192

A S P E C T I N D U S T R I A L E S T A T E

L O T S 5 4 - 5 8 (D P 2 6 9 1 3 5) M A M R E R O A D , K E M P S C R E E K

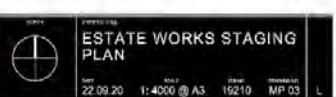


Figure 5 Aspect Industrial Estate Stage 1 Development



Figure 6 Local Subcatchment Boundaries in AIE XP-RAFTS model under Stage 1 Conditions

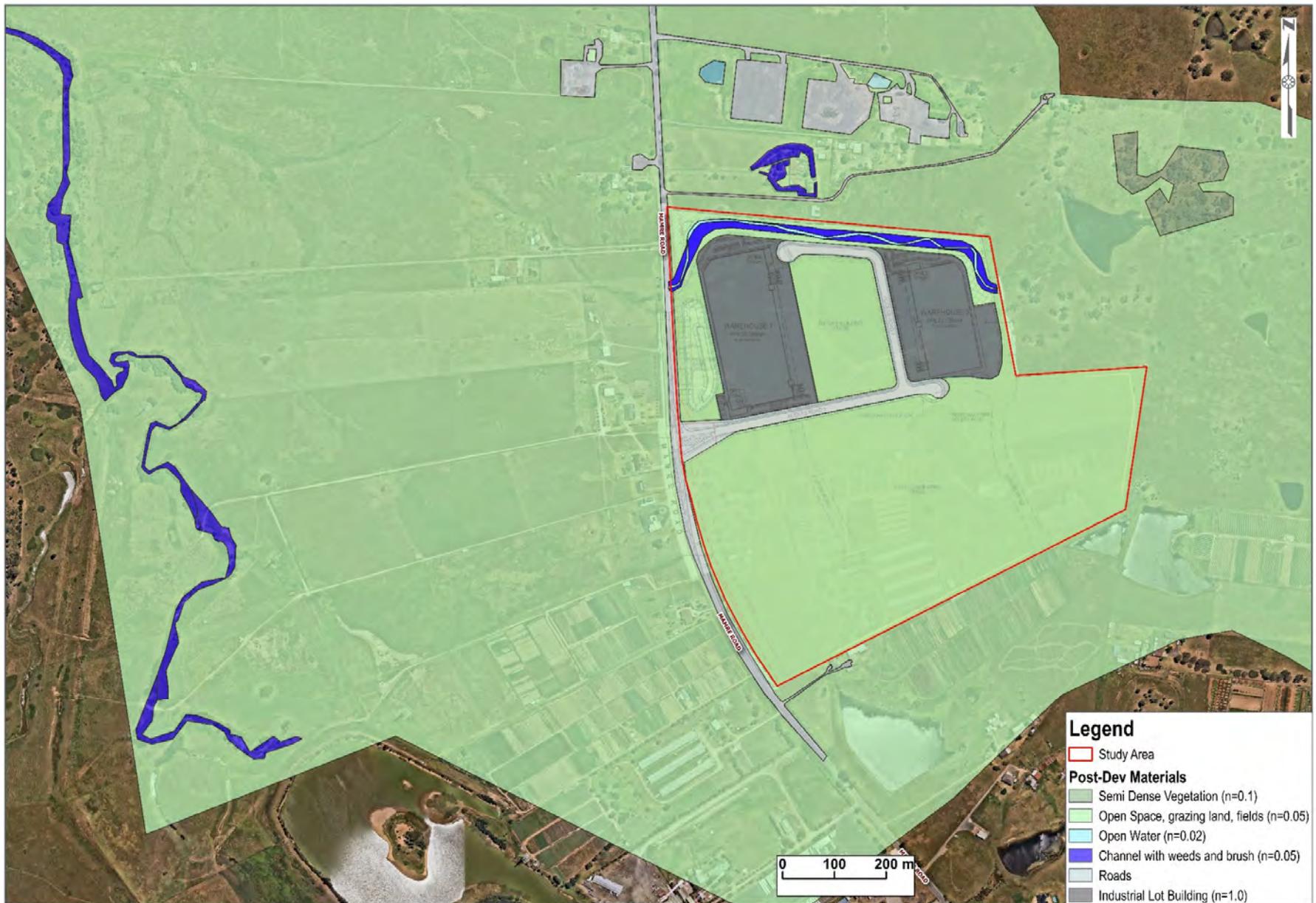


Figure 7 Adopted Roughness Zones under Stage 1 Conditions

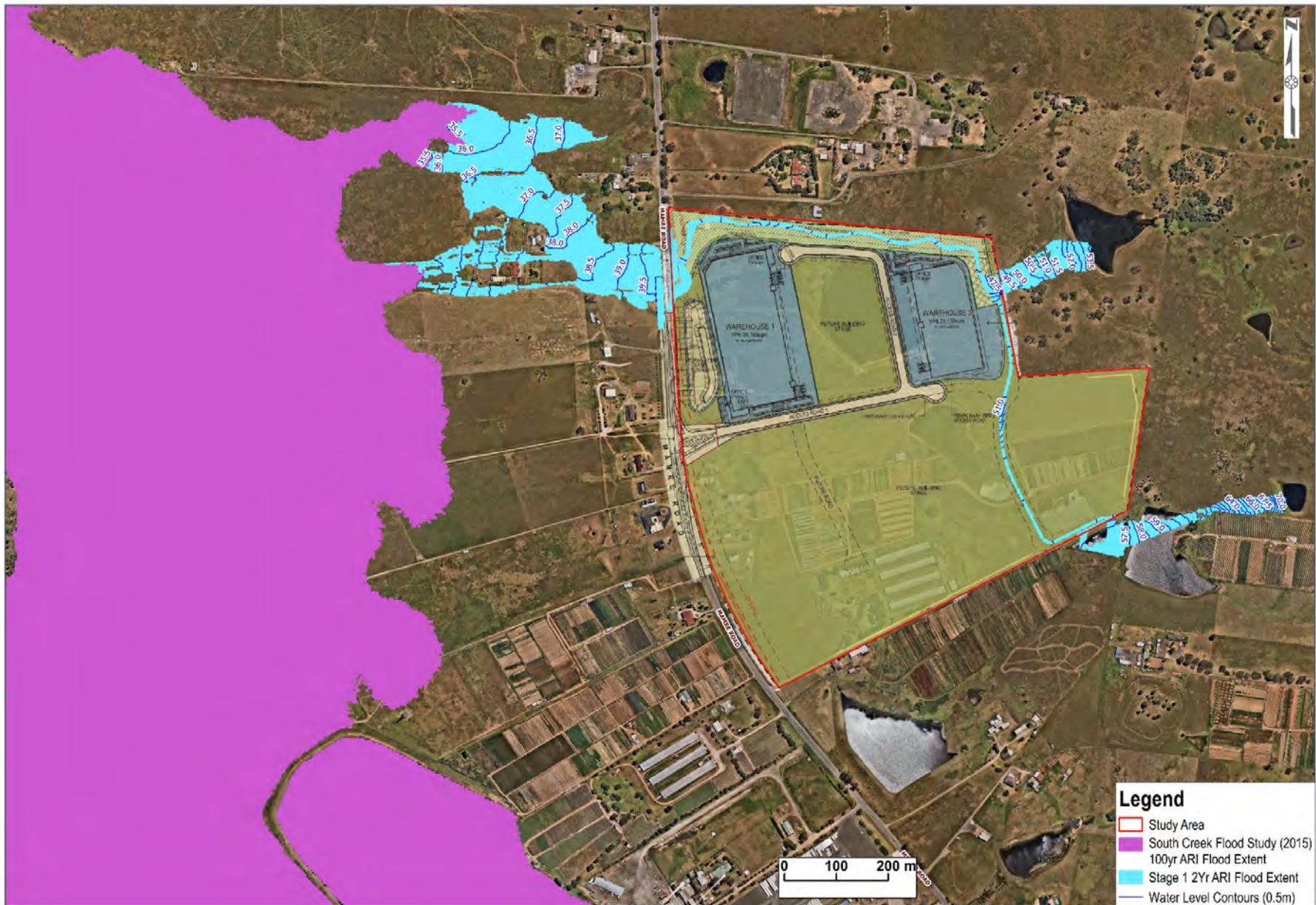


Figure 8 2 yr ARI Flood Extents and Flood Levels - Stage 1 Conditions

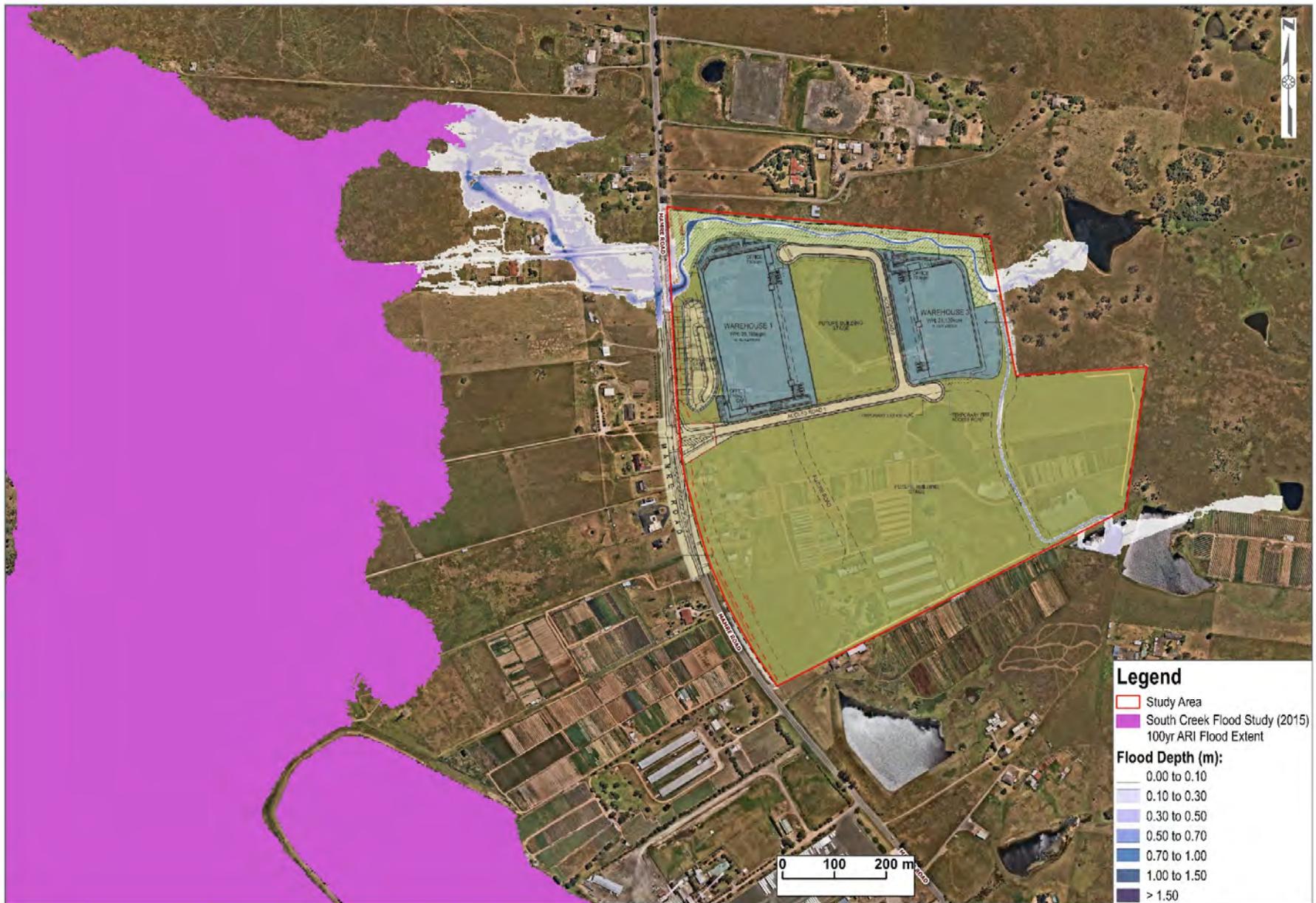


Figure 9 2 yr ARI Flood Depths - Stage 1 Conditions

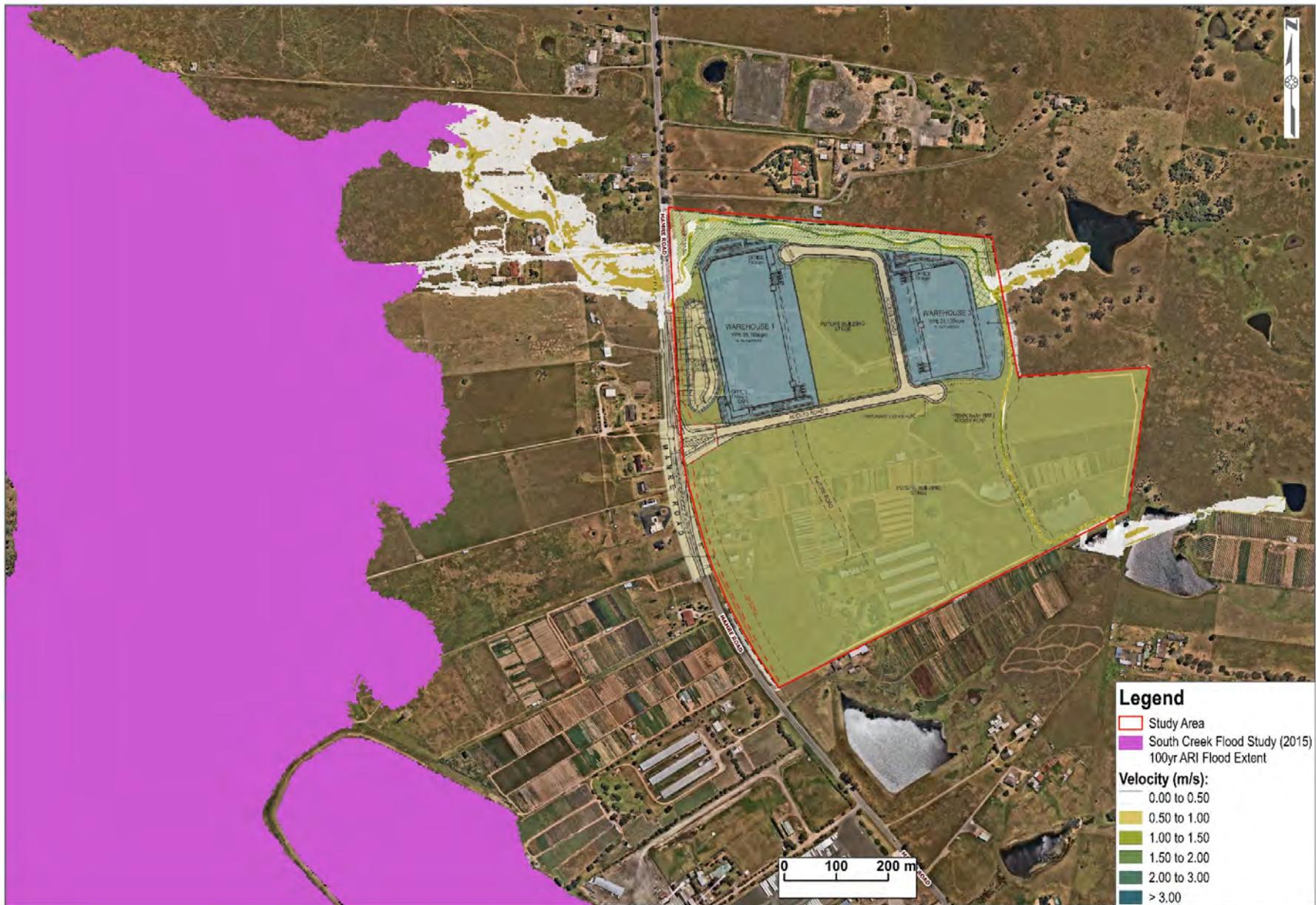


Figure 10 2 yr ARI Flood Velocities - Stage 1 Conditions

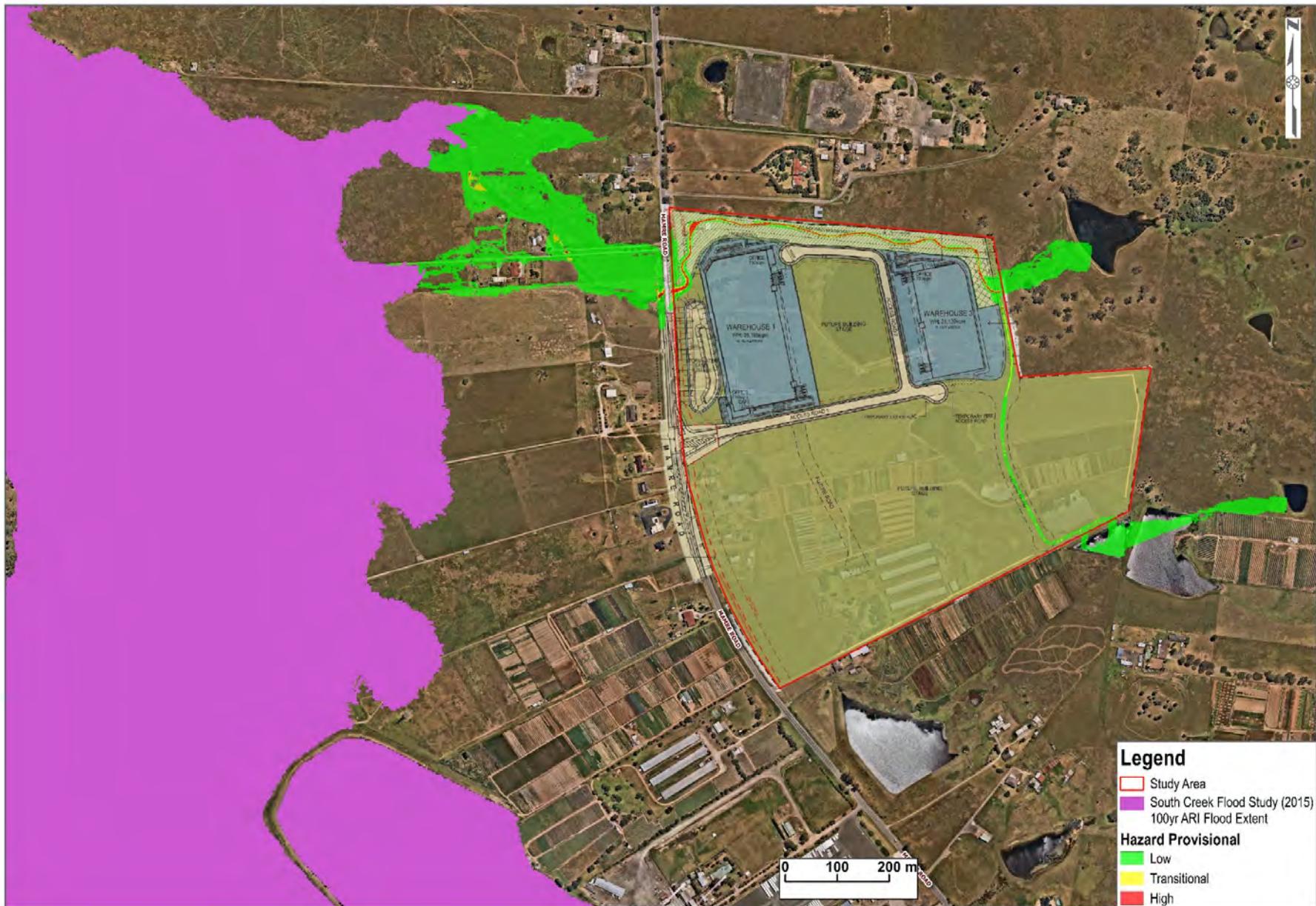


Figure 11 2 yr ARI Flood Hazards - Stage 1 Conditions

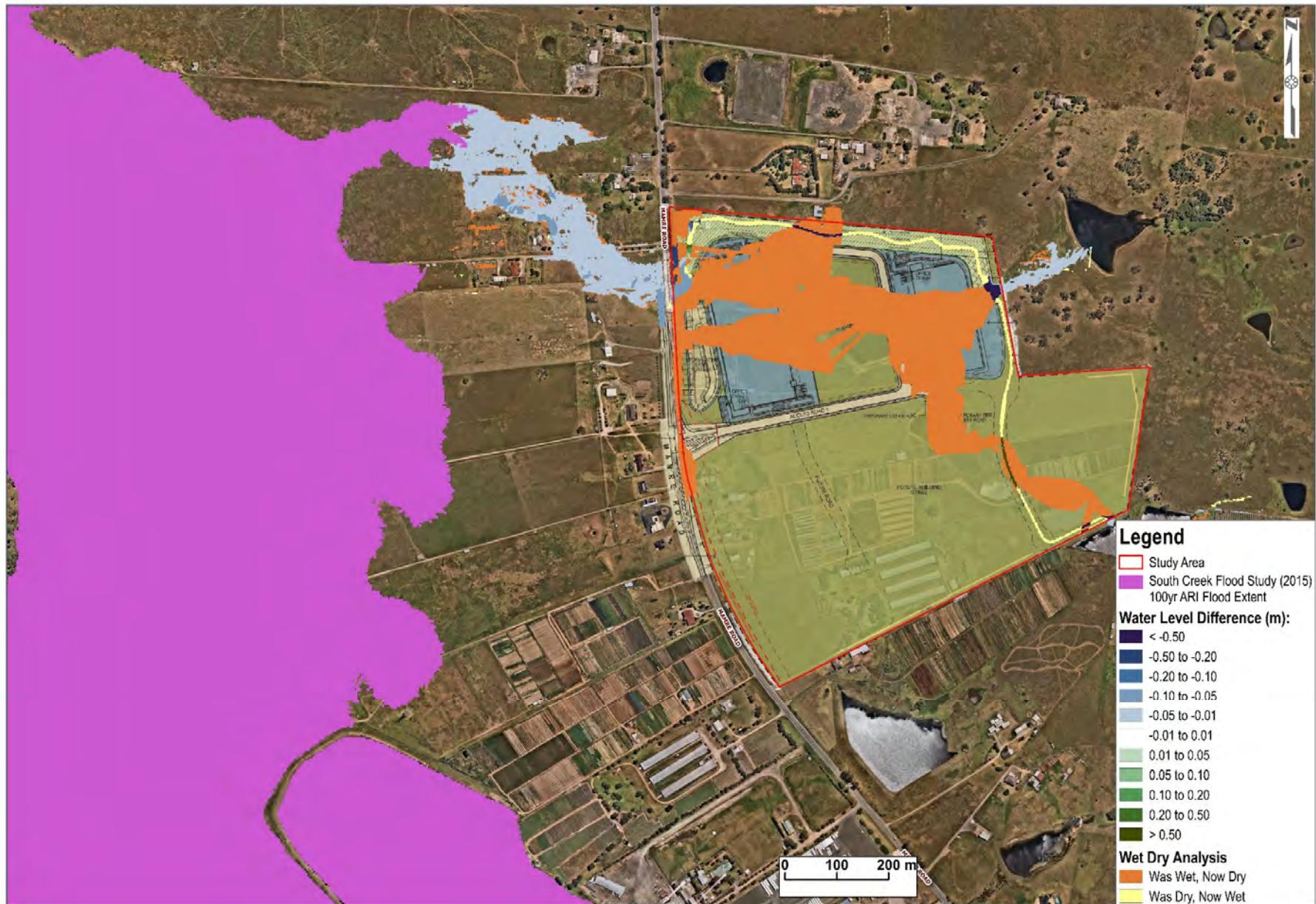


Figure 12 2 yr ARI Level Differences - (Stage 1 Conditions – Benchmark Conditions)

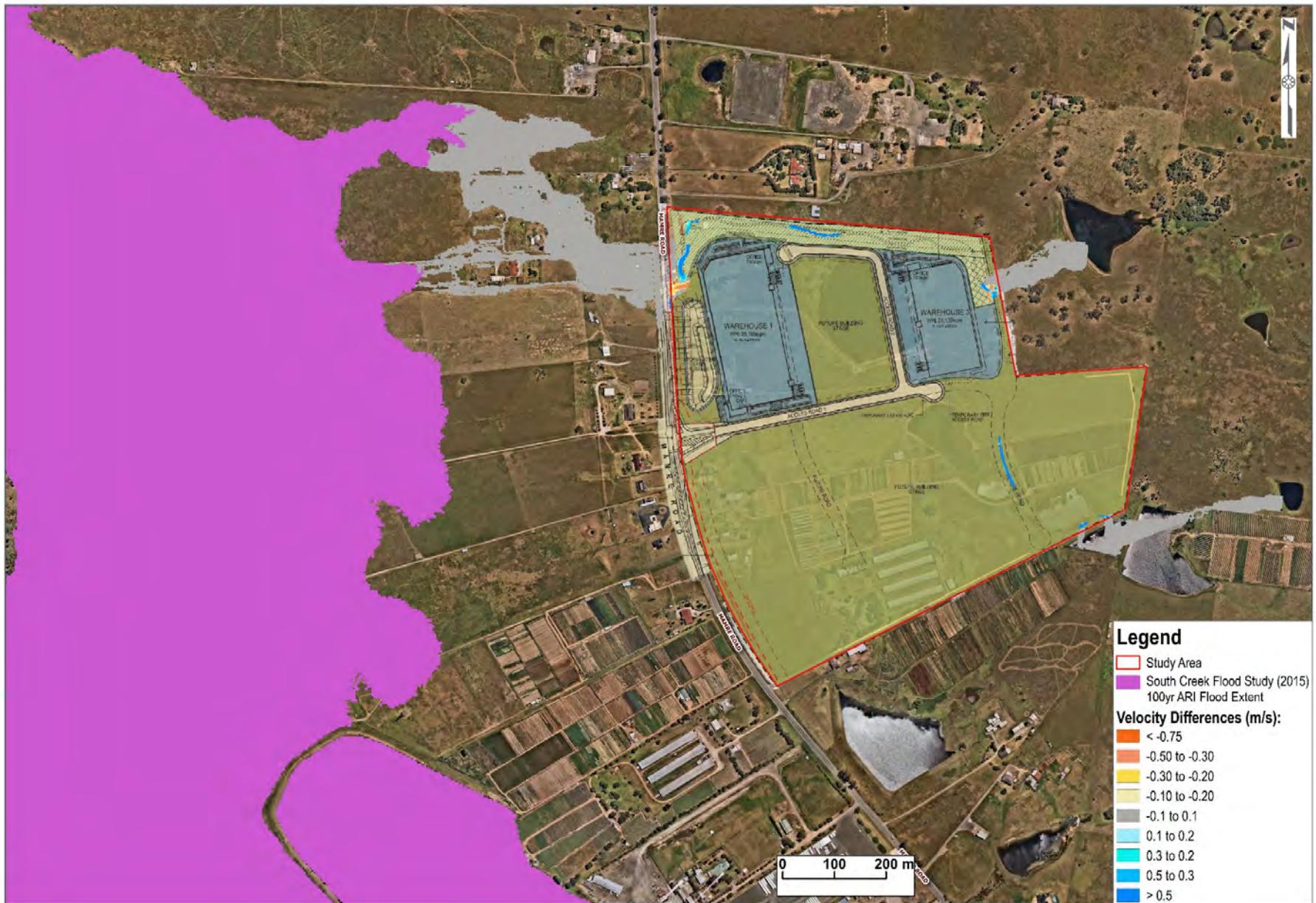


Figure 13 2 yr ARI Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)

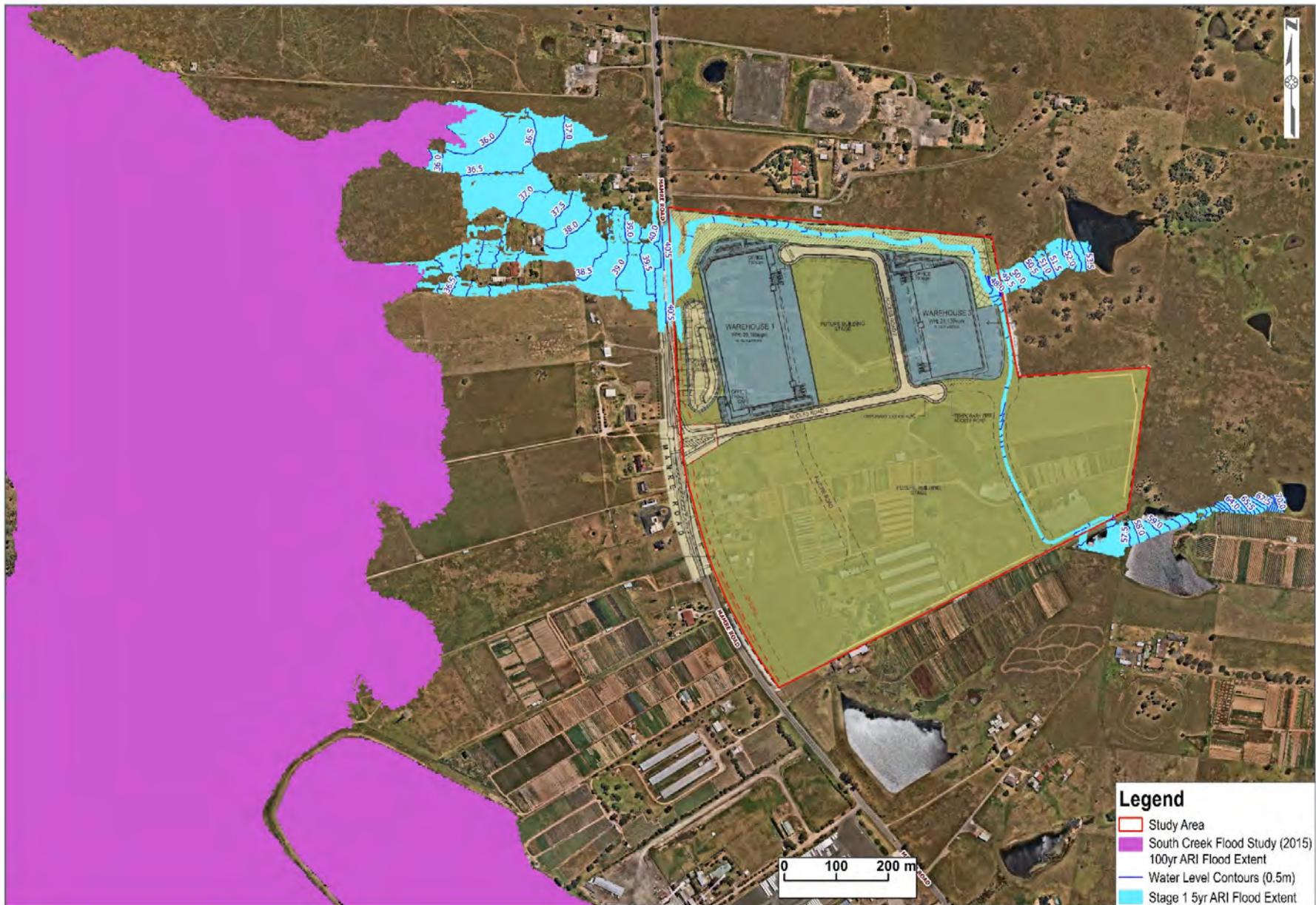


Figure 14 5 yr ARI Flood Extents and Flood Levels - Stage 1 Conditions

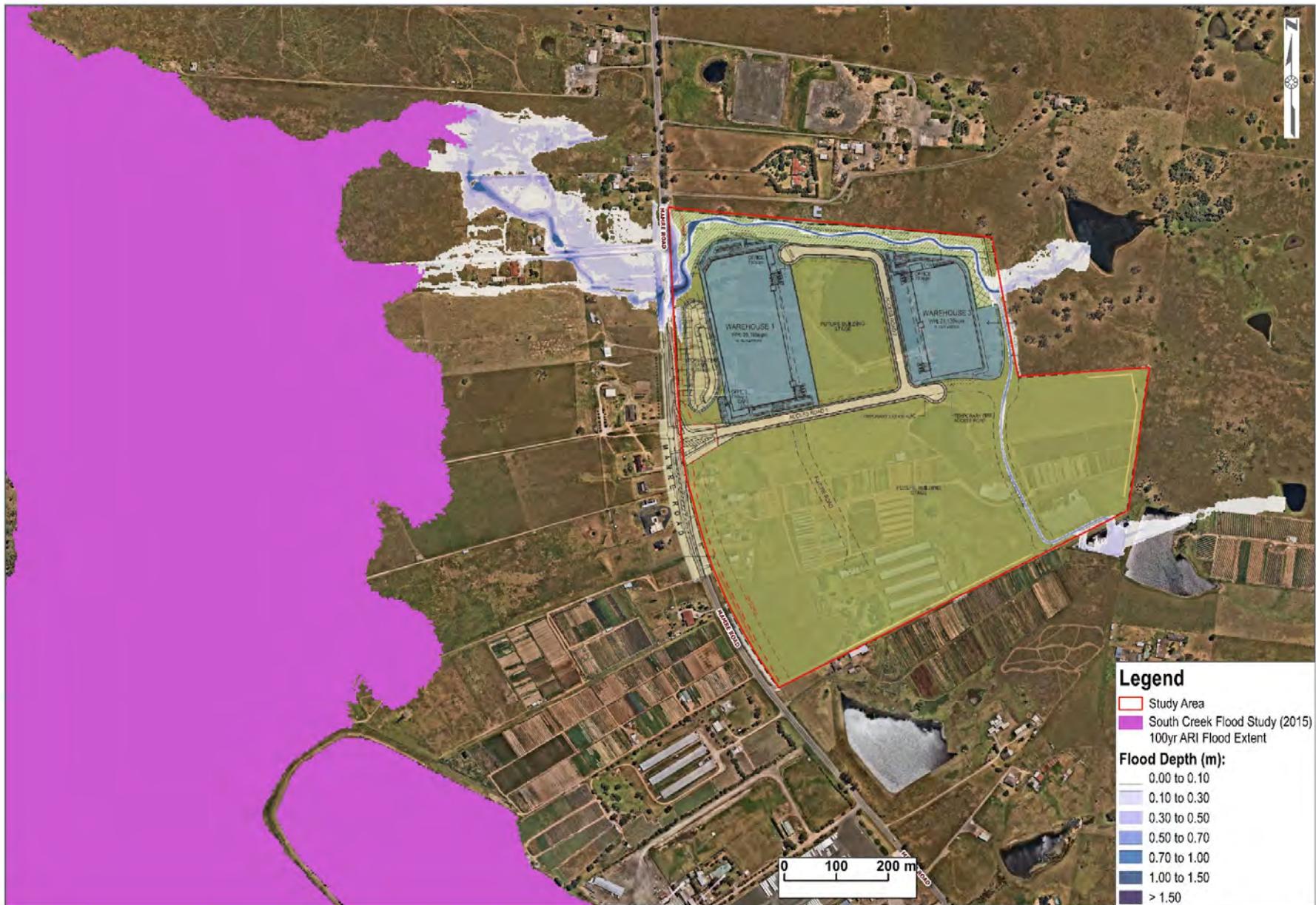


Figure 15 5 yr ARI Flood Depths - Stage 1 Conditions

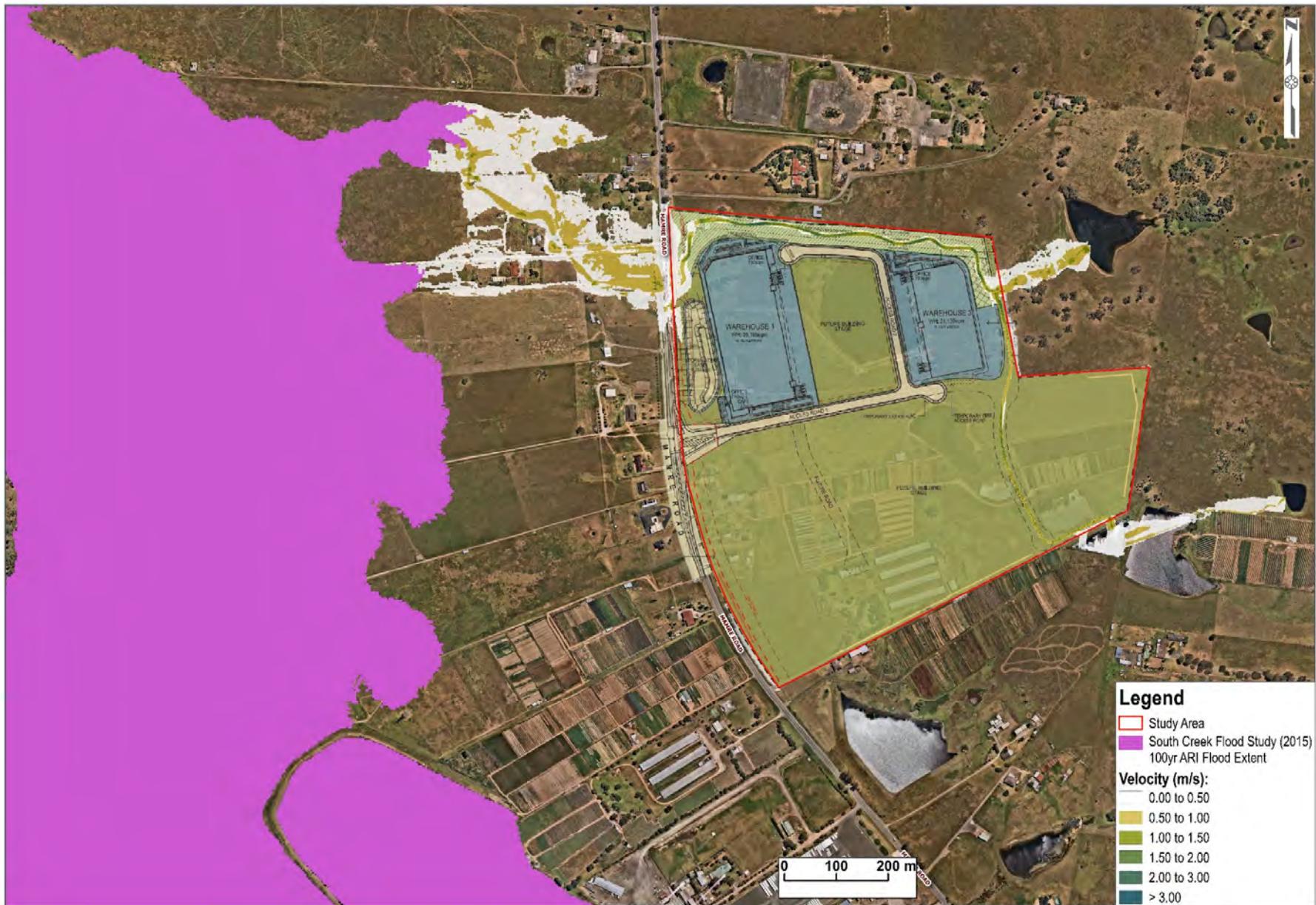


Figure 16 5 yr ARI Flood Velocities - Stage 1 Conditions

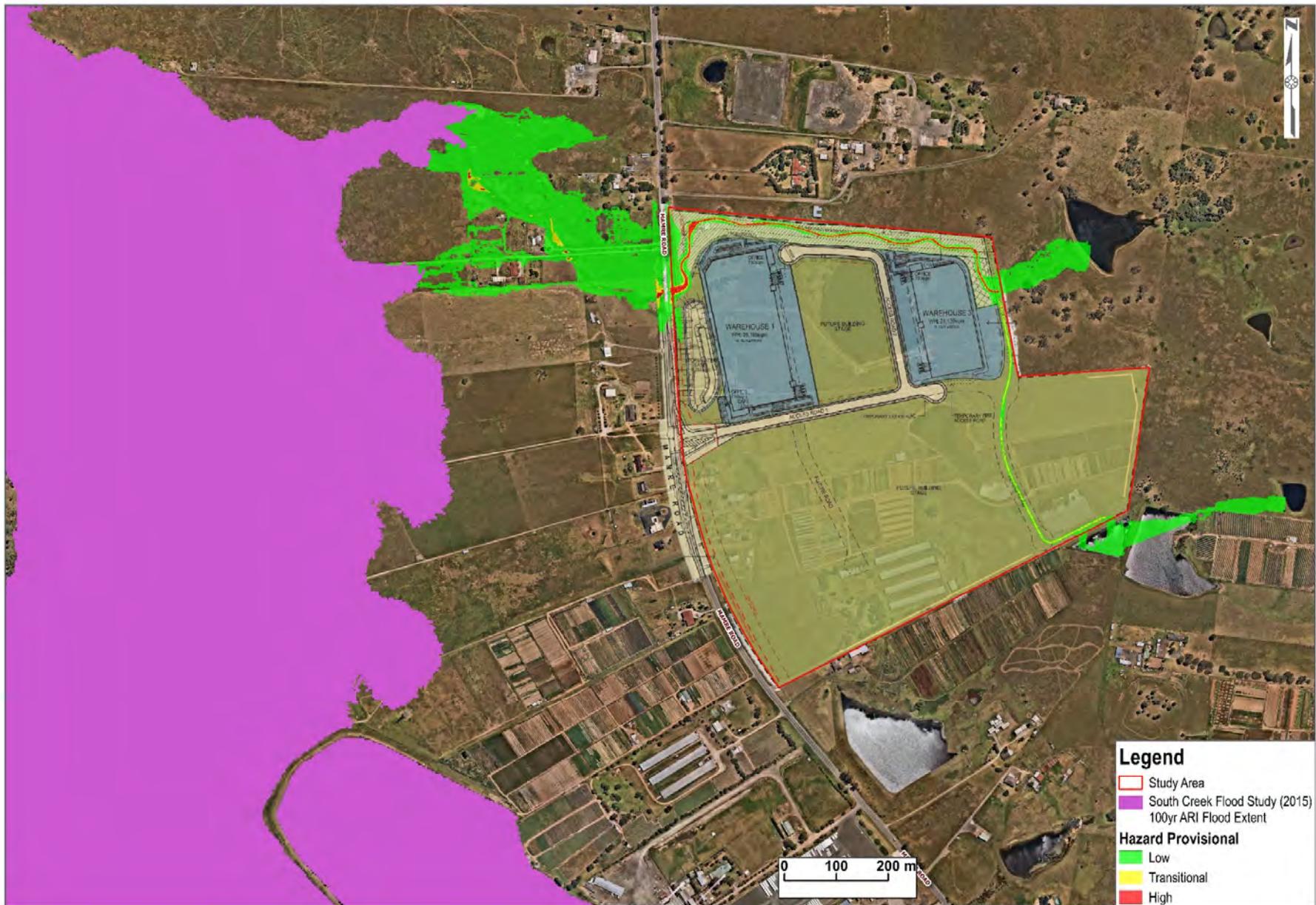


Figure 17 5 yr ARI Flood Hazards - Stage 1 Conditions

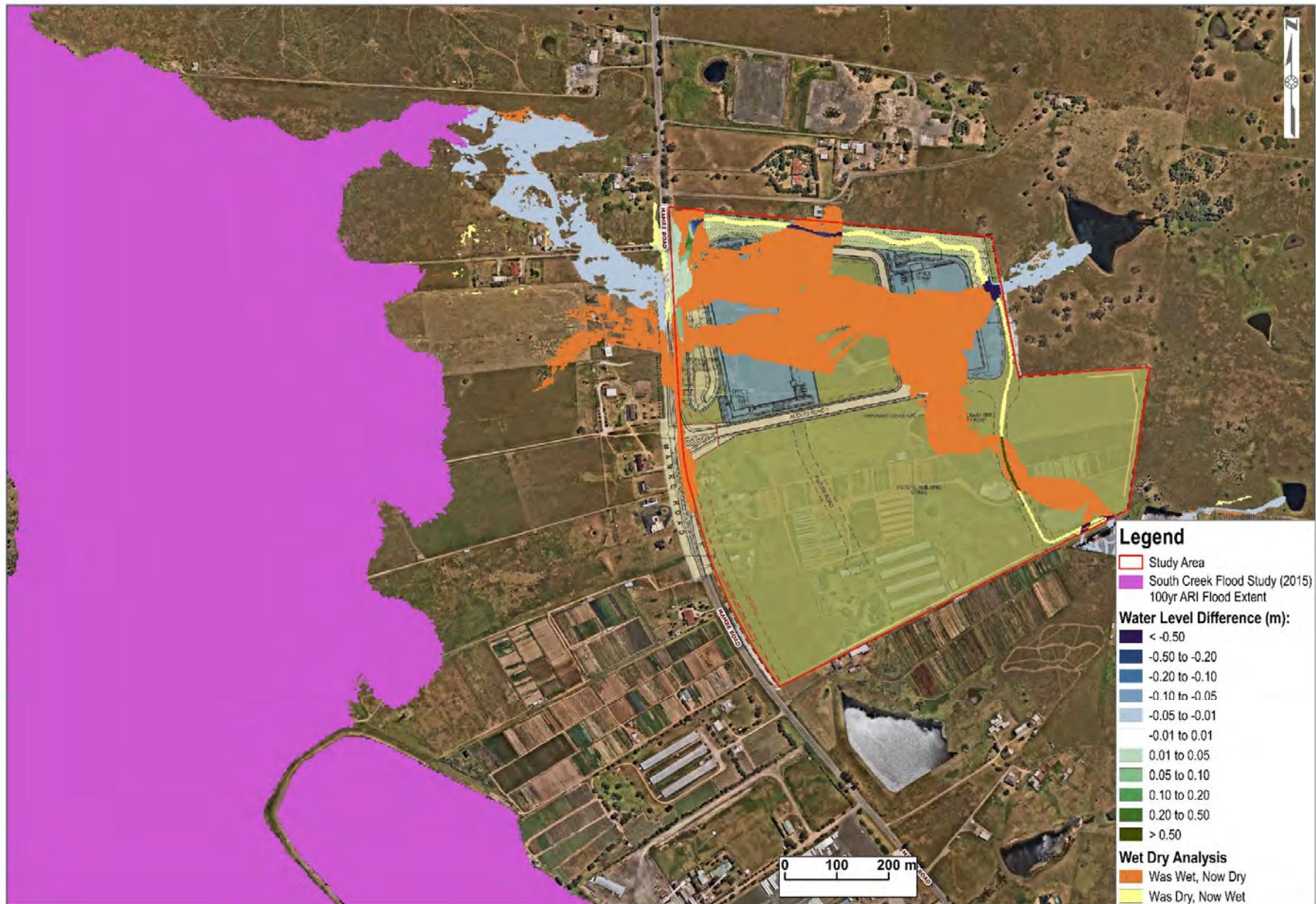


Figure 18 5 yr ARI Level Differences - (Stage 1 Conditions – Benchmark Conditions)

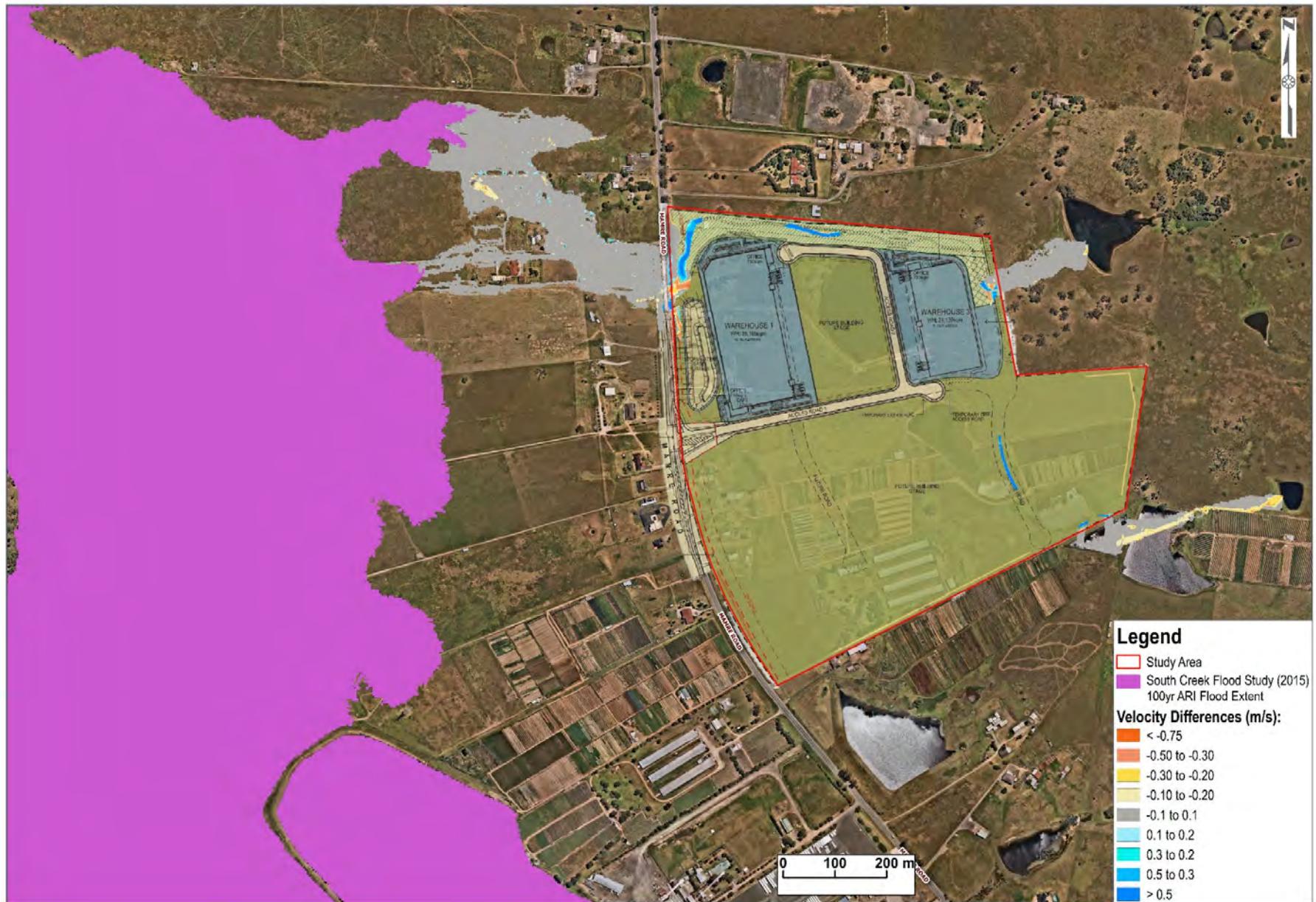


Figure 19 5 yr ARI Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)



Figure 20 100 yr ARI Flood Extents and Flood Levels - Stage 1 Conditions



Figure 21 100 yr ARI Flood Depths - Stage 1 Conditions

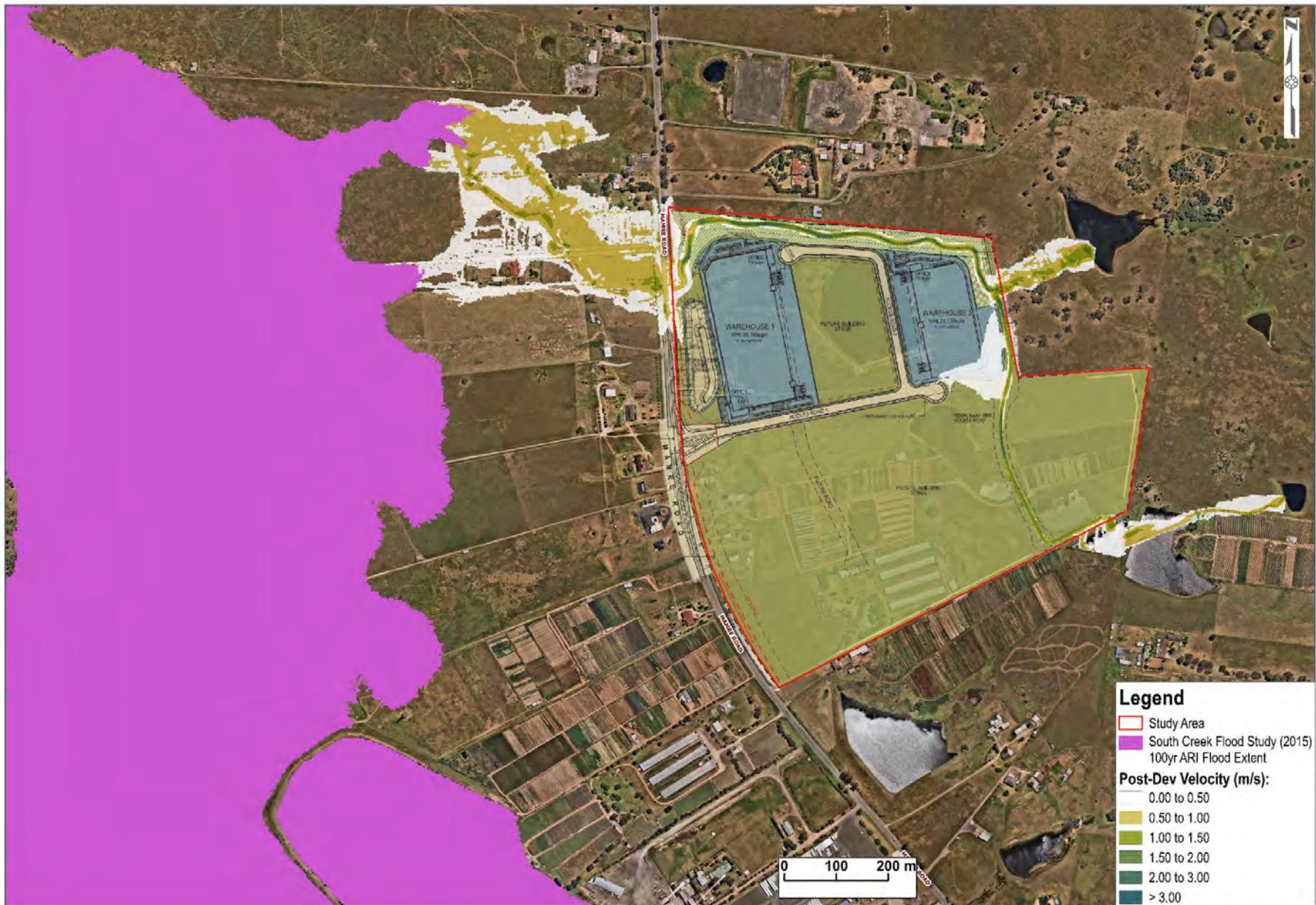


Figure 22 100 yr ARI Flood Velocities - Stage 1 Conditions

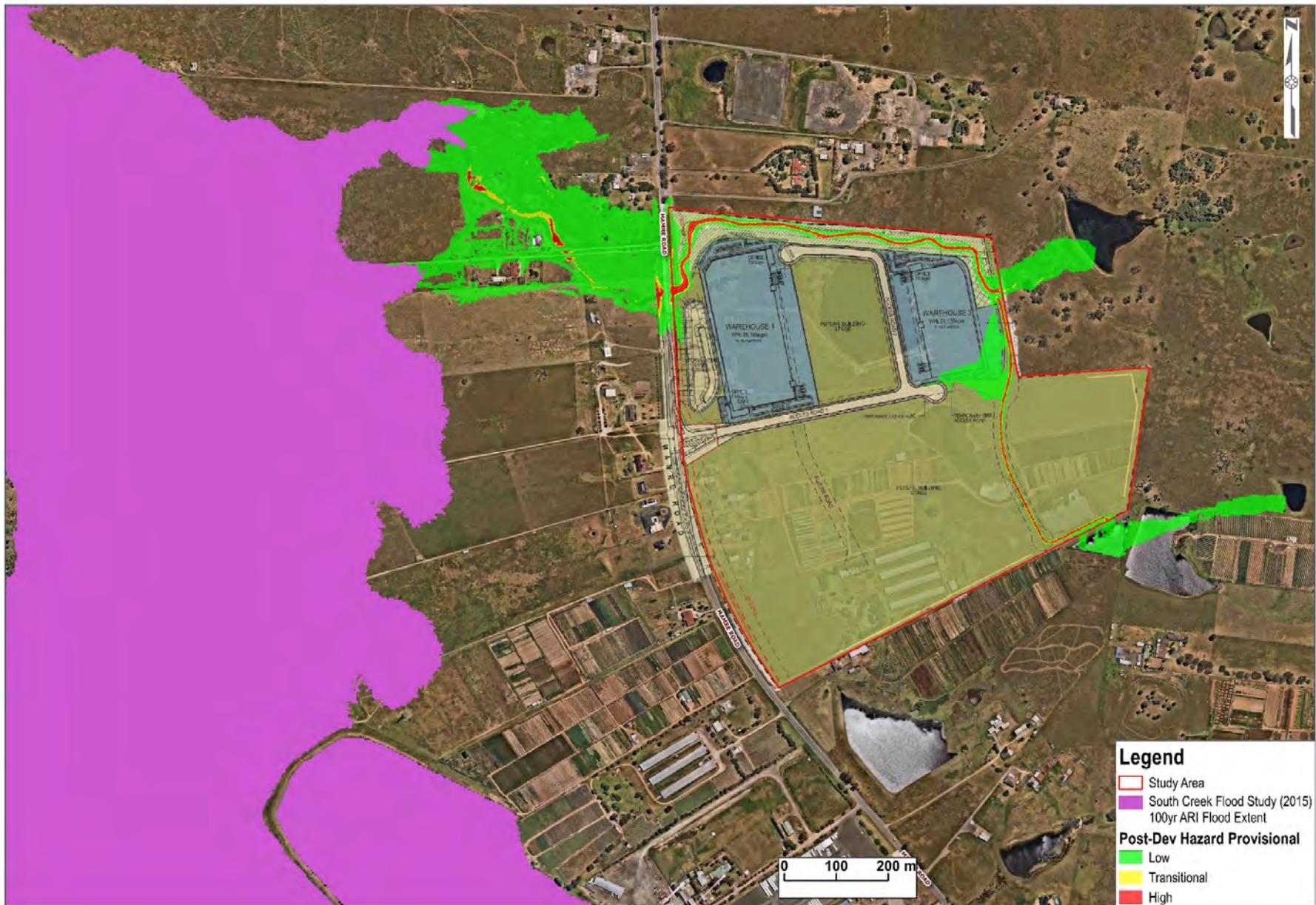


Figure 23 100 yr ARI Flood Hazards - Stage 1 Conditions

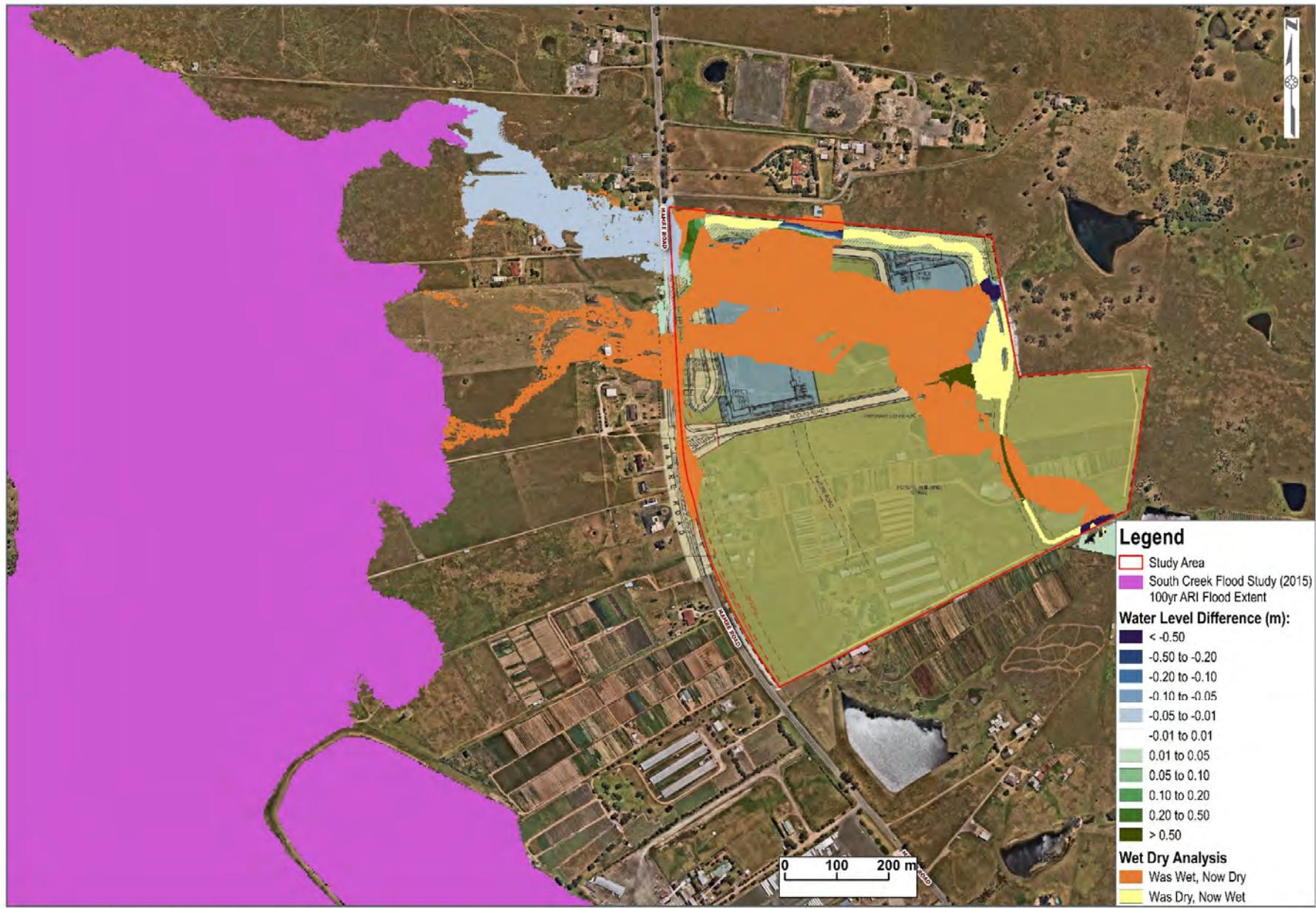


Figure 24 100 yr ARI Level Differences - (Stage 1 Conditions – Benchmark Conditions)

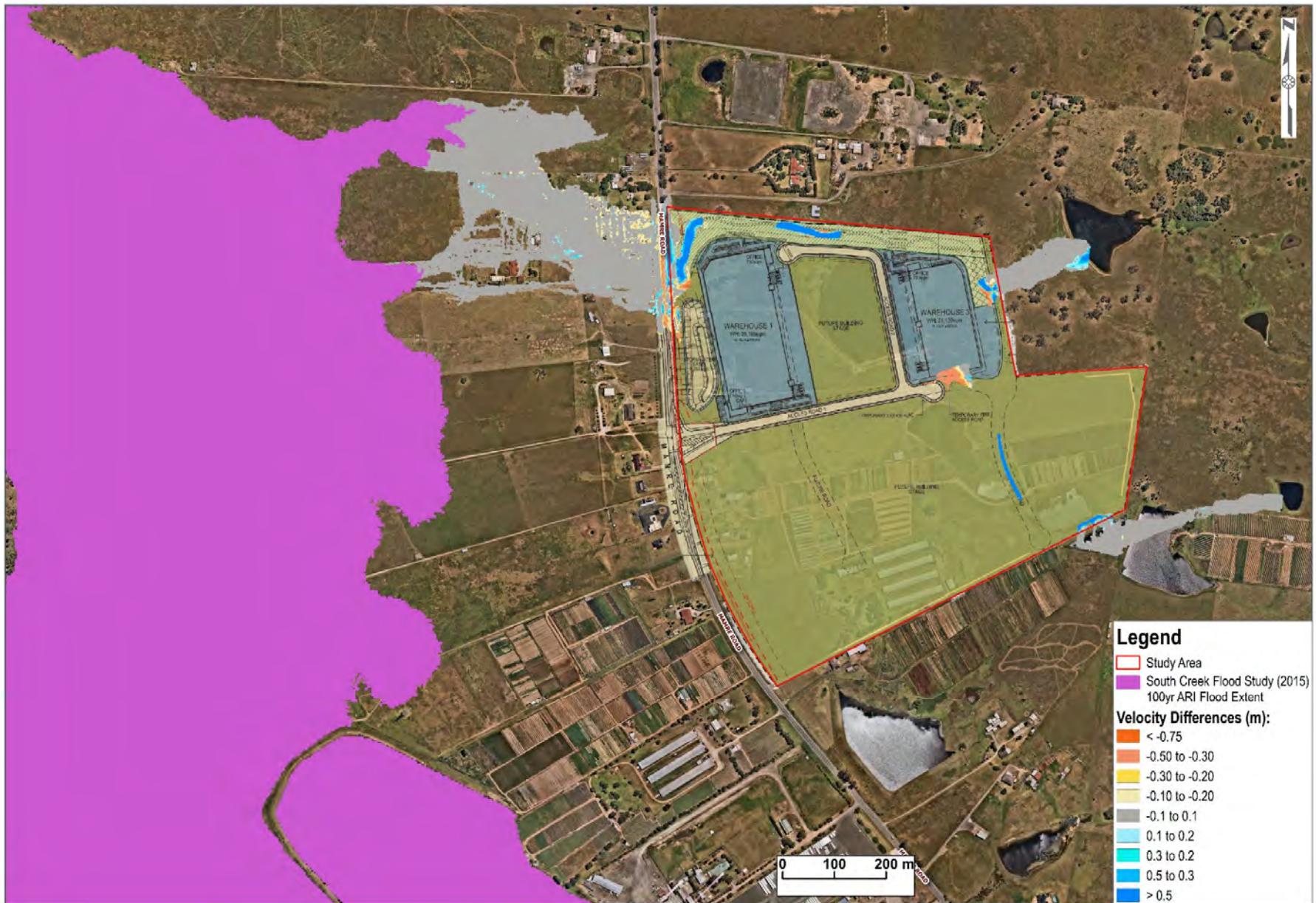


Figure 25 100 yr ARI Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)



Figure 26 200 yr ARI Flood Extents and Flood Levels - Stage 1 Conditions

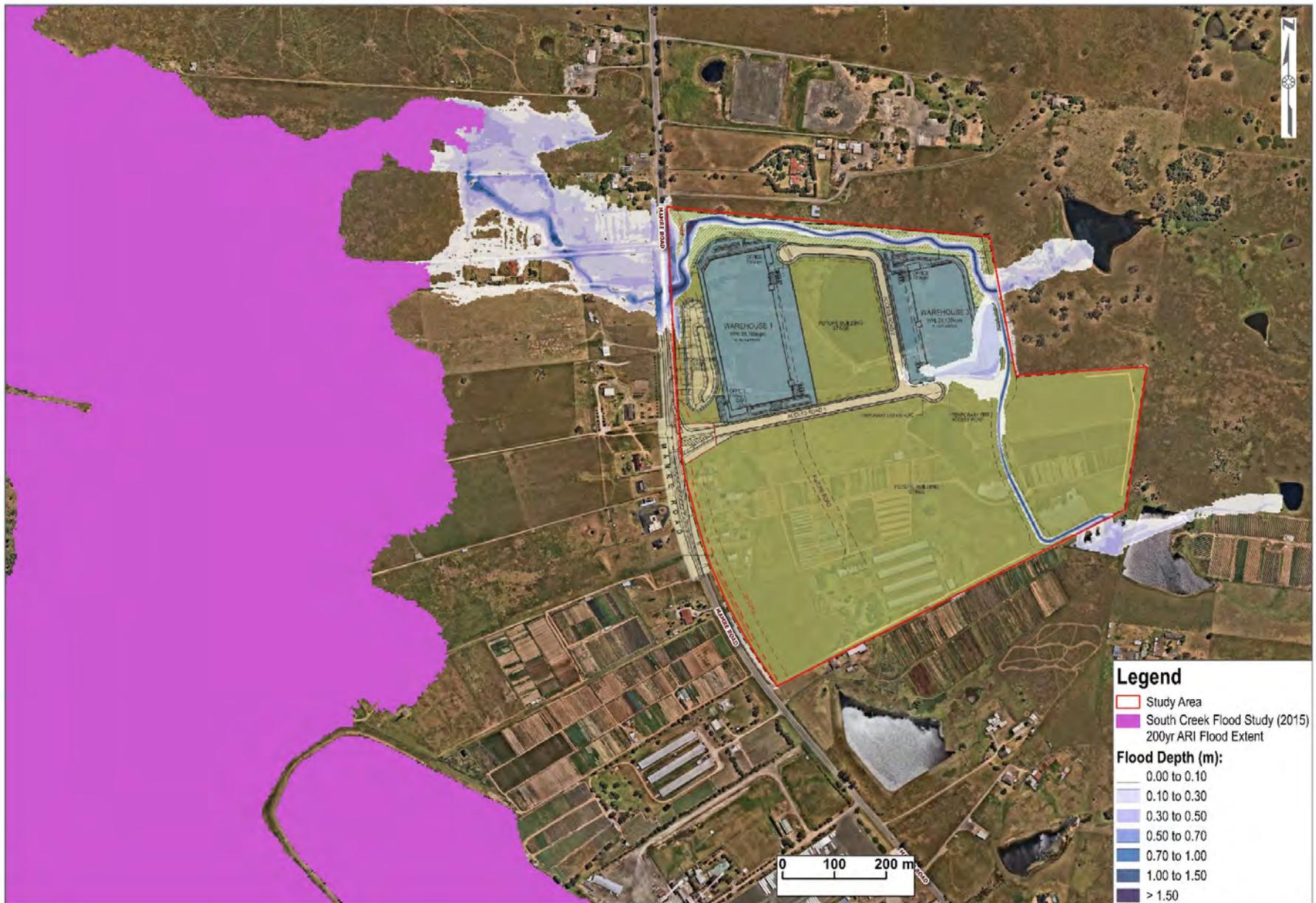


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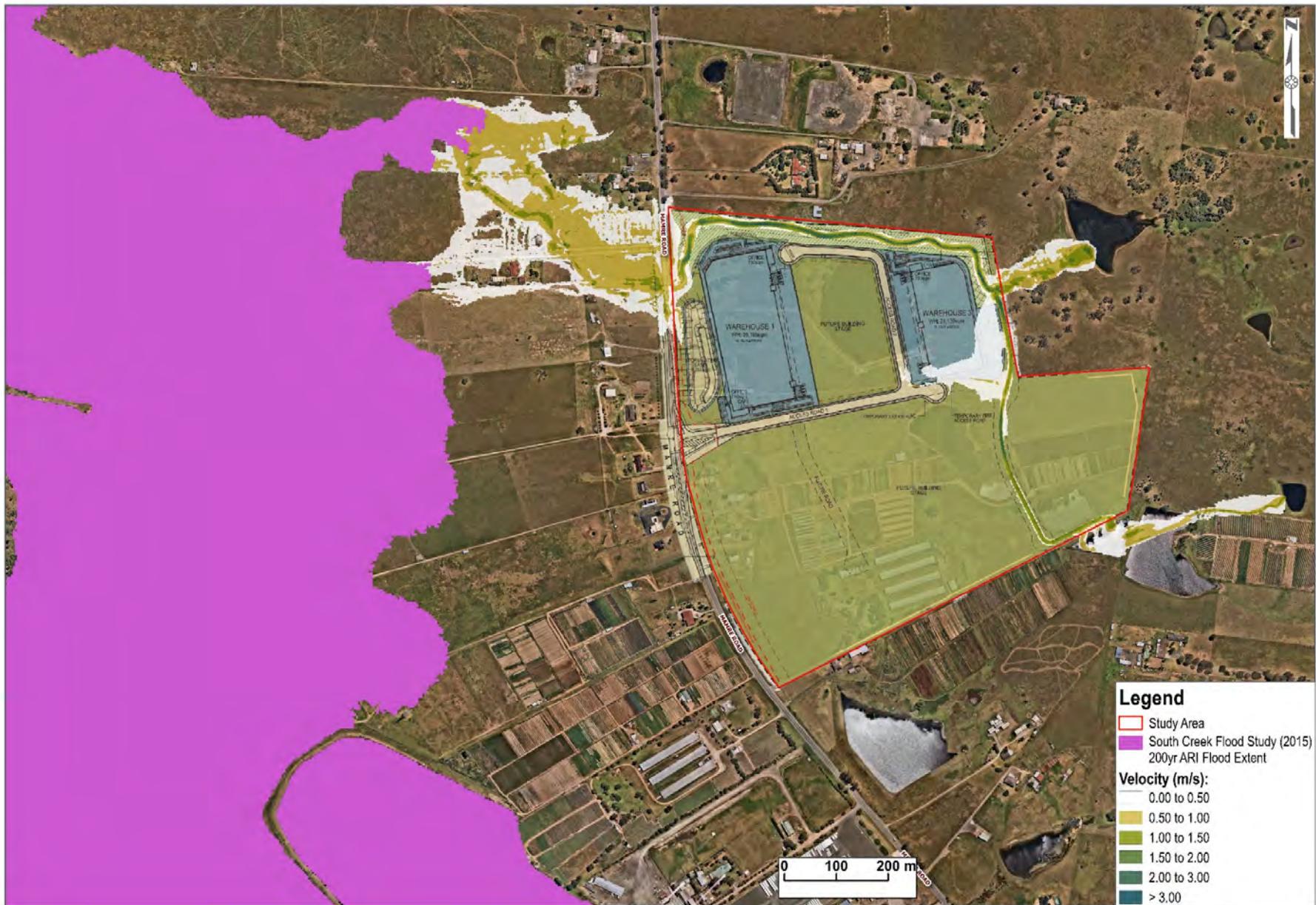


Figure 28 200 yr ARI Flood Velocities - Stage 1 Conditions

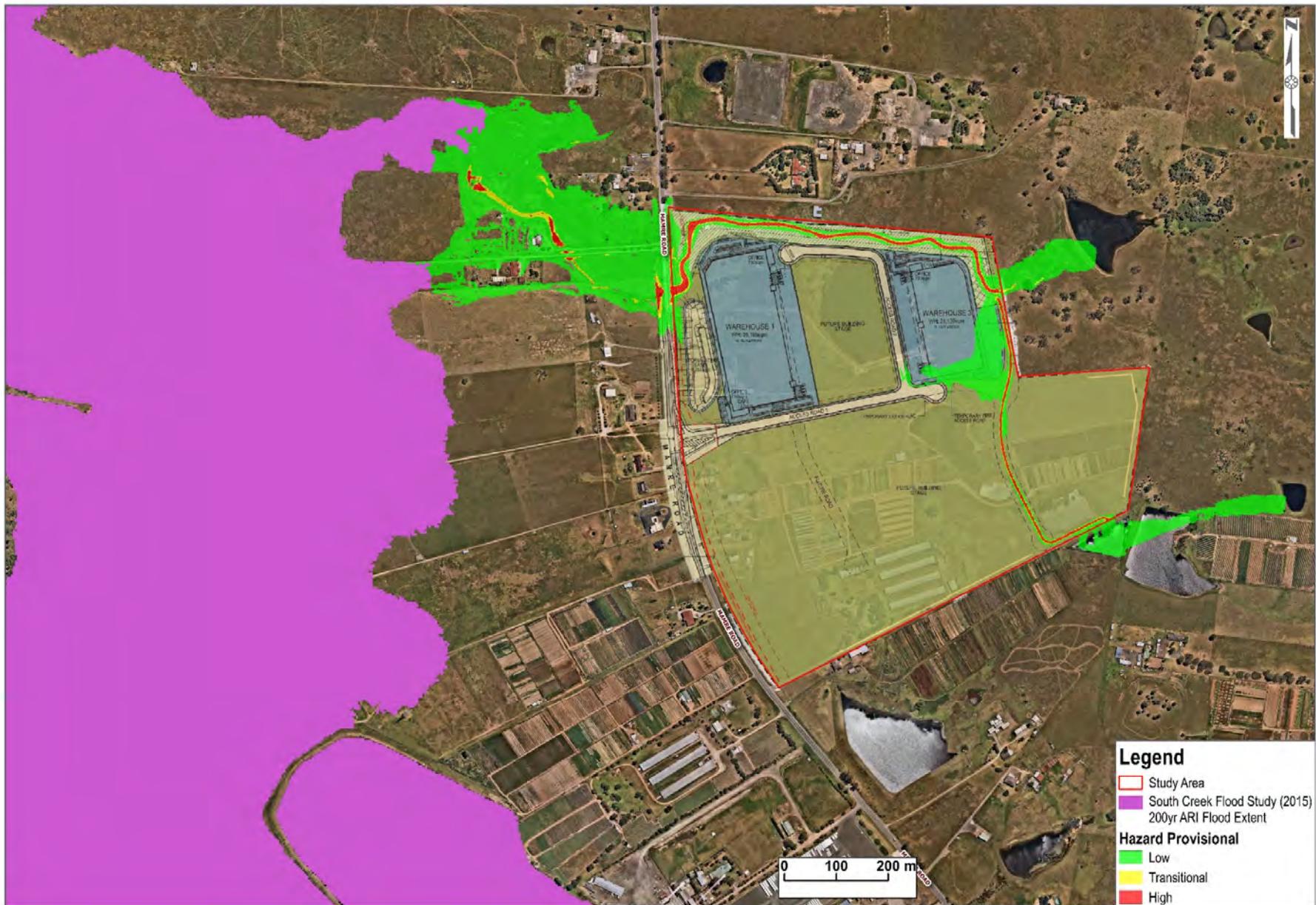


Figure 29 200 yr ARI Flood Hazards - Stage 1 Conditions

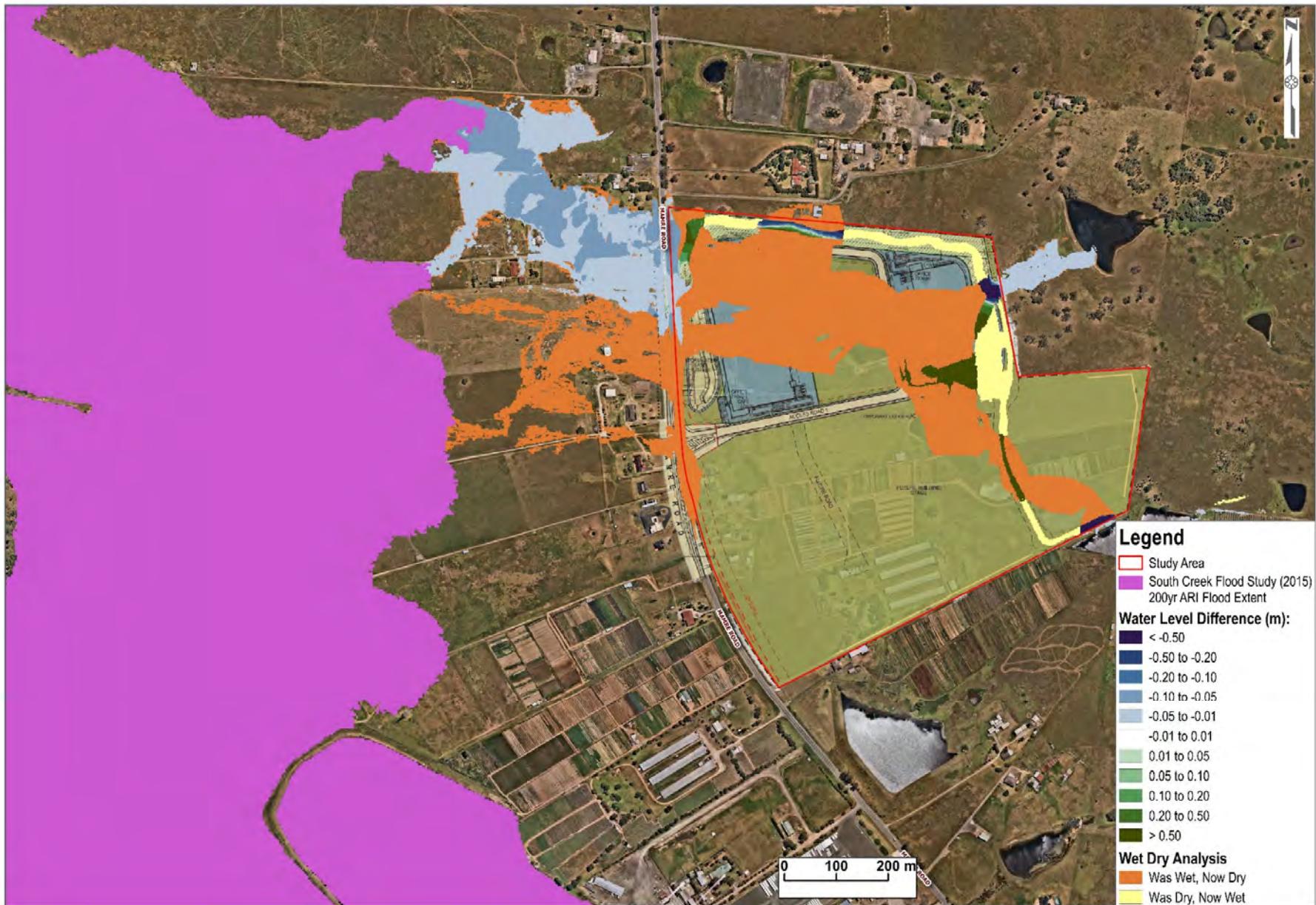


Figure 30 200 yr ARI Level Differences - (Stage 1 Conditions – Benchmark Conditions)

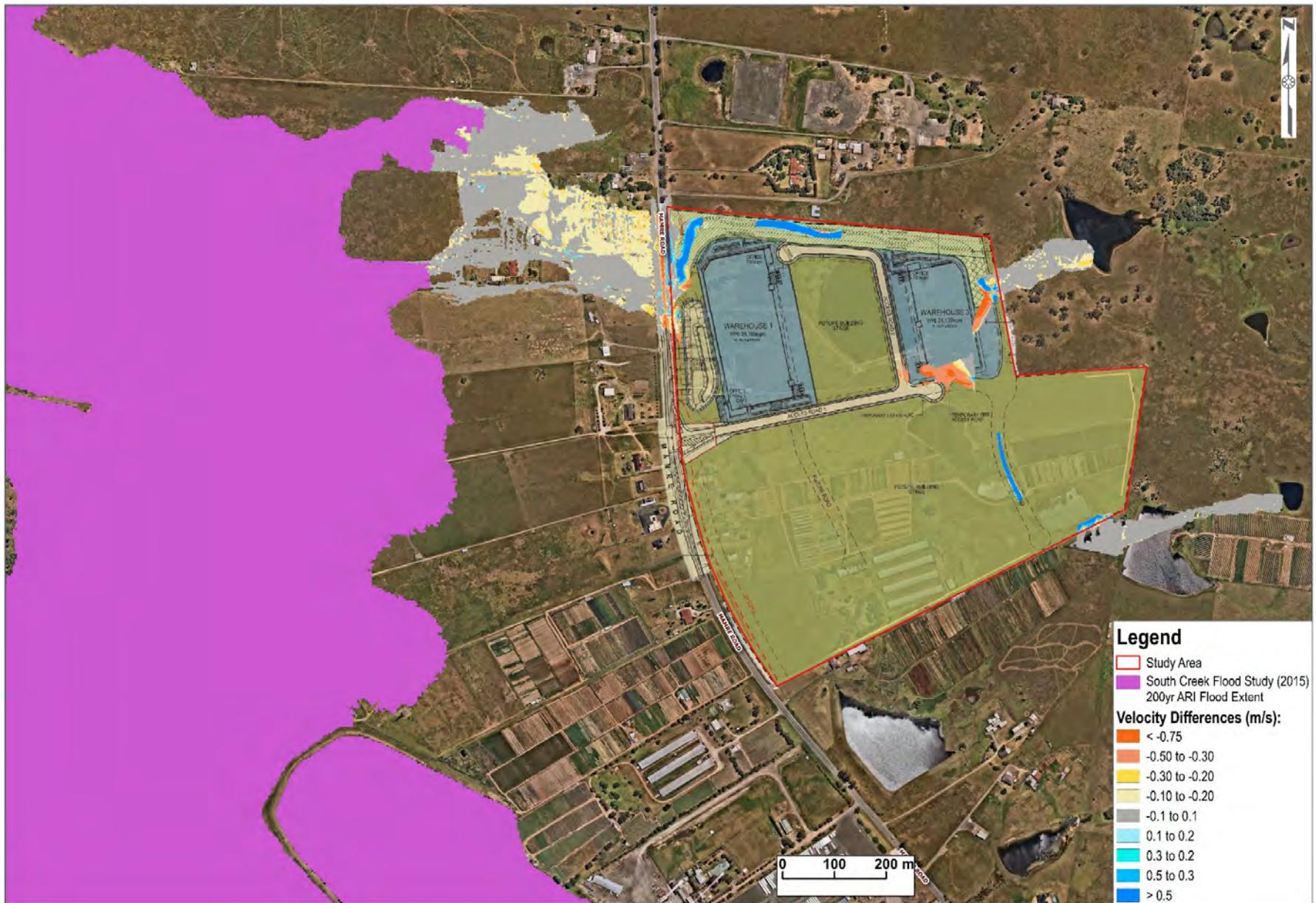


Figure 31 200 yr ARI Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)

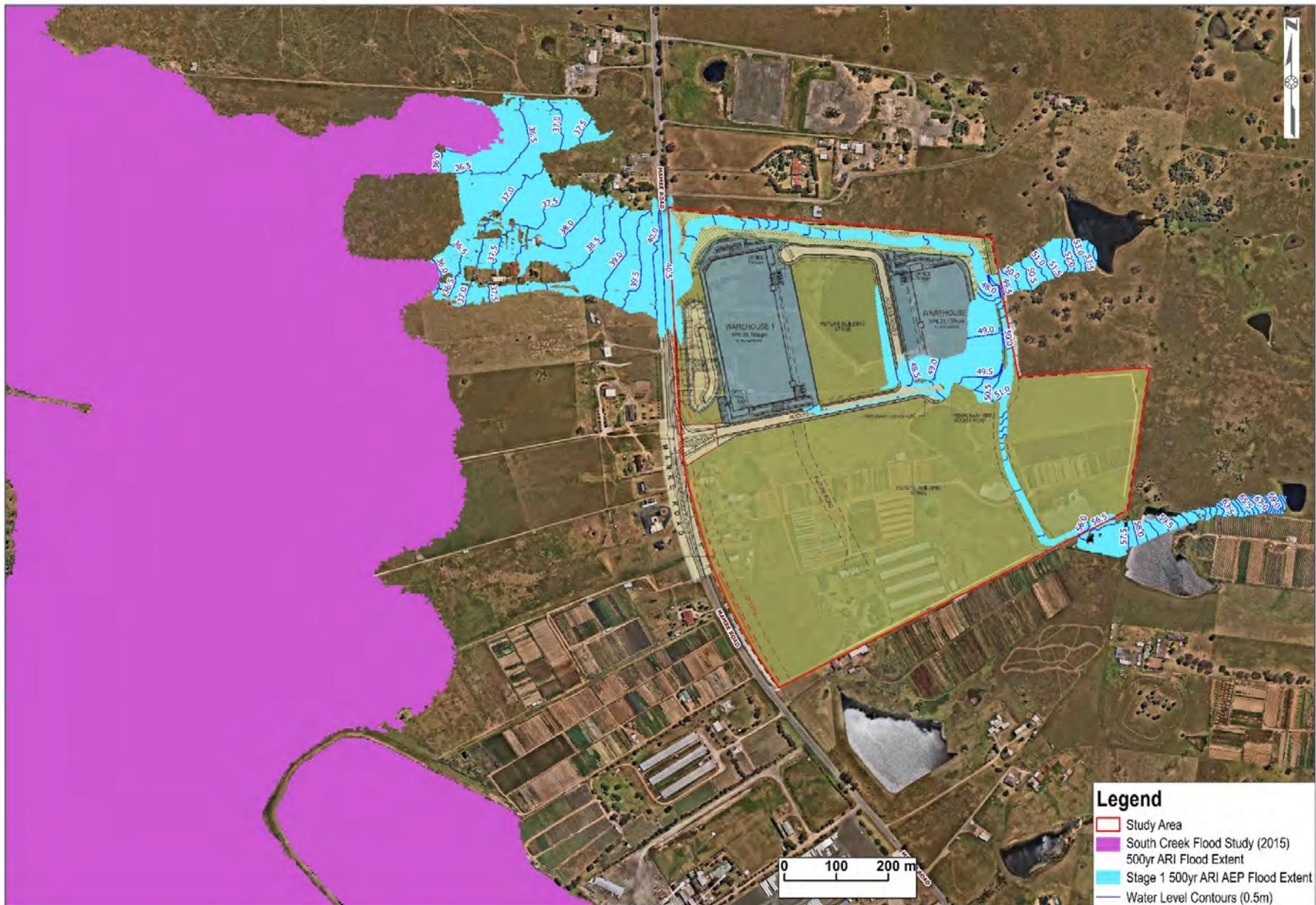


Figure 32 500 yr ARI Flood Extents and Flood Levels - Stage 1 Conditions



Figure 33 500 yr ARI Flood Depths - Stage 1 Conditions

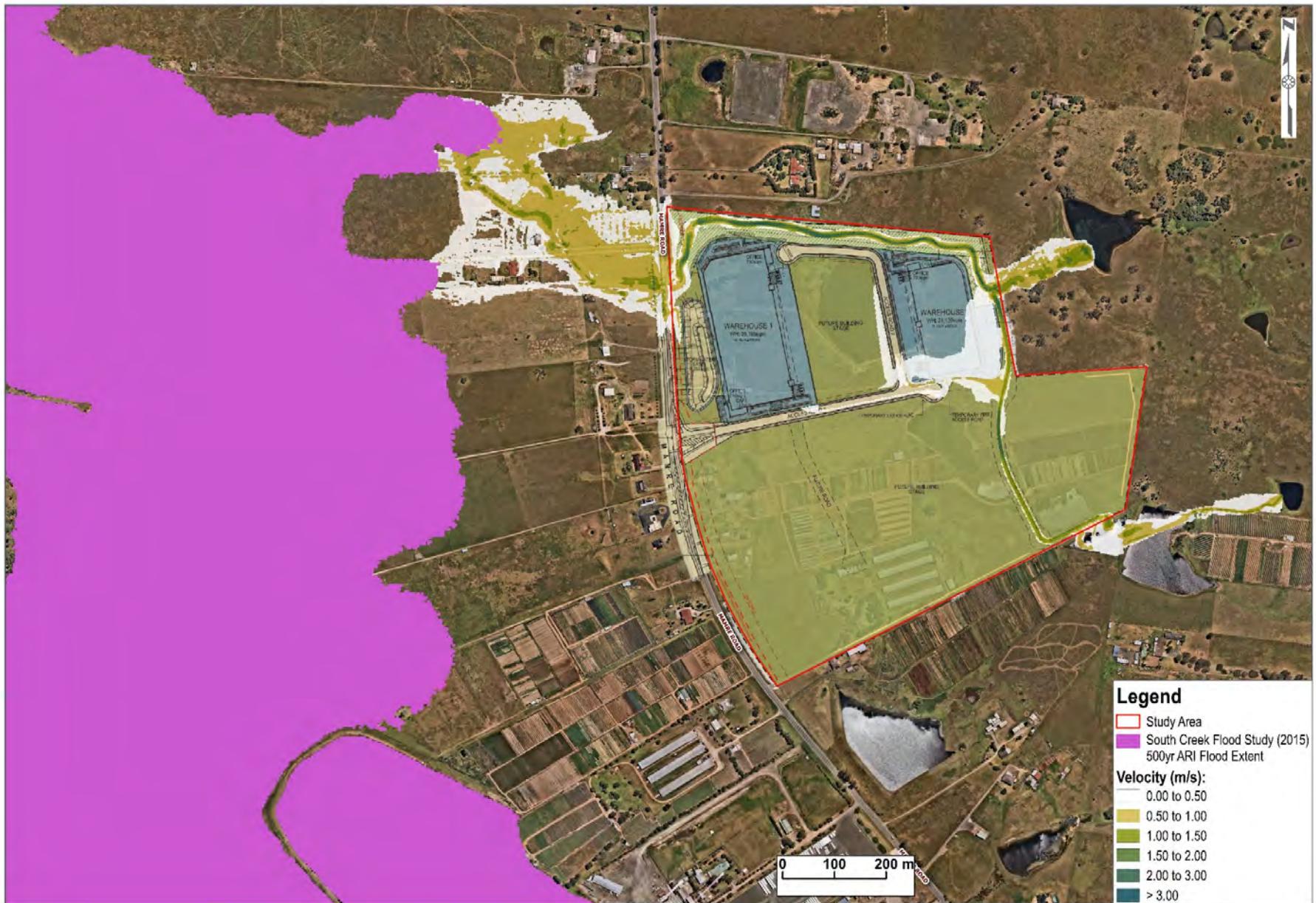


Figure 34 500 yr ARI Flood Velocities - Stage 1 Conditions

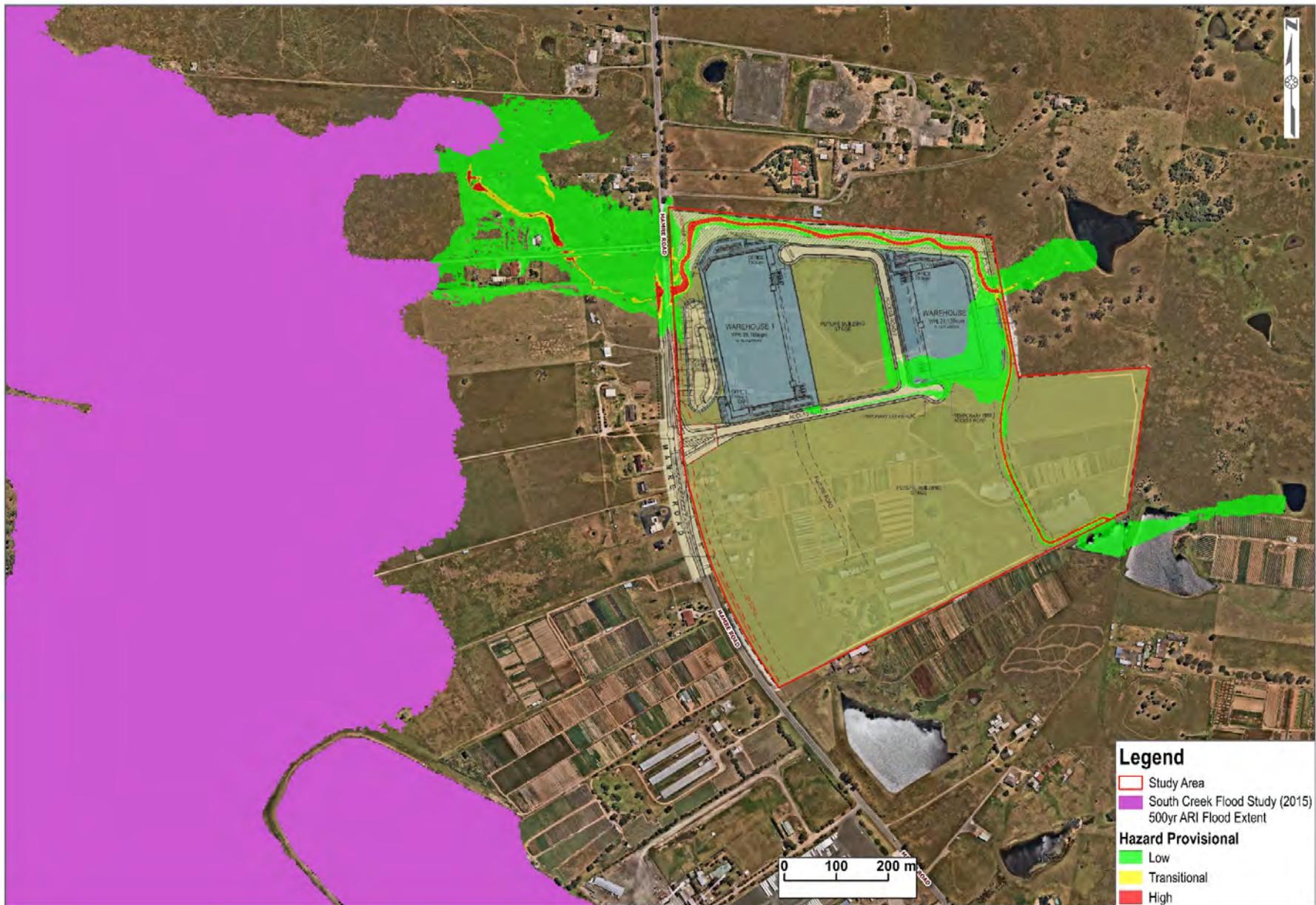


Figure 35 500 yr ARI Flood Hazards - Stage 1 Conditions

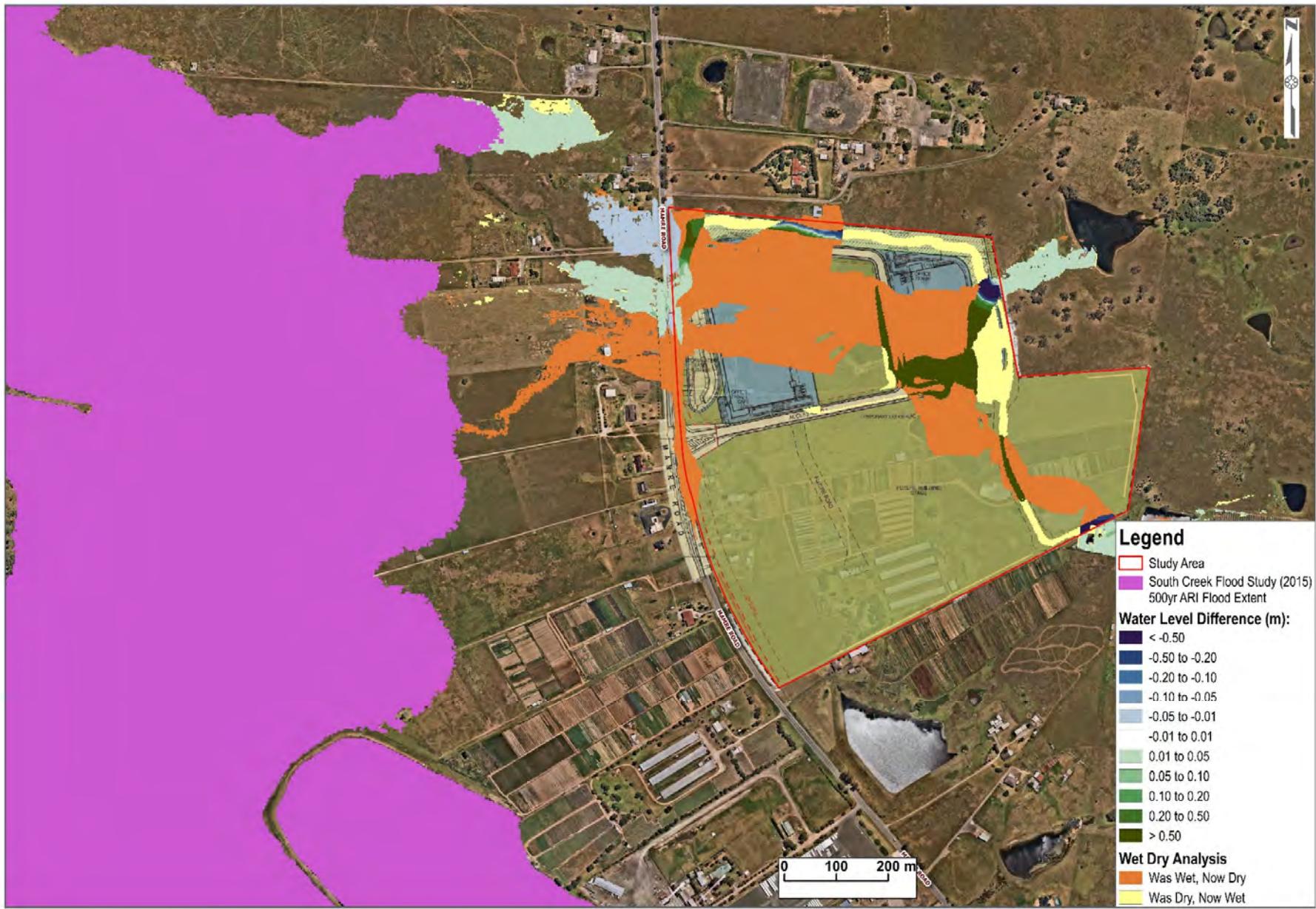


Figure 36 500 yr ARI Level Differences - (Stage 1 Conditions – Benchmark Conditions)

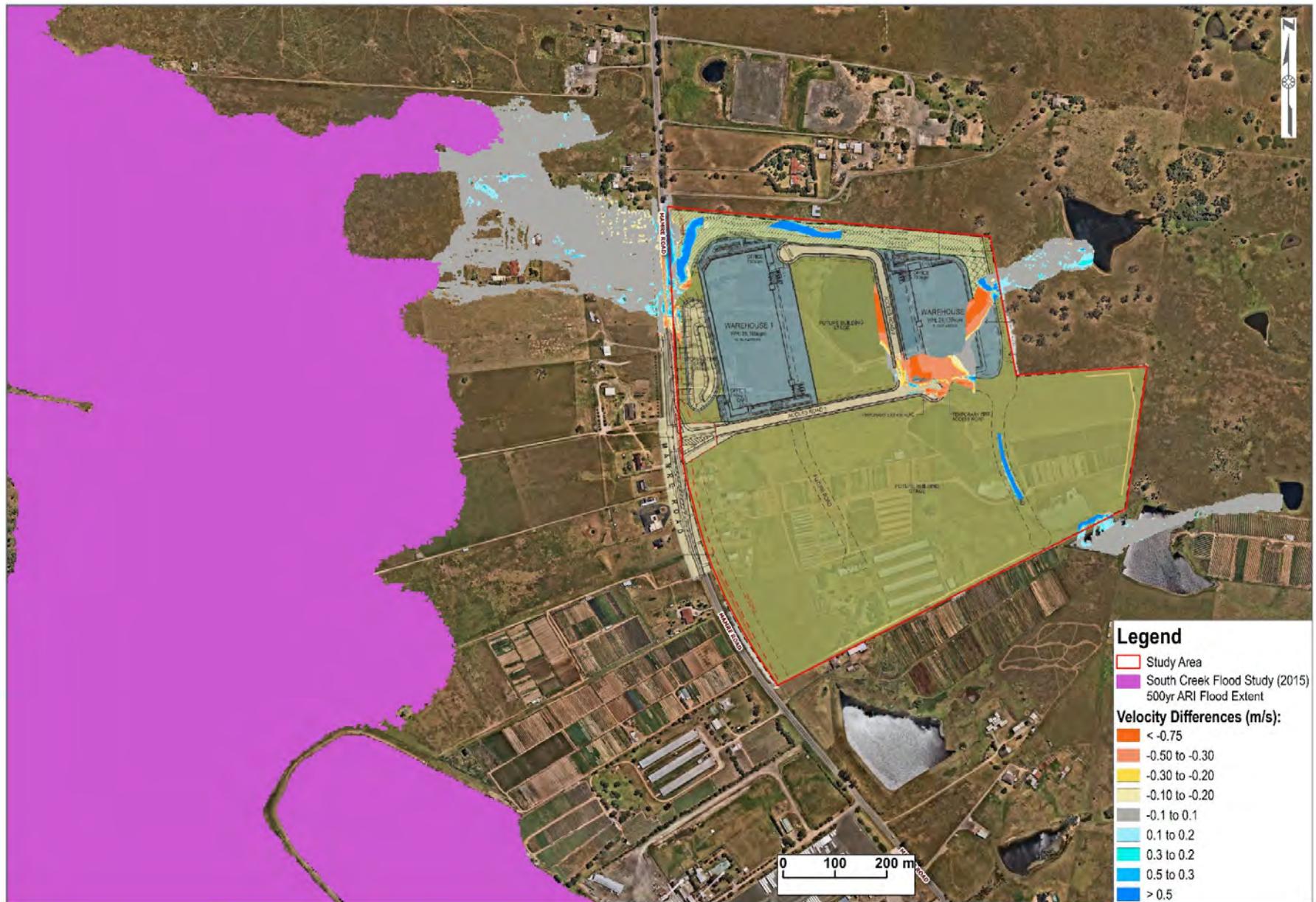


Figure 37 500 yr ARI Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)

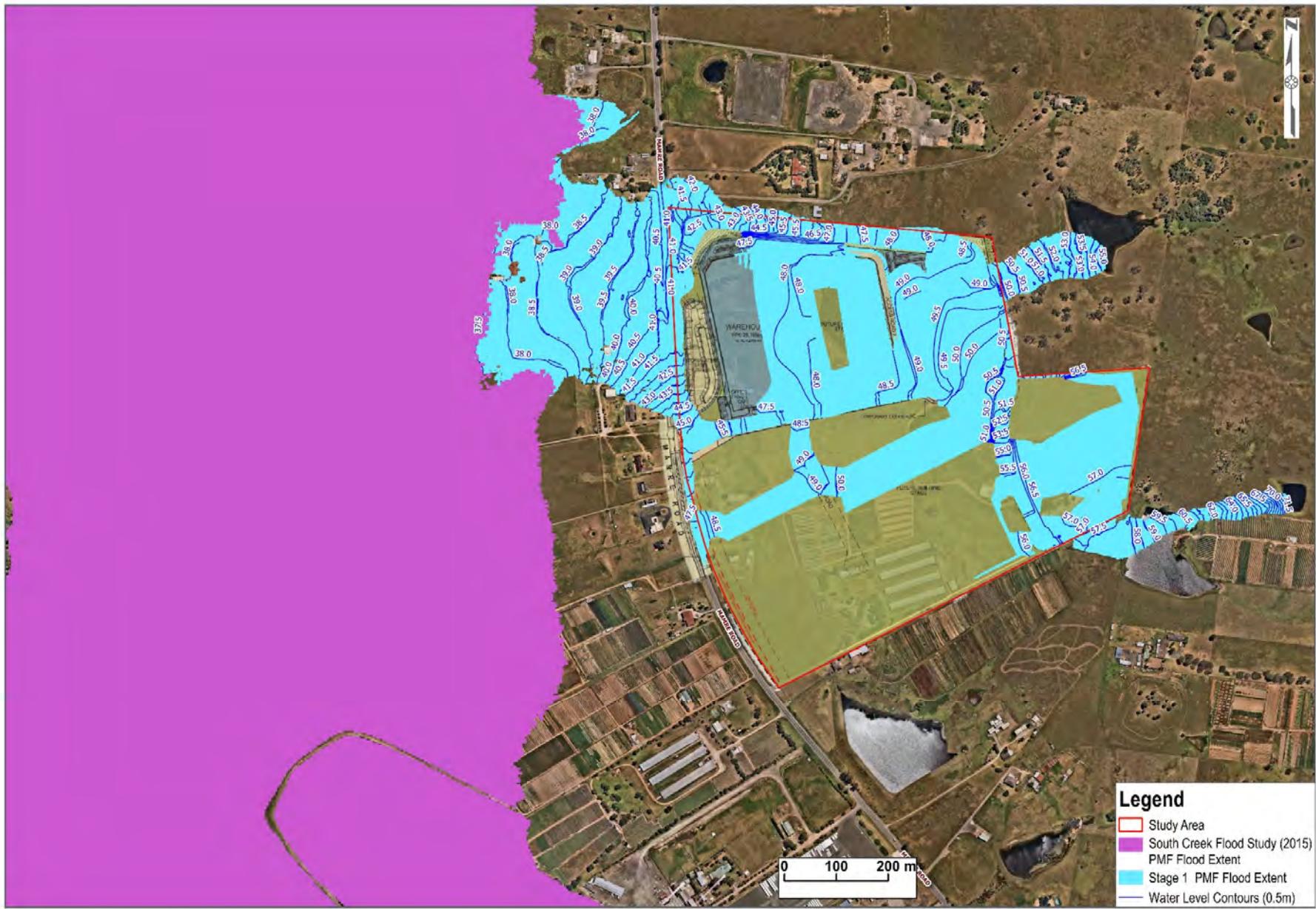


Figure 38 PMF Flood Extents and Flood Levels - Stage 1 Conditions

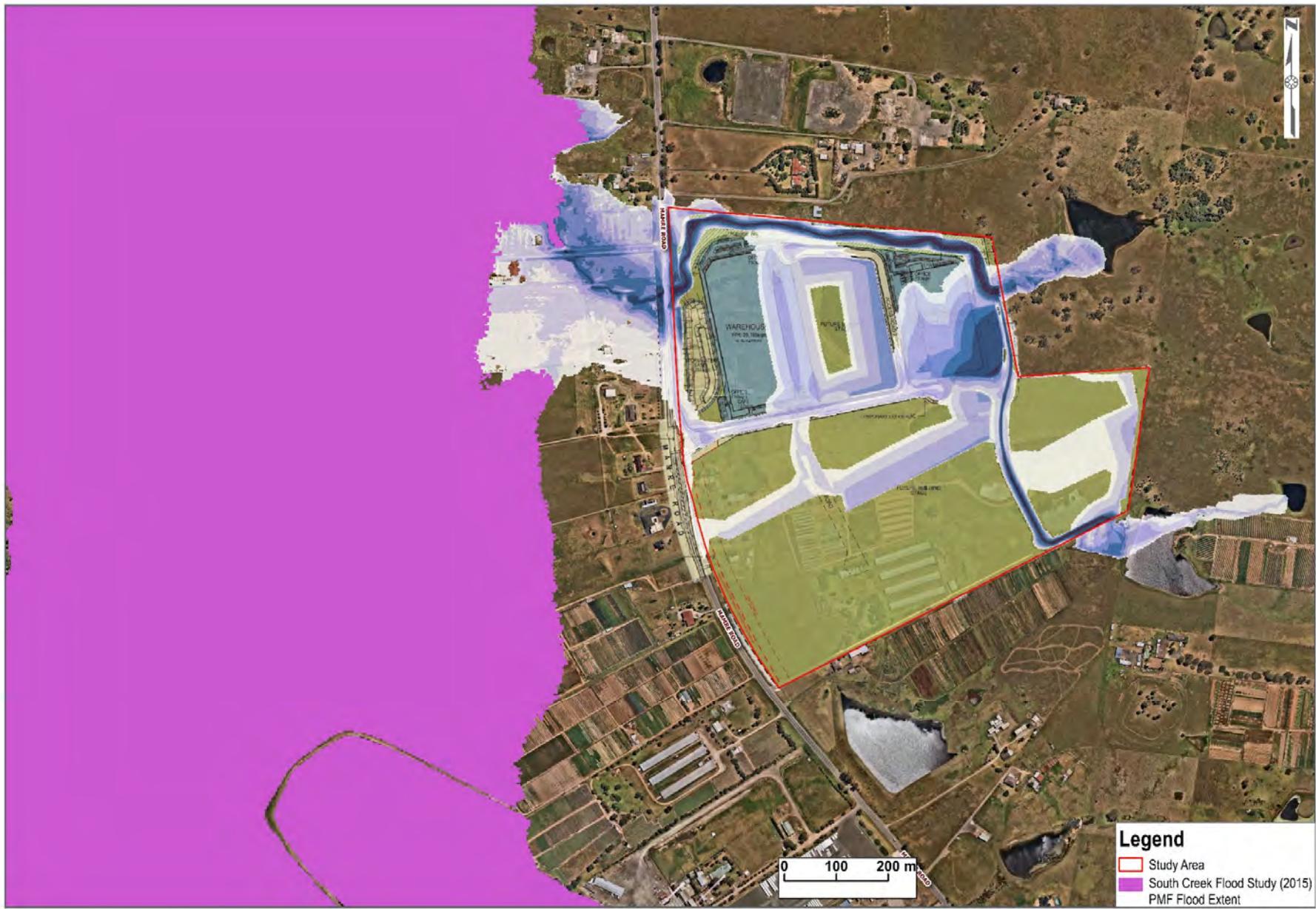


Figure 39 PMF Flood Depths - Stage 1 Conditions



Figure 40 PMF Flood Velocities - Stage 1 Conditions

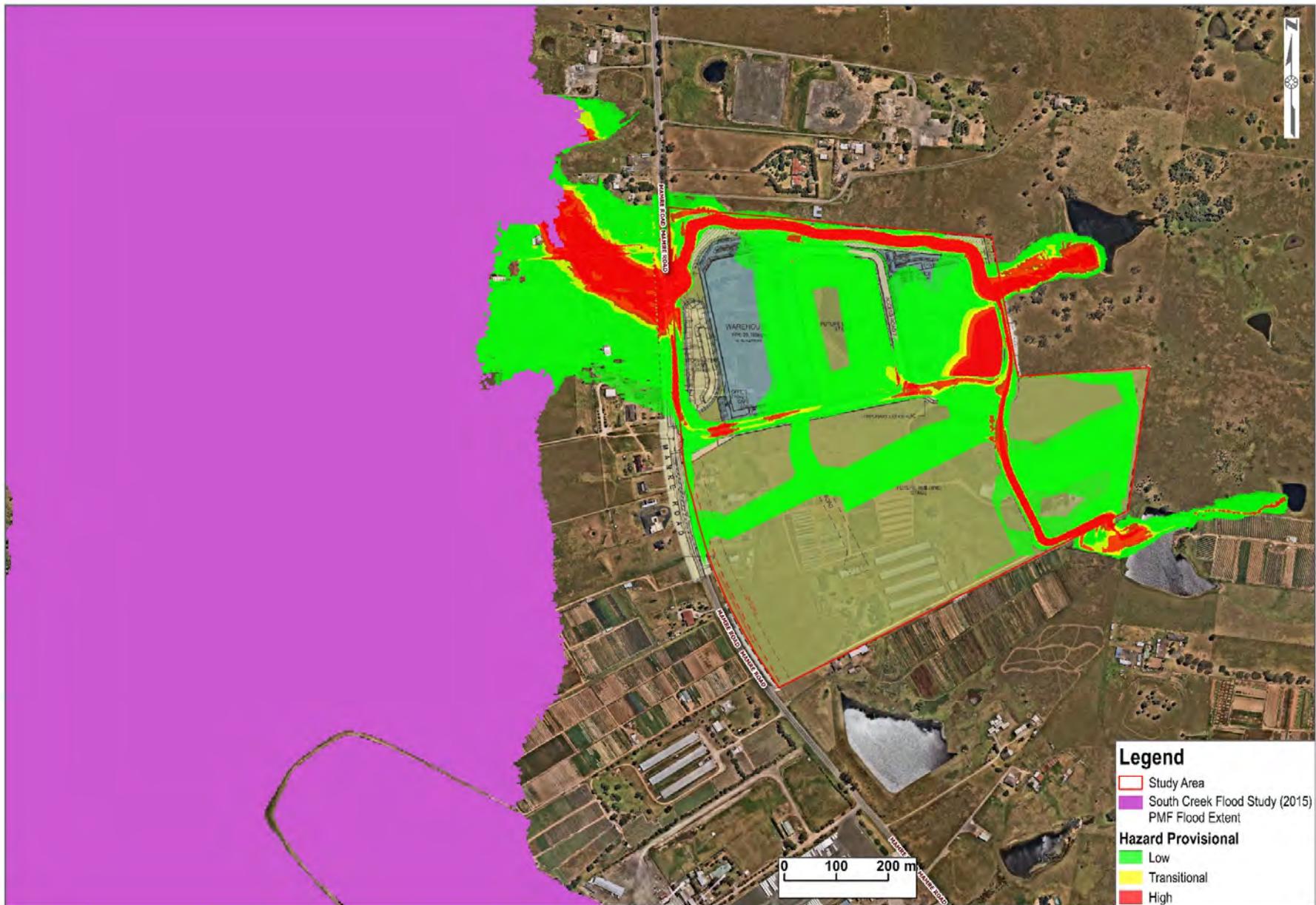


Figure 41 PMF Flood Hazards - Stage 1 Conditions

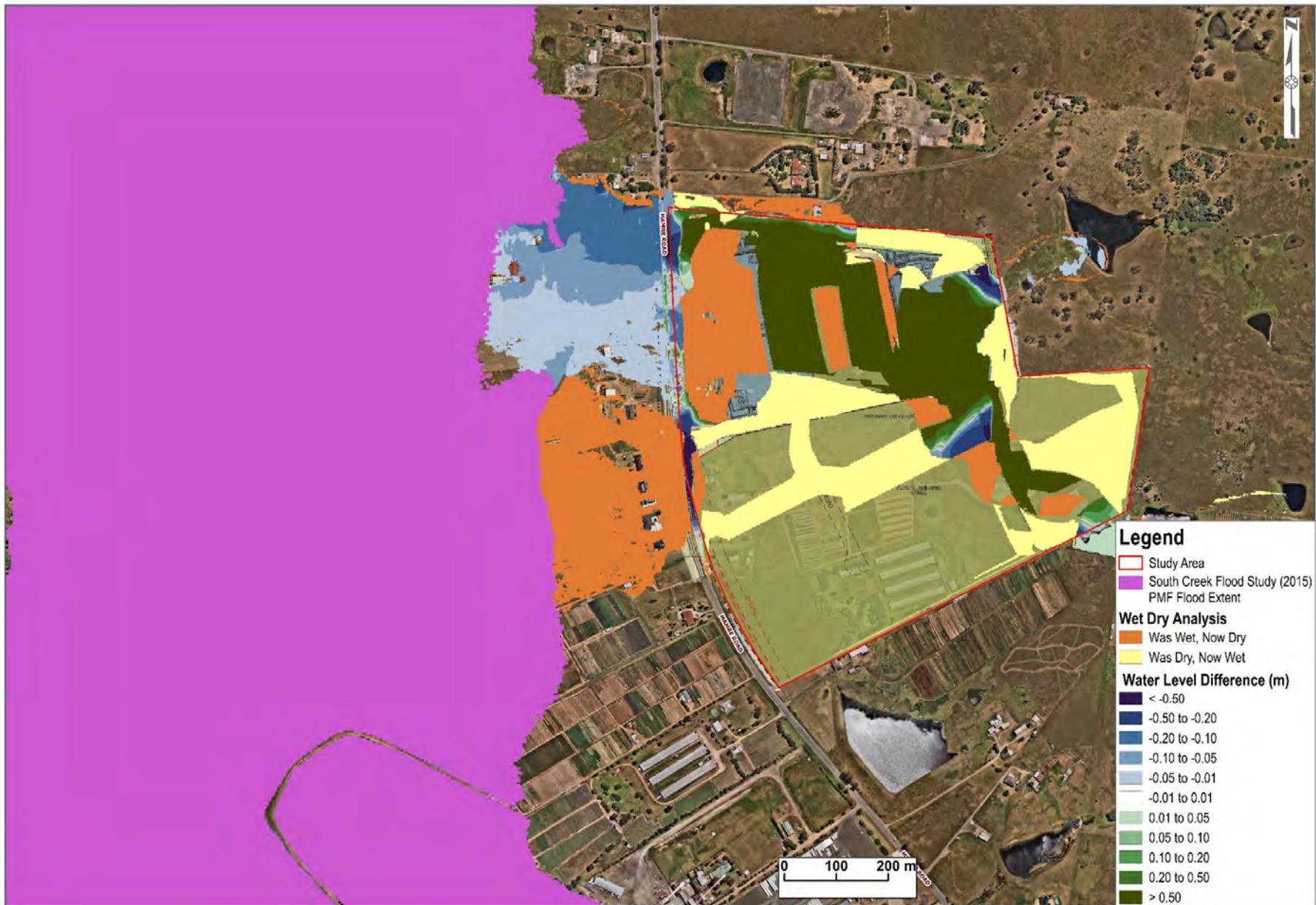


Figure 42 PMF Level Differences - (Stage 1 Conditions – Benchmark Conditions)

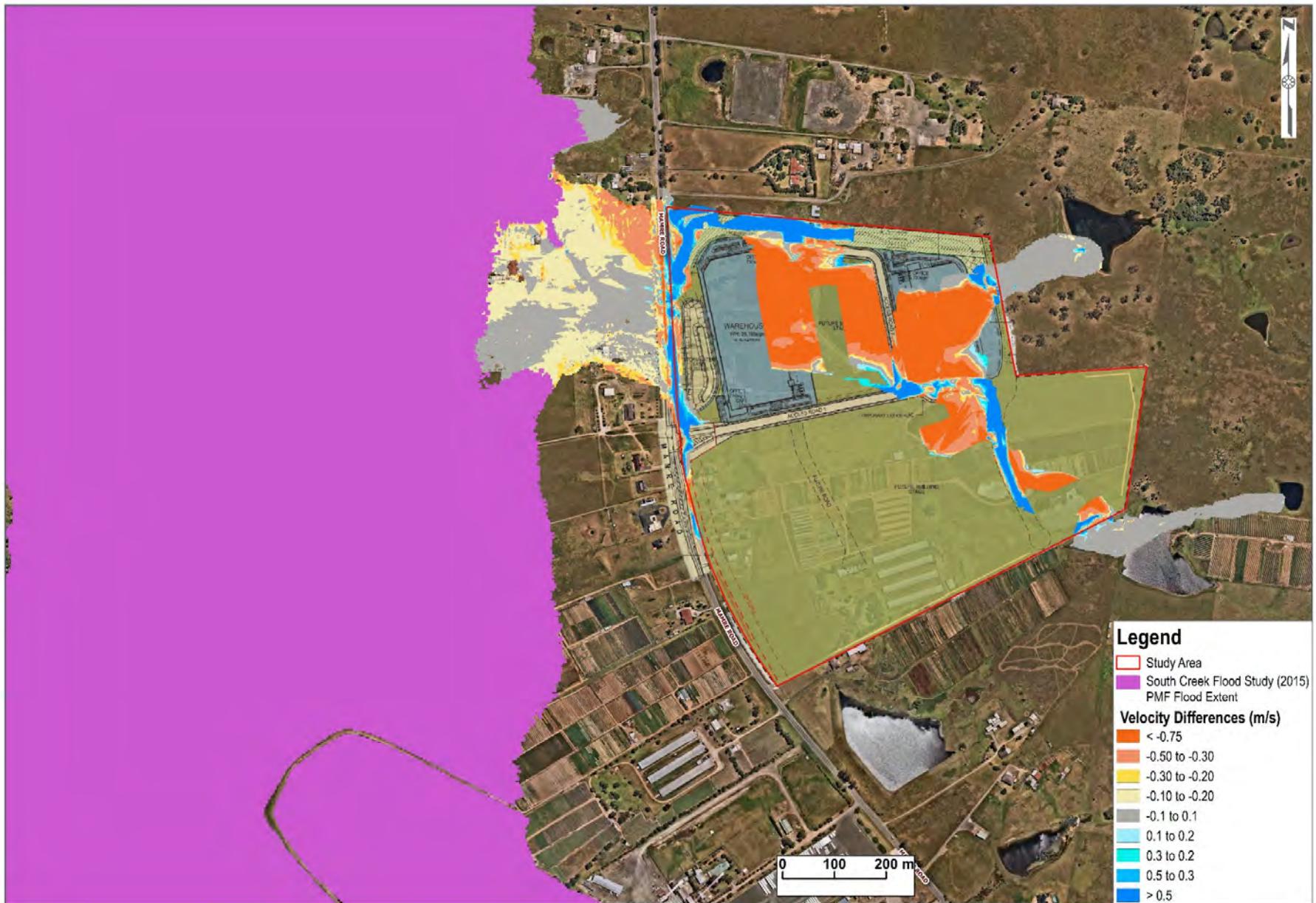


Figure 43 PMF Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)

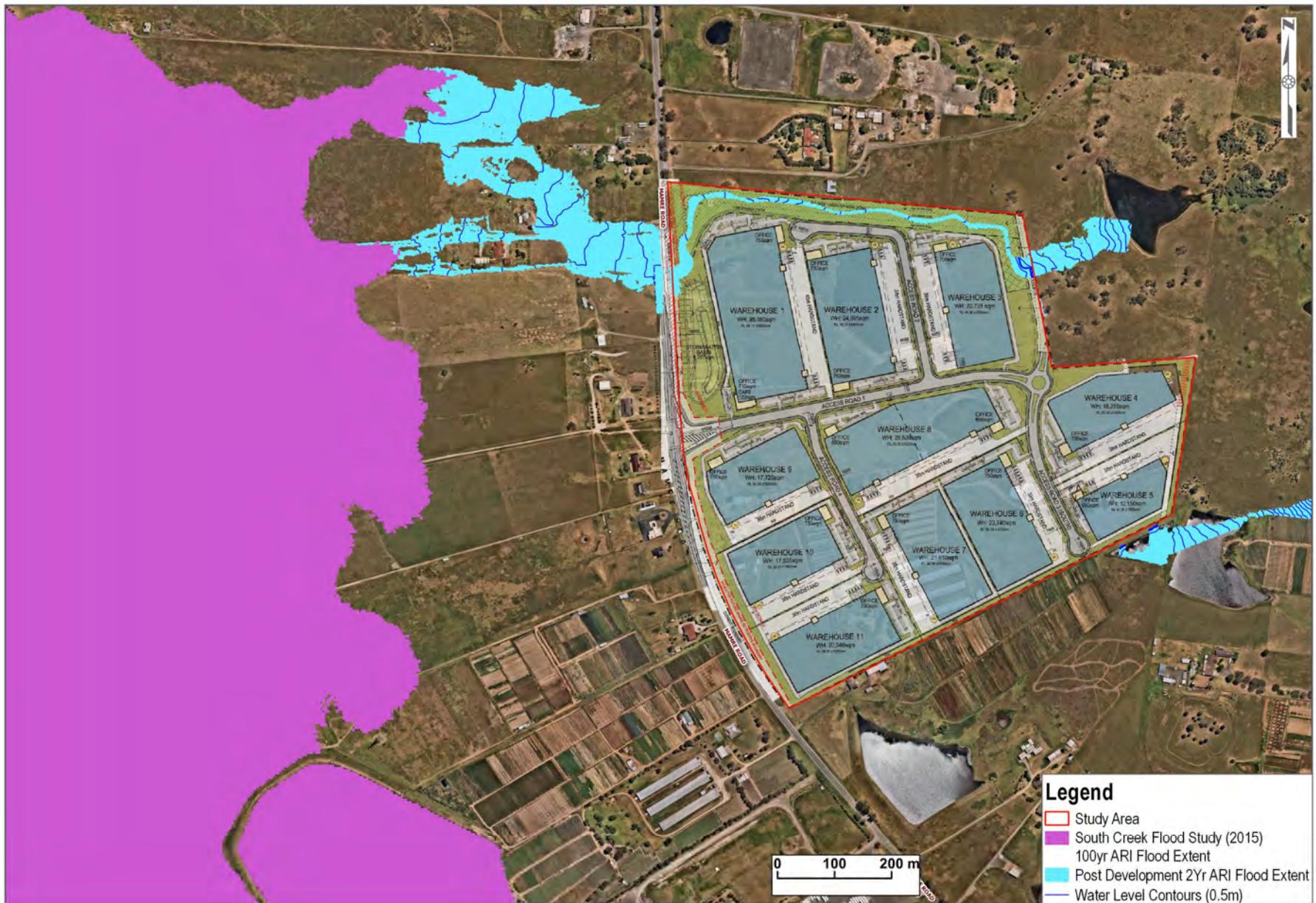


Figure 44 2 yr ARI Flood Extents and Flood Levels – Final Masterplan Conditions

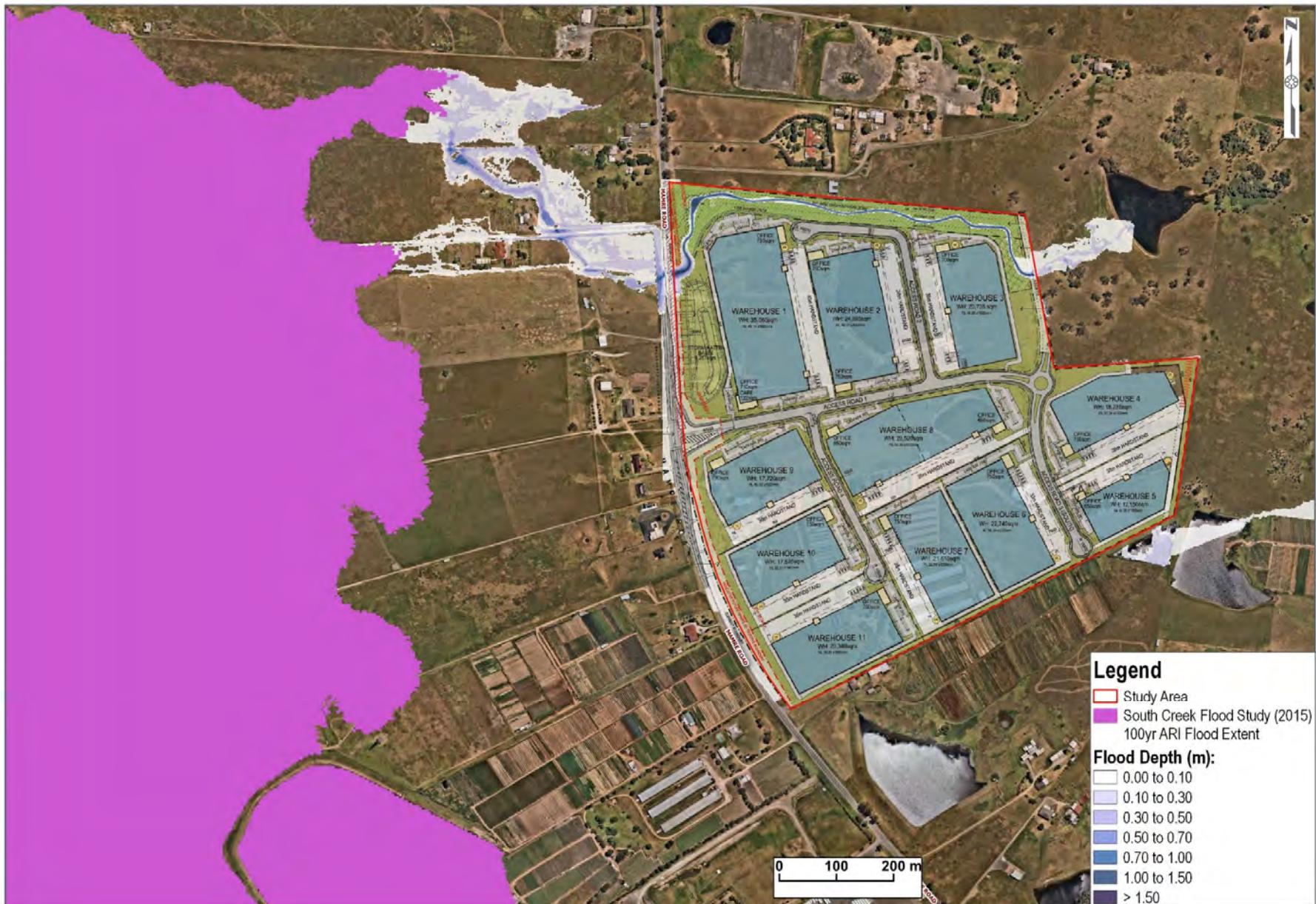


Figure 45 2 yr ARI Flood Depths - Final Masterplan Conditions

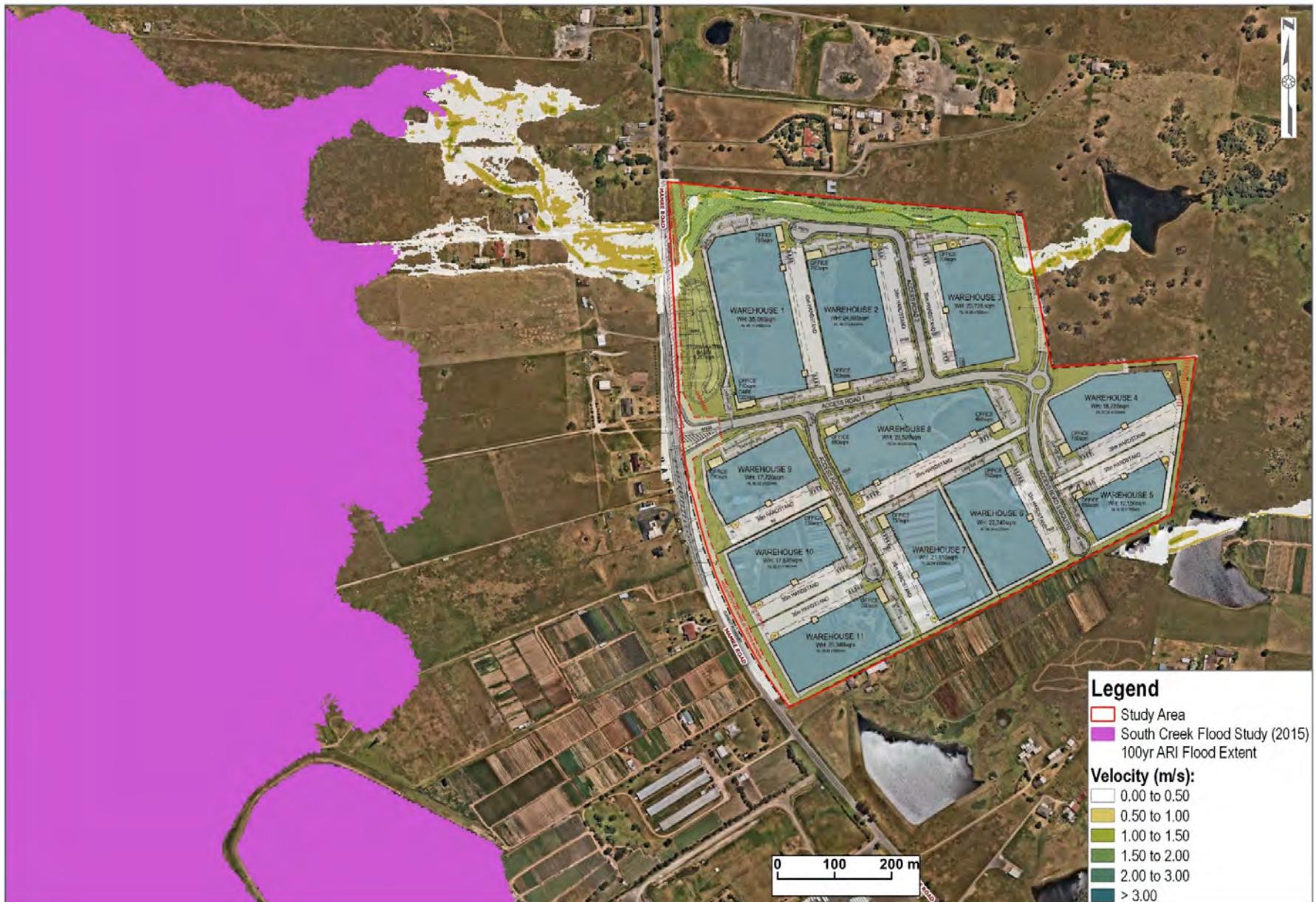


Figure 46 2 yr ARI Flood Velocities - Final Masterplan Conditions

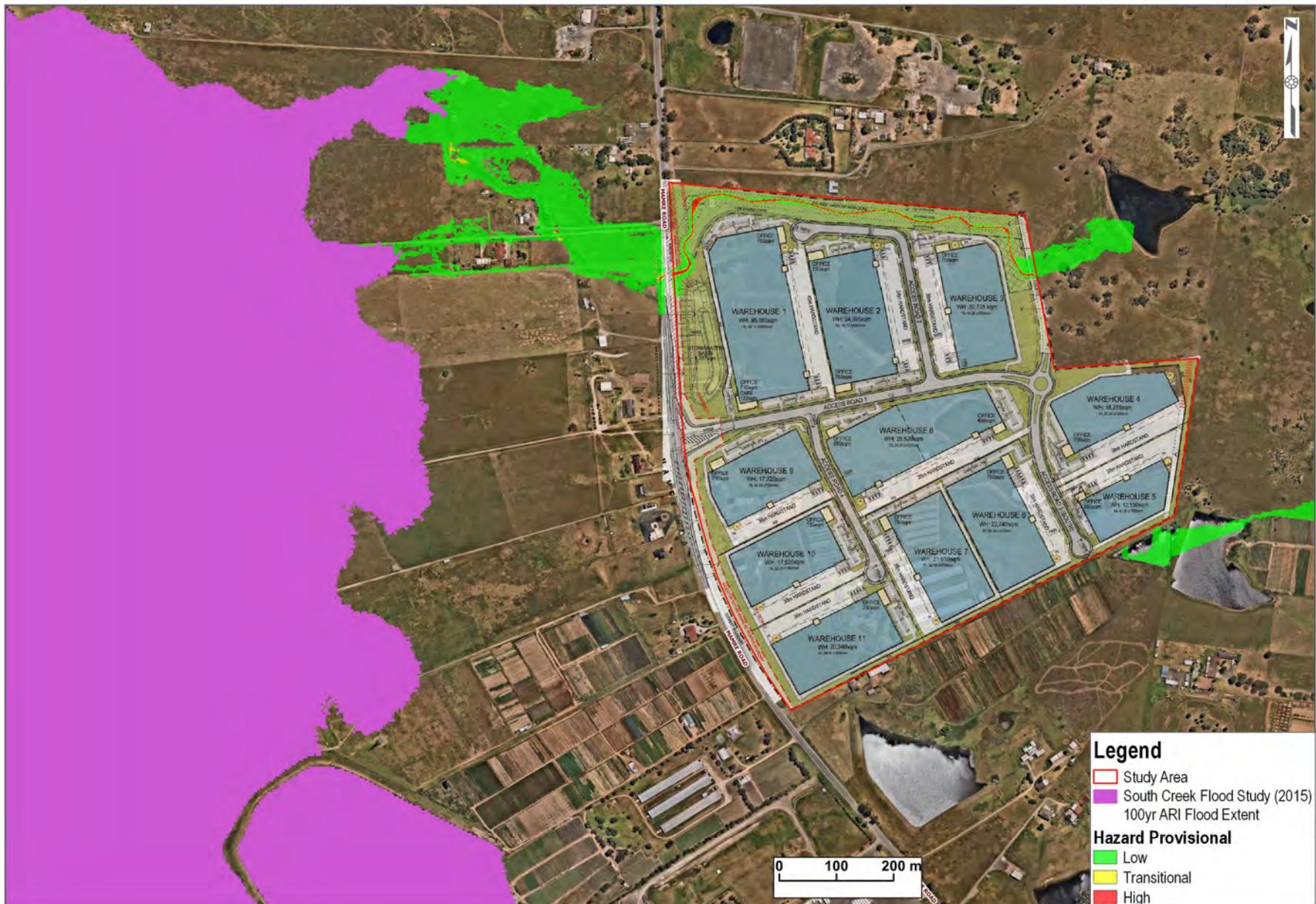


Figure 47 2 yr ARI Flood Hazards - Final Masterplan Conditions

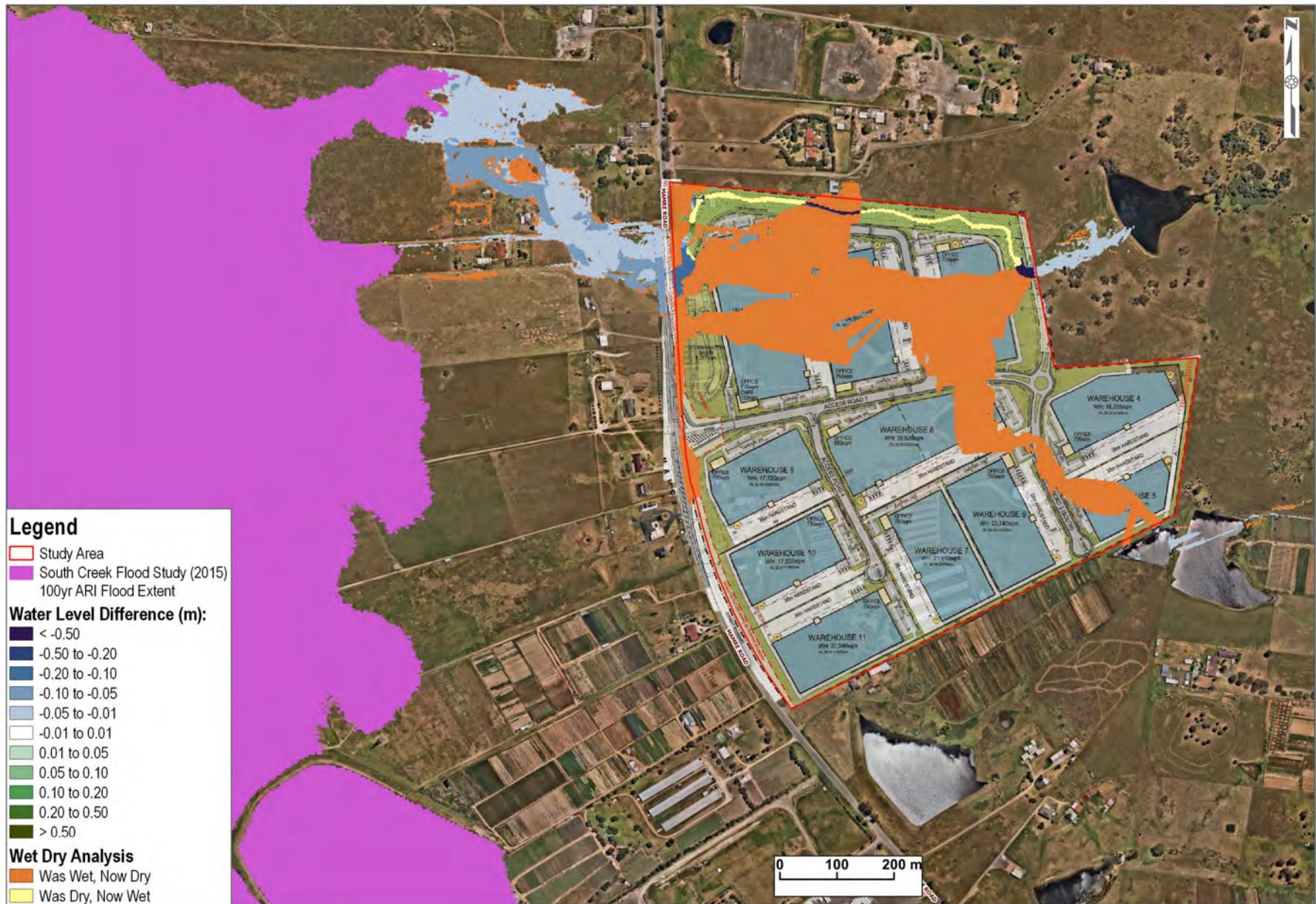


Figure 48 2 yr ARI Level Differences - (Final Masterplan Conditions – Benchmark Conditions)

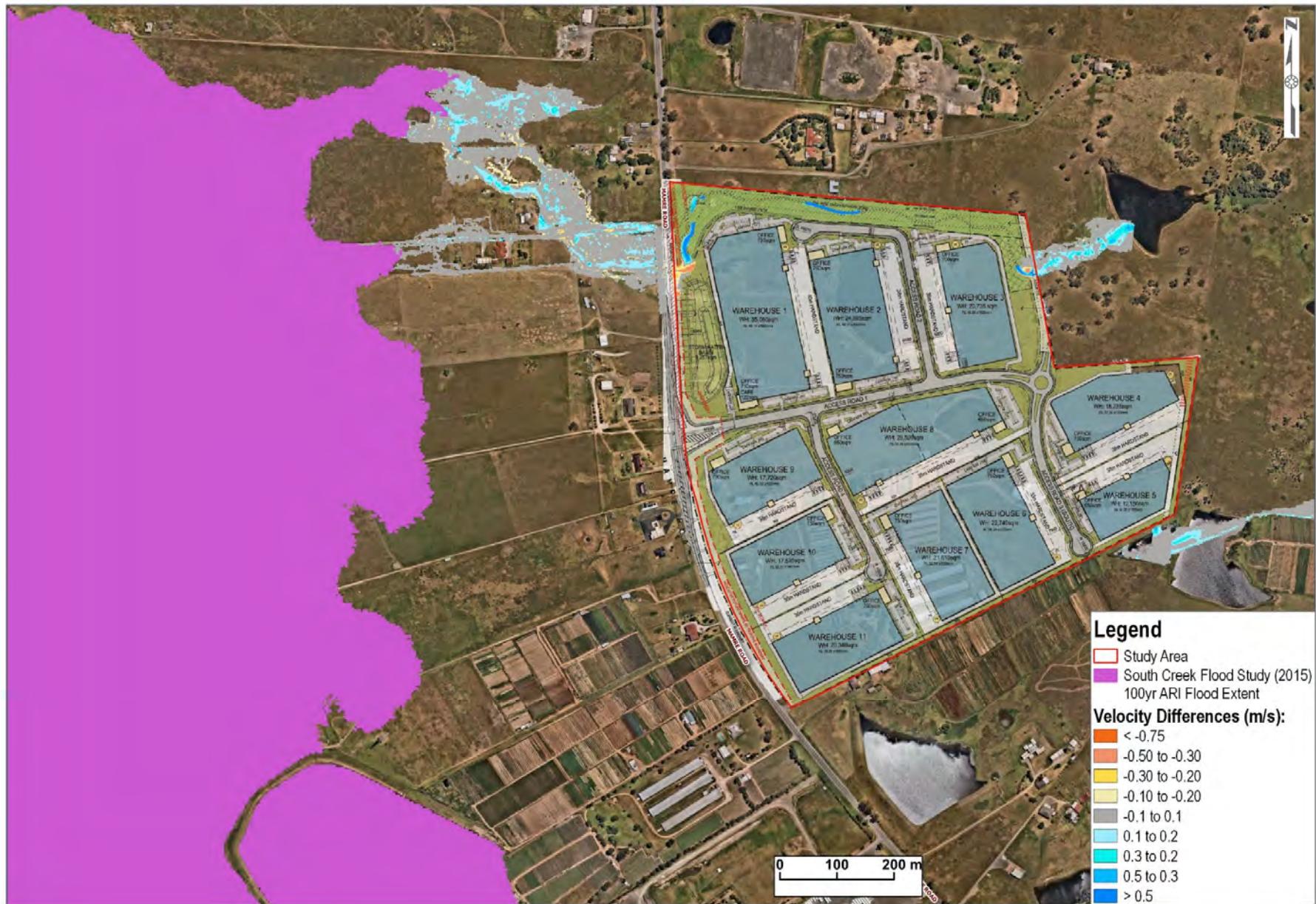


Figure 49 2 yr ARI Velocity Differences - (Final Masterplan Conditions – Benchmark Conditions)

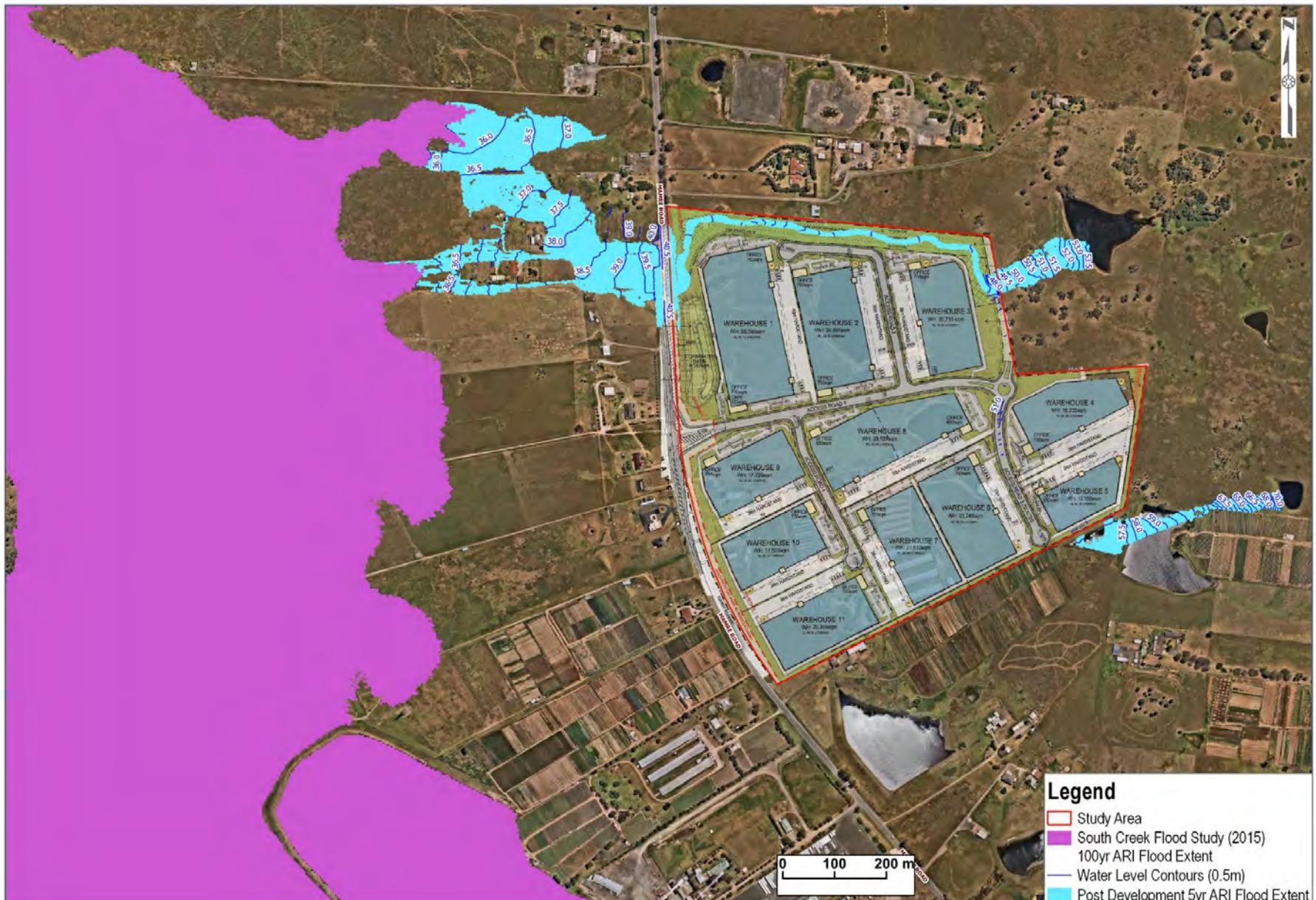


Figure 50 5 yr ARI Flood Extents and Flood Levels - Final Masterplan Conditions

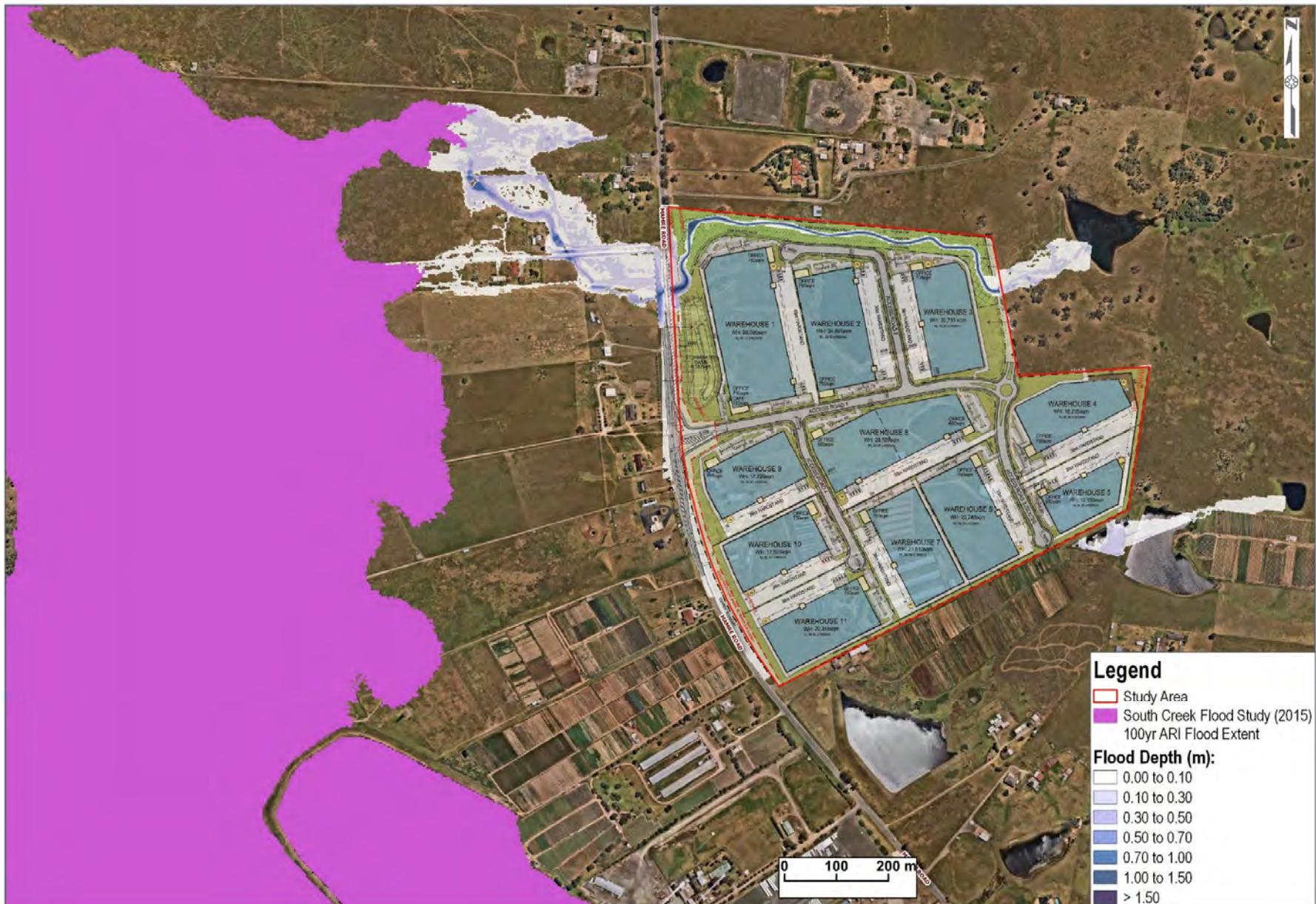


Figure 51 5 yr ARI Flood Depths - Final Masterplan Conditions

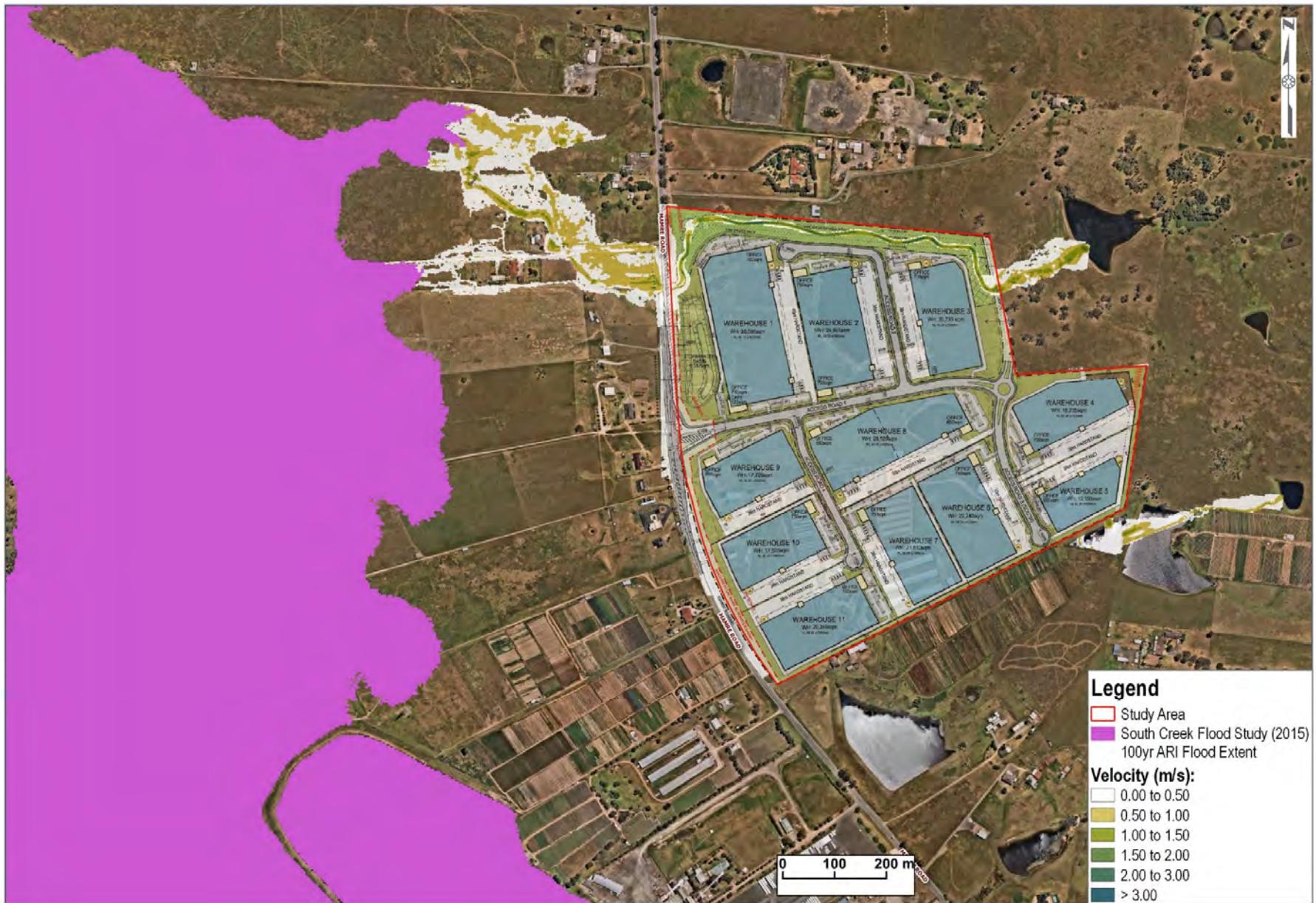


Figure 52 5 yr ARI Flood Velocities - Final Masterplan Conditions

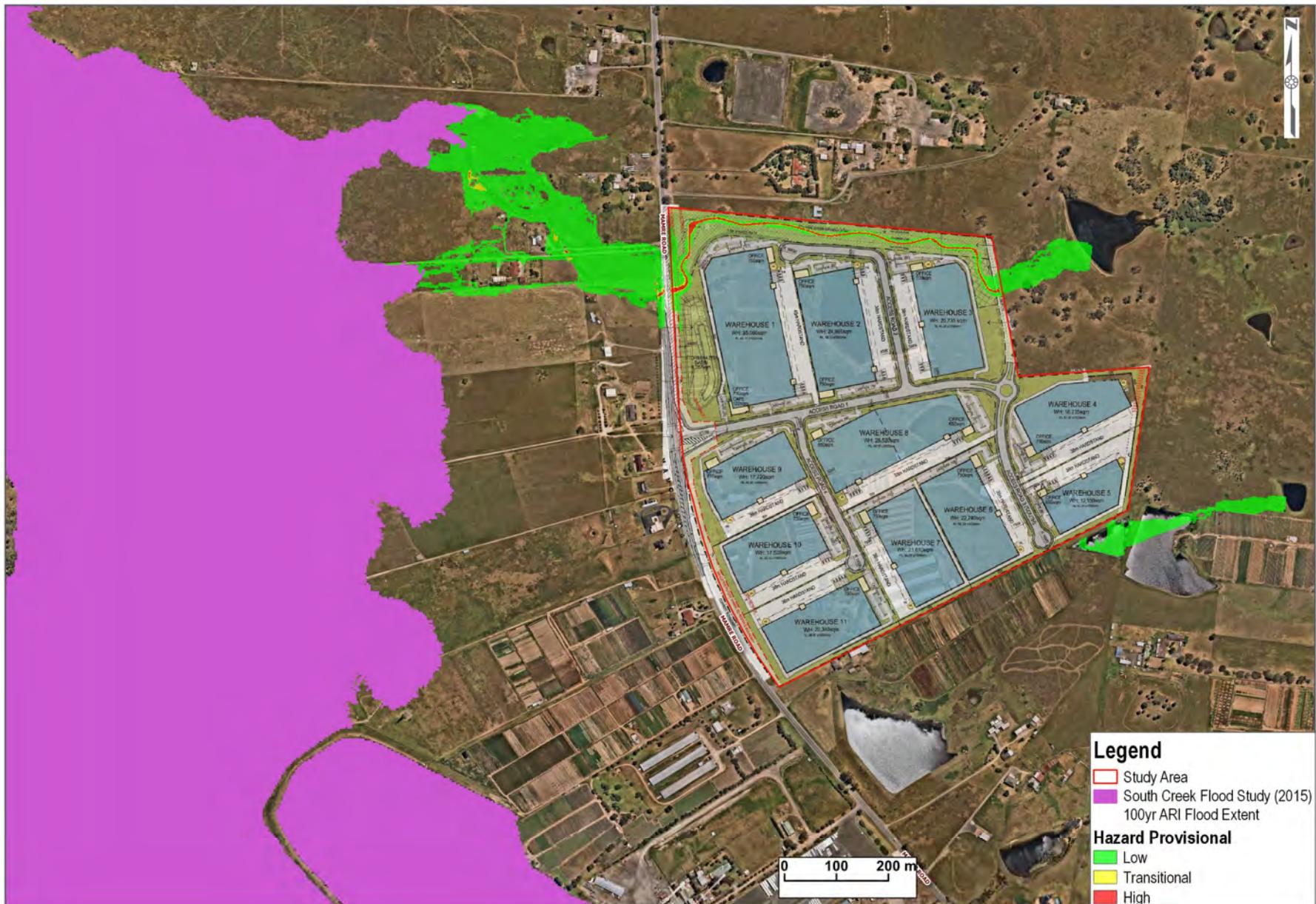


Figure 53 5 yr ARI Flood Hazards - Final Masterplan Conditions

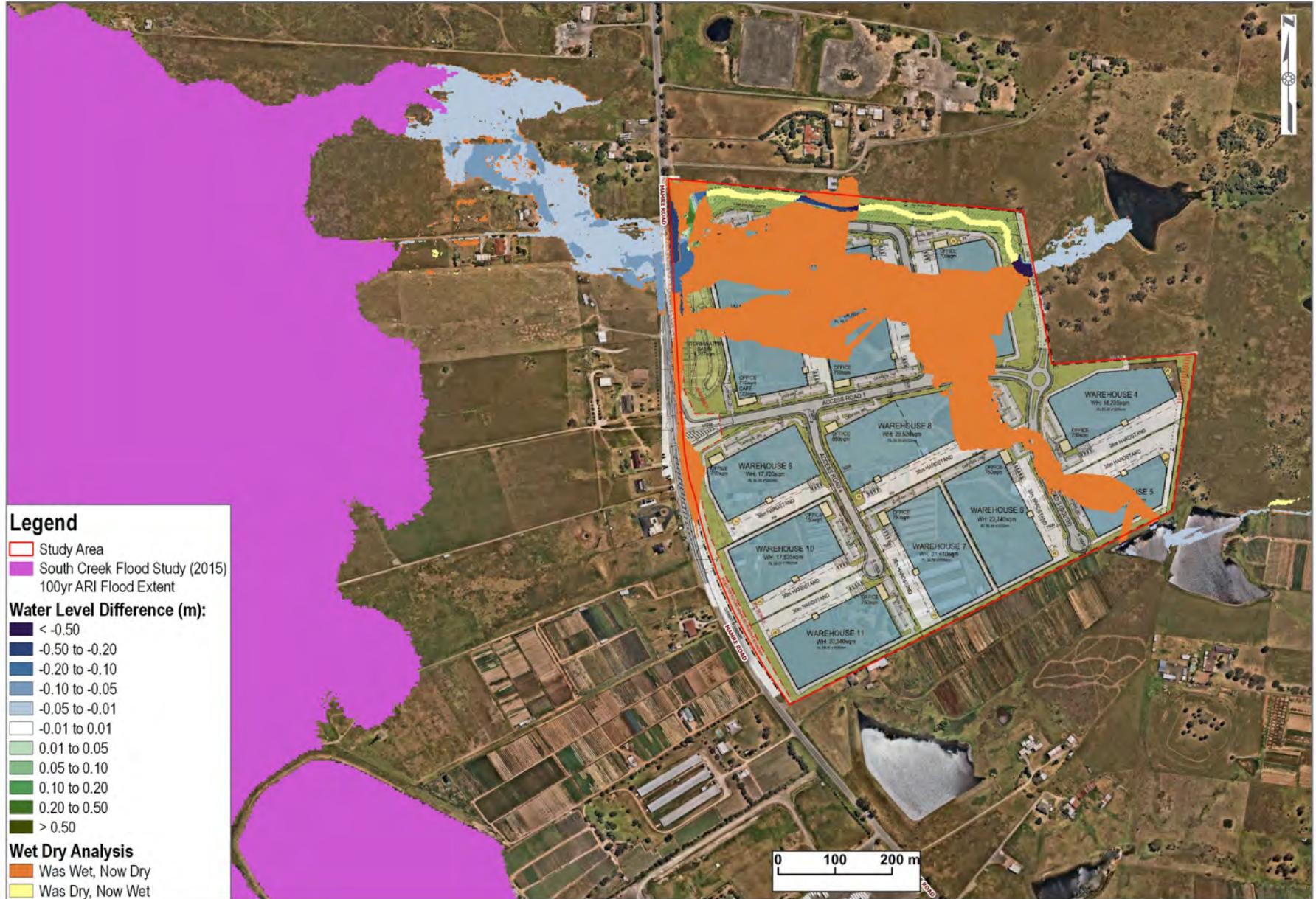


Figure 54 5 yr ARI Level Differences - (Final Masterplan Conditions – Benchmark Conditions)

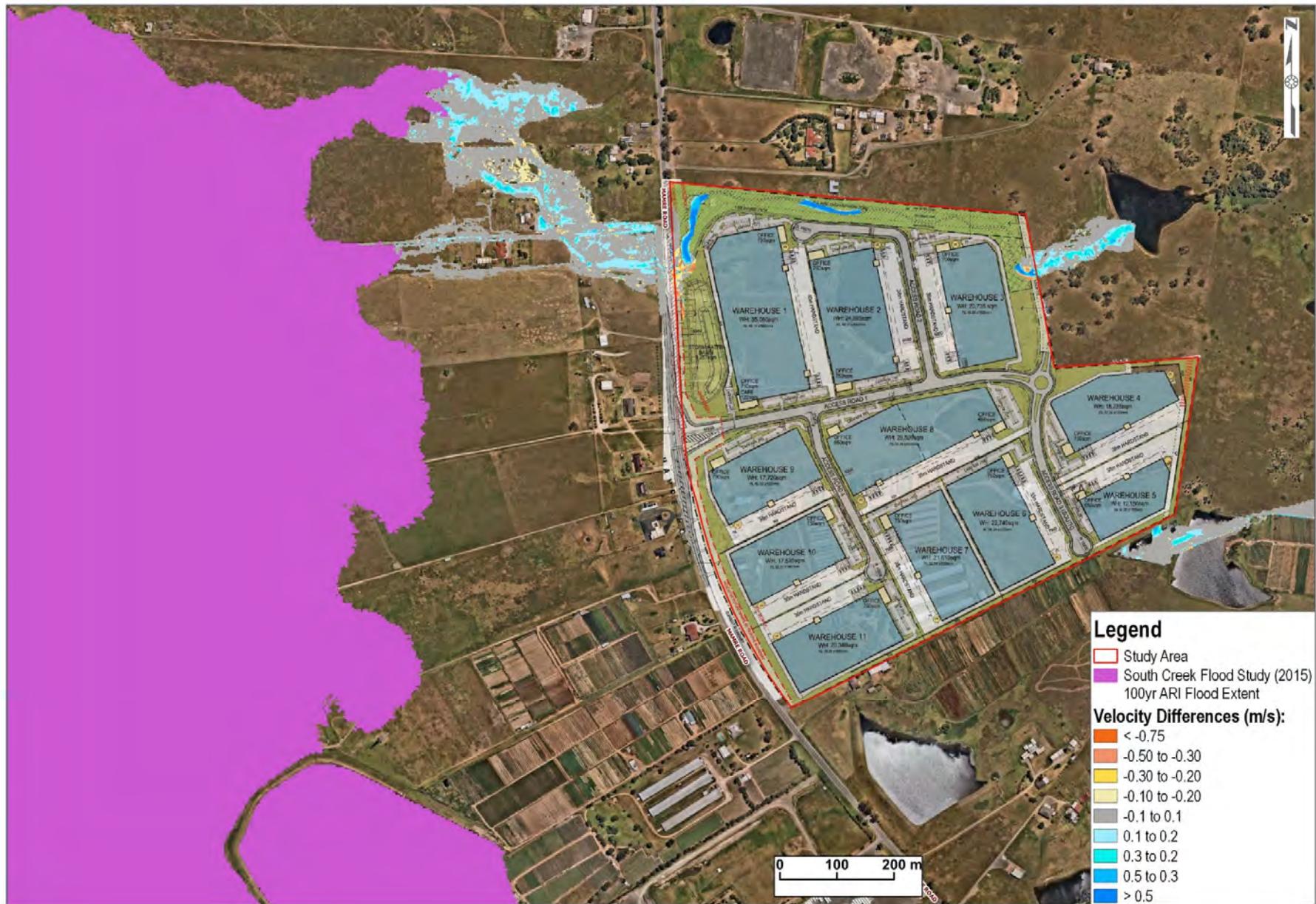


Figure 55 5 yr ARI Velocity Differences - (Final Masterplan Conditions – Benchmark Conditions)

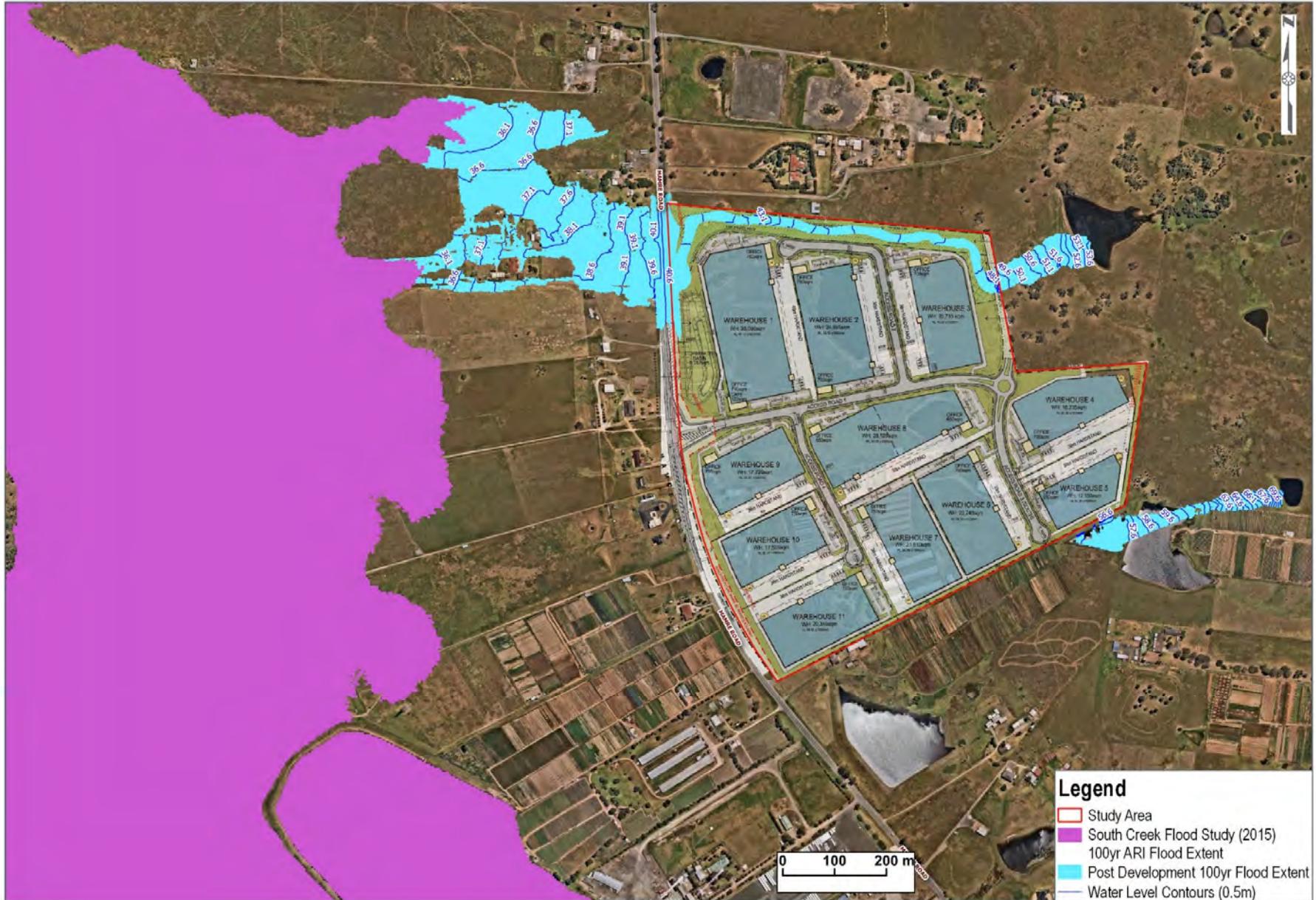


Figure 56 100 yr ARI Flood Extents and Flood Levels - Final Masterplan Conditions

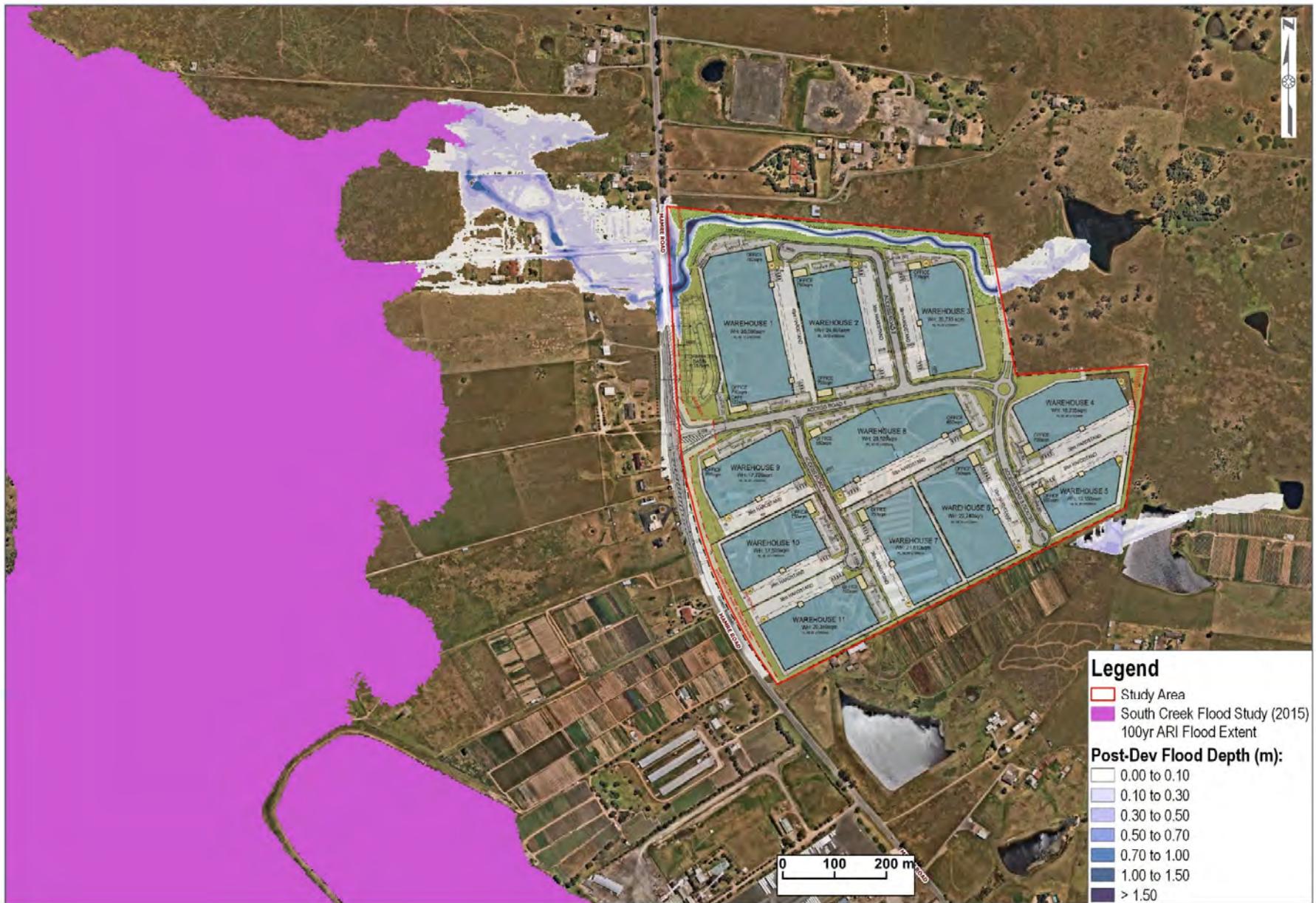


Figure 57 100 yr ARI Flood Depths - Final Masterplan Conditions

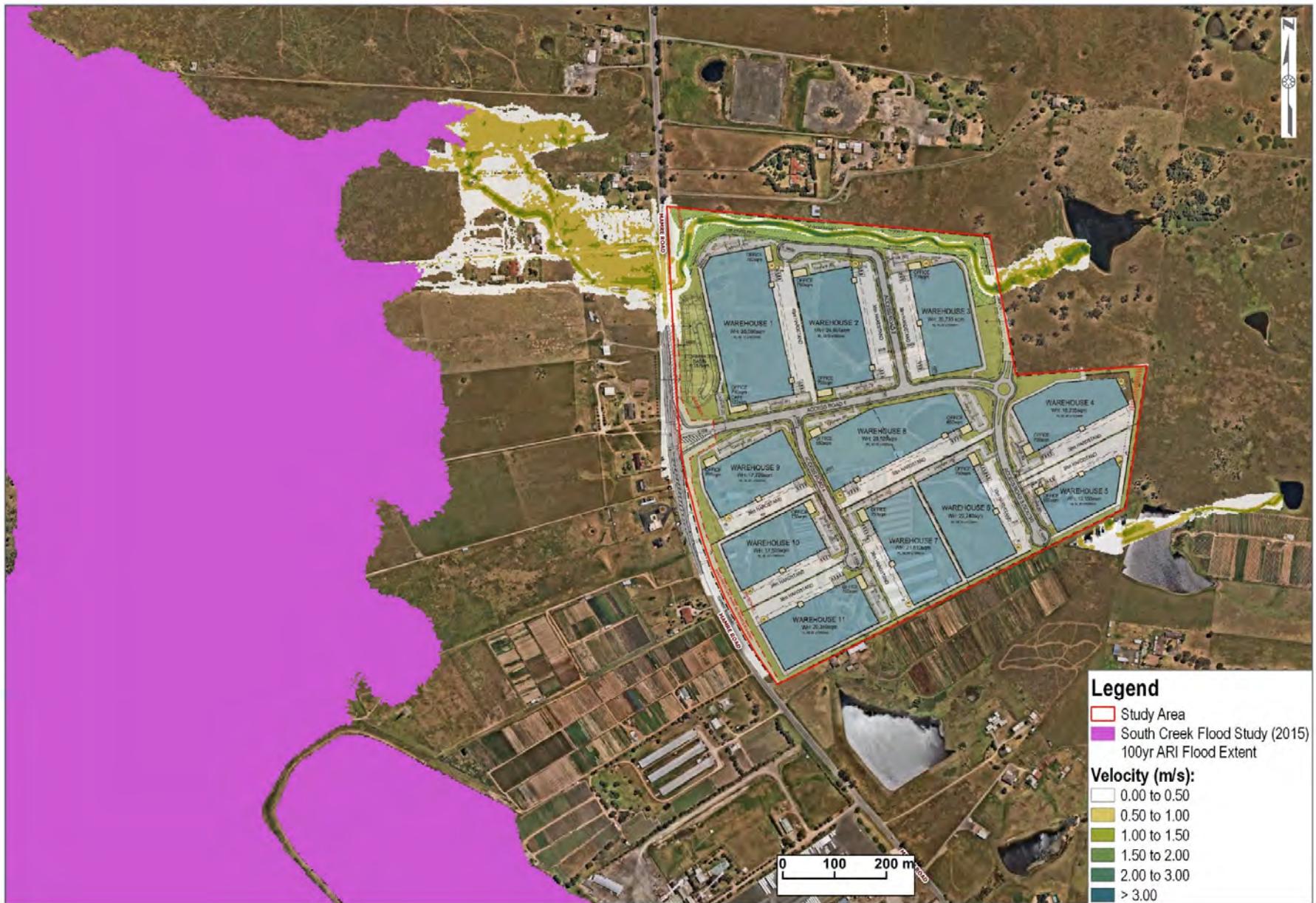


Figure 58 100 yr ARI Flood Velocities - Final Masterplan Conditions

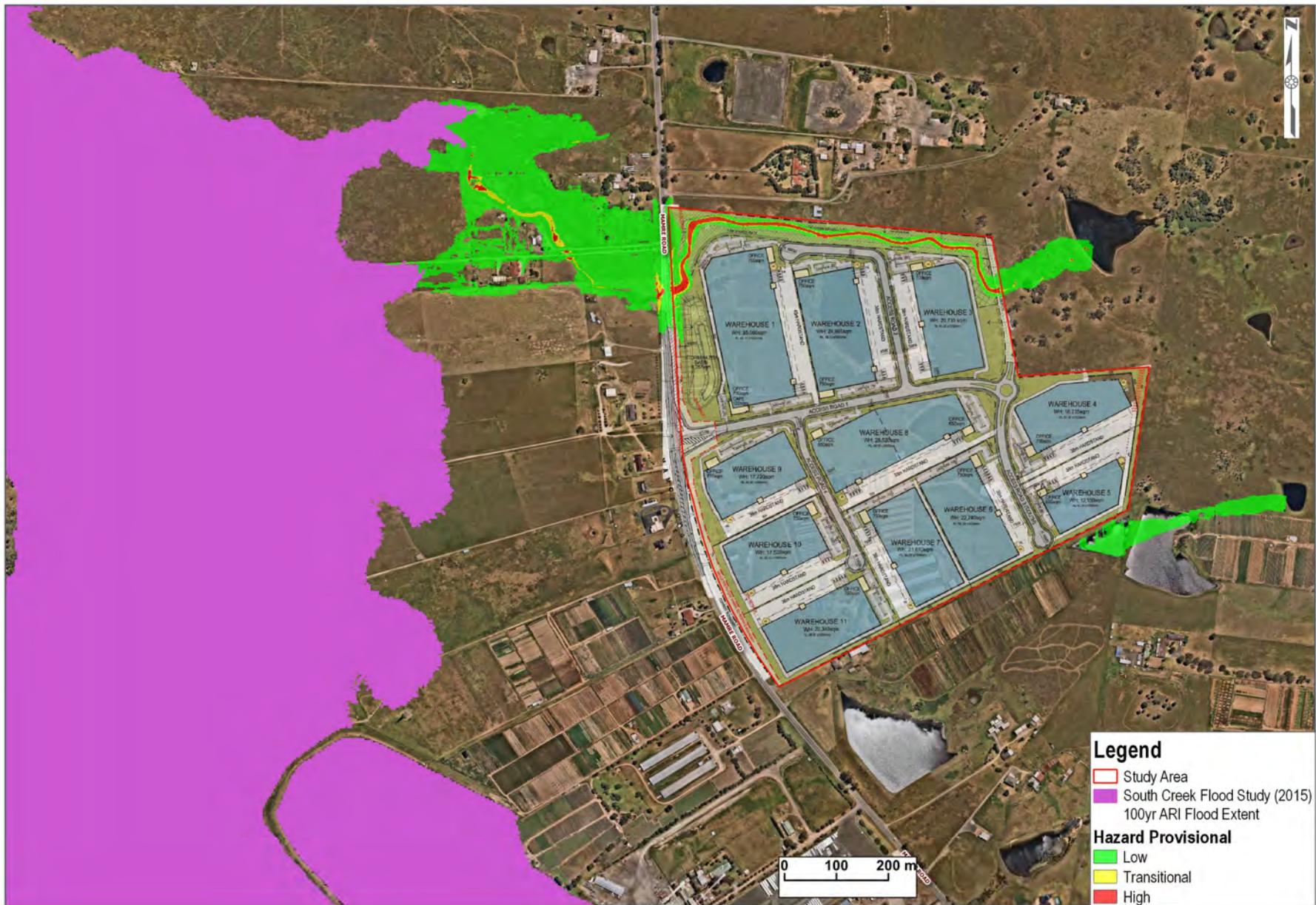


Figure 59 100 yr ARI Flood Hazards - Final Masterplan Conditions

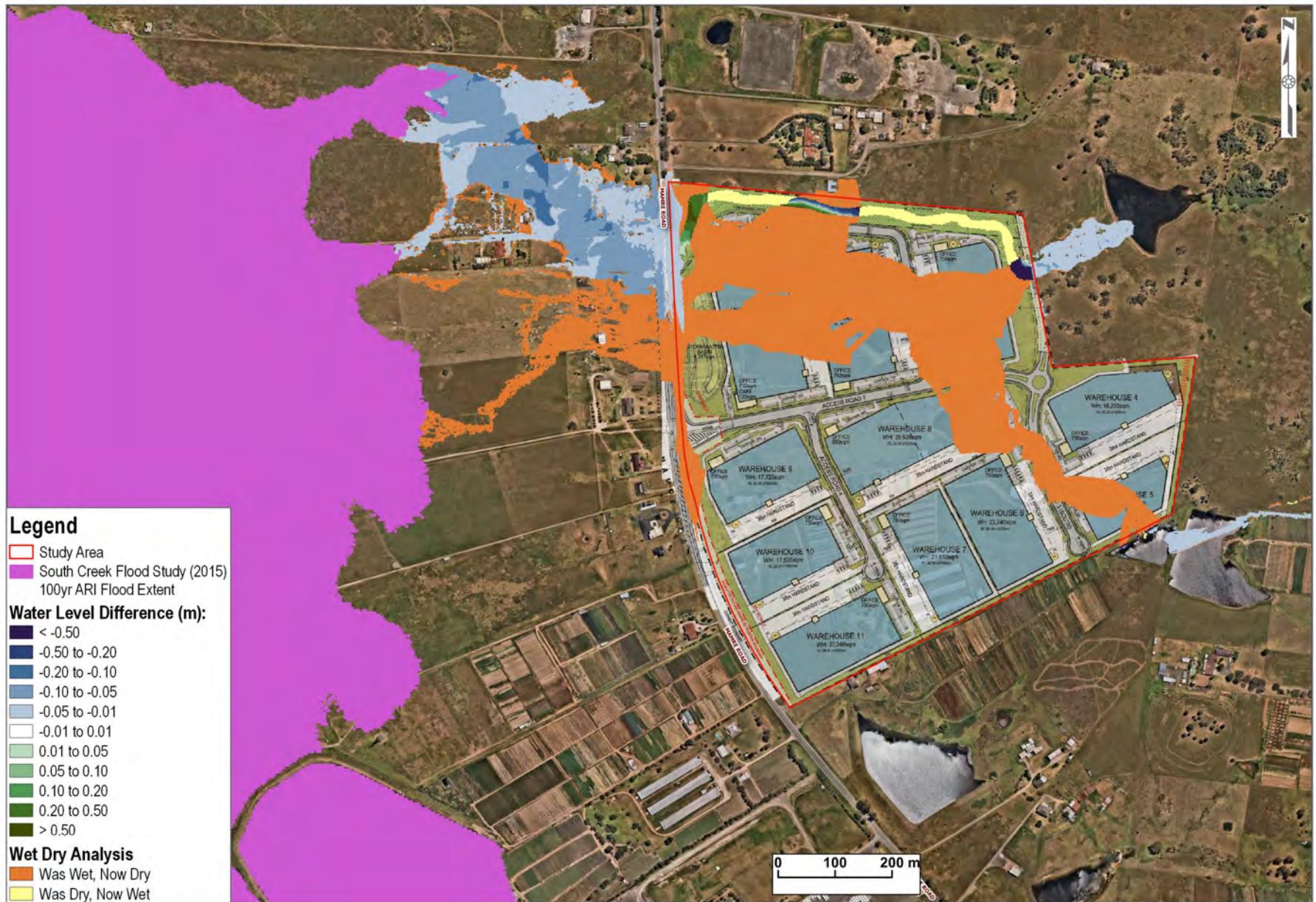


Figure 60 100 yr ARI Level Differences - (Final Masterplan Conditions – Benchmark Conditions)

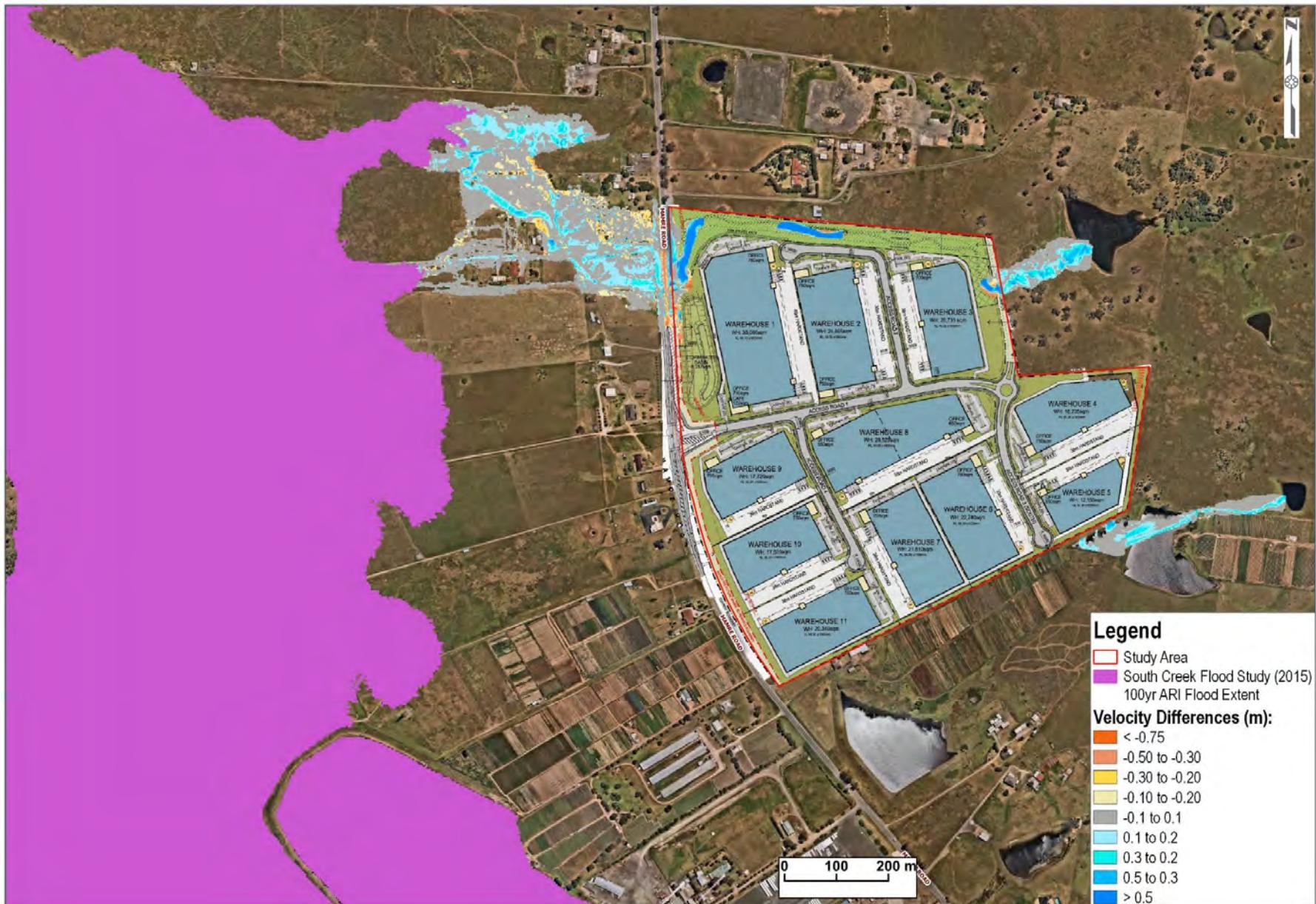


Figure 61 100 yr ARI Velocity Differences - (Final Masterplan Conditions – Benchmark Conditions)

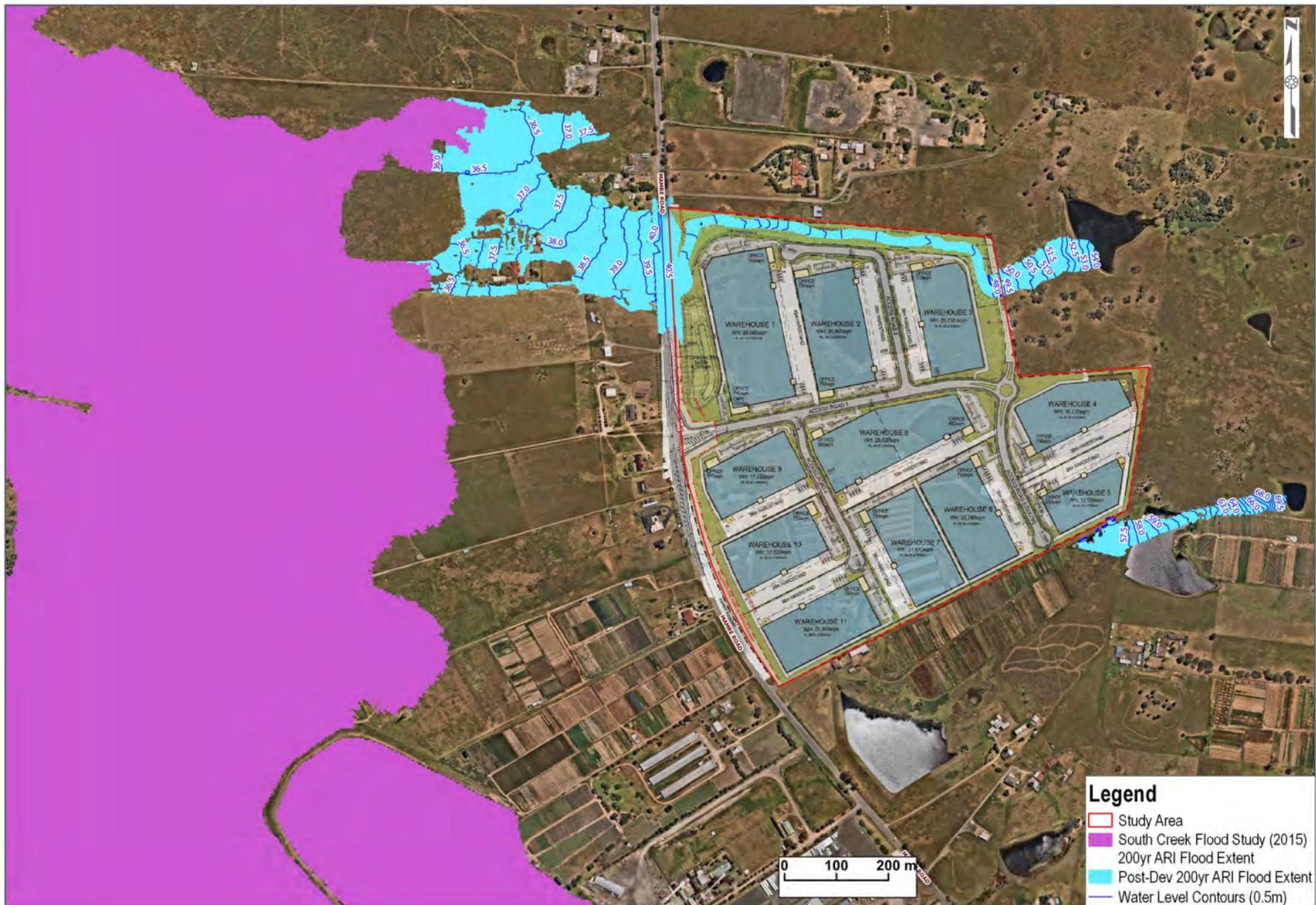


Figure 62 200 yr ARI Flood Extents and Flood Levels - Final Masterplan Conditions

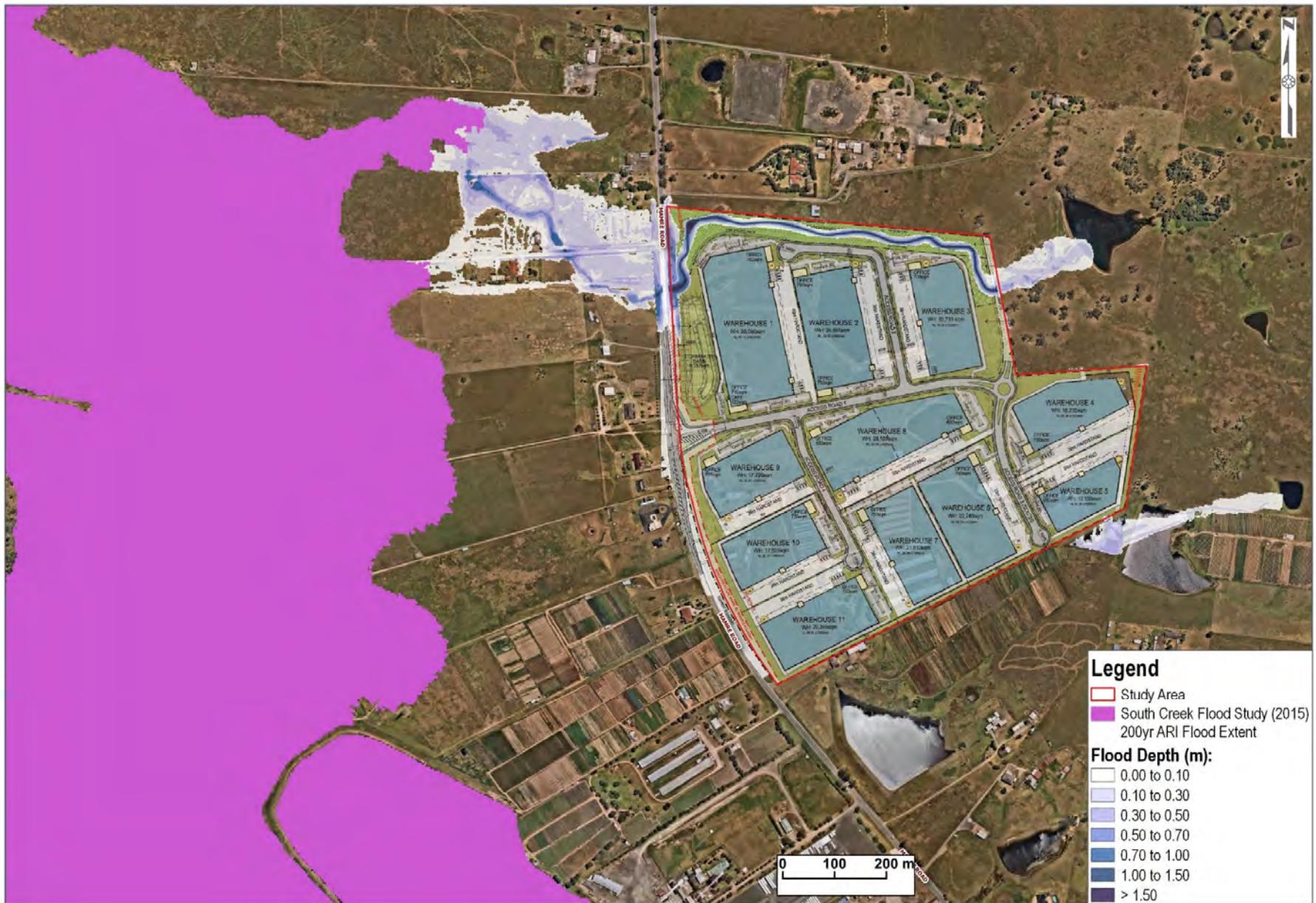


Figure 63 200 yr ARI Flood Depths - Final Masterplan Conditions

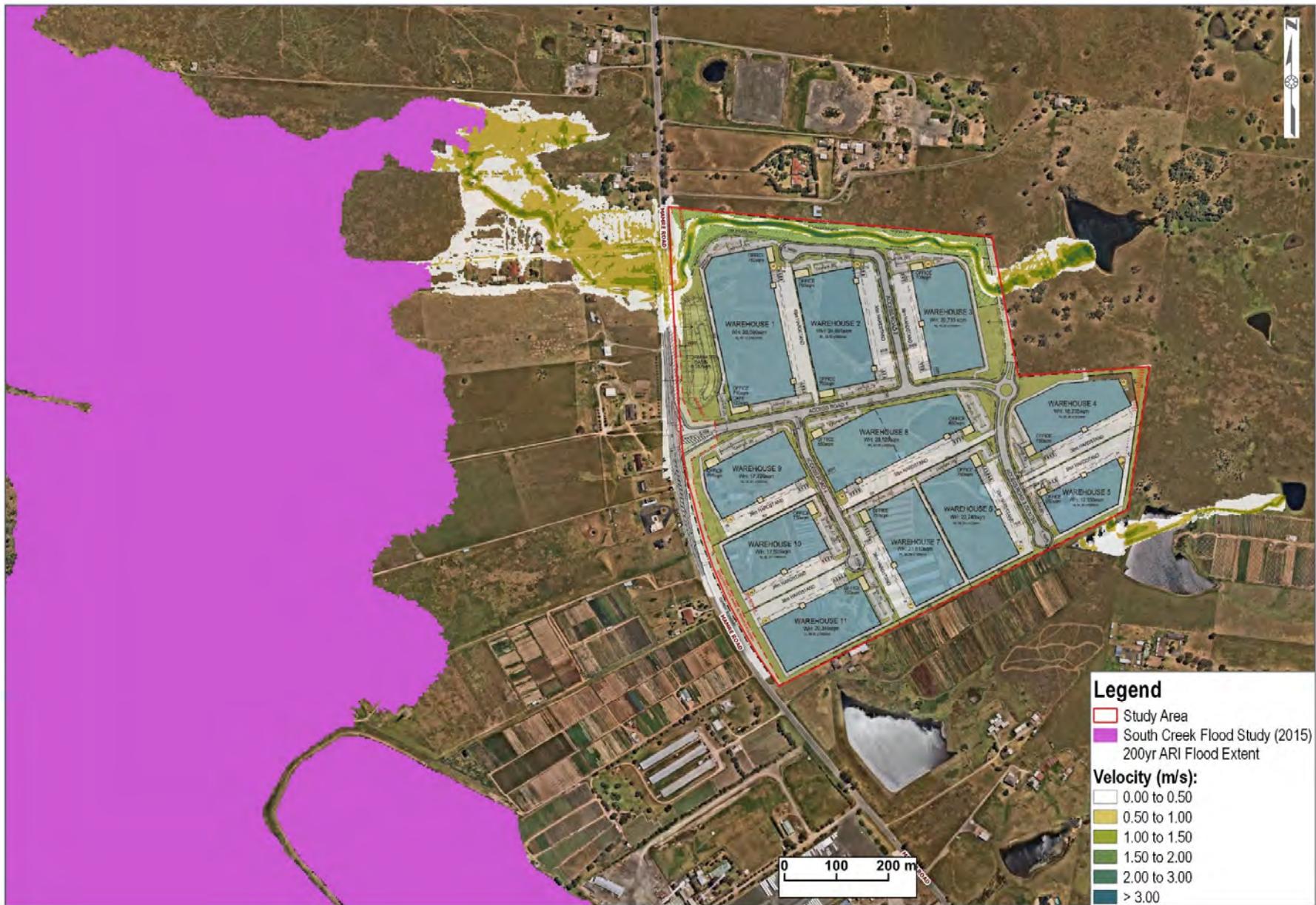


Figure 64 200 yr ARI Flood Velocities - Final Masterplan Conditions

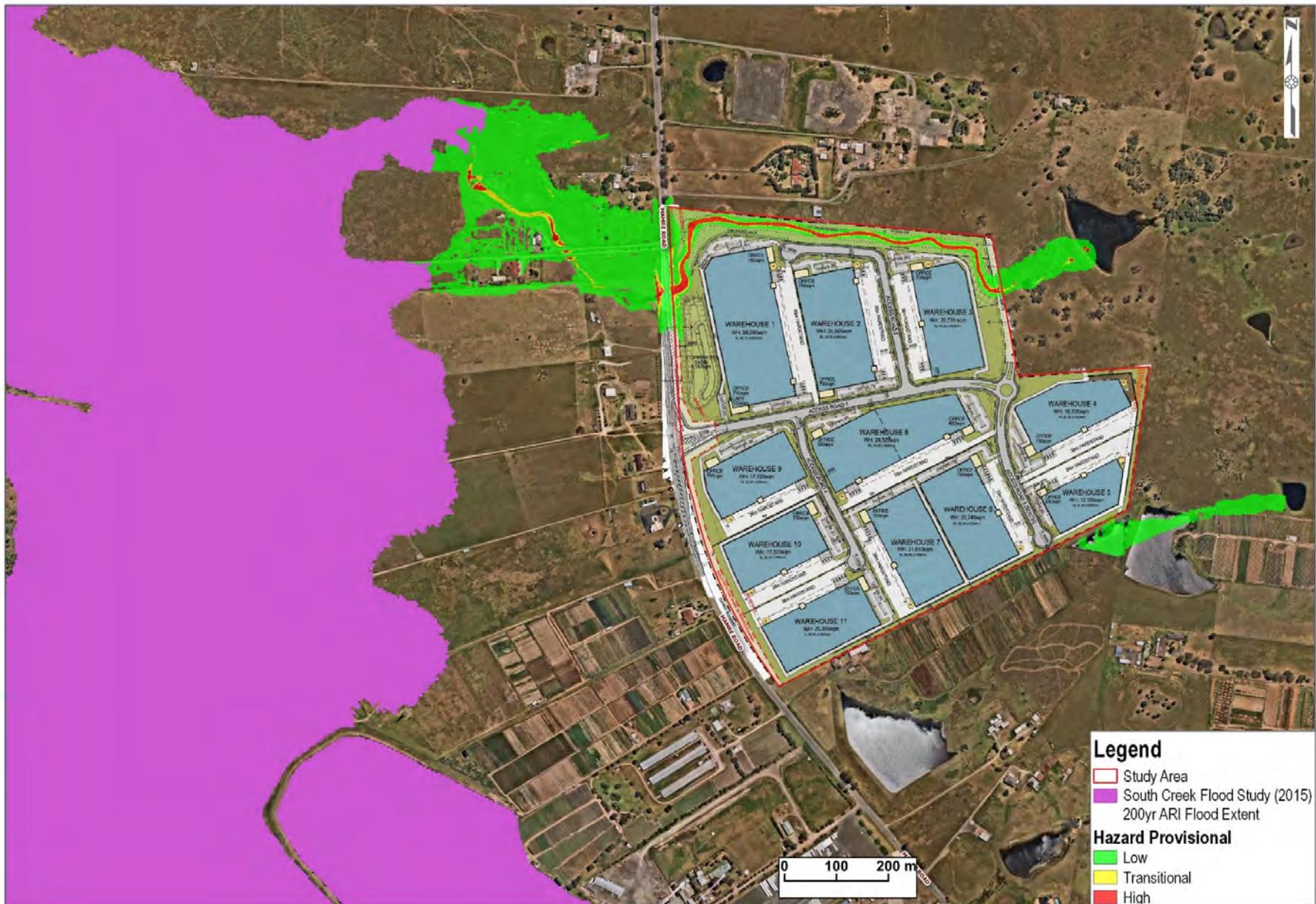


Figure 65 200 yr ARI Flood Hazards - Final Masterplan Conditions

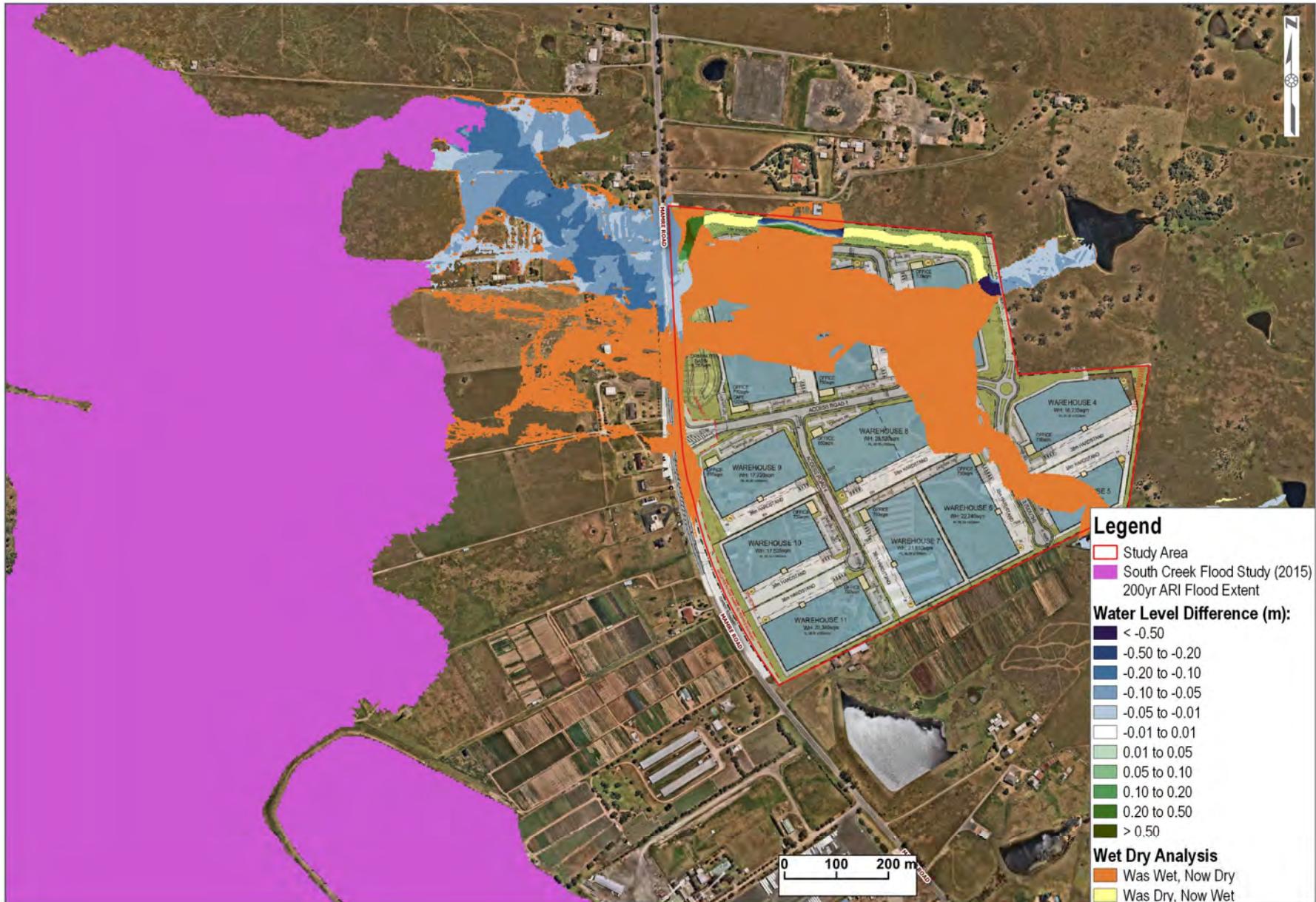


Figure 66 200 yr ARI Level Differences - (Final Masterplan Conditions – Benchmark Conditions)

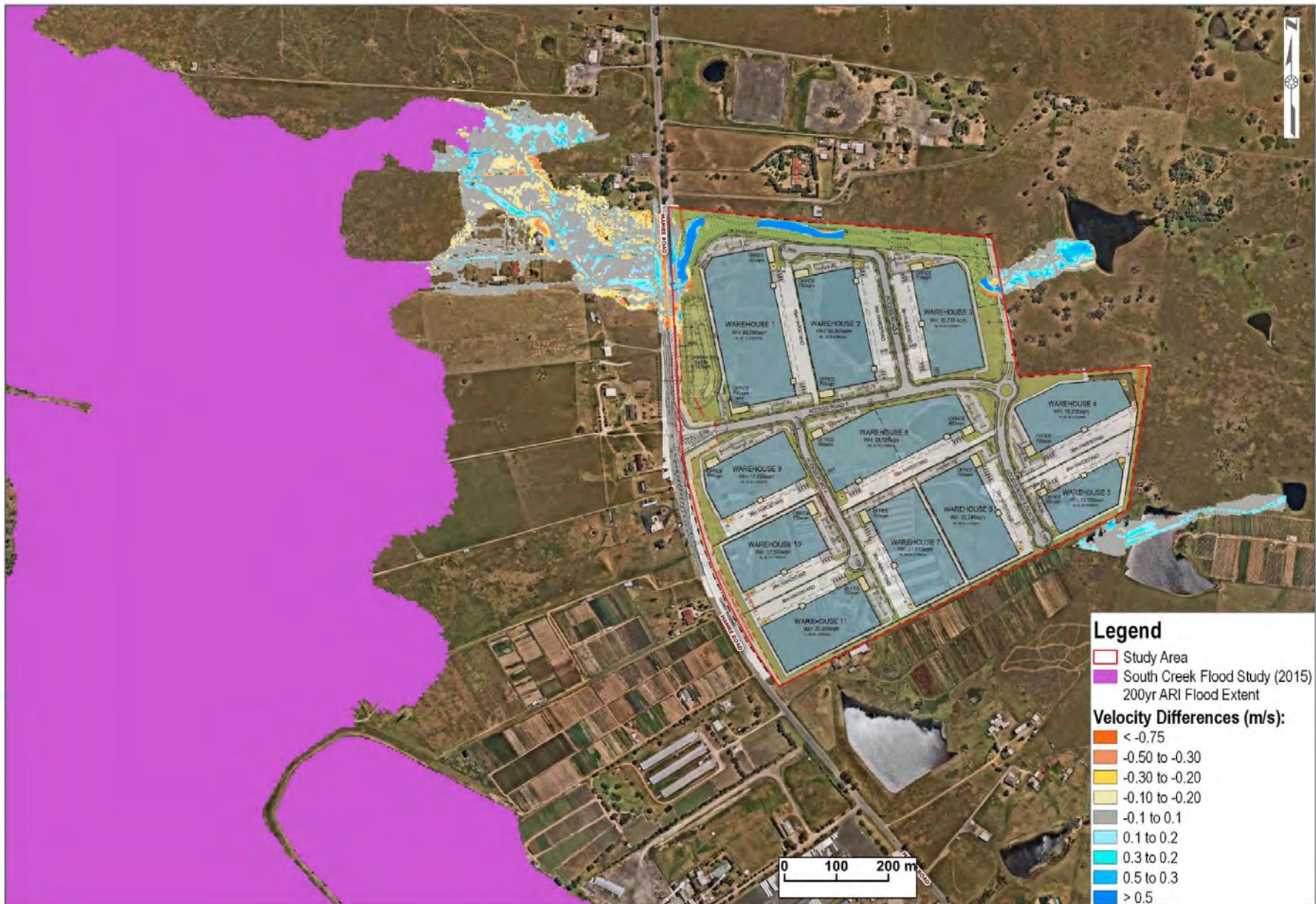


Figure 67 200 yr ARI Velocity Differences - (Final Masterplan Conditions – Benchmark Conditions)

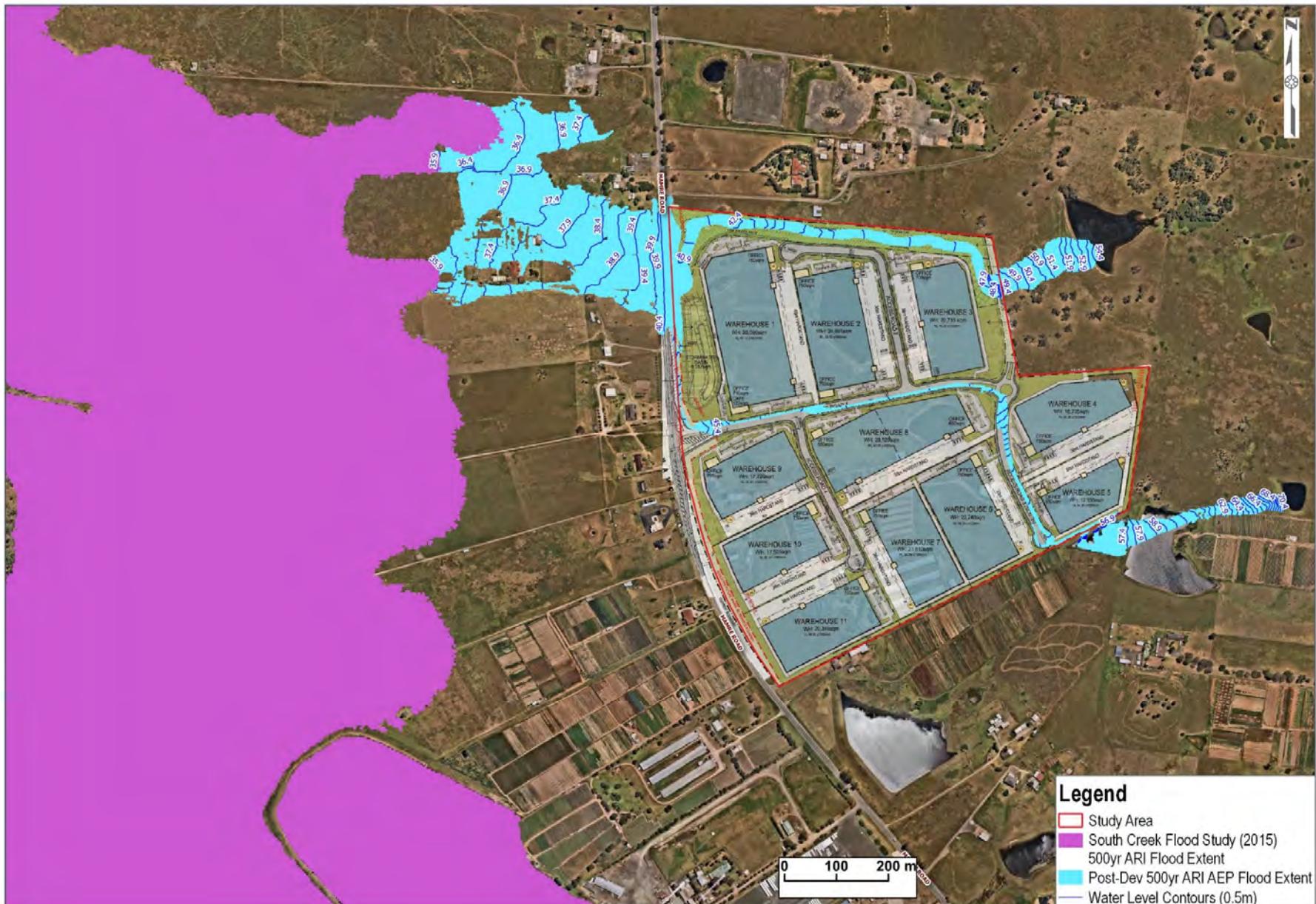


Figure 68 500 yr ARI Flood Extents and Flood Levels - Final Masterplan Conditions

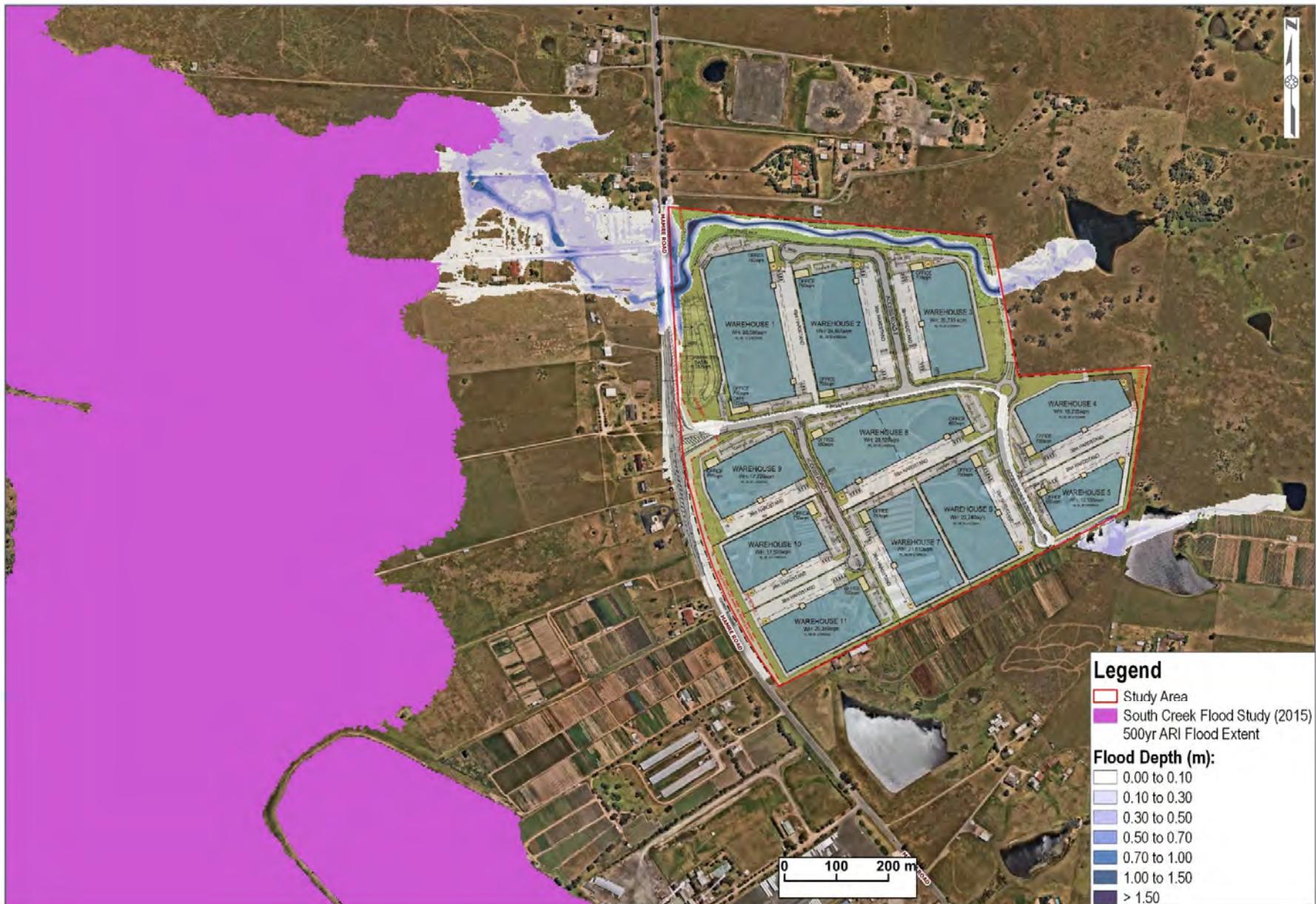


Figure 69 500 yr ARI Flood Depths - Final Masterplan Conditions

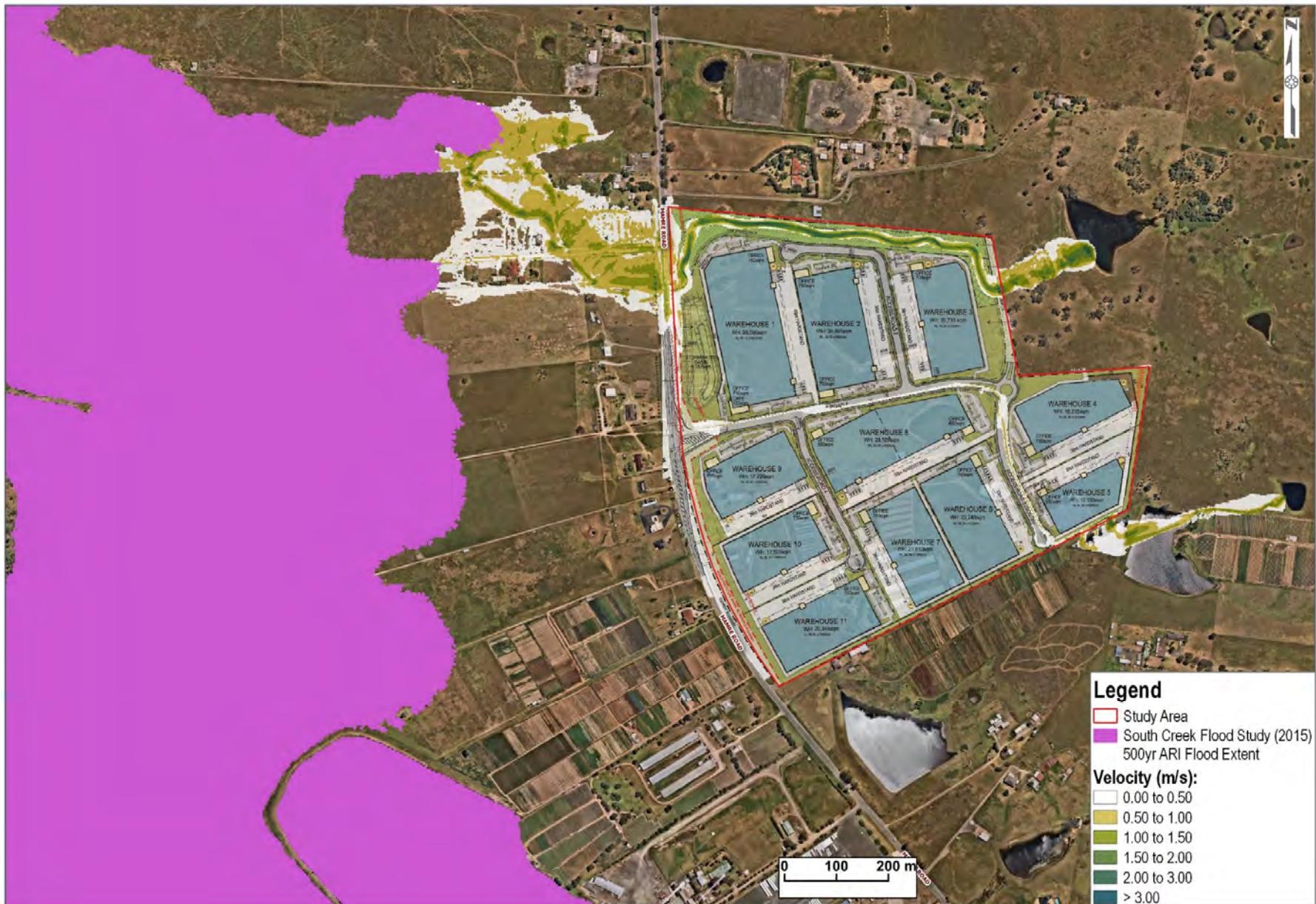


Figure 70 500 yr ARI Flood Velocities - Final Masterplan Conditions

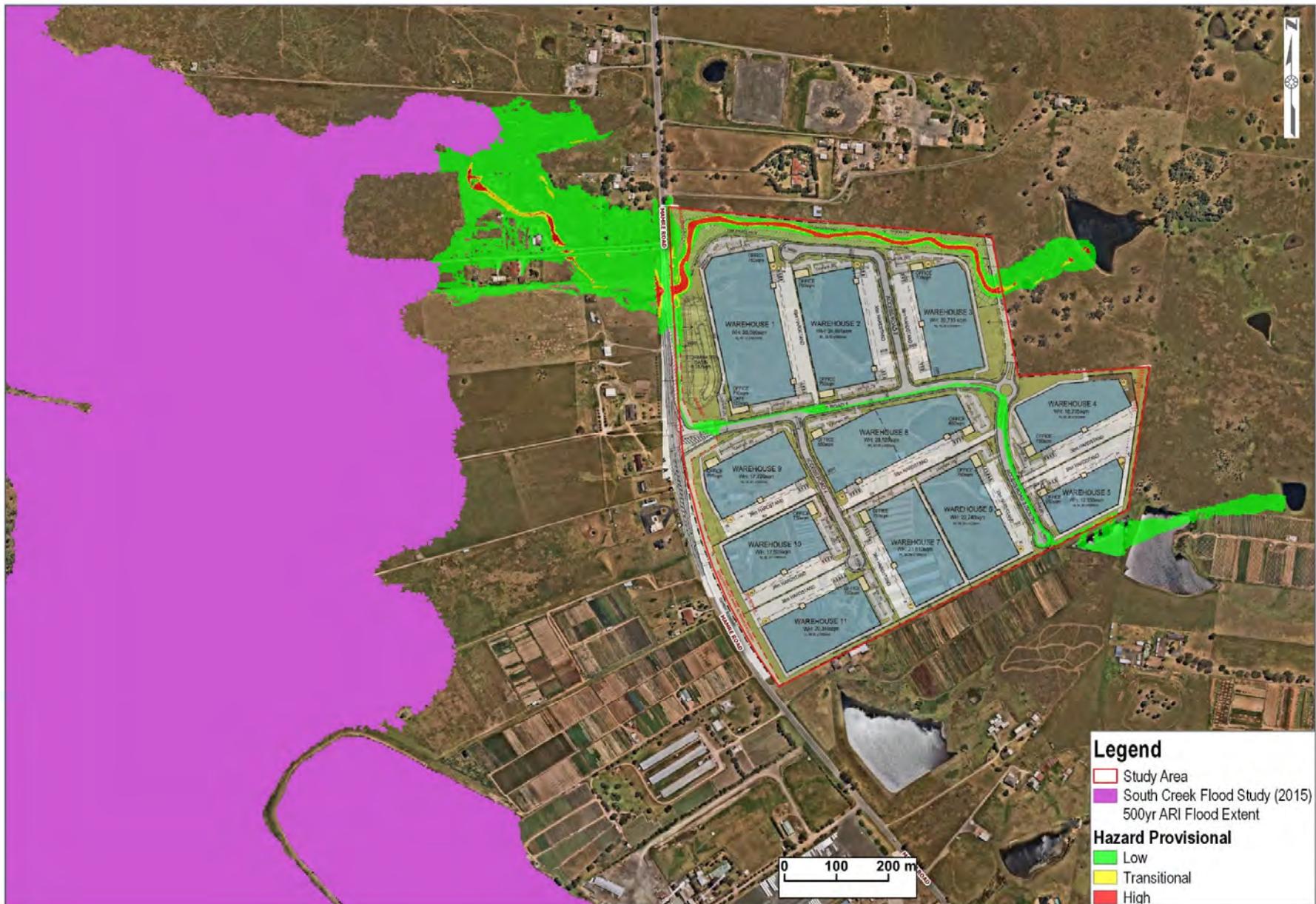


Figure 71 500 yr ARI Flood Hazards - Final Masterplan Conditions

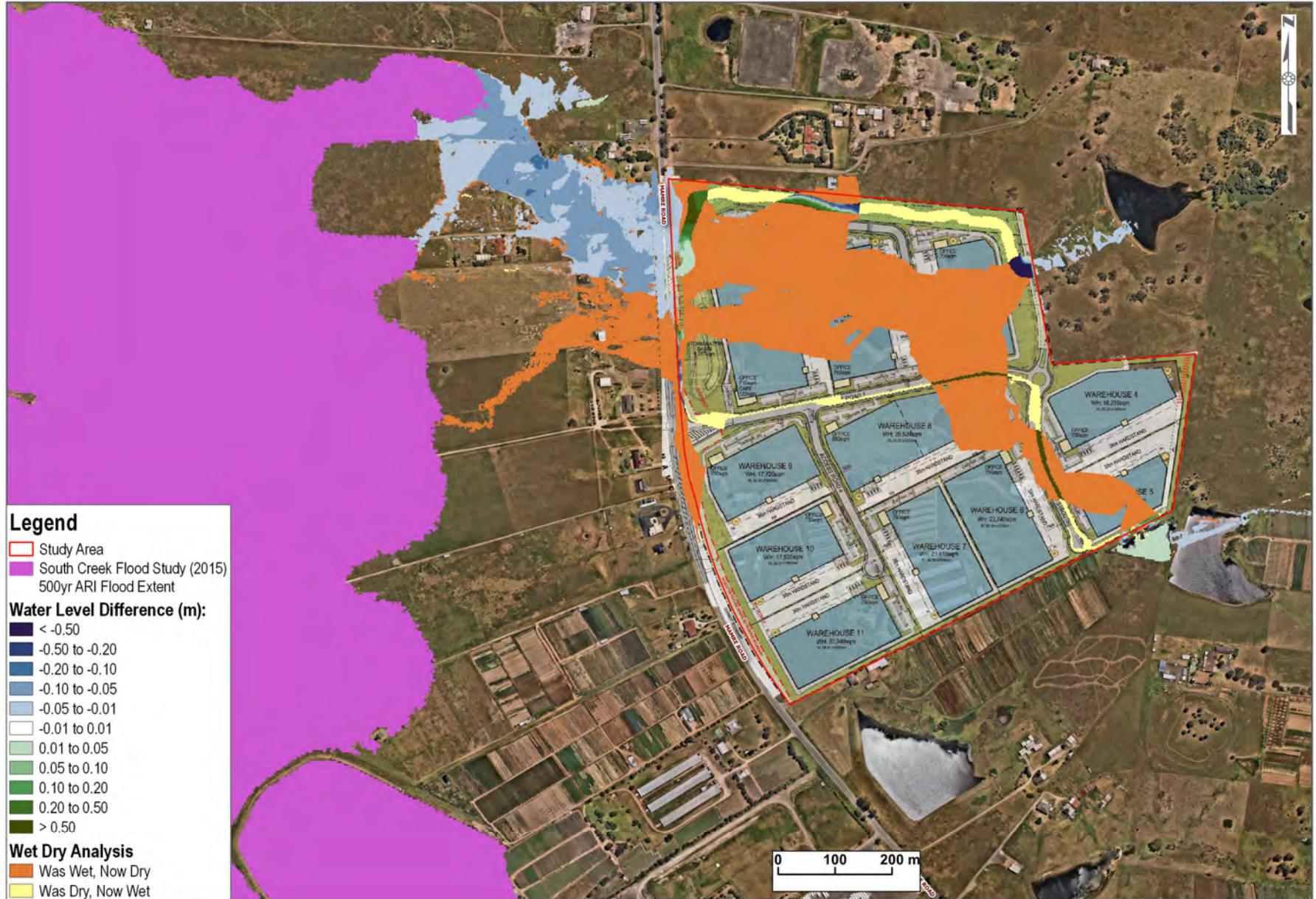


Figure 72 500 yr ARI Level Differences - (Final Masterplan Conditions – Benchmark Conditions)

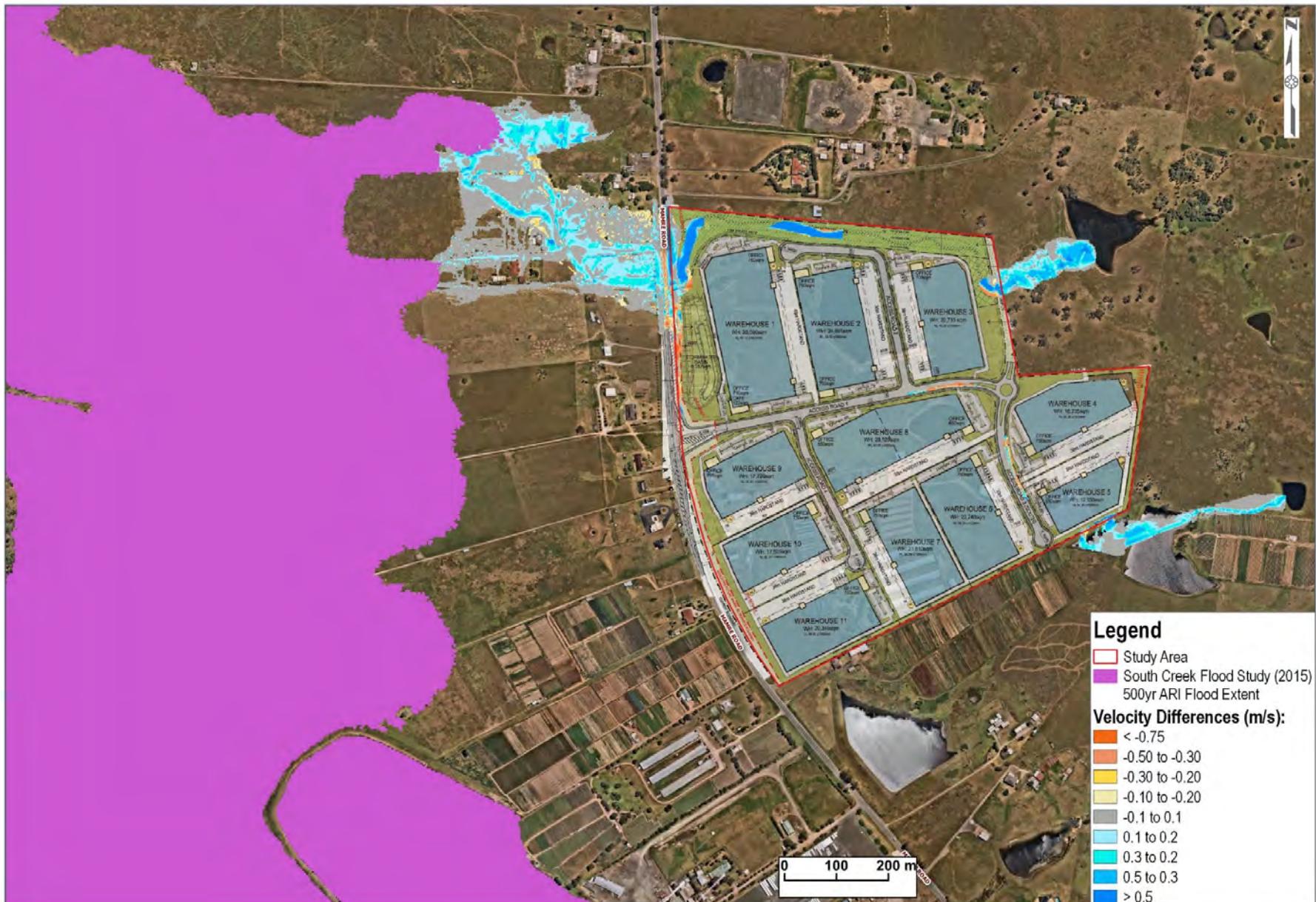


Figure 73 500 yr ARI Velocity Differences - (Final Masterplan Conditions – Benchmark Conditions)



Figure 74 PMF Flood Extents and Flood Levels - Final Masterplan Conditions

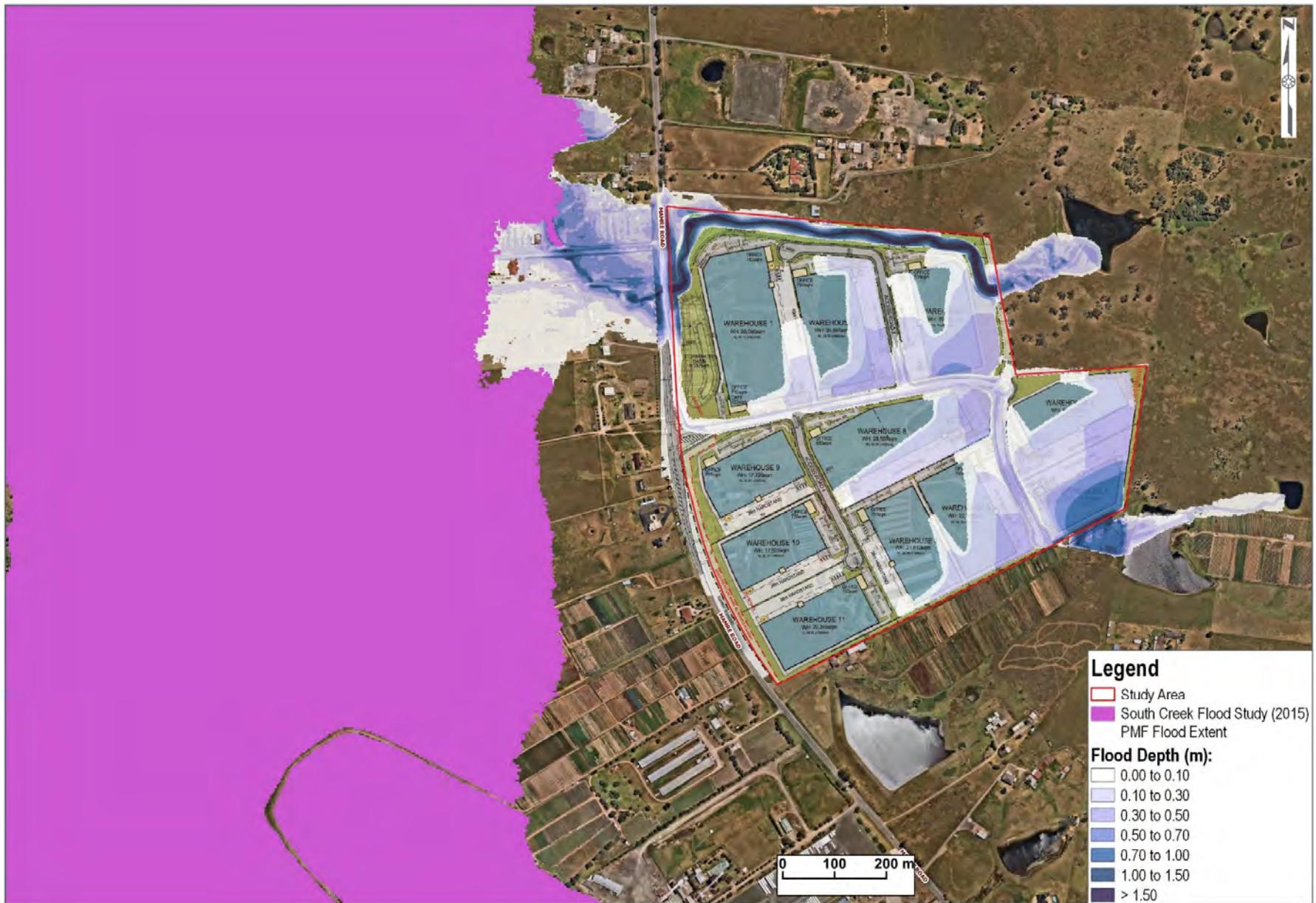


Figure 75 PMF Flood Depths - Final Masterplan Conditions

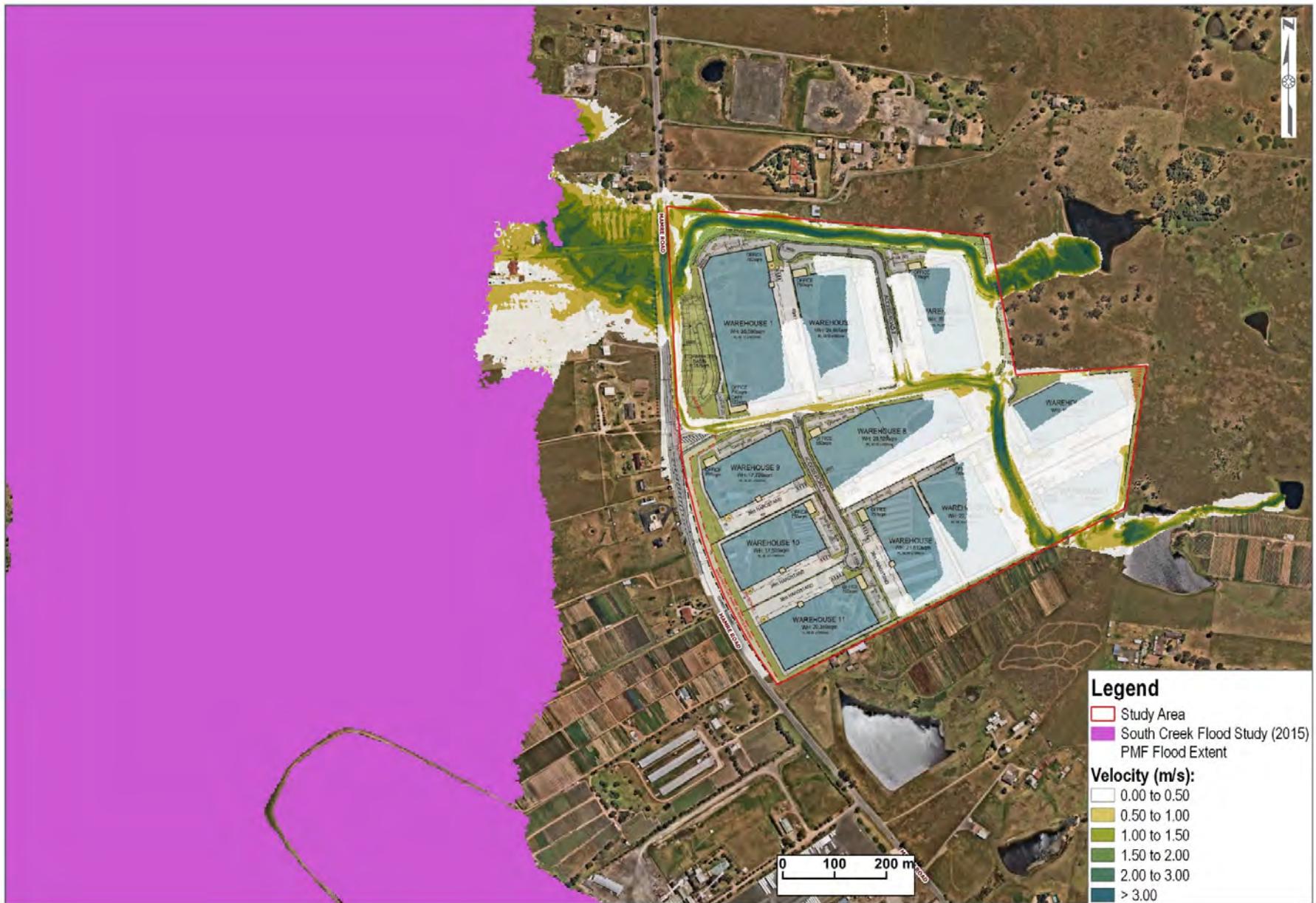


Figure 76 PMF Flood Velocities - Final Masterplan Conditions

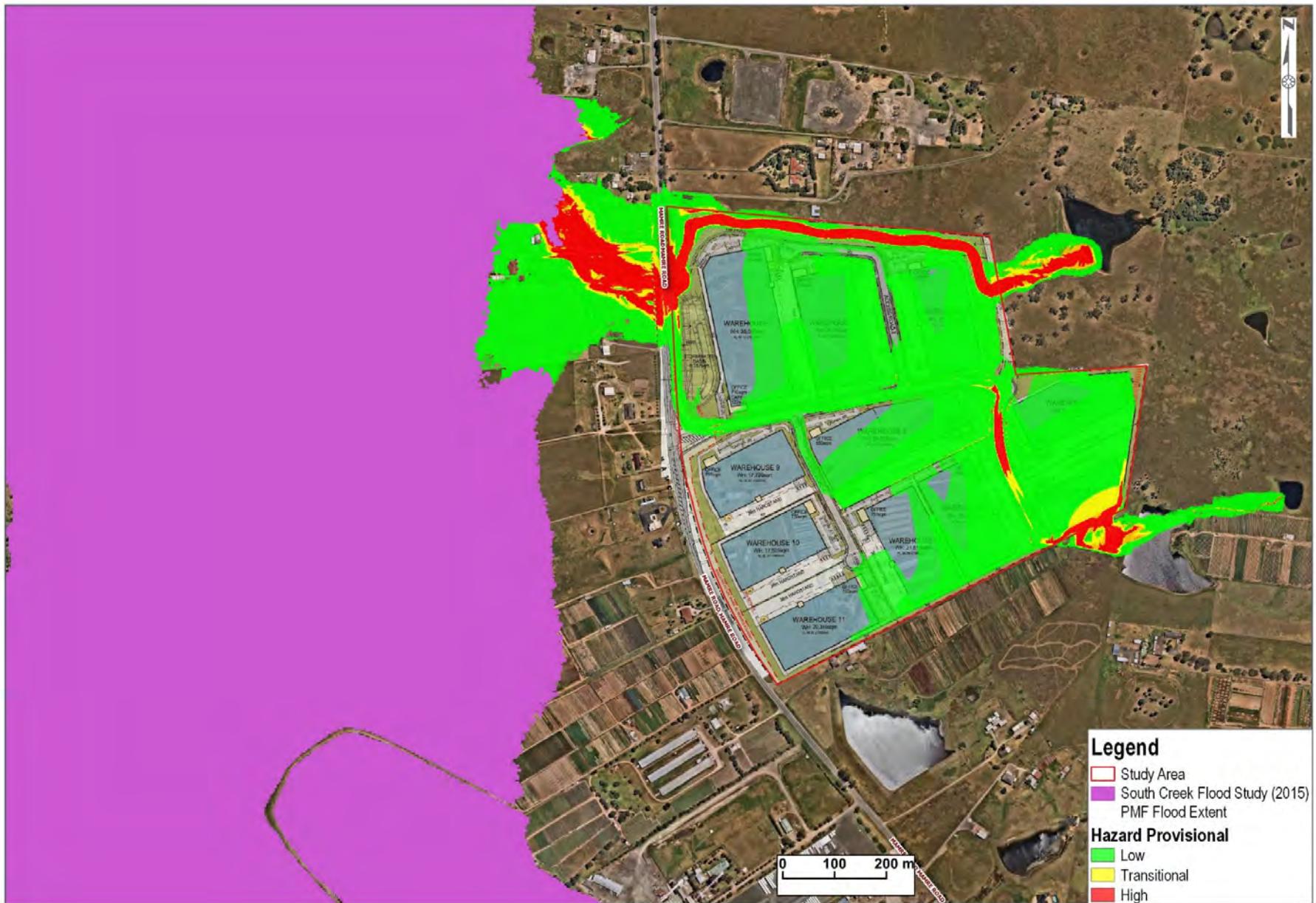


Figure 77 PMF Flood Hazards - Final Masterplan Conditions

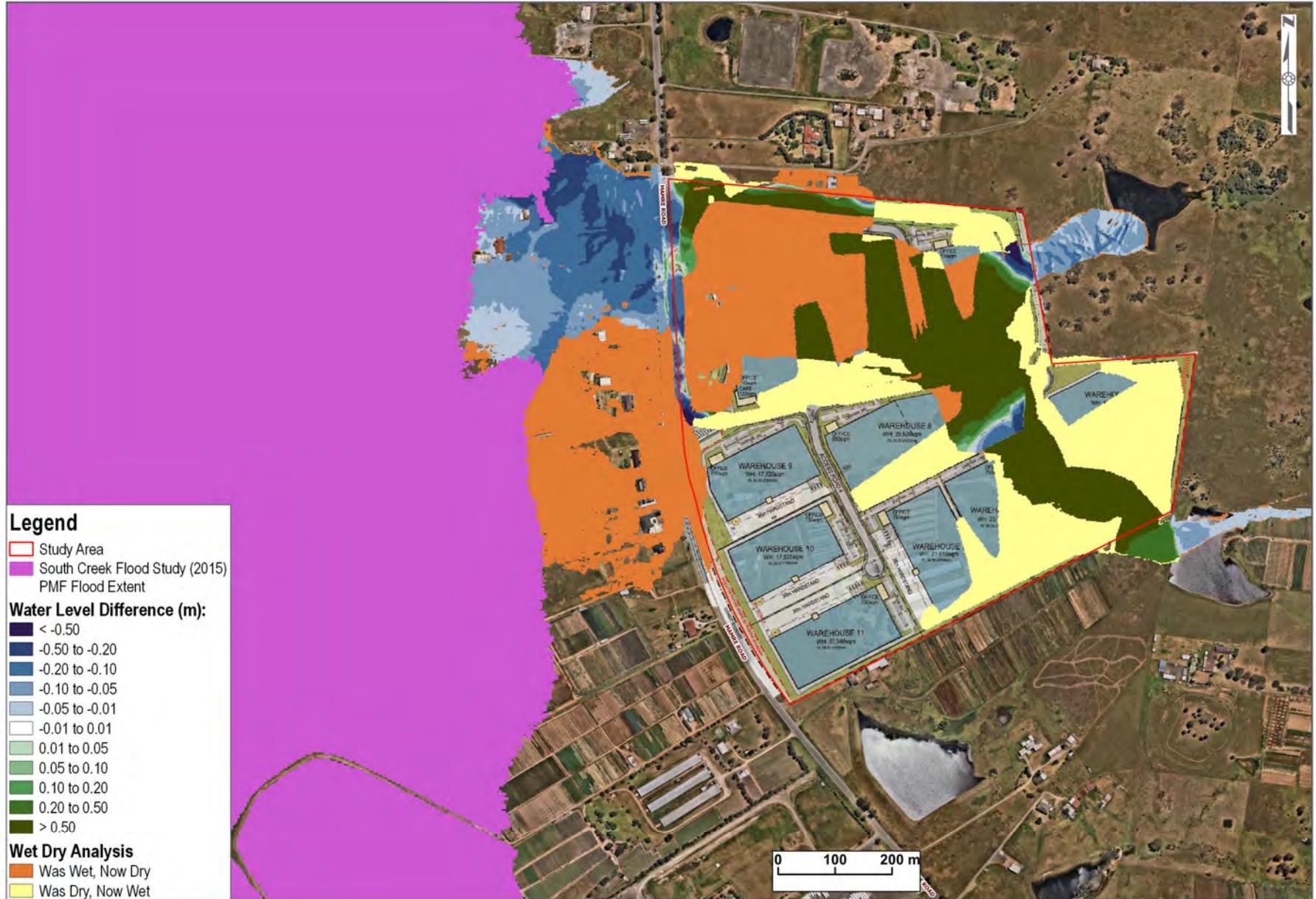


Figure 78 PMF Level Differences - (Final Masterplan Conditions – Benchmark Conditions)

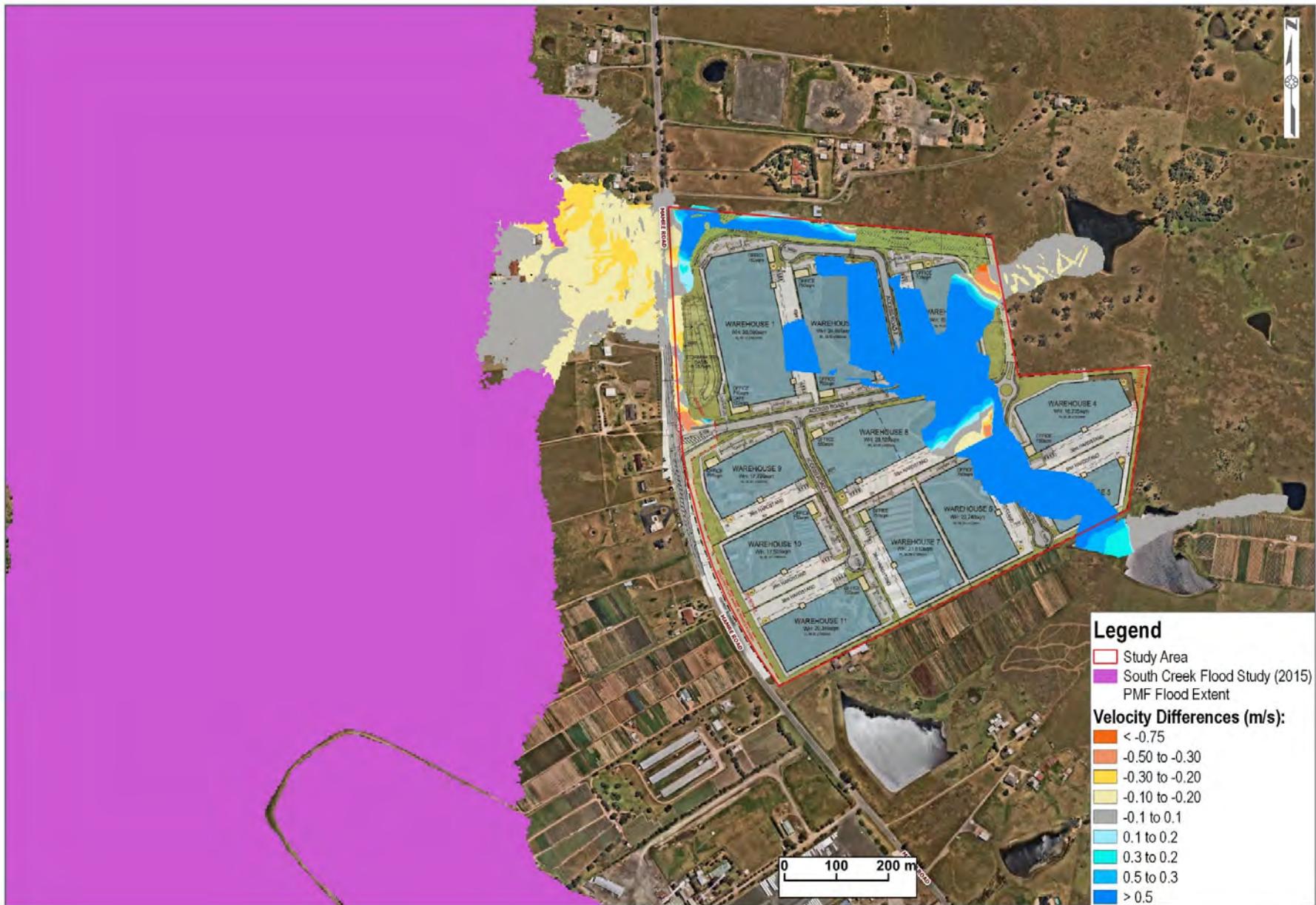


Figure 79 PMF Velocity Differences - (Final Masterplan Conditions – Benchmark Conditions)



OVERALL DEVELOPMENT DATA

Total Site Area	552,213 m ²
Riparian Area	20,145 m ²
Riparian Area	10,732 m ²
Total Developable Area	476,852 m ²
Total Office Area	11,000 m ²
Total Warehouse Area	264,426 m ²
Cars	60 m ²
Total Building Area	270,488 m ²
Reservision on User Area	4,813 m ²

LOT 1	
Site Area	59,821 m ²
Office	1,800 m ²
Warehouse	44,720 m ²
Total GFA	46,520 m ²
Carpark Provided	241

LOT 2	
Site Area	48,487 m ²
Office	1,500 m ²
Warehouse	30,880 m ²
Total GFA	32,380 m ²
Carpark Provided	152

LOT 3	
Site Area	41,881 m ²
Office	1,200 m ²
Warehouse	24,580 m ²
Total GFA	23,780 m ²
Carpark Provided	123

LOT 4	
Site Area	48,126 m ²
Office	1,200 m ²
Warehouse	24,530 m ²
Total GFA	23,530 m ²
Carpark Provided	116

LOT 5	
Site Area	29,742 m ²
Office	950 m ²
Warehouse	12,550 m ²
Total GFA	13,500 m ²
Carpark Provided	92

LOT 6	
Site Area	36,965 m ²
Office	750 m ²
Warehouse	21,790 m ²
Total GFA	22,540 m ²
Carpark Provided	108

LOT 7	
Site Area	38,381 m ²
Office	750 m ²
Warehouse	20,810 m ²
Total GFA	21,760 m ²
Carpark Provided	103

LOT 8	
Site Area	47,681 m ²
Office	1,200 m ²
Warehouse	27,100 m ²
Total GFA	28,300 m ²
Carpark Provided	141

LOT 9	
Site Area	38,982 m ²
Office	750 m ²
Warehouse	16,920 m ²
Total GFA	14,370 m ²
Carpark Provided	127

LOT 10	
Site Area	36,060 m ²
Office	750 m ²
Warehouse	18,500 m ²
Total GFA	19,250 m ²
Carpark Provided	90

LOT 11	
Site Area	41,130 m ²
Office	750 m ²
Warehouse	20,380 m ²
Total GFA	21,110 m ²
Carpark Provided	94

*All areas subject to survey

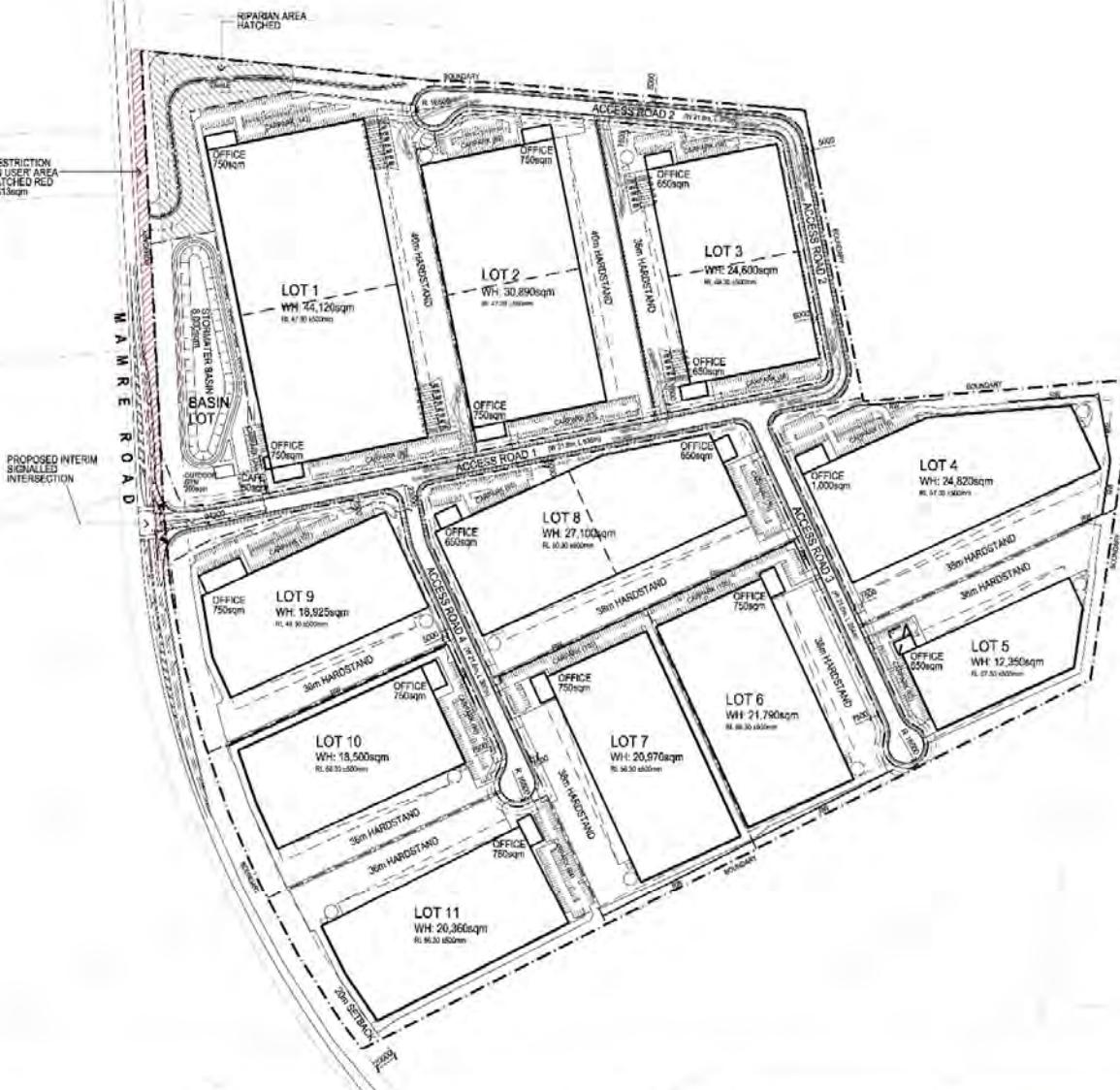


Figure A.1 Aspect Industrial Estate Preliminary Final Masterplan

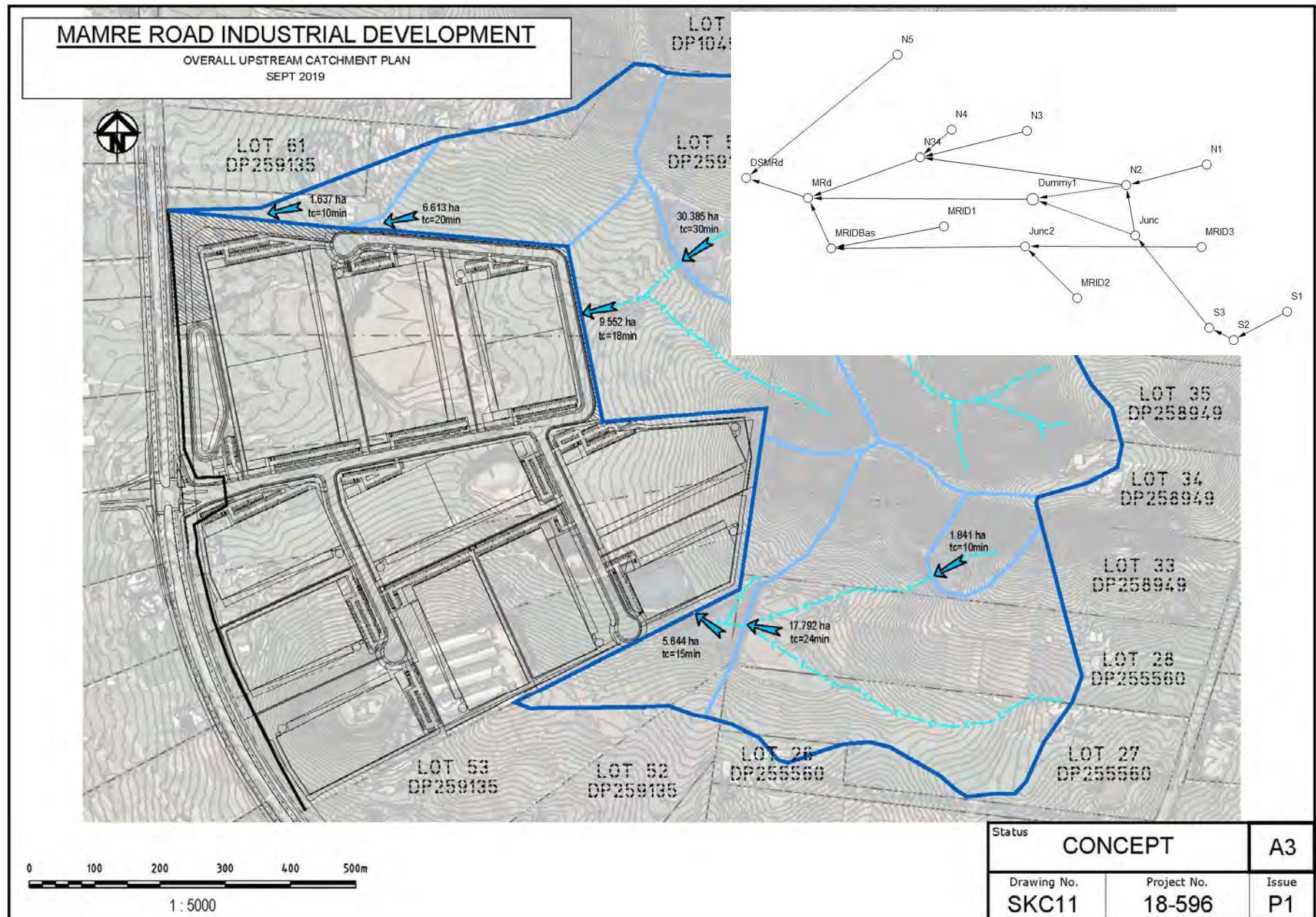


Figure A.2 Local Subcatchment Boundaries in AIE XP-RAFTS model under Preliminary Final Masterplan Conditions

APPENDIX A

PRELIMINARY MASTERPLAN CONDITIONS

A.1 Preliminary Masterplan Conditions without a Basin

A.1.1 ARR1987 Assessments

The assessment of the preliminary Masterplan Conditions without a Basin was based on Scenario 2.

Changes to preliminary Masterplan Conditions included:

- (i) Re-organising the model layout based on separating upstream flows conveyed through the estate from runoff generated within the estate;
- (ii) Reducing lag times for flows conveyed through the estate based on conveyance in pipes/culverts;
- (iii) Increasing the imperviousness of the estate (Nodes MRD1, MRD2, MRD3) to 90% impervious;
- (iv) Adopting an Initial Loss = 1 mm and Continuing Loss = 0 mm/h for impervious surfaces.

The results of the ARR1987 hydrological modelling of preliminary Masterplan Conditions without a Basin are summarised in **Attachment B2**.

A.1.2 ARR2019 Assessments

The assessment of preliminary Masterplan Conditions without a Basin was based on Scenario 5.

The same changes to the ARR2019 hydrological model were adopted.

The results of the ARR2019 hydrological modelling of preliminary Masterplan Conditions without a Basin are summarised in **Attachment B5**.

A.2 Preliminary Masterplan Conditions with a Basin

The concept sizing of a basin to mitigate the impact of ultimate development on 2 yr ARI and 100 yr ARI runoff from the estate was undertaken for ARR1987 conditions. A similar concept sizing of a basin to mitigate the impact of development on 50% AEP and 1% AEP runoff from the estate was undertaken for ARR2019 conditions.

Three basin assessments were as follows.

- The first ARR1987 assessment targeted the 2yr ARI (12 hour) and 100 yr ARI (2 hour) peak flows under benchmark conditions ie. targeted local runoff only
- The second ARR1987 assessment targeted the 2yr ARI (36 hour) and 100 yr ARI (36 hour) peak flows under benchmark conditions (which targets the critical storm burst duration for the South Creek catchment)
- The third ARR2019 assessment targeted the 50%AEP (6 hour) and 1% AEP (45 mins) peak flows under benchmark conditions ie. targeted local runoff only

The key basin characteristics are summarised in Table A.1.

The results of the ARR1987 hydrological modelling of preliminary Masterplan Conditions with a Basin are summarised in **Attachment B3**.

Table A.1 Summary of Concept Basin Properties

ARR	Basin Footprint (m ²)	Max 1% AEP Depth (m)	1% AEP Basin Volume (m ³)	Max 50% AEP Depth (m)	50% AEP Basin Volume (m ³)	Primary Outlet	Secondary Spillway Width (m)	Crest Level (m)	Embankment Crest Level above Primary Outlet IL
Basin sized to meet target at Mamre Road - 2 yr ARI (12 hr) & 100 yr ARI (2 hr)									
1987	8000	2.94	23,500	1.41	11,250	3 x 0.6m diam RCPs	3	2.3	3.2
Basin sized to meet target at Mamre Road - 2 yr ARI (36 hr) & 100 yr ARI (36 hr)									
1987	8000	5.36	42,900	3.06	24,500	1 x 0.5m diam RCP	0.5	3.00	5.6
Basin sized to meet target at Mamre Road - 50% AEP (6 hr) & 1% AEP (45 mins)									
2019	8000	3.58	28,710	2.12	16,820	1 x 0.5m diam RCP	3	2.5	3.9

It was concluded under the first ARR1987 basin scenario that:

- (i) While the 2 yr ARI target is met for 9 hour and 12 hour storm bursts, the peak 2 yr ARI flow at Mamre Road would increase above benchmark levels for all other burst durations (albeit at levels lower the critical 2 yr ARI peak flow);
- (ii) Under the 5 yr ARI storm bursts the peak 5 yr ARI flow at Mamre Road would decrease below benchmark levels for all burst durations greater than 2 hours while increasing in shorter storm burst up to 2 hours;
- (iii) Under the 100 yr ARI storm bursts the peak 100 yr ARI flow at Mamre Road would decrease below benchmark levels for all burst durations up to 24 hours; and
- (iv) The peak 100 yr ARI flow at Mamre Road under preliminary Masterplan Conditions equalled the 36 hour 100 yr ARI flow under benchmark conditions;

It was concluded under the second ARR1987 basin scenario that:

- (i) Meeting the 2 yr ARI target substantially increases the size of the basin;
- (ii) The peak flows at Mamre Road under preliminary Masterplan Conditions would be lower than under benchmark conditions for all storm burst duration under 2 yr ARI, 5 yr ARI and 100 yr ARI storm bursts; however
- (iii) The basin would be 80% larger than the basin assessed under the first scenario

The results of the ARR2019 hydrological modelling of preliminary Masterplan Conditions with a Basin are summarised in **Attachment B6**.

It was concluded under the ARR2019 basin scenario that:

- (i) While 50% AEP target is met for the 6 hour storm burst the peak 50% AEP flow at Mamre Road would increase above benchmark levels for all other burst durations less than 6 hours (albeit at levels lower the critical 50% AEP peak flow);

- (ii) Under the 20% AEP storm bursts the peak 20% AEP flow at Mamre Road would decrease below benchmark levels for all burst durations less than 6 hours;
- (iii) Under the 1% AEP storm bursts the peak 1% AEP flow at Mamre Road would decrease below benchmark levels for all burst durations up to 90 minutes.
- (iv) The peak 1% AEP flow at Mamre Road under preliminary Masterplan Conditions during an 9 hour storm burst (the indicative critical storm burst for the South Creek catchment under ARR2019) would increase by 1.04 m³/s above the 9 hour 100 yr ARI flow under benchmark conditions;
- (v) The peak 1% AEP flow at Mamre Road under preliminary Masterplan Conditions during an 9 hour storm burst of 12.1 m³/s compares to the estimated 727 m³/s in South Creek at Node 1.17 and an increase of 1.04 m³/s represents a 0.15% increase in South Creek assuming that the peaks coincide.

A.3 SSR and PSD

Based on the first ARR1987 assessment which targeted the 2yr ARI (12 hour) and 100 yr ARI (2 hour) peak flows under benchmark condition, indicative Site Storage Requirements (SSR) and Permissible Site Discharge (PSD) for 2 yr ARI and 100 yr ARI events were determined for Aspect Industrial Estate. These SSR and PSD values are summarised in **Table A.2**.

Table A.2 Indicative SSR and PSD Values for Aspect Industrial Estate

ARR		SSR (m ³)		SSR (m ³ /ha)	
		2 yr ARI	100 yr ARI	2 yr ARI	100 yr ARI
1987	2 yr ARI (12 hr) & 100 yr ARI (2 hr)	11,250	23,500	201	420
		PSD (m ³ /s)		PSD (L/s/ha)	
1987	2 yr ARI (12 hr) & 100 yr ARI (2 hr)	2.39	6.58	42.8	117.7

As described in the Mamre Road Flood, Riparian Corridor and Integrated Water Cycle Management Strategy prepared by Sydney Water, 2020:¹

This Integrated Water Cycle Management study has been prepared to inform and support the rezoning of the Mamre Road Precinct. Controls prescribed by this study will inform the Precinct DCP and ensures that:

- *Land use is compatible with flood risk*
- *Flood management approaches are effective and consistent across the catchment*
- *Water sensitive urban design approaches achieve pollution reduction targets and contribute to emerging waterway health targets in a flexible and cost-effective way*
- *Sufficient land is allocated for stormwater and flood management on private lots and in the public domain*

¹ Sydney Water (2020) "Mamre Road Flood, Riparian Corridor and Integrated Water Cycle Management Strategy", Final Report, October, 61 pp + Apps

In Section 6.4.2 Detention Strategy:

It is recommended that each industrial lot implements on-site stormwater detention as prescribed by Table 6.

Table 6 OSD requirements on industrial lots within Mamre Road Precinct

Zone	50% AEP SSR (m ³ /ha)	50% AEP PSD (l/s/ha)	1% AEP SSR inclusive of 50% AEP SSR (m ³ /ha)	1% AEP PSD (l/s/ha)
East Catchments draining towards Ropes Creek	190	40	393	150
North Catchment draining towards WaterNSW Warragamba Pipeline	190	40	393	150
West Catchments draining towards Ropes Creek	190	40	393	150

It is concluded that the unit SSR and PSD values for Aspect Industrial Estate are comparable to the unit SSR and PSD given in Table 6 from Sydney Water, 2020.

APPENDIX B

SUMMARIES OF HYDROLOGICAL RESULTS

AWE200083 Aspect Industrial Estate ARR1987 Hydrology

MRd Peak Flow (m3/s)	Basin sized to meet target at Mamre Road - 2 yr ARI (12 hr) & 100 yr ARI (2 hr)											
	Storm Burst Duration (mins)											
	30	45	60	90	120	180	270	360	540	720	1440	2160
2 yr ARI												
PreDev	2.01	3.56	4.39	4.85	5.25	5.07	5.30	5.74	6.31	6.27	4.76	3.84
PostDev No Basin	10.97	10.27	9.57	9.43	10.92	6.71	6.69	6.56	7.16	7.63	5.47	4.32
PostDev With Basin	3.15	4.52	5.26	5.43	5.72	5.49	5.85	5.98	6.19	6.27	4.93	4.14
PostDev+Basin - PreDev	1.14	0.96	0.87	0.58	0.48	0.42	0.54	0.23	-0.12	0.00	0.16	0.30
5 yr ARI												
PreDev	4.85	6.82	7.98	8.26	8.60	7.99	9.09	8.71	8.61	8.56	6.54	5.29
PostDev No Basin	14.36	13.40	12.89	13.25	14.72	9.33	10.79	9.80	9.70	10.26	7.39	5.85
PostDev With Basin	5.79	7.35	8.32	8.43	8.77	7.84	8.84	8.28	8.09	8.20	6.50	5.50
PostDev+Basin - PreDev	0.94	0.53	0.34	0.17	0.17	-0.15	-0.25	-0.43	-0.53	-0.36	-0.04	0.21
100 yr ARI												
PreDev	14.99	17.83	19.91	19.98	20.96	16.35	18.68	16.76	14.77	14.54	11.10	9.03
PostDev No Basin	23.21	22.29	24.13	25.85	26.66	18.74	21.06	18.50	16.14	16.90	12.29	9.81
PostDev With Basin	14.59	17.67	19.70	19.60	20.37	15.46	18.27	15.77	14.31	14.44	10.83	9.03
PostDev+Basin - PreDev	-0.40	-0.16	-0.21	-0.38	-0.59	-0.89	-0.41	-1.00	-0.46	-0.11	-0.27	0.00

MRd Peak Flow (m3/s)	Basin sized to meet target at Mamre Road - 2 yr ARI (36 hr) & 100 yr ARI (36 hr)											
	Storm Burst Duration (mins)											
	30	45	60	90	120	180	270	360	540	720	1440	2160
2 yr ARI												
PreDev	2.01	3.56	4.39	4.85	5.25	5.07	5.30	5.74	6.31	6.27	4.76	3.84
PostDev No Basin	10.97	10.27	9.57	9.43	10.92	6.71	6.69	6.56	7.16	7.63	5.47	4.32
PostDev With Basin	1.90	3.04	3.63	3.79	4.04	3.91	4.21	4.35	4.70	4.77	3.69	3.11
PostDev+Basin - PreDev	-0.11	-0.52	-0.76	-1.05	-1.21	-1.15	-1.09	-1.39	-1.61	-1.49	-1.07	-0.73
5 yr ARI												
PreDev	4.85	6.82	7.98	8.26	8.60	7.99	9.09	8.71	8.61	8.56	6.54	5.29
PostDev No Basin	14.36	13.40	12.89	13.25	14.72	9.33	10.79	9.80	9.70	10.26	7.39	5.85
PostDev With Basin	4.04	5.38	6.21	6.32	6.63	5.80	6.74	6.29	6.31	6.36	4.93	4.35
PostDev+Basin - PreDev	-0.81	-1.44	-1.77	-1.95	-1.97	-2.19	-2.35	-2.42	-2.31	-2.21	-1.61	-0.94
100 yr ARI												
PreDev	14.99	17.83	19.91	19.98	20.96	16.35	18.68	16.76	14.77	14.54	11.10	9.03
PostDev No Basin	23.21	22.29	24.13	25.85	26.66	18.74	21.06	18.50	16.14	16.90	12.29	9.81
PostDev With Basin	11.15	13.14	14.62	14.71	15.39	11.66	13.76	12.15	12.78	12.78	10.15	9.04
PostDev+Basin - PreDev	-3.85	-4.69	-5.29	-5.27	-5.57	-4.69	-4.92	-4.62	-1.99	-1.76	-0.94	0.01

AWE200083 Aspect Industrial Estate ARR12019 Hydrology

MRd Peak Flow (m3/s)	Basin sized to meet target at Mamre Road - 50% AEP (6 hr) & 1% AEP (45 mins)											
	Storm Burst Duration (mins)											
	15	20	25	30	45	60	90	120	180	270	360	540
50% AEP												
PreDev	0.00	0.00	0.00	0.00	0.00	0.00	0.29	1.00	1.99	2.72	3.23	2.91
PostDev No Basin	9.99	9.48	9.03	8.58	7.22	5.70	5.87	4.40	4.60	4.89	4.22	
PostDev With Basin	0.45	0.48	0.51	0.57	0.60	0.93	1.65	2.34	2.84	3.16	2.80	
PostDev+Basin - PreDev	0.45	0.48	0.51	0.57	0.60	0.65	0.35	0.11	-0.07	-0.11		
20% AEP												
PreDev	4.91	6.57	7.28	7.41	7.73	6.74	6.21	6.01				
PostDev No Basin	12.91	12.36	12.20	11.16	11.20	8.85	8.25	7.95				
PostDev With Basin	0.81	2.13	3.27	4.33	5.33	5.60	5.62	6.08				
PostDev+Basin - PreDev	-4.10	-4.44	-4.00	-3.09	-2.40	-1.14	-0.59	0.06				
1% AEP												
PreDev	19.10	21.12	22.07	23.32	22.57	19.03	18.68	15.16	12.72	13.67	11.07	
PostDev No Basin	29.58	29.90	30.54	30.47	28.50	24.24	23.92	18.63	15.65	16.19	13.29	
PostDev With Basin	17.91	20.54	21.59	22.8								

AWE200083 Aspect Industrial Estate ARR1987 Hydrology

Benchmark Conditions

Attachment B1

Updated PMF

2 yr ARI	ARR Edition	1987	Source: 2012 Upper South Creek Flood Study (WMAwater)										200 yr ARI	ARR Edition	1987	Source: 2012 Upper South Creek Flood Study (WMAwater)													
ARI (yrs)	Subcatchment ID	2	2	2	2	2	2	2	2	2	2	Peak Flow (m³/s)	Critical Duration (hrs)	ARI (yrs)	Subcatchment ID	200	200	200	200	200	200	200	200	200	Peak Flow (m³/s)	Critical Duration (hrs)			
Storm Burst Duration (mins)																													
N5	0.62	1.20	1.49	1.64	1.77	1.63	1.77	1.81	1.89	1.97	1.39	1.07	1.97	12.0	N5	6.39	7.09	7.85	7.77	8.23	6.29	6.65	5.72	4.91	5.03	3.53	2.78	2.23	2.0
N1	0.46	0.90	1.16	1.32	1.42	1.34	1.38	1.54	1.61	1.66	1.22	0.95	1.66	12.0	N1	4.97	5.74	6.28	6.41	5.00	5.72	4.88	4.17	4.32	3.12	2.47	2.41	2.0	
N2	0.72	1.31	1.60	1.76	1.90	1.79	1.93	2.02	2.13	2.21	1.60	1.25	2.21	12.0	N2	6.70	7.59	8.36	8.28	8.77	7.67	7.49	6.46	5.56	5.68	4.10	3.25	8.77	2.0
S1	0.10	0.14	0.17	0.18	0.20	0.14	0.16	0.14	0.12	0.12	0.08	0.06	0.20	2.0	S1	0.72	0.66	0.78	0.80	0.76	0.52	0.45	0.33	0.29	0.29	0.19	0.15	0.80	1.5
S2	0.35	0.60	0.72	0.82	0.88	0.85	0.88	0.98	1.02	1.08	0.78	0.61	1.08	12.0	S2	3.15	3.61	3.95	3.91	4.19	3.21	3.63	3.13	2.69	2.78	2.01	1.60	4.19	2.0
S3	0.56	0.91	1.06	1.07	1.16	1.12	1.28	1.25	1.35	1.43	1.01	0.79	1.43	12.0	S3	4.28	4.75	5.34	5.57	5.86	4.46	4.68	4.11	3.53	3.64	2.59	2.06	5.86	2.0
MRID3	0.14	0.27	0.34	0.38	0.41	0.38	0.40	0.43	0.45	0.47	0.34	0.26	0.47	12.0	MRID3	1.45	1.64	1.80	1.78	1.86	1.44	1.59	1.37	1.17	1.21	0.86	0.68	1.86	2.0
MRID2a	0.28	0.54	0.72	0.82	0.88	0.85	0.85	0.99	1.03	1.06	0.78	0.62	1.06	12.0	MRID2a	3.05	3.60	3.92	3.87	3.97	3.13	3.66	3.11	2.67	2.78	2.03	1.61	3.97	2.0
Junc	0.98	1.70	2.05	2.25	2.43	2.34	2.49	2.65	2.81	2.92	2.12	1.67	2.92	12.0	Junc	8.63	9.88	10.88	10.92	11.58	8.86	9.82	8.53	7.35	7.49	5.47	4.35	11.58	2.0
MRID1	0.15	0.29	0.42	0.57	0.64	0.70	0.68	0.76	0.97	0.88	0.75	0.67	0.97	9.0	MRID1	1.71	2.36	2.73	2.90	3.01	2.78	2.77	2.87	2.67	2.58	2.10	1.82	3.01	2.0
N3	0.17	0.30	0.36	0.38	0.34	0.44	0.39	0.40	0.41	0.27	0.21	0.44	4.5	N3	1.48	1.59	1.80	1.82	1.94	1.51	1.37	1.16	1.00	1.01	0.68	0.54	1.94	2.0	
N4	0.05	0.08	0.10	0.10	0.09	0.11	0.10	0.10	0.10	0.07	0.05	0.11	4.5	N4	0.39	0.41	0.46	0.48	0.51	0.39	0.35	0.29	0.25	0.25	0.17	0.13	0.51	2.0	
N34	0.22	0.38	0.46	0.46	0.48	0.43	0.55	0.49	0.50	0.51	0.34	0.26	0.55	4.5	N34	1.87	2.00	2.26	2.29	2.45	1.90	1.71	1.45	1.25	1.26	0.85	0.67	2.45	2.0
MRd	2.01	3.56	4.39	4.85	5.25	5.07	5.30	5.74	6.31	6.27	4.76	3.84	6.31	9.0	MRd	17.78	20.76	23.18	23.25	24.45	19.09	21.14	18.83	16.50	16.21	12.39	10.08	24.45	2.0
MRID2b	0.24	0.35	0.40	0.42	0.46	0.31	0.42	0.39	0.35	0.35	0.22	0.17	0.46	2.0	MRID2b	1.57	1.56	1.90	2.07	2.05	1.46	1.26	0.95	0.83	0.83	0.55	0.43	2.07	1.5
DSMRd	2.66	4.66	5.89	6.35	6.90	6.70	7.02	7.58	8.35	7.95	6.24	5.07	8.35	9.0	DSMRd	21.90	26.46	29.55	29.77	31.18	24.91	27.14	24.30	21.56	20.88	16.38	13.30	31.18	2.0
5 yr ARI	ARR Edition	1987	Source: 2012 Upper South Creek Flood Study (WMAwater)										500 yr ARI	ARR Edition	1987	Source: 2012 Upper South Creek Flood Study (WMAwater)													
ARI (yrs)	Subcatchment ID	5	5	5	5	5	5	5	5	5	5	Peak Flow (m³/s)	Critical Duration (hrs)	ARI (yrs)	Subcatchment ID	500	500	500	500	500	500	500	500	500	Peak Flow (m³/s)	Critical Duration (hrs)			
Storm Burst Duration (mins)																													
N5	1.61	2.36	2.74	2.78	2.89	2.49	3.12	2.75	2.57	2.68	1.89	1.47	3.12	4.5	N5	7.72	8.43	9.40	9.25	9.86	7.60	7.59	6.52	5.61	5.72	4.02	3.18	9.86	2.0
N1	1.19	1.83	2.14	2.25	2.39	2.14	2.45	2.29	2.19	2.28	1.66	1.30	2.45	4.5	N1	6.11	6.84	7.50	7.42	7.74	6.01	6.54	5.58	4.77	4.93	3.56	2.82	2.31	2.0
N2	1.79	2.54	2.92	2.96	3.10	2.79	3.34	3.02	2.90	3.01	2.18	1.71	3.34	4.5	N2	8.13	9.03	9.99	9.90	10.51	8.19	8.57	7.38	6.35	6.47	4.67	3.71	0.61	2.0
S1	0.20	0.23	0.30	0.36	0.37	0.26	0.25	0.18	0.16	0.16	0.10	0.08	0.37	2.0	S1	0.88	0.78	0.90	0.92	0.87	0.58	0.51	0.37	0.32	0.32	0.22	0.17	2.92	2.0
S2	0.83	1.16	1.34	1.38	1.48	1.36	1.55	1.44	1.40	1.47	1.07	0.84	1.55	4.5	S2	3.84	4.31	4.72	4.75	5.07	3.90	4.16	3.59	3.08	3.18	2.29	1.82	7.74	2.0
S3	1.29	1.65	1.89	1.97	2.14	1.75																							

AWE200083 Aspect Industrial Estate ARR1987 Hydrology

Preliminary Masterplan Conditions without Basin Conditions

Attachment B2

Based on the Preliminary Masterplan

2 yr ARI	ARR Edition	1987	Pervious Area Losses								Source: 2012 Upper South Creek Flood Study (WMWater)								200 yr ARI	ARR Edition	1987	Pervious Area Losses								Source: 2012 Upper South Creek Flood Study (WMWater)								
			Initial Burst Loss (mm)				15	Continuing (mm/h)				1.5	Roughness				0.025							Initial Burst Loss (mm)				15	Continuing (mm/h)				1.5	Roughness				0.025
ARI (yrs)	Subcatchment ID	2	2	2	2	2	2	2	2	2	2	2	Peak Flow (m³/s)	720	1440	2160	Critical Duration (hrs)	ARI (yrs)	Subcatchment ID	200	200	200	200	200	200	200	200	200	200	200	200	200	200	Peak Flow (m³/s)	Critical Duration (hrs)			
		Storm Burst Duration (mins)												Storm Burst Duration (mins)												Storm Burst Duration (mins)												
N5	0.59	1.18	1.46	1.60	1.76	1.61	1.75	1.81	1.88	1.98	1.39	1.07	1.98	12.0	N5																0.00	2.0						
N1	0.43	0.87	1.14	1.29	1.38	1.31	1.35	1.54	1.60	1.66	1.21	0.95	1.66	12.0	N1																0.00	2.0						
N2	1.18	2.13	2.60	2.76	2.96	2.85	3.12	3.23	3.45	3.59	2.59	2.03	3.59	12.0	N2																0.00	2.0						
N3	0.16	0.28	0.34	0.37	0.34	0.42	0.38	0.39	0.40	0.27	0.21	0.42	4.5	N3																0.00	2.0							
N4	0.04	0.07	0.09	0.09	0.09	0.11	0.10	0.10	0.10	0.07	0.05	0.11	4.5	N4																0.00	2.0							
N34	1.37	2.44	2.99	3.11	3.34	3.22	3.54	3.62	3.90	3.99	2.91	2.29	3.99	12.0	N34																0.00	2.0						
S1	0.10	0.14	0.16	0.18	0.19	0.13	0.16	0.14	0.12	0.12	0.08	0.06	0.19	2.0	S1																0.00	1.5						
S2	0.33	0.57	0.71	0.80	0.86	0.84	0.97	1.02	1.08	0.78	0.61	1.08	12.0	S2																0.00	2.0							
S3	0.53	0.86	1.04	1.06	1.15	1.11	1.24	1.24	1.34	1.43	1.01	0.79	1.43	12.0	S3																0.00	2.0						
MRID3	0.12	0.22	0.29	0.33	0.36	0.33	0.34	0.38	0.40	0.41	0.30	0.23	0.41	1.5	MRID3																0.00	1.5						
MRID2	5.52	4.97	5.31	5.62	5.34	2.87	2.54	1.92	1.72	1.72	1.13	0.88	5.62	1.5	MRID2																0.00	1.5						
Junc2	7.35	6.62	7.05	7.47	7.10	3.83	3.39	2.56	2.29	2.30	1.50	1.17	7.47	1.5	Junc2																0.00	1.5						
MRID1	-	4.88	5.18	5.50	5.18	2.83	2.50	1.85	1.67	1.68	1.11	0.86	5.50	1.5	MRID1																0.00	2.0						
Junc1	0.65	1.08	1.04	1.06	1.15	1.11	1.24	1.24	1.34	1.43	1.01	0.79	1.43	12.0	Junc																0.00	1.5						
Dummy1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.5	Dummy1																0.00	2.0						
MRIDBas	10.97	10.27	9.44	9.18	10.77	6.62	5.84	4.35	3.95	3.97	2.61	2.03	10.97	0.5	MRIDBas																0.00	0.5						
MRd	10.97	10.27	9.57	9.43	10.92	6.71	6.69	6.56	7.16	7.63	5.47	4.32	10.97	0.5	MRd																0.00	2.0						
DSMRd	10.99	10.30	10.14	10.31	11.69	7.65	8.42	8.32	9.04	9.61	6.86	5.39	11.69	2.0	DSMRd																0.00	2.0						
5 yr ARI	ARR Edition	1987	Pervious Area Losses								Source: 2012 Upper South Creek Flood Study (WMWater)								500 yr ARI	ARR Edition	1987	Pervious Area Losses								Source: 2012 Upper South Creek Flood Study (WMWater)								
			Initial Burst Loss (mm)				15	Continuing (mm/h)				1.5	Roughness				0.025							Initial Burst Loss (mm)				15	Continuing (mm/h)				1.5	Roughness				0.025
ARI (yrs)	Subcatchment ID	5	5	5	5	5	5	5	5	5	5	5	Peak Flow (m³/s)	720	1440	2160	Critical Duration (hrs)	ARI (yrs)	Subcatchment ID	500	500	500	500	500	500	500	500	500	500	500	500	500	500	Peak Flow (m³/s)	Critical Duration (hrs)			
		Storm Burst Duration (mins)												Storm Burst Duration (mins)												Storm Burst Duration (mins)												
N5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.5	N5																0.00	2.0						
N1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.5	N1																0.00	2.0						
N2	0.00	0.00	0.00	0																																		

AWE200083 Aspect Industrial Estate ARR1987 Hydrolog

Basin sized to meet target at Mamre Road - 2 yr ARI (12 hr) & 100 yr ARI (2 hr)

Post-Development with Basin Conditions

Attachment B

Based on the Preliminary Masterplan

AWE200083 Aspect Industrial Estate ARR2019 Hydrology

Attachment B4

Updated PMF

AWE200083 Aspect Industrial Estate ARR2019 Hydrology

Preliminary Masterplan without Basin Conditions

Attachment B5

Updated PMF

Updated PMF																																			
50% AEP	ARR Edition	2019	Pervious Area Losses							Source: 2012 Upper South Creek Flood Study (WMAwater)							0.5% AEP	ARR Edition	2019	Pervious Area Losses															
			Initial Burst Loss (mm)			28.5		BX			1.3		Roughness			0.025					Initial Burst Loss (mm)			10		BX			1.3		Roughness			0.025	
AEP	Subcatchment ID	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	Peak Flow (m3/s)	Critical Duration (hrs)	AEP	Subcatchment ID	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	Peak Flow (m3/s)	Critical Duration (hrs)	
		Storm Burst Duration (mins)							Peak Flow (m3/s)							Storm Burst Duration (mins)							Peak Flow (m3/s)												
N5	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.44	0.83	1.04	1.21	1.01	1.21	6.00	N5	10.74	12.64	12.84	12.37	11.71	10.74	8.94	8.47	6.58	5.62	12.84	0.42								
N1	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.32	0.66	0.85	0.99	0.85	0.99	6.00	N1	8.02	9.76	10.37	10.18	9.80	8.98	7.40	7.12	5.58	4.71	10.37	0.42								
N2	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.87	1.47	1.89	2.18	1.86	2.18	6.00	N2	17.48	19.51	20.10	19.92	19.49	18.27	15.48	15.00	11.87	10.11	20.10	0.42								
N3	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.12	0.19	0.23	0.26	0.22	0.26	6.00	N3	2.69	2.93	2.82	2.71	2.47	2.27	1.91	1.77	1.38	1.21	2.93	0.33								
N4	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.06	0.07	0.06	0.07	6.00	N4	0.71	0.76	0.73	0.70	0.63	0.57	0.49	0.45	0.35	0.31	0.76	0.33								
N34	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.99	1.65	2.12	2.44	2.08	2.44	6.00	N34	18.11	18.75	19.28	19.23	19.06	18.70	16.51	16.14	13.09	11.27	19.28	0.42								
S1	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.07	0.08	0.08	0.09	0.07	0.09	6.00	S1	1.10	1.08	1.02	0.97	0.82	0.74	0.62	0.61	0.43	0.40	1.13	0.17								
S2	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.25	0.42	0.55	0.64	0.55	0.64	6.00	S2	5.46	6.31	6.62	6.56	6.31	5.80	4.80	4.61	3.60	3.04	6.62	0.42								
S3	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.38	0.59	0.76	0.87	0.74	0.87	6.00	S3	7.86	8.70	8.79	8.60	8.28	7.63	6.38	6.10	4.74	4.00	8.79	0.42								
MRID3	1.74	1.73	1.61	1.56	1.33	1.25	0.97	1.07	0.61	0.55	0.53	0.39	1.84	0.17	MRID3	5.88	5.54	4.96	4.68	3.87	3.55	3.12	3.09	1.99	1.87	6.10	0.17								
MRID2	5.15	5.15	4.79	4.66	4.00	3.74	2.91	3.20	1.82	1.65	1.59	1.16	5.45	0.17	MRID2	17.34	16.52	14.78	13.94	11.49	10.55	9.29	9.18	5.95	5.55	17.98	0.17								
Junc2	6.84	6.86	6.36	6.19	5.33	4.98	3.88	4.26	2.42	2.20	2.12	1.55	7.23	0.17	Junc2	23.17	22.06	19.74	18.61	15.35	14.11	12.40	12.26	7.94	7.42	24.05	0.17								
MRID1	5.02	5.06	4.64	4.54	3.95	3.61	2.86	3.14	1.79	1.63	1.56	1.14	5.32	0.17	MRID1	17.04	16.09	14.39	13.58	11.19	10.29	9.08	9.00	5.79	5.40	17.71	0.17								
Junc	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.38	0.59	0.76	0.87	0.74	0.87	6.00	Junc	7.86	8.70	8.79	8.60	8.28	7.63	6.38	6.10	4.74	4.00	8.79	0.42								
Dummy1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	Dummy1	2.48	5.34	5.98	5.58	4.87	3.16	1.23	0.97	0.15	0.00	5.98	0.42								
MRIDBas	10.05	9.99	9.48	9.03	8.58	7.22	5.70	5.87	4.20	3.82	3.66	2.68	10.79	0.17	MRIDBas	34.00	31.31	30.25	28.34	24.80	22.62	19.31	18.86	13.60	12.65	36.37	0.17								
MRd	10.05	9.99	9.48	9.03	8.58	7.22	5.70	5.87	4.40	4.60	4.89	4.22	10.79	0.17	MRd	36.50	38.90	39.36	41.05	40.63	37.21	30.85	30.12	23.28	19.74	41.05	0.50								
DSMRd	10.05	9.99	9.48	9.03	8.58	7.22	5.73	5.87	4.91	5.33	5.95	5.19	10.79	0.17	DSMRd	45.42	49.68	51.39	52.93	51.80	47.41	39.32	38.33	29.83	25.25	52.93	0.50								
20% AEP	ARR Edition	2019	Pervious Area Losses							Source: 2012 Upper South Creek Flood Study (WMAwater)							0.2% AEP	ARR Edition	2019	Pervious Area Losses							Source: 2012 Upper South Creek Flood Study (WMAwater)								
			Initial Burst Loss (mm)			16		BX			1.3		Roughness			0.025					Initial Burst Loss (mm)			10		BX			1.3		Roughness			0.025	
AEP	Subcatchment ID	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	Peak Flow (m3/s)	Critical Duration (hrs)	AEP	Subcatchment ID	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	Peak Flow (m3/s)	Critical Duration (hrs)	
		Storm Burst Duration (mins)							Peak Flow (m3/s)							Storm Burst Duration (mins)							Peak Flow (m3/s)												
N5	0.74	1.34	1.84	2.26	2.96	3.09	2.83	2.96	2.32	2.16	2.07	3.09	1.00	N5	8.71	10.49	10.90	10.57	10.09	9.25	7.67	7.36	5.74	10.90	0.42										
N1	0.54	0.98	1.35	1.67	2.29	2.46	2.33	2.41	1.96	1.80	1.74	2.46	1.00	N1	6.47	8.01	8.69	8.65	8.41	7.70	6.36	6.17	4.88	8.69	0.42										
N2	1.54	2.67	3.55	4.09	5.12	5.41	5.03	5.28	4.26	3.95	3.78	5.41	1.00	N2	14.82	16.95																			

AWE200083 Aspect Industrial Estate ARR2019 Hydrology

Attachment B6

Preliminary Masterplan with Basin Conditions																															
Basin sized to meet target at Mamre Road - 2 yr ARI (12 hr) & 100 yr ARI (2 hr)																															
50% AEP		ARR Edition		2019		Pervious Area Losses					Source: 2012 Upper South Creek Flood Study (WMAwater)					ARR Edition		2019		Pervious Area Losses					Source: 2012 Upper South Creek Flood Study (WMAwater)						
						Initial Burst Loss (mm)	28.5	BX	1.3	Roughness	0.025									Initial Burst Loss (mm)	28.5	BX	1.3	Roughness	0.025						
AEP	Subcatchment ID	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	Peak Flow (m³/s)	Critical Duration (hrs)	AEP	Subcatchment ID	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	Peak Flow (m³/s)	Critical Duration (hrs)				
		15	20	25	30	45	60	90	120	180	270	360	540			15	20	25	30	45	60	90	120	180	270	360	540				
N5		0.00	0.00	0.00	0.00	0.00	0.12	0.44	0.83	1.04	1.21	1.01	1.21	6.0	N5																
N1		0.00	0.00	0.00	0.00	0.09	0.32	0.66	0.85	0.99	0.85	0.99	6.0		N1																
N2		0.00	0.00	0.00	0.00	0.26	0.87	1.47	1.89	2.18	1.86	2.18	6.0		N2																
N3		0.00	0.00	0.00	0.00	0.03	0.12	0.19	0.23	0.26	0.22	0.26	6.0		N3																
N4		0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.06	0.07	0.06	0.07	6.0		N4																
N34		0.00	0.00	0.00	0.00	0.30	0.99	1.65	2.12	2.44	2.08	2.44	6.0		N34																
S1		0.00	0.00	0.00	0.00	0.03	0.07	0.08	0.08	0.09	0.07	0.09	6.0		S1																
S2		0.00	0.00	0.00	0.00	0.08	0.25	0.42	0.55	0.64	0.55	0.64	6.0		S2																
S3		0.00	0.00	0.00	0.00	0.12	0.38	0.59	0.76	0.87	0.74	0.87	6.0		S3																
MRID3		1.73	1.61	1.56	1.33	1.25	0.97	1.07	0.61	0.55	0.53	0.39	1.73	0.3	MRID3																
MRID2		5.15	4.79	4.66	4.00	3.74	2.91	3.20	1.82	1.65	1.59	1.16	5.15	0.3	MRID2																
Junc2		6.86	6.36	6.19	5.33	4.98	3.88	4.26	2.42	2.20	2.12	1.55	6.86	0.3	Junc2																
MRID1		5.06	4.64	4.54	3.95	3.61	2.86	3.14	1.79	1.63	1.56	1.14	5.06	0.3	MRID1																
Junc		0.00	0.00	0.00	0.00	0.12	0.38	0.59	0.76	0.87	0.74	0.87	6.0		Junc																
Dummy															Dummy																
MRIDBas		9.99	9.48	9.03	8.58	7.22	5.70	5.87	4.20	3.82	3.66	2.68	9.99	0.3	MRIDBas																
MRd		0.45	0.48	0.51	0.57	0.60	0.93	1.65	2.34	2.84	3.16	2.80	3.16	6.0		MRd															
DSMRd		0.45	0.48	0.51	0.57	0.60	0.93	1.65	2.34	2.84	3.16	2.80	3.16	6.0		DSMRd															
Peak Inflow (m³/s)		Peak Outflow (m³/s)		Max Vol (m³)		Max Stage (m)		Peak Inflow (m³/s)		Peak Outflow (m³/s)		Max Vol (m³)		Max Stage (m)		Peak Inflow (m³/s)		Peak Outflow (m³/s)		Max Vol (m³)		Max Stage (m)		Peak Inflow (m³/s)		Peak Outflow (m³/s)		Max Vol (m³)		Max Stage (m)	
20% AEP	Subcatchment ID	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	Peak Flow (m³/s)	Critical Duration (hrs)	AEP	Subcatchment ID	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	Peak Flow (m³/s)	Critical Duration (hrs)				
		15	20	25	30	45	60	90	120	180	270	360	540			15	20	25	30	45	60	90	120	180	270	360	540				
N5		0.00	0.00	0.00	0.06	0.60	1.15	1.74	2.05	1.97	1.80	1.91	2.05	2.0	N5																
N1		0.00	0.00	0.00	0.05	0.44	0.84	1.34	1.65	1.64	1.50	1.60	1.65	2.0	N1																
N2		0.00	0.00	0.00	0.14	1.24	2.23	3.03	3.63	3.52	3.27	3.46	3.63	2.0	N2																
N3		0.00	0.00	0.00	0.02	0.16	0.31	0.41	0.47	0.41	0.39	0.40	0.47	2.0	N3																
N4		0.00	0.00	0.00	0.01	0.05	0.08	0.11	0.12	0.11	0.10	0.10	0.12	2.0	N4																
N34		0.00	0.00	0.00	0.16	1.41	2.52	3.37	4.05	3.93	3.66	3.87	4.05	2.0	N34																
S1		0.00	0.00	0.00	0.01	0.12	0.18	0.17	0.20	0.14	0.13	0.13	0.20	2.0	S1																
S2		0.00	0.00	0.00	0.04	0.36	0.64	0.89	1.07	1.05	0.98	1.03	1.07	2.0	S2																
S3		0.00	0.00	0.00</																											

AWE20083 Aspect Industrial Estate ARR1987 Hydrology

Stage 1 Conditions with Ultimate Basin

Attachment B7

Ultimate Basin sized to meet target at Mamre Road - 2 yr ARI (12 hr) & 100 yr ARI (2 hr)												Ultimate Basin sized to meet target at Mamre Road - 2 yr ARI (12 hr) & 100 yr ARI (2 hr)																	
2 yr ARI		ARR Edition		1987		Pervious Area Losses				Source: 2012 Upper South Creek Flood Study (WMAwater)		200 yr ARI		ARR Edition		1987		Pervious Area Losses				Source: 2012 Upper South Creek Flood Study (WMAwater)							
						Initial Burst Loss (mm)				15		BX		Continuing (mm/h)				1.5		Initial Burst Loss (mm)				15					
						Storm Burst Duration (mins)								Peak Flow (m3/s)				Critical Duration (hrs)		Storm Burst Duration (mins)									
Subcatchment ID		30		45		60				90		120		180				270		360				540					
N5	0.59	1.18	1.46	1.60	1.76	1.61	1.75	1.81	1.88	1.98	1.39	1.07	1.98	12.0	N5	6.34	7.03	7.78	7.72	8.18	6.23	6.62	5.70	4.91	5.03	3.53	2.78	8.18	2.0
N1	0.43	0.87	1.14	1.29	1.38	1.31	1.35	1.54	1.60	1.66	1.21	0.95	1.66	12.0	N1	4.91	5.69	6.23	6.12	4.92	5.68	4.87	4.13	4.29	3.12	2.47	6.32	2.0	
N2	1.30	2.34	2.88	3.08	3.29	3.17	3.43	3.60	3.85	3.96	2.88	2.26	3.96	12.0	N2	12.05	13.53	15.05	15.20	15.92	12.27	13.40	11.52	9.98	10.16	7.43	5.91	15.92	2.0
N3	0.16	0.28	0.34	0.35	0.38	0.34	0.42	0.38	0.39	0.40	0.27	0.21	0.42	4.5	N3	1.45	1.56	1.79	1.80	1.94	1.48	1.36	1.16	1.00	1.01	0.68	0.54	1.94	2.0
N4	0.04	0.07	0.09	0.09	0.09	0.09	0.11	0.10	0.10	0.10	0.07	0.05	0.11	4.5	N4	0.37	0.40	0.45	0.47	0.51	0.38	0.34	0.29	0.25	0.25	0.17	0.13	0.51	2.0
N34	1.46	2.58	3.19	3.38	3.64	3.50	3.78	3.93	4.27	4.30	3.18	2.52	4.30	12.0	N34	12.84	14.54	16.33	16.45	17.27	13.42	14.46	12.66	11.01	10.92	8.17	6.58	17.27	2.0
S1	0.10	0.14	0.17	0.18	0.20	0.14	0.16	0.14	0.12	0.12	0.08	0.06	0.20	2.0	S1	0.70	0.65	0.78	0.80	0.76	0.52	0.45	0.33	0.29	0.29	0.19	0.15	0.80	1.5
S2	0.33	0.60	0.72	0.88	0.85	0.88	0.98	1.02	1.08	1.08	0.78	0.61	1.08	12.0	S2	3.07	3.55	3.83	3.79	4.05	3.15	3.60	3.10	2.69	2.77	2.01	1.60	4.05	2.0
S3	0.53	0.86	1.04	1.06	1.15	1.11	1.24	1.24	1.34	1.43	1.01	0.79	1.43	12.0	S3	4.23	4.66	5.20	5.42	5.70	4.41	4.64	4.07	3.52	3.62	2.59	2.06	5.70	2.0
MRID3	0.12	0.22	0.29	0.33	0.36	0.33	0.34	0.38	0.40	0.41	0.30	0.23	0.41	12.0	MRID3	1.30	1.46	1.60	1.60	1.66	1.29	1.42	1.22	1.04	1.08	0.76	0.60	1.66	2.0
MRID2a	0.06	0.14	0.19	0.25	0.29	0.32	0.31	0.35	0.46	0.41	0.35	0.32	0.46	9.0	MRID2a	0.80	1.12	1.29	1.37	1.42	1.31	1.30	1.36	1.27	1.23	1.01	0.86	1.42	2.0
MRID2b	0.17	0.31	0.47	0.57	0.64	0.61	0.57	0.72	0.81	0.80	0.62	0.51	0.81	9.0	MRID2b	2.04	2.50	2.76	2.72	2.82	2.37	2.71	2.37	2.09	2.16	1.64	1.33	2.82	2.0
Junc2	1.30	2.34	2.88	3.08	3.29	3.17	3.43	3.60	3.85	3.96	2.88	2.26	3.96	12.0	Junc2	12.05	13.53	15.05	15.20	15.92	12.27	13.40	11.52	9.98	10.16	7.43	5.91	15.92	2.0
MRID1	1.89	1.59	2.32	2.22	2.15	1.49	1.33	1.14	1.38	1.49	1.11	0.94	2.32	1.0	MRID1	5.30	4.72	6.13	5.91	5.67	4.37	4.32	3.95	3.61	3.88	2.90	2.40	6.13	1.0
MRID1b	1.10	0.98	1.04	1.11	1.04	0.58	0.52	0.39	0.38	0.39	0.27	0.22	1.11	1.5	MRID1b	2.52	2.31	2.51	2.67	2.52	1.44	1.30	1.03	0.93	0.95	0.68	0.55	2.67	1.5
Junc1	0.65	1.08	1.32	1.38	1.49	1.44	1.58	1.60	1.74	1.79	1.29	1.02	1.79	12.0	Junc1	5.51	6.08	6.80	7.01	7.35	5.69	6.00	5.24	4.45	4.55	3.34	2.66	7.35	2.0
Stage1	0.22	0.31	0.39	0.48	0.53	0.55	0.55	0.64	0.93	0.77	0.84	0.73	0.93	9.0	Stage1	1.35	1.75	2.01	2.23	2.33	2.27	2.36	2.36	2.25	2.20	2.06	1.90	4.05	9.0
Node6	0.23	0.45	0.65	0.80	0.89	0.88	0.82	1.03	1.27	1.19	0.96	0.82	1.27	9.0	Node6	2.82	3.58	3.95	3.98	4.15	3.61	3.93	3.60	3.30	3.37	2.64	2.19	4.15	2.0
MRIDBas	1.89	1.59	2.32	2.22	2.15	1.49	1.33	1.14	1.38	1.49	1.11	0.94	2.32	1.0	MRIDBas	5.30	4.72	6.13	5.91	5.67	4.37	4.32	3.95	3.61	3.88	2.90	2.40	6.13	1.0
MRd	1.90	3.34	4.15	4.57	4.89	4.78	5.45	6.23	6.01	4.74	4.00	6.23	9.0	MRd	2.82	3.58	3.95	3.98	4.15	3.61	3.93	3.60	3.30	3.37	2.64	2.19	4.15	2.0	
DSMRd	2.43	4.24	5.40	5.87	6.35	6.12	6.37	6.87	7.91	7.39	5.94	4.98	7.91	9.0	DSMRd	20.													

AWE200083 Aspect Industrial Estate ARR1987 Hydrology

Final Masterplan No Basin

Attachment B8

(refer Attachment B2 for Preliminary Masterplan No Basin)

2 yr ARI	ARR Edition	1987	Pervious Area Losses				Source: 2012 Upper South Creek Flood Study (WMAwater)				200 yr ARI				Pervious Area Losses				Source: 2012 Upper South Creek Flood Study (WMAwater)										
			Initial Burst Loss (mm)	Continuing (mm/h)	15	BX	1.3	Roughness	0.025					Initial Burst Loss (mm)	Continuing (mm/h)	15	BX	1.3	Roughness	0.025									
ARI (yrs)																													
Subcatchment ID	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	Critical Duration (hrs)							
	30	45	60	90	120	180	270	360	540	720	1440	2160	Peak Flow (m3/s)	Critical Duration (hrs)	Subcatchment ID		30	45	60	90	120	180	270	360	540	720	1440	2160	Peak Flow (m3/s)
Storm Burst Duration (mins)																													
N5	0.62	1.20	1.49	1.64	1.77	1.63	1.77	1.81	1.89	1.97	1.39	1.07	1.97	12.0	N5	6.39	7.09	7.85	7.77	8.23	6.29	6.65	5.72	4.91	5.03	3.53	2.78	8.23	2.0
N1	0.46	0.90	1.16	1.32	1.42	1.34	1.38	1.54	1.61	1.66	1.22	0.95	1.66	12.0	N1	4.97	5.74	6.28	6.20	6.41	5.00	5.72	4.88	4.17	4.32	3.12	2.47	6.41	2.0
N2	1.57	2.43	2.93	3.15	3.39	3.18	3.51	3.62	3.86	4.06	2.92	2.29	4.06	12.0	N2	12.02	13.36	14.87	15.00	15.49	12.02	13.46	11.57	9.94	10.29	7.46	5.94	15.49	2.0
N3	0.17	0.30	0.36	0.36	0.38	0.34	0.44	0.39	0.40	0.41	0.27	0.21	0.44	4.5	N3	1.48	1.59	1.80	1.82	1.94	1.51	1.37	1.16	1.00	1.01	0.68	0.54	1.94	2.0
N4	0.05	0.08	0.10	0.10	0.10	0.09	0.11	0.10	0.10	0.07	0.05	0.11	4.5	N4	0.39	0.41	0.46	0.48	0.51	0.39	0.35	0.29	0.25	0.25	0.17	0.13	0.51	2.0	
N34	1.75	2.67	3.29	3.49	3.73	3.53	3.94	3.97	4.29	4.40	3.22	2.54	4.40	12.0	N34	12.79	14.46	16.27	16.26	16.82	13.18	14.52	12.75	11.03	11.06	8.21	6.61	16.82	2.0
S1	0.10	0.14	0.17	0.18	0.20	0.14	0.16	0.14	0.12	0.12	0.08	0.06	0.20	2.0	S1	0.72	0.66	0.78	0.80	0.76	0.52	0.45	0.33	0.29	0.29	0.19	0.15	0.80	1.5
S2	0.35	0.60	0.72	0.82	0.88	0.85	0.88	0.98	1.02	1.08	0.78	0.61	1.08	12.0	S2	3.15	3.61	3.95	3.91	4.19	3.21	3.63	3.13	2.69	2.78	2.01	1.60	4.19	2.0
S3	0.56	0.91	1.06	1.07	1.16	1.12	1.28	1.25	1.35	1.43	1.01	0.79	1.43	12.0	S3	4.28	4.75	5.34	5.57	5.86	4.46	4.68	4.11	3.53	3.64	2.59	2.06	5.86	2.0
MRID3	1.54	1.39	1.49	1.58	1.50	0.82	0.73	0.57	0.51	0.51	0.33	0.26	1.58	1.5	MRID3	3.55	3.25	3.58	3.83	3.63	2.07	1.82	1.35	1.18	0.79	0.63	3.83	1.5	
MRID2a	3.05	2.73	2.90	3.08	2.90	1.59	1.41	1.04	0.94	0.95	0.63	0.49	3.08	1.5	MRID2a	6.86	6.35	6.78	7.17	6.81	3.76	3.35	2.51	2.19	2.20	1.49	1.19	7.17	1.5
MRID2b	2.76	2.49	2.66	2.83	2.68	1.46	1.29	0.99	0.93	0.94	0.63	0.49	2.83	1.5	MRID2b	6.29	5.77	6.28	6.70	6.33	3.63	3.26	2.52	2.19	2.21	1.51	1.20	6.70	1.5
Junc2	1.57	2.43	2.93	3.15	3.39	3.18	3.51	3.62	3.86	4.06	2.92	2.29	4.06	12.0	Junc2	12.02	13.36	14.87	15.00	15.49	12.02	13.46	11.57	9.94	10.29	7.46	5.94	15.49	2.0
MRID1	3.04	2.49	3.39	3.31	3.22	2.02	1.77	1.39	1.35	1.40	0.95	0.76	3.39	1.0	MRID1	7.48	6.04	8.12	7.89	7.67	5.05	4.57	3.69	3.25	3.33	2.34	1.88	8.12	1.0
MRID1b	1.10	0.98	1.04	1.11	1.03	0.59	0.52	0.40	0.39	0.40	0.27	0.22	1.11	1.5	MRID1b	2.53	2.32	2.51	2.67	2.52	1.44	1.30	1.04	0.93	0.96	0.68	0.55	2.67	1.5
Junc1	1.54	1.39	1.49	1.58	1.51	1.41	1.64	1.61	1.73	1.85	1.33	1.04	1.85	12.0	Junc1	5.35	5.80	6.58	6.74	6.78	5.34	6.00	5.14	4.43	4.64	3.37	2.69	6.78	2.0
Stage1	6.59	6.86	6.46	6.95	6.44	4.15	4.17	3.34	3.16	3.24	2.19	1.74	6.95	1.5	Stage1	16.07	16.85	16.14	16.71	16.09	10.41	10.50	8.51	7.47	7.62	5.32	4.27	16.85	0.8
Node6	5.63	4.95	5.18	5.49	5.17	3.04	2.69	2.03	1.87	1.89	1.25	0.98	5.63	0.5	Node6	12.93	11.66	12.49	13.25	12.45	7.36	6.59	5.02	4.38	4.40	3.00	2.39	13.25	1.5
MRIDBas	6.59	6.86	6.46	6.95	6.44	4.15	4.17	3.34	3.16	3.24	2.19	1.74	6.95	0.5	MRIDBas	16.07	16.85	16.14	16.71	16.09	10.41	10.50	8.51	7.47	7.62	5.32	4.27	16.85	0.8
MRd	8.34	8.37	8.53	9.18	8.59	5.98	6.64	6.41	7.21	7.00	5.31	4.28	9.18	1.5	MRd	24.94	23.33	27.80	30.73	28.58	22.62	23.35	20.56	18.09	17.47	13.46	10.88	30.73	1.5
DSMRd	8.95	8.96	9.72	10.54	9.94	7.49	8.26	8.20	9.07	8.97	6.70	5.35	10.54	9.0	DSMRd	31.33	30.03	35.56	38.01	36.24	28.16	29.98	25.45	22.61	22.49	16.99	13.66	38.01	1.5
5 yr ARI																													
Subcatchment ID	ARR Edition	1987	Pervious Area Losses				Source: 2012 Upper South Creek Flood Study (WMAwater)				500 yr ARI				ARR Edition				Pervious Area Losses										
			Initial Burst Loss (mm)	Continuing (mm/h)	15	BX	1.3	Roughness	0.025							ARR Edition	1987		Initial Burst Loss (mm)	Continuing (mm/h)	15	BX	1.3	Roughness	0.025				
ARI (yrs)																													
Subcatchment ID	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	Critical Duration (hrs)							
	30	45	60	90	120	180	270	360	540	720	1440	2160	Peak Flow (m3/s)	Critical Duration (hrs)	Subcatchment ID		30	45	60	90	120	180	270	360	540	720	1440	2160	Peak Flow (m3/s)
Storm Burst Duration (mins)																													
N5	1.61	2.36	2.74	2.78	2.89	2.49	3.12	2.75	2.57	2.68	1.89	1.47	3.12	4.5	N5	7.72	8.43	9.40	9.25	9.86	7.60	7.59	6.52	5.61	5.72	4.02	3.18	9.86	2.0
N1	1.19	1.83	2.14	2.25	2.39	2.14	2.45	2.29	2.19	2.28	1.66	1.30	2.45	4.5	N1	6.11	6.84	7.50	7.42	7.74	6.01	6.54	5.58	4.77	4.93	3.56	2.82</		

AWE200083 Aspect Industrial Estate ARR1987 Hydrology

Ultimate Basin sized to meet target at Mamre Road - 2 yr ARI (36 hr) & 100 yr ARI (36 hr)

Final Masterplan with Basin Conditions

Attachment E

Preliminary Masterplan with Bas