Flood Impact Assessment

Aspect Industrial Estate (AIE)

AWE200083

Prepared for
Mirvac

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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. This report addresses the relevant SEARs considerations

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

The concept details of the draft Aspect Industrial Estate masterplan are given in Figure 2. The draft masterplan responded to the flooding risks by separating upstream runoff from local internal runoff and implementing a number of measures:

In response to considerations raised by DPIE the draft 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

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 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 two phases.

In the Phase 1 the hydrological model of benchmark conditions was modified to represent Ultimate Conditions (based on the draft Masterplan) without a Basin and with a Basin. The draft 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. It should be noted that the diversion of upstream runoff around the site was included in both scenarios for Ultimate Conditions. 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.

In the Phase 2 the hydrological model of benchmark conditions was modified to represent Stage 1 Conditions with a Basin (sized based on Ultimate Conditions).

Ultimate Conditions without a Basin

The assessment of Ultimate Conditions without a Basin under ARR1987 was based on Scenario 2 (refer Cardno, 2020). The results of the ARR1987 hydrological modelling of Ultimate Conditions without a Basin are summarised in **Attachment B2**.

The assessment of Ultimate Conditions without a Basin under ARR2019 was based on Scenario 5 (refer Cardno, 2020). The same changes to the ARR2019 hydrological model were adopted.

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

Ultimate Conditions with a Basin

The concept sizing of a basin was undertaken by Cardno to mitigate the impact of development on 2 yr ARI and 100 yr ARI runoff from the estate was undertaken for ARR1987 conditions. Refer to the Civil Engineering report for detailed basin sizing, invert levels and details of minor and major storm event discharge control devices. 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.

The 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 as follows.

Summary of Concept Basin Properties

ARR	Basin Footprint	Max 1% AEP Depth	1% AEP Basin Volume	Max 50% AEP Depth	50% AEP Basin Volume	Primary Outlet	Secondary Spillway Width	Secondary Spillway Crest Level	Embankment Crest Level above Primary Outlet IL
	(m2)	(m)	(m3)	(m)	(m3)		(m)	(m)	(m)
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

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

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 that 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 Future 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 Future 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 Ultimate 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 Future Conditions during an 9 hour storm burst (the indicative critical storm burst for the South Creek catchment under ARR2019) would increase by 1.04 m^3/s above the 9 hour 100 yr ARI flow under benchmark conditions;

(v) The peak 1% AEP flow at Mamre Road under Future Conditions during an 9 hour storm burst of 12.1 m^3/s compares to the estimated 727 m^3/s in South Creek at Node 1.17 and an increase of 1.04 m^3/s represents a 0.15% increase in South Creek assuming that the peaks coincide.

Stage 1 Conditions with a Basin

Based on the basin assessment undertaken under ultimate conditions, the first ARR1987 basin scenario (see above) was adopted for Stage 1 assessment purposes. The results of the ARR1987 hydrological modelling of Stage 1 Conditions with an (ultimate) Basin are summarised in **Attachment B7**.

Stream Erosion Index

The SEI has been assessed at Mamre Road under Ultimate 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 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

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 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). The basin was not explicitly modelled rather the outflow (as estimated by Cardno) 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.

Flood Impact Assessment

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.

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 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 950m 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 Concept 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, utility infrastructure, 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. 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 1.3**).

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 concept details of the draft Aspect Industrial Estate masterplan are given in **Figure 2.** The draft masterplan responded to the flooding risks by separating upstream runoff from local internal runoff and implementing the following measures:

(i) Capturing upstream runoff just inside the site boundary and conveying this via a dedicated trunk drainage line to an outfall on the northern boundary which discharges into a swale which conveys runoff to the existing Mamre Road crossing in all events up to the 100 yr ARI event;

(ii) A swale constructed along the uphill boundary is intended to capture any local overland flows which are not conveyed along the trunk drainage lines and to convey this upstream local runoff to the major swale located on the northern and eastern boundary; and

(iii) Directing all runoff from within the industrial estate 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.

In response to considerations raised by DPIE the draft 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 Aspect Industrial Estate masterplan are given in **Figure 4.**

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:

(iii) 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

(iv) 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.

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 WorleyParsons 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

ARR1987 Hydrology			**ARR2019 Hydrology**		
ARI (yrs)	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	233	0.75	PMF	233	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 also 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 is around 11% higher than the estimated 100 yr ARI peak flow at Mamre Road.

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

The indicativeARR2019 peak flows were obtained by modifying the 2015 Worley Parsons model by adopting a global storm (not catchment dependent storms) and a uniform initial burst loss (refer Section 3.4.2) across the catchment. An areal reduction factor was not applied to the rainfall intensities obtained from the ARR Data Hub.

Table 2 Summary of Estimated Peak Flows in South Creek at Node 1.17

	Storm Burst			
Event	2 hr	9 hr	36 hr	
2 yr ARI	13.6	151	305	ARR1987 - Worley Parsons, 2015 Model
100 yr ARI	360	774	956	ARR1987 - Worley Parsons, 2015 Model
1% AEP	558	727	563	ARR2019 - Modified WorleyParsons, 2015 Model

It was noted that the indicative peak flow under ARR2019 is lower than estimated under ARR1987 and the critical storm burst duration reduces from 36 hours to 9 hours.

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 fee 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 WorleyParsons 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 and ultimate development.

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.*

Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
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
Very Rare	0.005	0.5	200	200
	0.002	0.2	500	500
	0.001	0.1	1000	1000
	0.0005	0.05	2000	2000
Extreme	0.0002	0.02	5000	5000
			↓	
			PMP/ PMPDF	

Figure 1.2.1. Australian Rainfall and Runoff Preferred Terminology

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.

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 two phases.

In the Phase 1 the hydrological model of benchmark conditions was modified to represent Ultimate Conditions (based on the draft Masterplan) 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 3**. The draft 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.

It should be noted that the diversion of upstream runoff around the site was included in both scenarios for Ultimate Conditions. 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.

In the Phase 2 the hydrological model of benchmark conditions was modified to represent Stage 1 Conditions with a Basin (sized based on Ultimate Conditions). The subcatchment boundaries and the link-node layout of the local XP-RAFTS model are given in **Figure 6**.

2.1 Ultimate Conditions without a Basin

2.1.1 ARR1987 Assessments

The assessment of Ultimate Conditions without a Basin was based on Scenario 2.

Changes to Ultimate 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 Ultimate Conditions without a Basin are summarised in **Attachment B2**.

2.1.2 ARR2019 Assessments

The assessment of Ultimate 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 Ultimate Conditions without a Basin are summarised in **Attachment B5**.

2.2 Ultimate 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 3.

Table 3 Summary of Concept Basin Properties

ARR	Basin Footprint	Max 1% AEP Depth	1% AEP Basin Volume	Max 50% AEP Depth	50% AEP Basin Volume	Primary Outlet	Secondary Spillway		Embankment Crest Level above Primary Outlet IL
							Width	Crest Level	
	(m2)	(m)	(m3)	(m)	(m3)		(m)	(m)	(m)
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

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

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 Future 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 Future 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 Ultimate 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 Future Conditions during an 9 hour storm burst (the indicative critical storm burst for the South Creek catchment under ARR2019) would increase by 1.04 m^3/s above the 9 hour 100 yr ARI flow under benchmark conditions;

(v) The peak 1% AEP flow at Mamre Road under Future Conditions during an 9 hour storm burst of 12.1 m^3/s compares to the estimated 727 m^3/s in South Creek at Node 1.17 and an increase of 1.04 m^3/s represents a 0.15% increase in South Creek assuming that the peaks coincide.

2.3 Stage 1 Conditions with a Basin

Based on the basin assessment undertaken under ultimate conditions, the first ARR1987 basin scenario (see **Table 3**) was adopted for Stage 1 assessment purposes.

The results of the ARR1987 hydrological modelling of Stage 1 Conditions with an (ultimate) Basin are summarised in **Attachment B7**.

2.4 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 Ultimate 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 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 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 (see **Figure 5**).

The roughness zones under Stage 1 Conditions are mapped in **Figure 6**.

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 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). The basin was not explicitly modelled rather the outflow from the basin was input just downstream of the basin.

The downstream boundary condition was a fee 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.

3.1 Stage 1 Conditions with a Basin

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.

3.1.1 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.

3.1.2 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.

3.1.3 100 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.

3.1.4 200 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.

3.1.5 500 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.

3.1.6 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.

4 Flood Impact Assessment

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

4.1 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.

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.

4.2 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.

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 addresses 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 the 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

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.

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.

(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) has been assessed at Mamre Road under Ultimate Conditions without a Basin and Future Conditions with a Basin based on continuous (6 minute) MUSIC modelling.

It was calculated that the SEI under Future Conditions without a Basin and Future 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.

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.

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

The flood hazards experienced in the Aspect Industrial Estate 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.

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 Ultimate 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 ultimate 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 would be exposed only to potential flood risks and damages in extreme floods. In the PMF, the Stage 1 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 Ultimate 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 ultimate 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

(1) 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 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

WorleyParsons (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.

APPENDIX A
FIGURES

Figure 1   Location of Aspect Industrial Estate

mirvac

OVERALL DEVELOPMENT DATA

Total Site Area	558,213 m²
Access Roads Area	44,557 m²
Riparian Area	10,145 m²
Basin Lot Area	18,732 m²
Total Developable Area	476,953 m²
Total Office Area	11,000 m²
Total Warehouse Area	264,425 m²
Cafe	60 m²
Total Building Area	275,485 m²
Restriction on User Area	4,613 m²

	Site Area	Offices	Warehouse	Total GFA	Carpark Provided
LOT 1	69,821 m²	1,500 m²	44,120 m²	45,620 m²	241
LOT 2	49,497 m²	1,500 m²	30,890 m²	32,390 m²	152
LOT 3	41,581 m²	1,300 m²	24,600 m²	25,900 m²	123
LOT 4	48,126 m²	1,000 m²	24,820 m²	25,820 m²	116
LOT 5	28,742 m²	650 m²	12,350 m²	13,000 m²	62
LOT 6	36,963 m²	750 m²	21,790 m²	22,540 m²	105
LOT 7	38,361 m²	750 m²	20,970 m²	21,720 m²	103
LOT 8	47,681 m²	1,300 m²	27,100 m²	28,400 m²	141
LOT 9	38,982 m²	750 m²	18,925 m²	19,675 m²	127
LOT 10	36,069 m²	750 m²	18,500 m²	19,250 m²	90
LOT 11	41,130 m²	750 m²	20,360 m²	21,110 m²	94

*All areas subject to survey

SBA ARCHITECTS

ASPECT INDUSTRIAL ESTATE

LOTS 54-58 MAMRE ROAD, KEMPS CREEK

SSDA ESTATE MASTERPLAN

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Figure 2 Aspect Industrial Estate Draft Masterplan

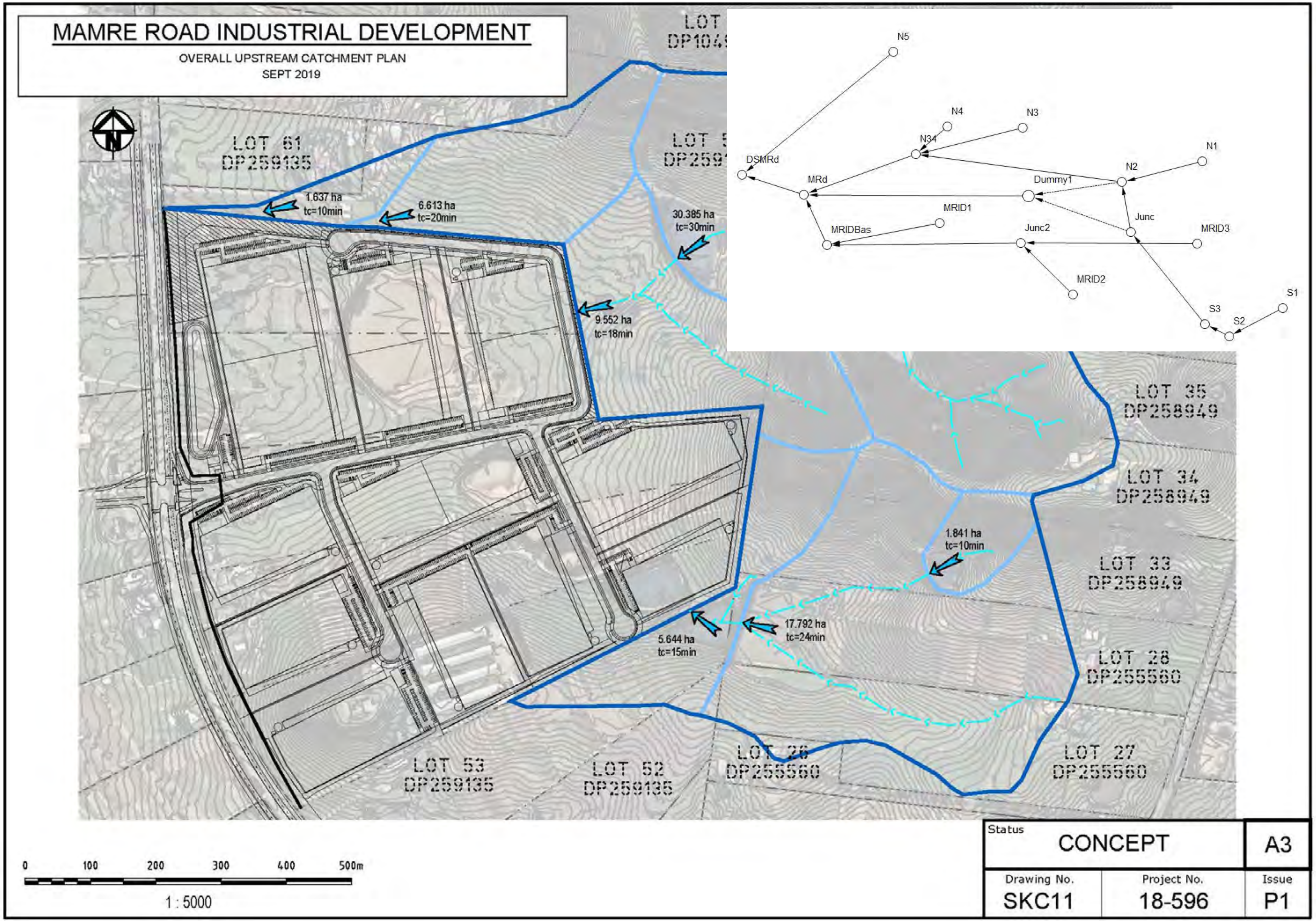

Figure 3 Local Subcatchment Boundaries in AIE XP-RAFTS model under Draft Masterplan Conditions

OVERALL DEVELOPMENT DATA

Total Site Area.	558,213 m²
Rev. Boundary Site Area	544,209 m²
Access Roads Area	43,489 m²
Future Roads Area	3,324 m²
Creek Riparian Area	29,615 m²
Retained Riparian Area	3,955 m²
Basin Lot Area	17,290 m²
Total Developable Area	446,536 m²
Total Office Area (incl. dock off.)	11,510 m²
Total Warehouse Area	239,530 m²
Cafe	122 m²
Total Building Area	251,162 m²
Restriction on User Area	4,613 m²

WAREHOUSE 1

Site Area	58,156 m²
Offices	1,460 m²
Warehouse	35,060 m²
Dock Office	200 m²
Cafe	122 m²
Total GFA	36,842 m²
Carpark Provided	233

WAREHOUSE 2

Site Area	41,945 m²
Offices	1,500 m²
Warehouse	24,895 m²
Dock Office	200 m²
Total GFA	26,595 m²
Carpark Provided	144

WAREHOUSE 3

Site Area	42,882 m²
Offices	700 m²
Warehouse	20,735 m²
Dock Office	100 m²
Total GFA	21,535 m²
Carpark Provided	89

WAREHOUSE 4

Site Area	41,044 m²
Offices	750 m²
Warehouse	18,235 m²
Dock Office	100 m²
Total GFA	19,085 m²
Carpark Provided	93

WAREHOUSE 5

Site Area	28,392 m²
Offices	650 m²
Warehouse	12,150 m²
Dock Office	100 m²
Total GFA	12,900 m²
Carpark Provided	60

WAREHOUSE 6

Site Area	37,843 m²
Offices	750 m²
Warehouse	22,740 m²
Dock Office	100 m²
Total GFA	23,590 m²
Carpark Provided	106

WAREHOUSE 7

Site Area	37,847 m²
Offices	750 m²
Warehouse	21,610 m²
Dock Office	100 m²
Total GFA	22,460 m²
Carpark Provided	100

WAREHOUSE 8

Site Area	50,786 m²
Offices	1,300 m²
Warehouse	28,520 m²
Dock Office	200 m²
Total GFA	30,020 m²
Carpark Provided	175

WAREHOUSE 9

Site Area	35,571 m²
Offices	750 m²
Warehouse	17,720 m²
Dock Office	100 m²
Total GFA	18,570 m²
Carpark Provided	85

WAREHOUSE 10

Site Area	33,421 m²
Offices	750 m²
Warehouse	17,525 m²
Dock Office	100 m²
Total GFA	18,375 m²
Carpark Provided	87

WAREHOUSE 11

Site Area	38,649 m²
Offices	750 m²
Warehouse	20,340 m²
Dock Office	100 m²
Total GFA	21,190 m²
Carpark Provided	90

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

SBA ARCHITECTS

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ASPECT INDUSTRIAL ESTATE

LOTS 54-58 (DP259135) MAMRE ROAD, KEMPS CREEK

SSDA ESTATE MASTERPLAN

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Figure 4 Aspect Industrial Estate Final Masterplan

Figure 5 Aspect Industrial Estate Stage 1 Development

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

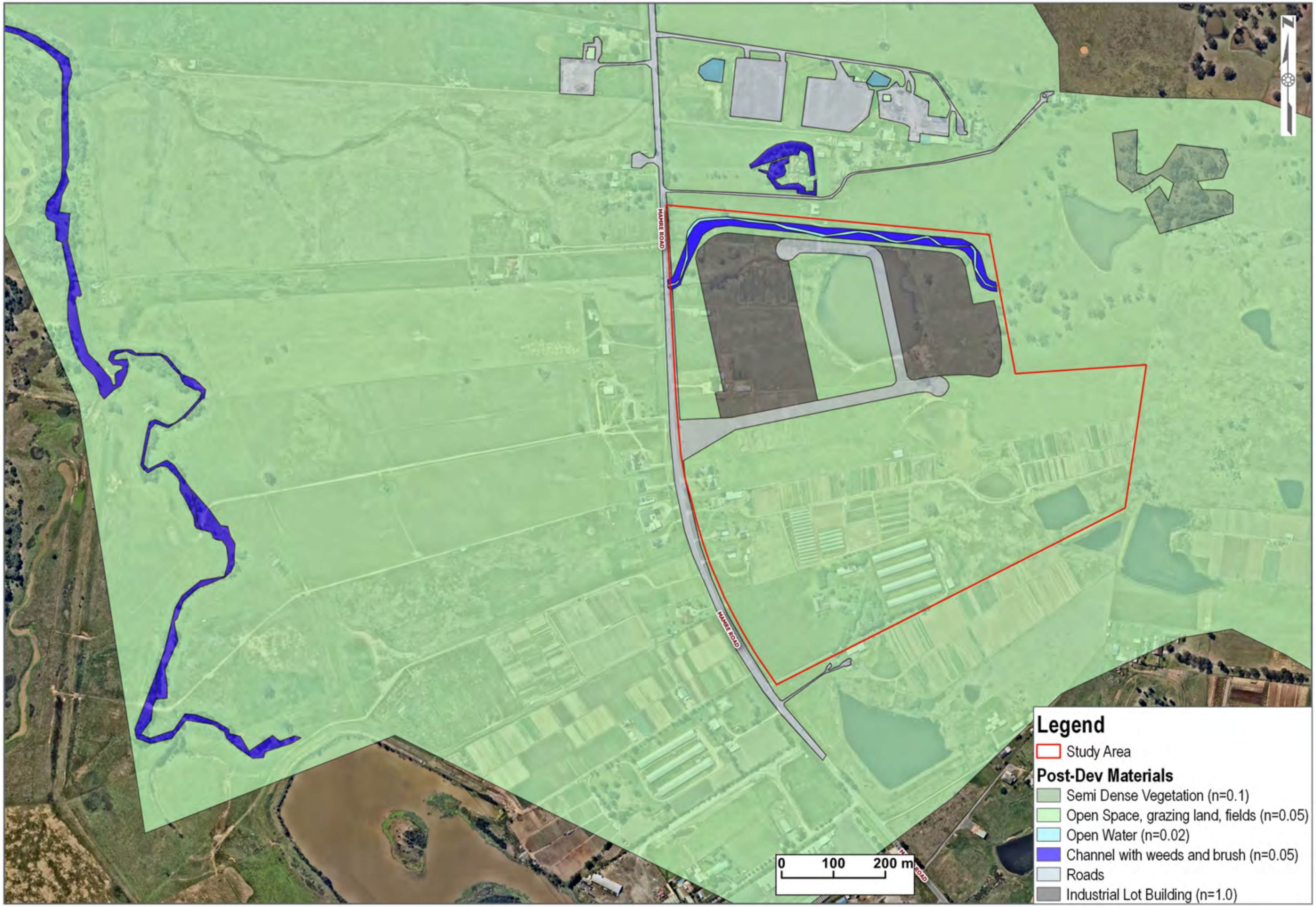

Figure 7 Adopted Roughness Zones under Stage 1 Conditions

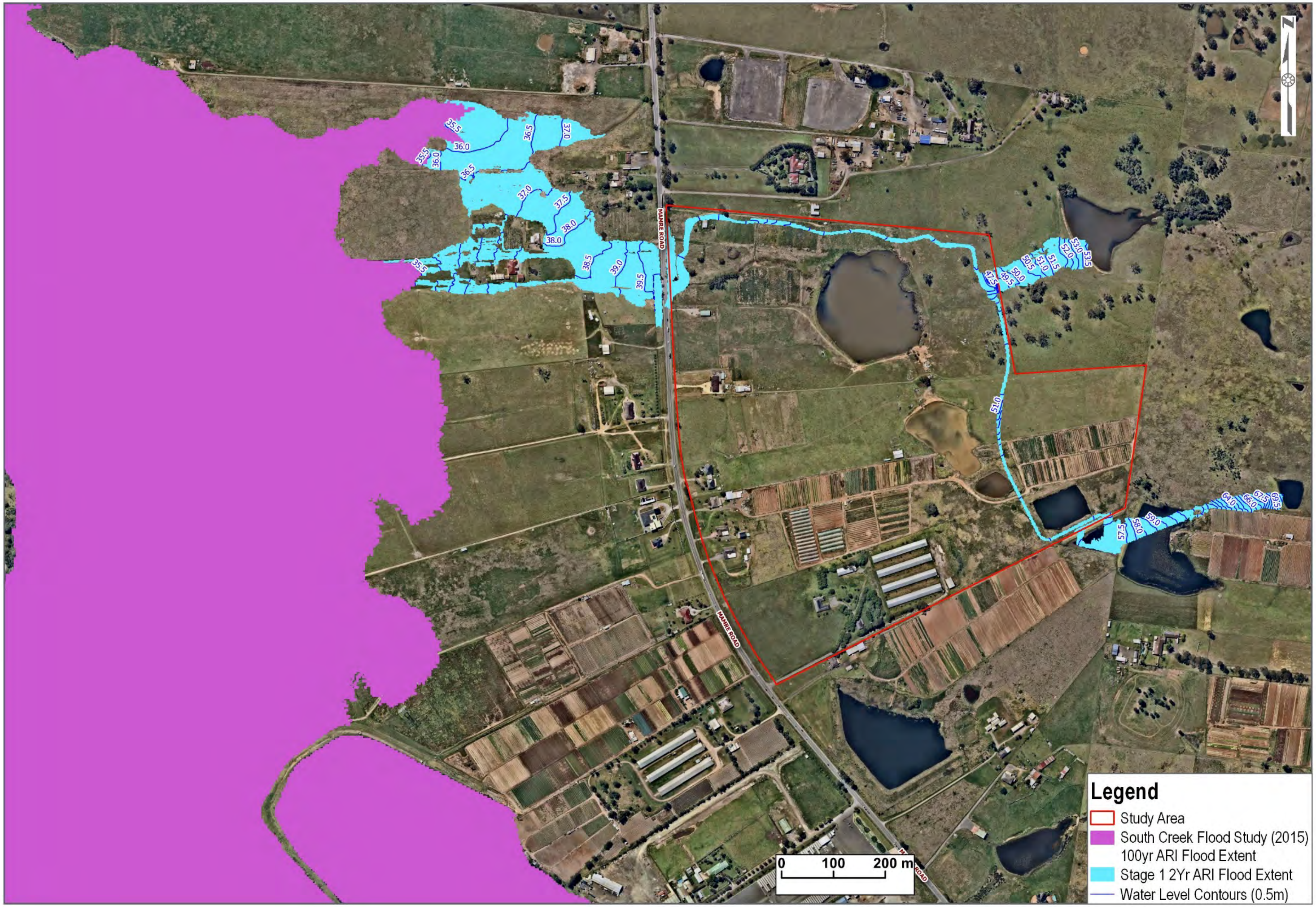

Figure 8 2 yr ARI Flood Extents and Flood Levels - Stage 1 Conditions

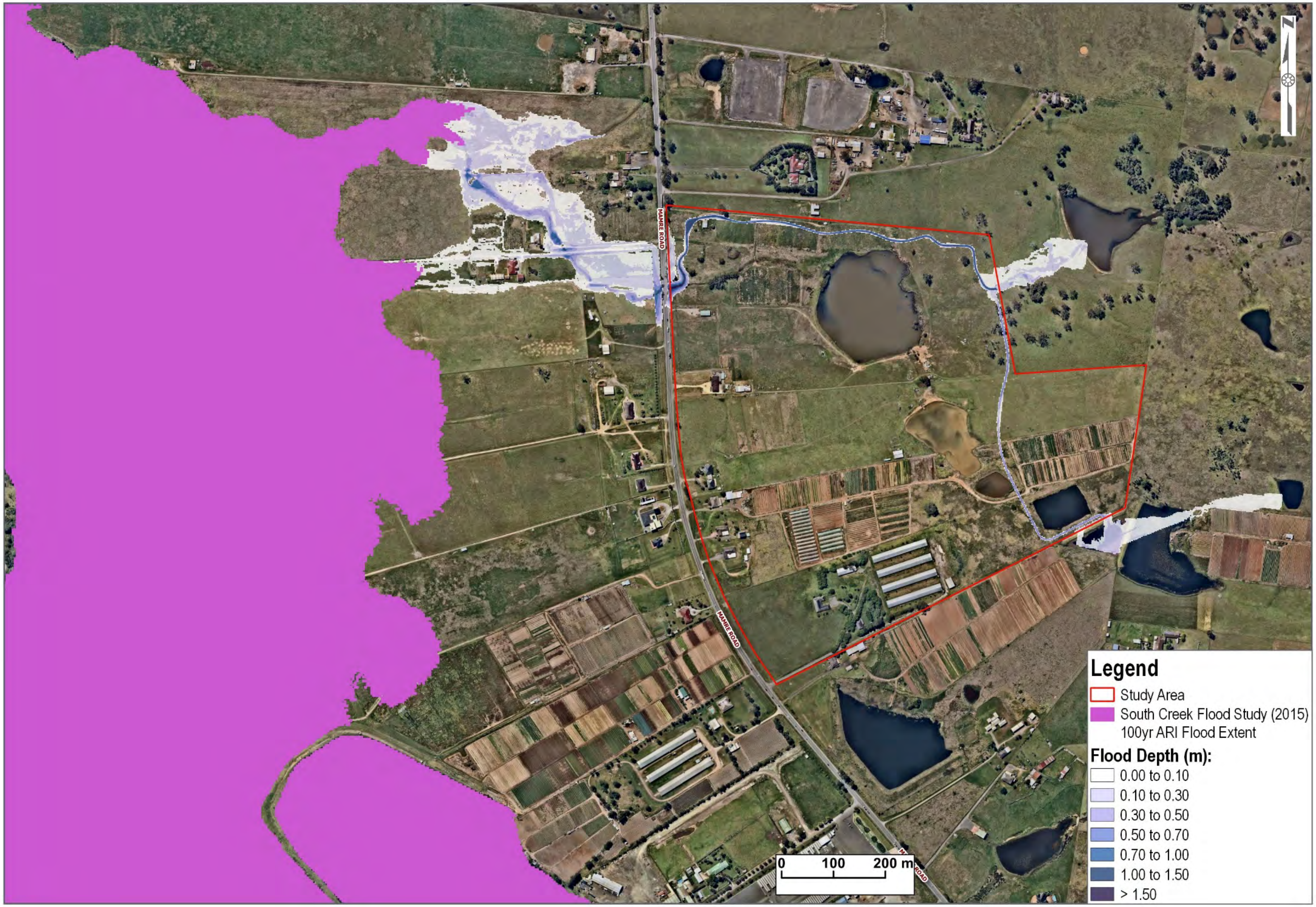

Figure 9 2 yr ARI Flood Depths - Stage 1 Conditions

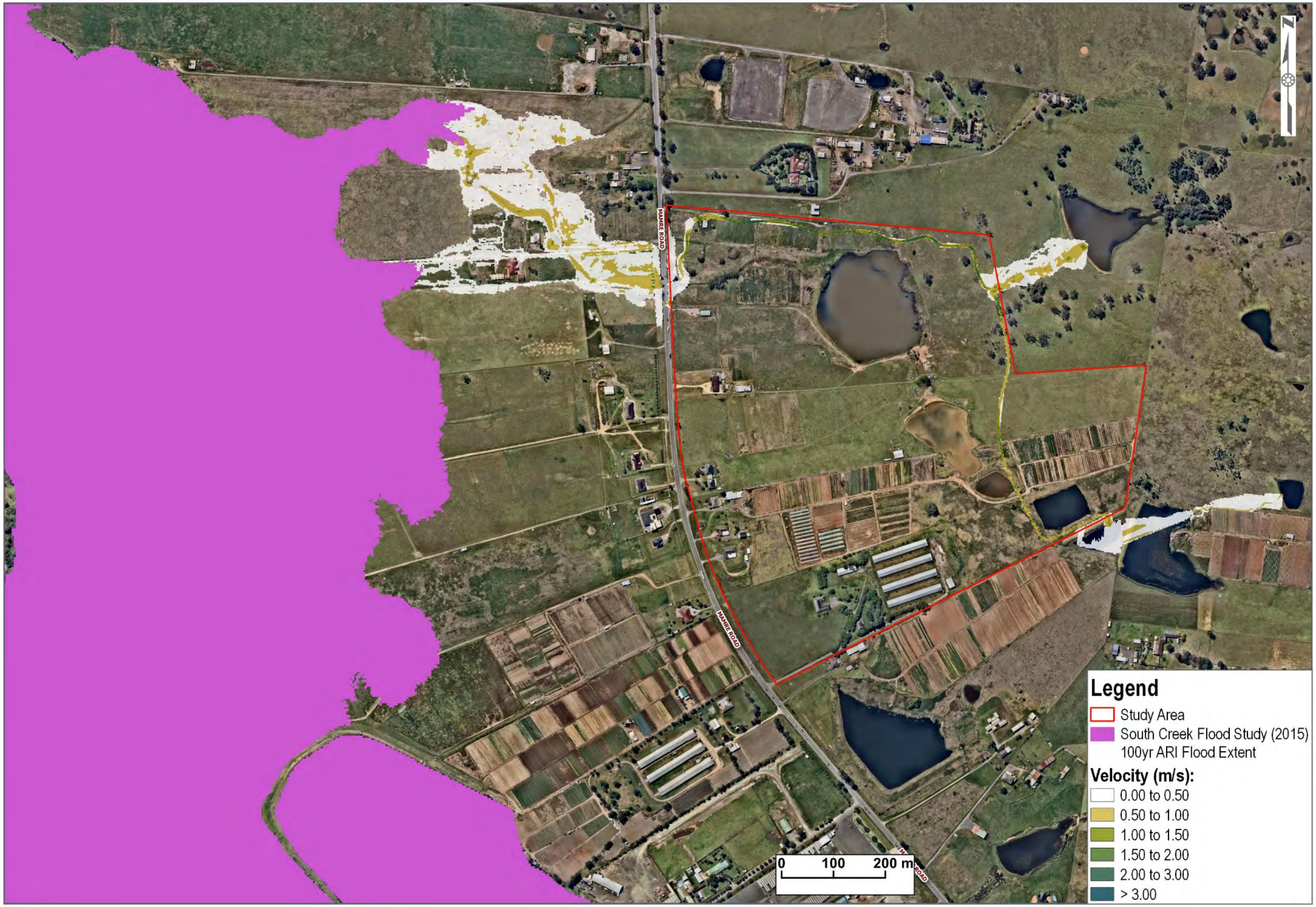

Figure 10   2 yr ARI Flood Velocities - Stage 1 Conditions

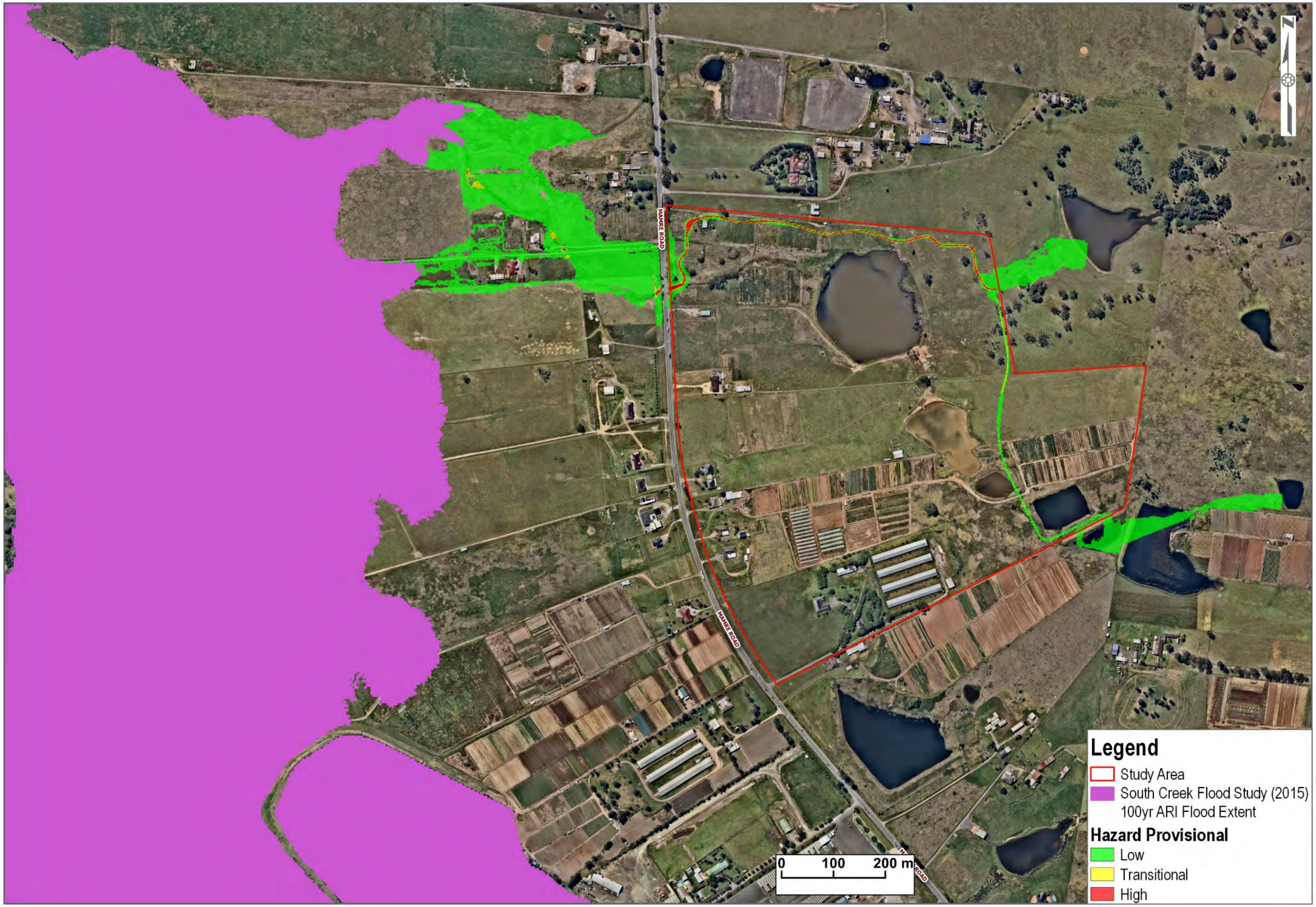

Figure 11 2 yr ARI Flood Hazards - Stage 1 Conditions

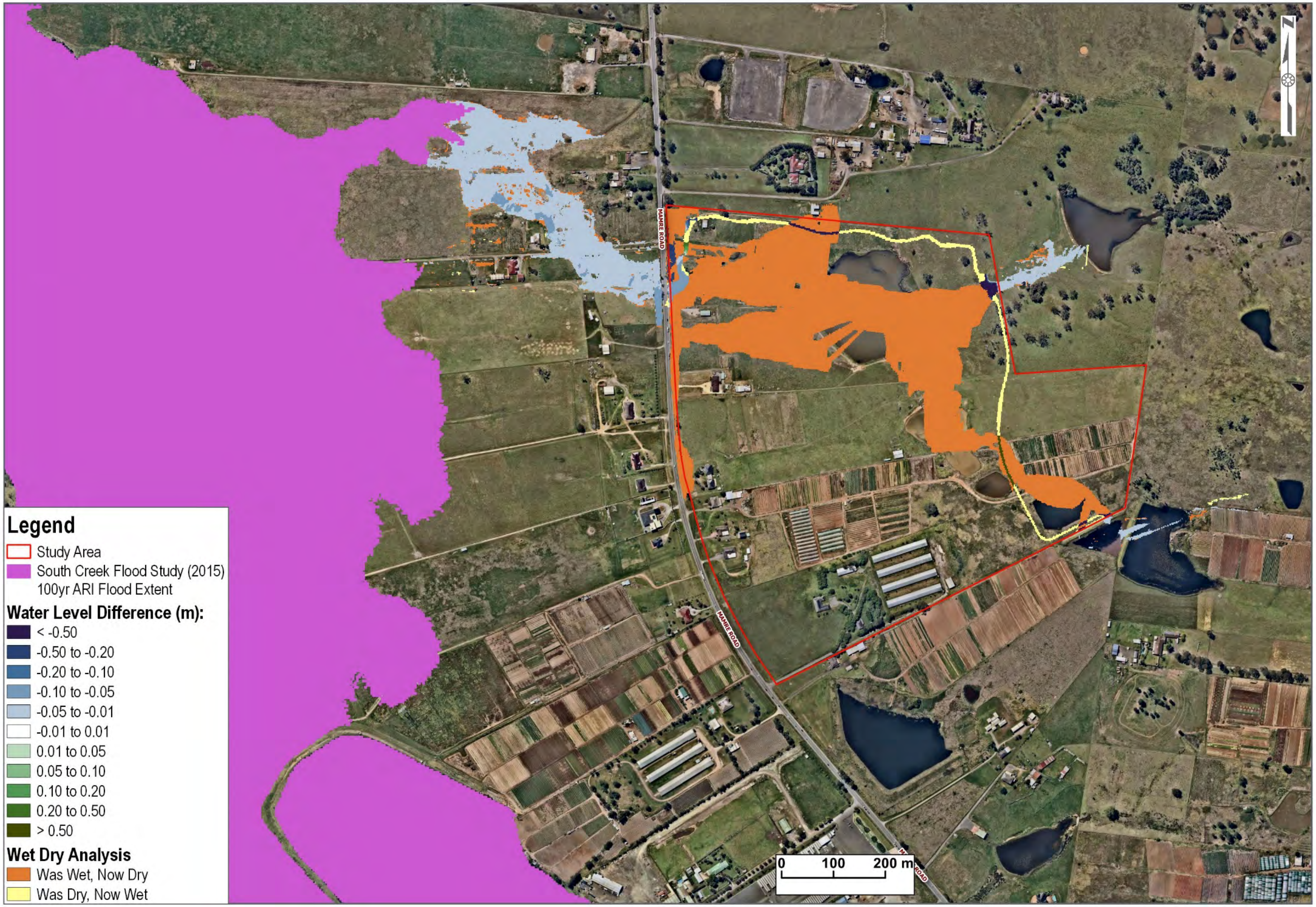

Figure 12 2 yr ARI Level Differences - (Stage 1 Conditions – Benchmark Conditions)

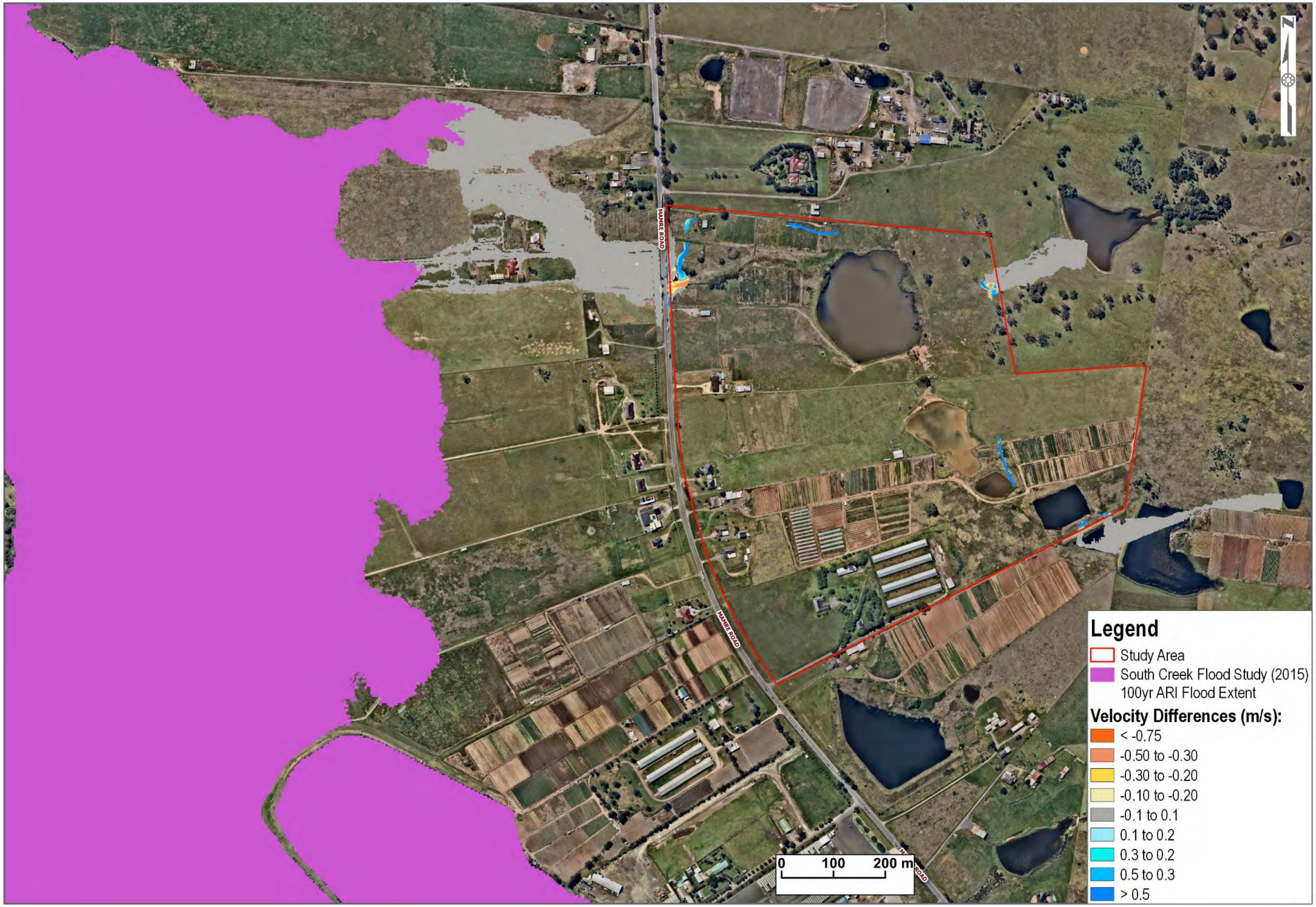

Figure 13 2 yr ARI Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)

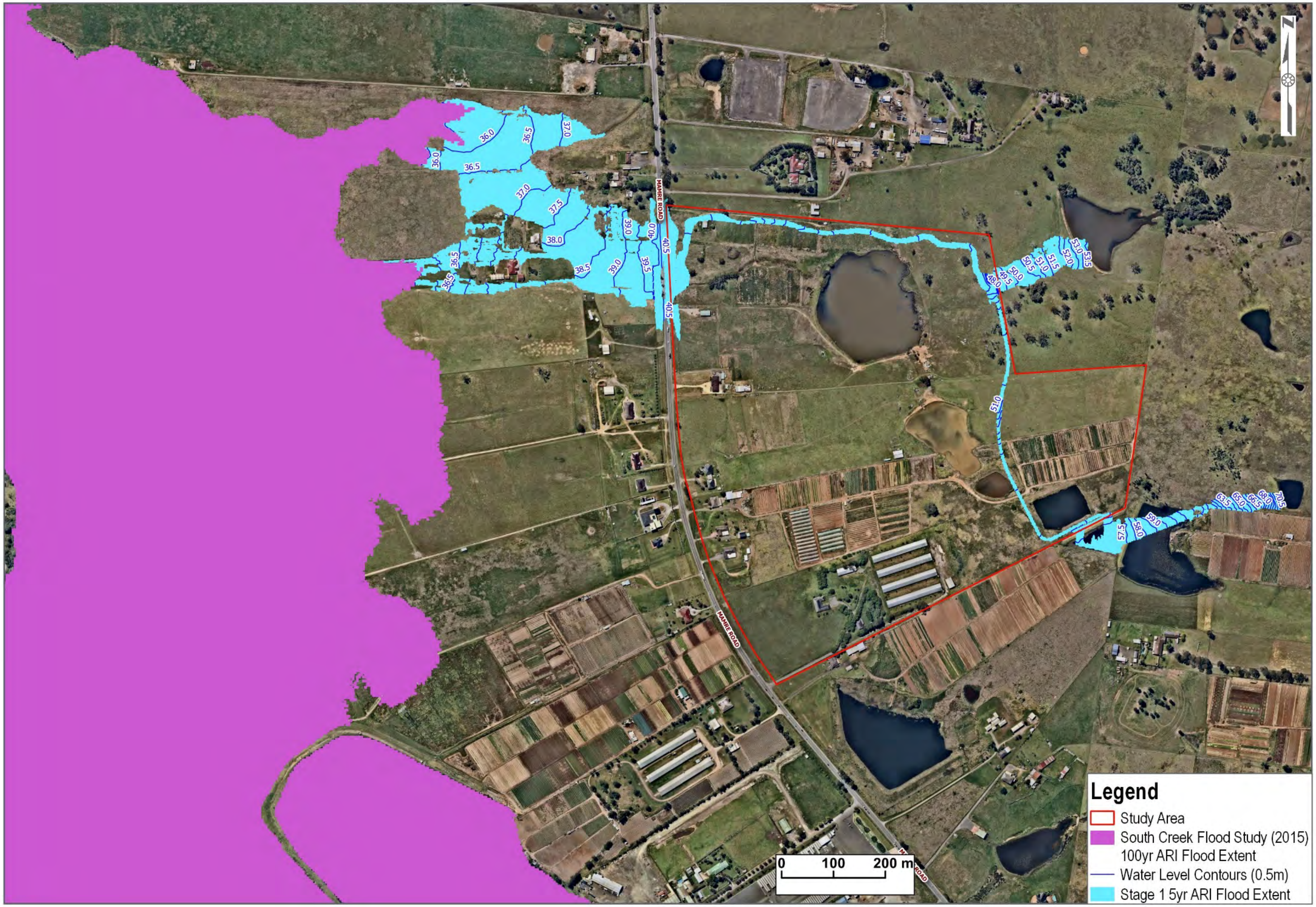

Figure 14 5 yr ARI Flood Extents and Flood Levels - Stage 1 Conditions

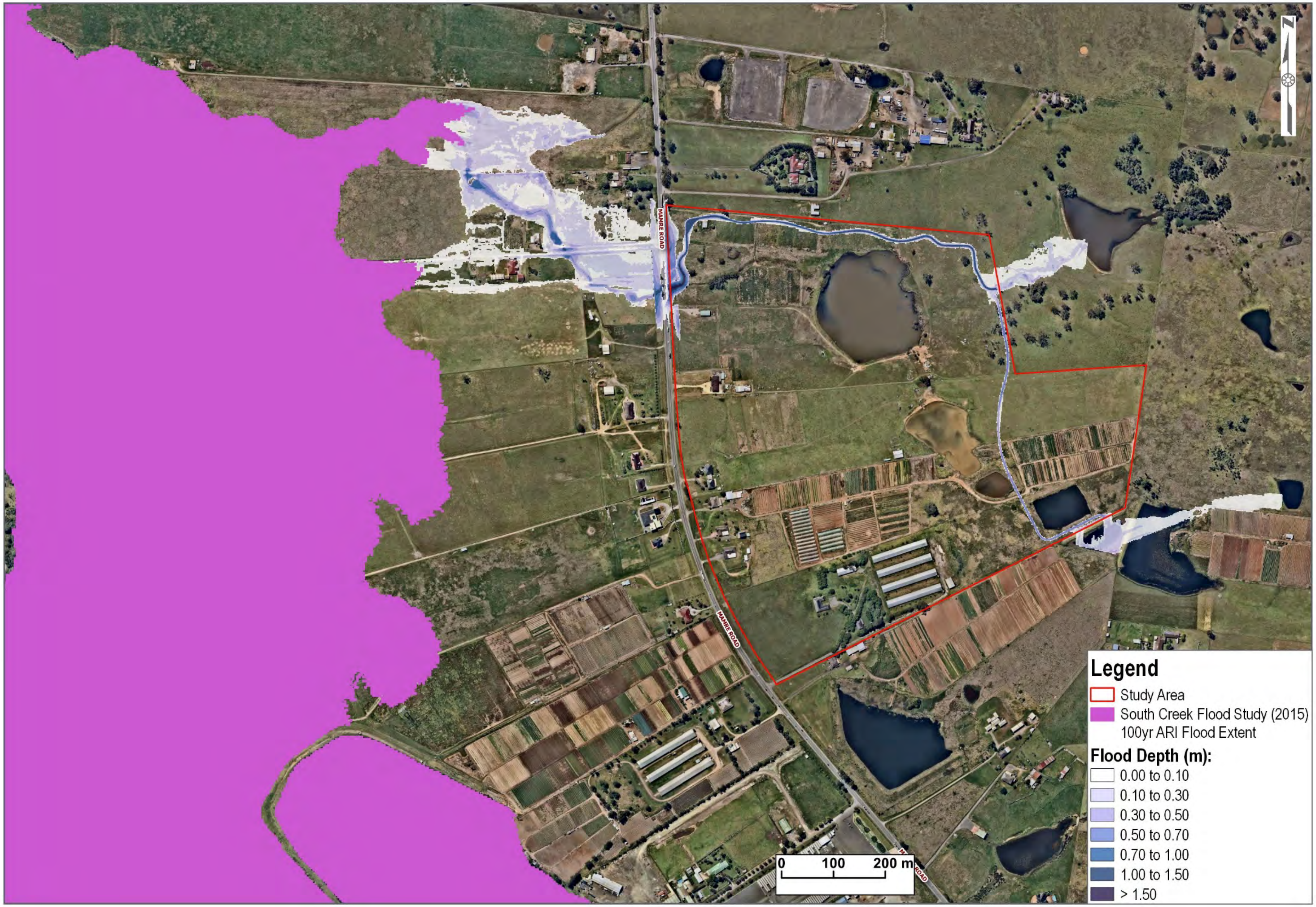

Figure 15 5 yr ARI Flood Depths - Stage 1 Conditions

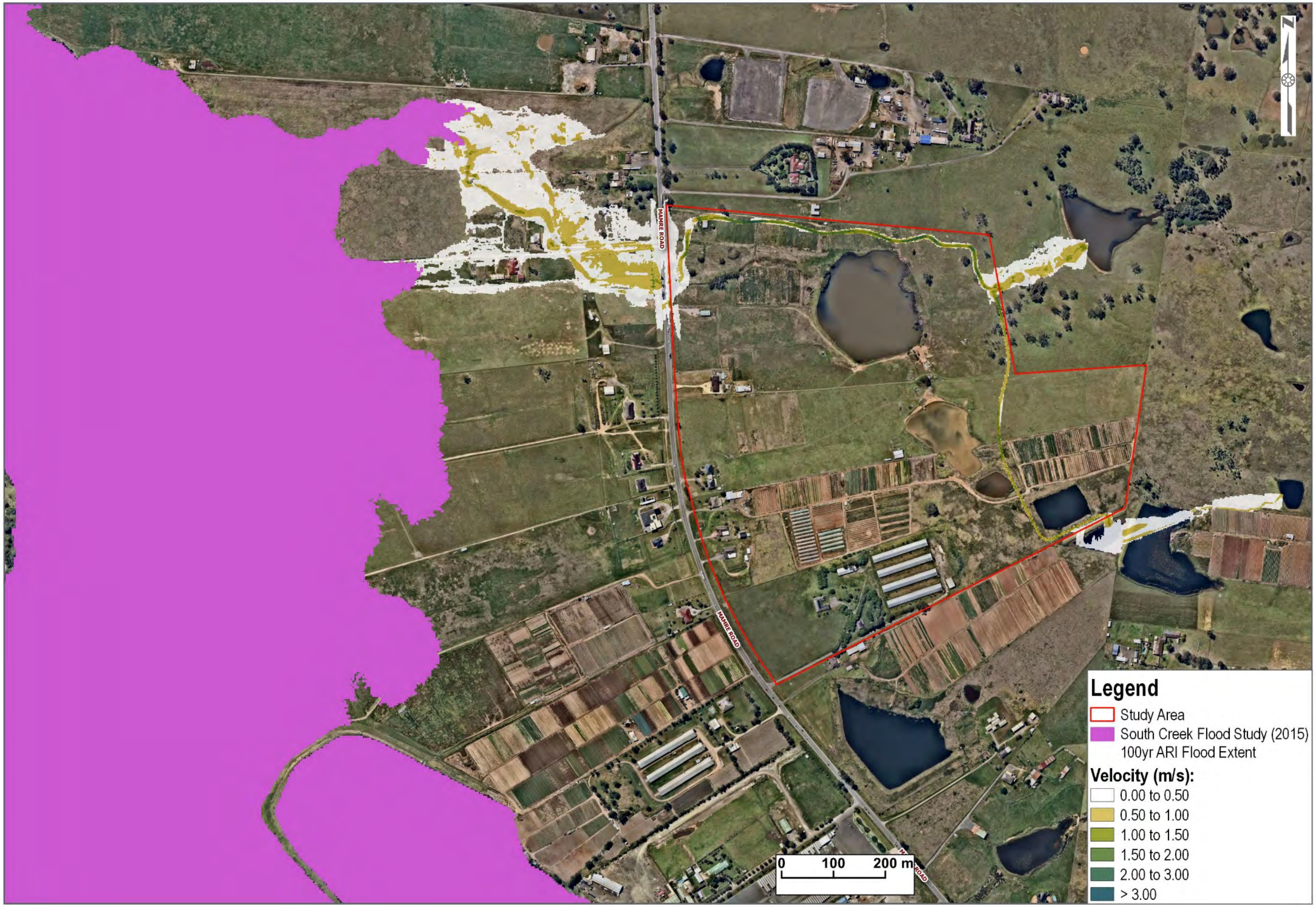

Figure 16 5 yr ARI Flood Velocities - Stage 1 Conditions

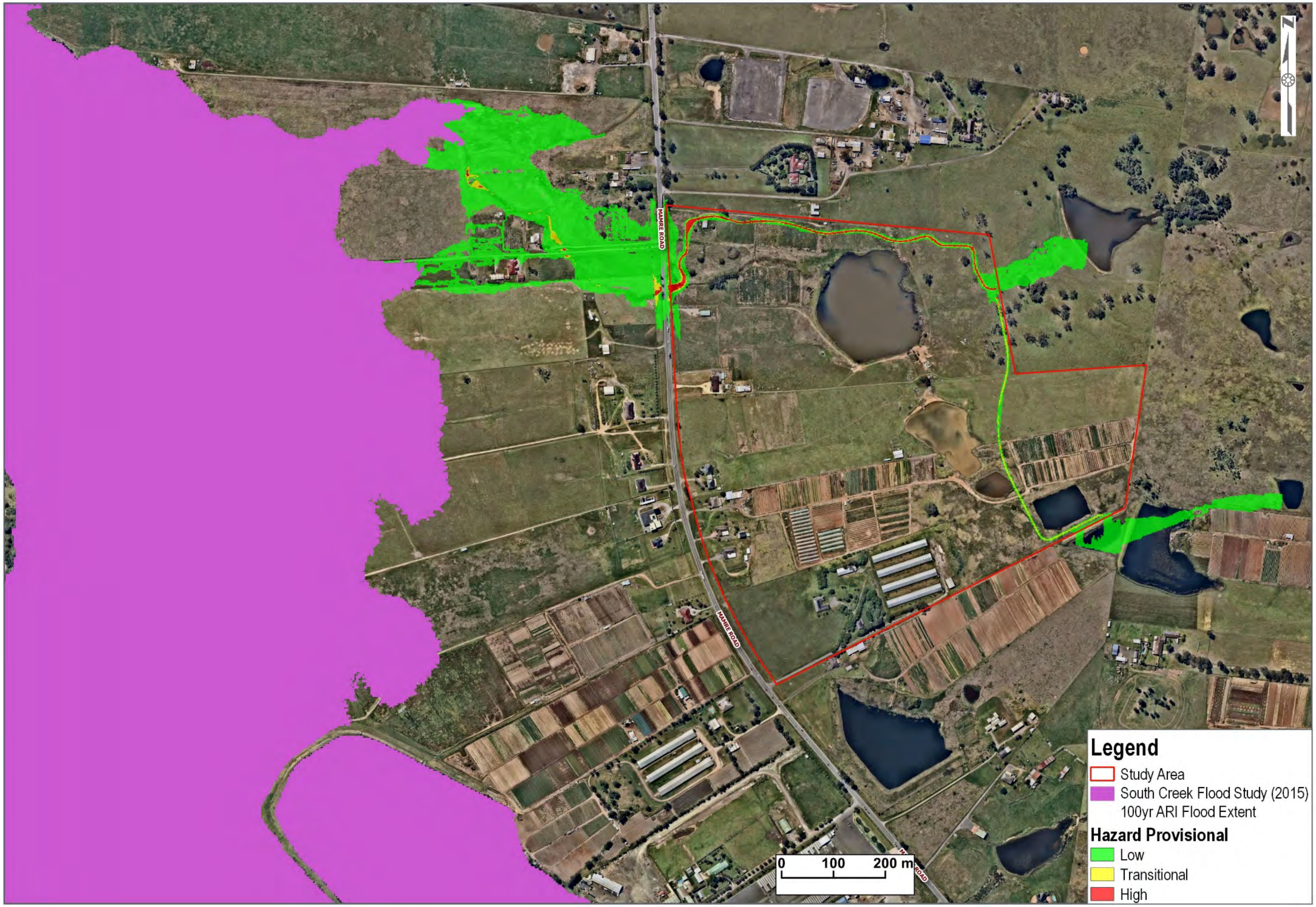

Figure 17 5 yr ARI Flood Hazards - Stage 1 Conditions

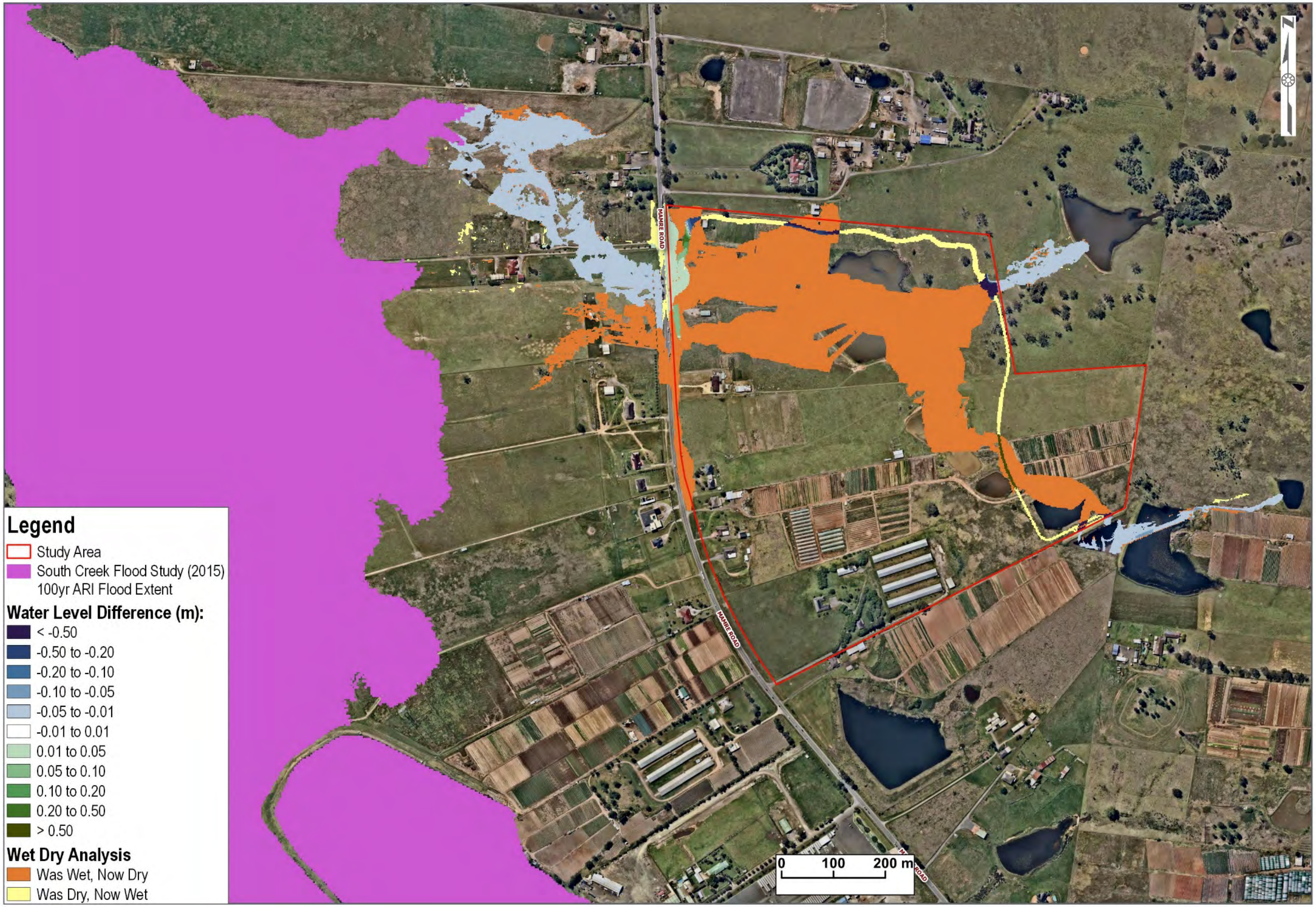

Figure 18 5 yr ARI Level Differences - (Stage 1 Conditions – Benchmark Conditions)

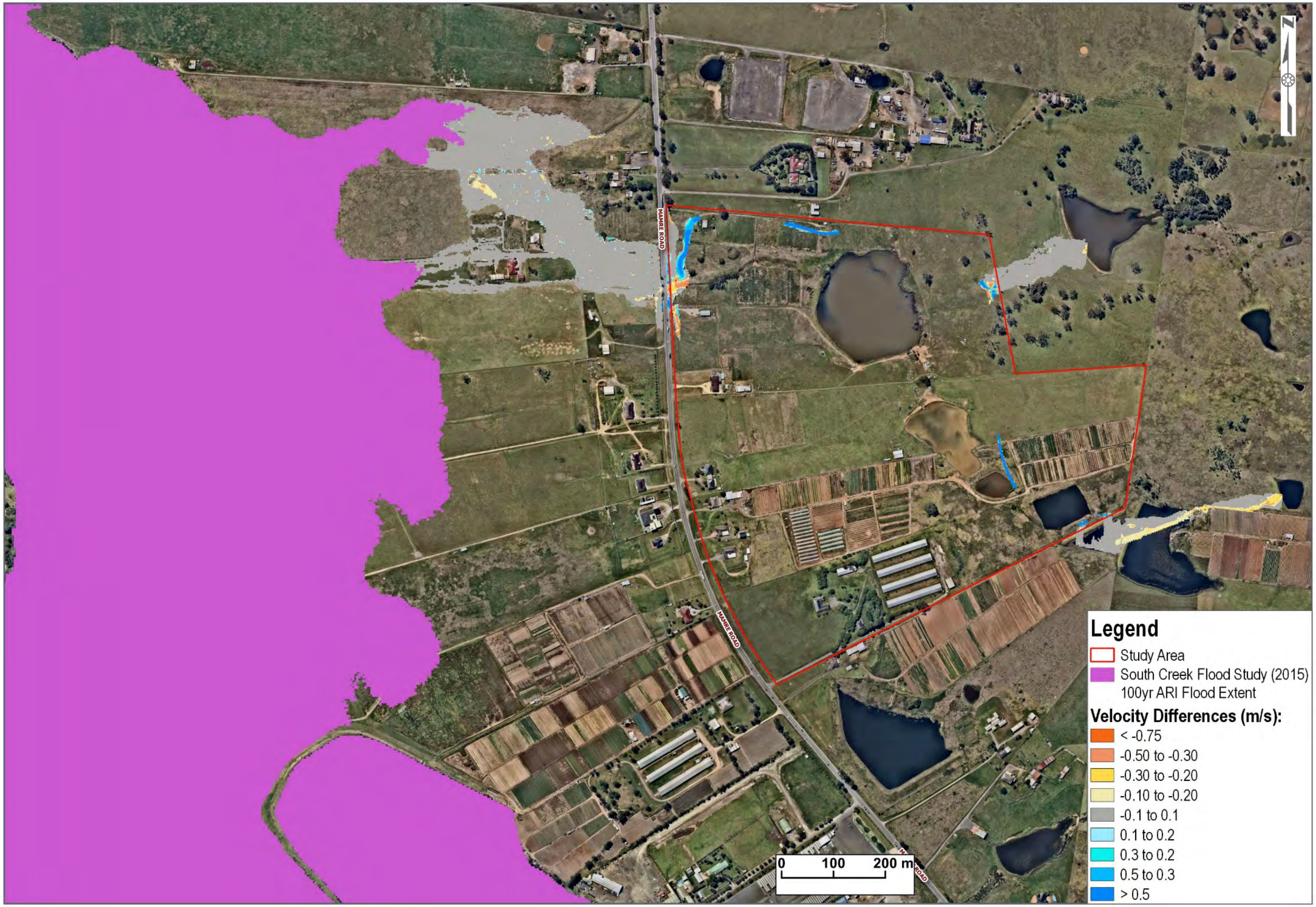

Figure 19 5 yr ARI Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)

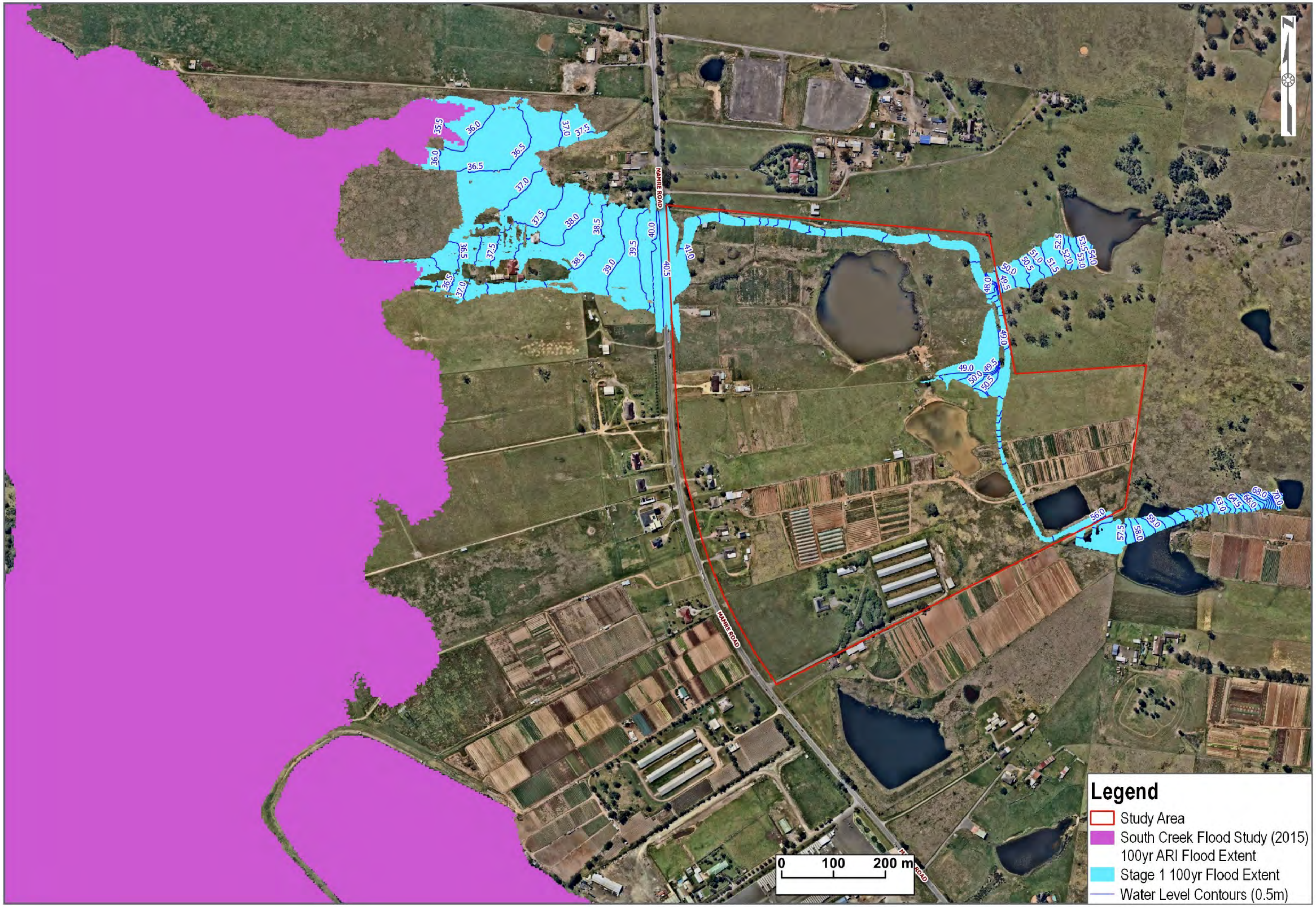

Figure 20 100 yr ARI Flood Extents and Flood Levels - Stage 1 Conditions

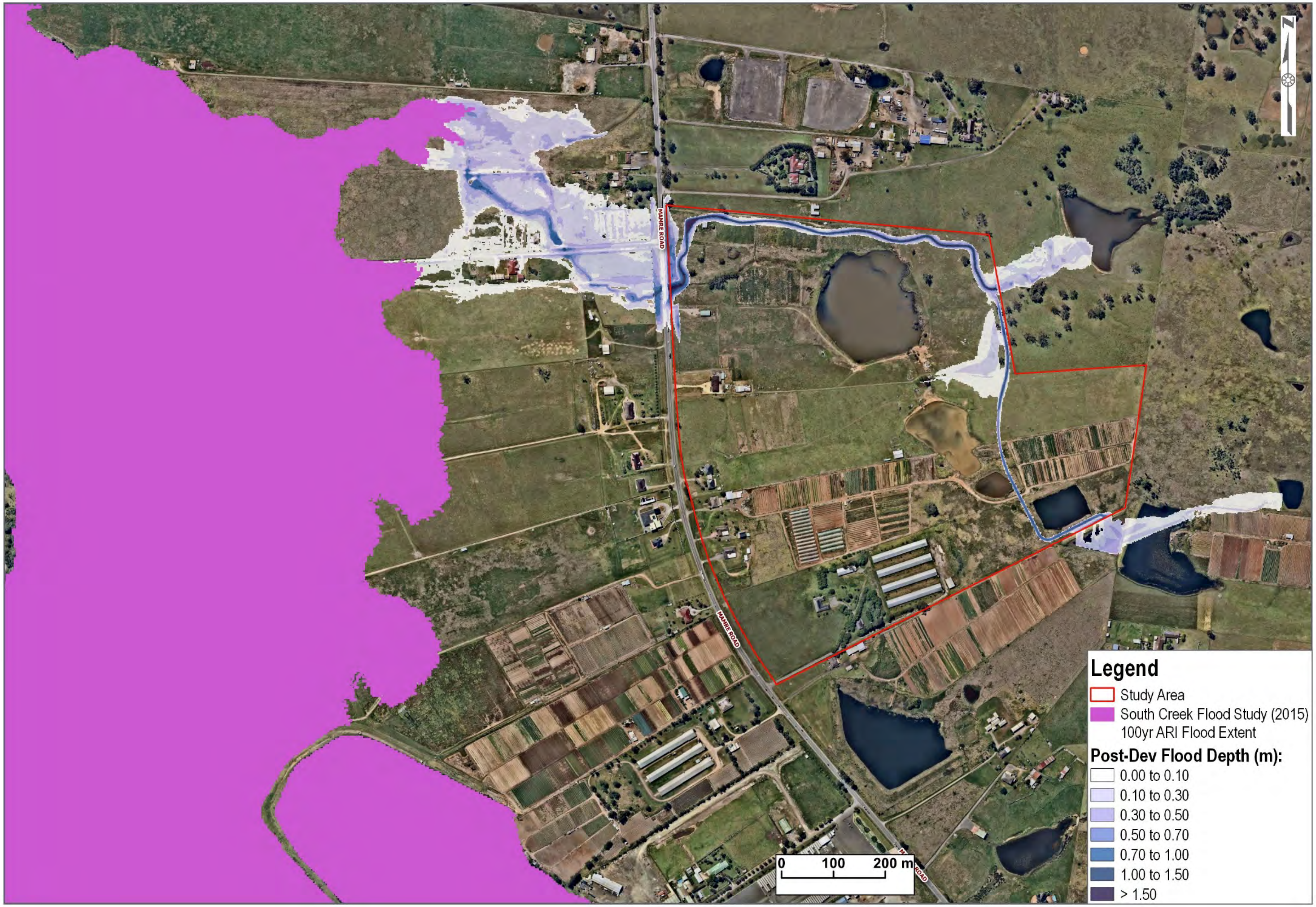

Figure 21 100 yr ARI Flood Depths - Stage 1 Conditions

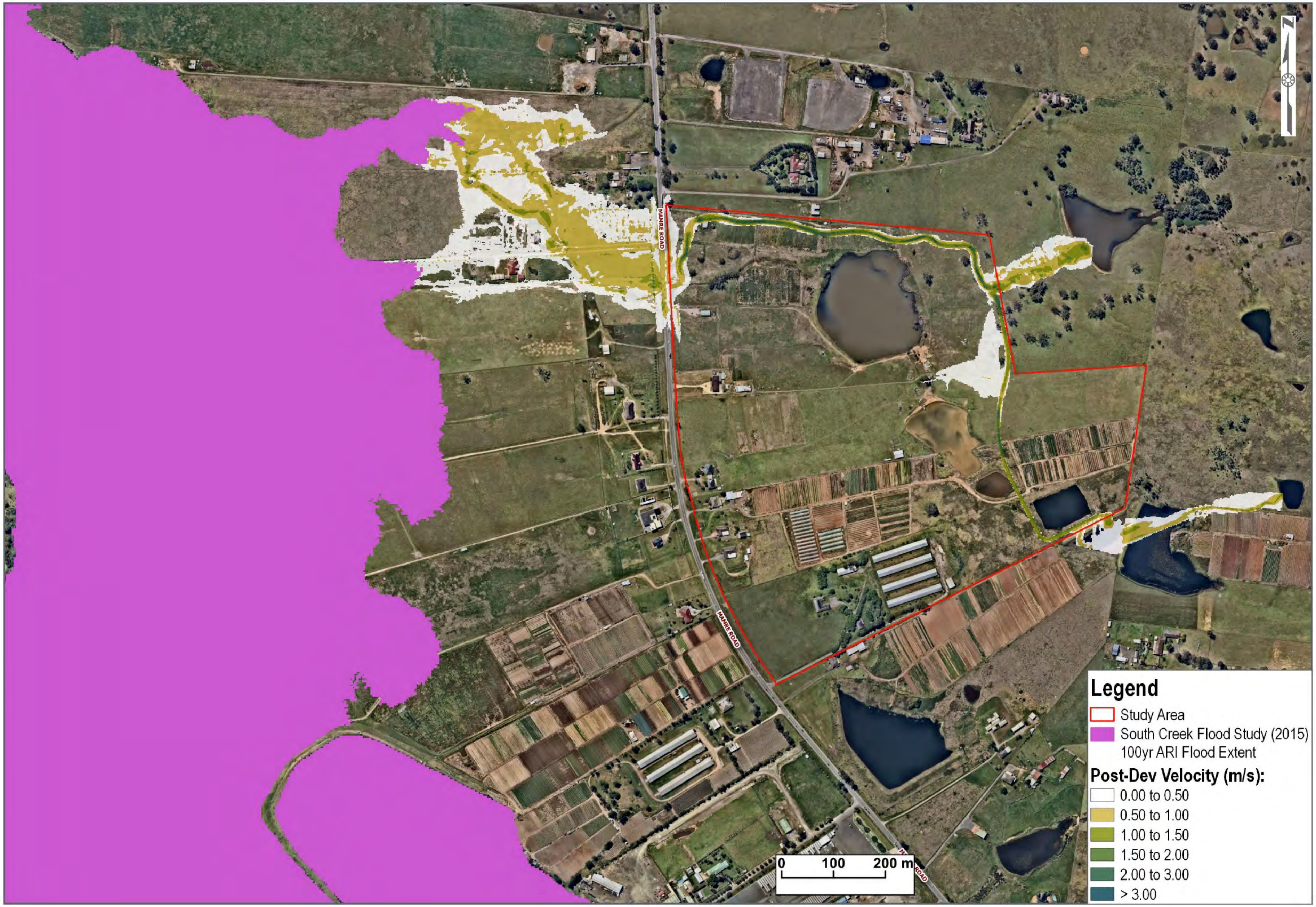

Figure 22 100 yr ARI Flood Velocities - Stage 1 Conditions

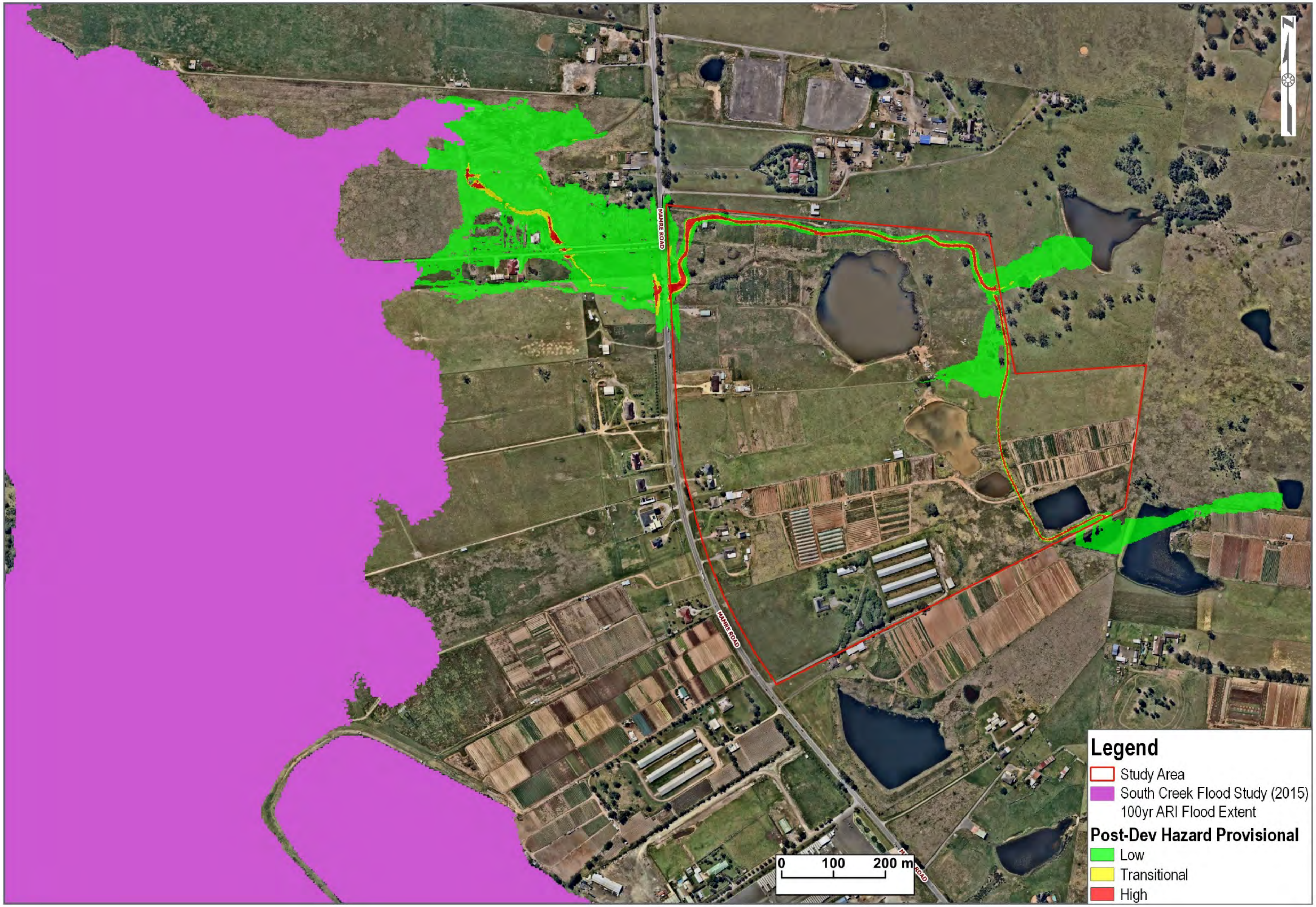

Figure 23 100 yr ARI Flood Hazards - Stage 1 Conditions

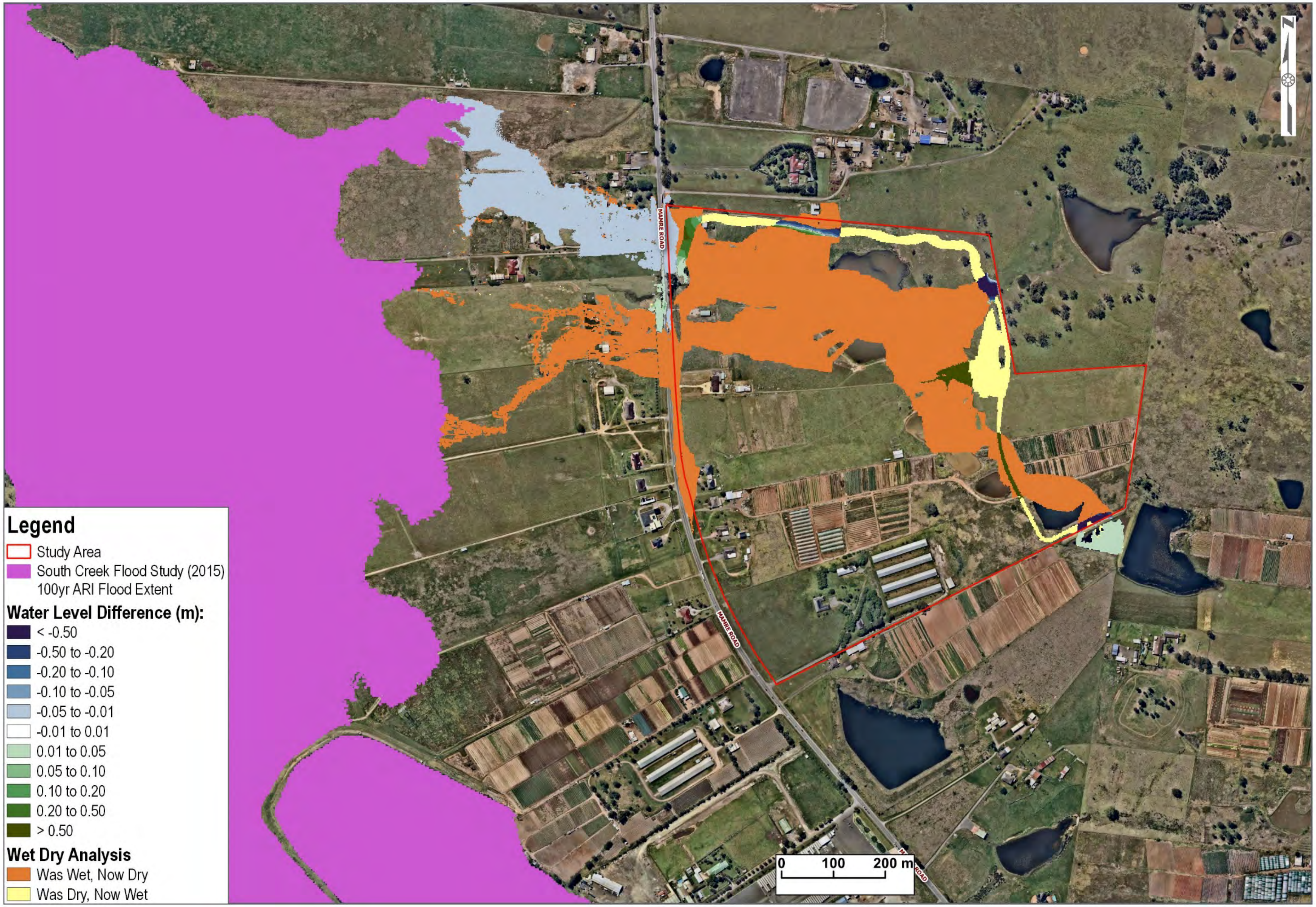

Figure 24 100 yr ARI Level Differences - (Stage 1 Conditions – Benchmark Conditions)

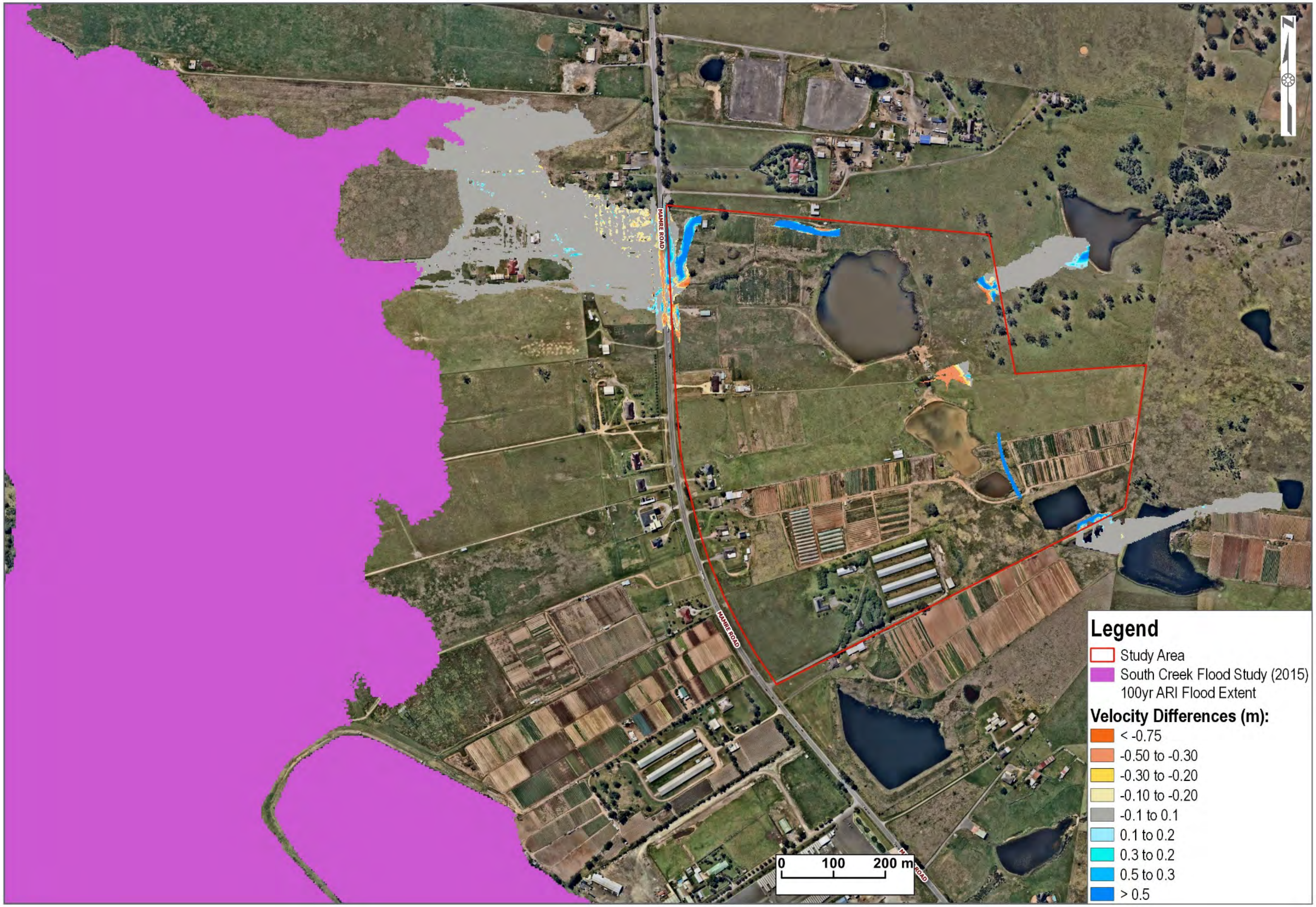

Figure 25 100 yr ARI Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)

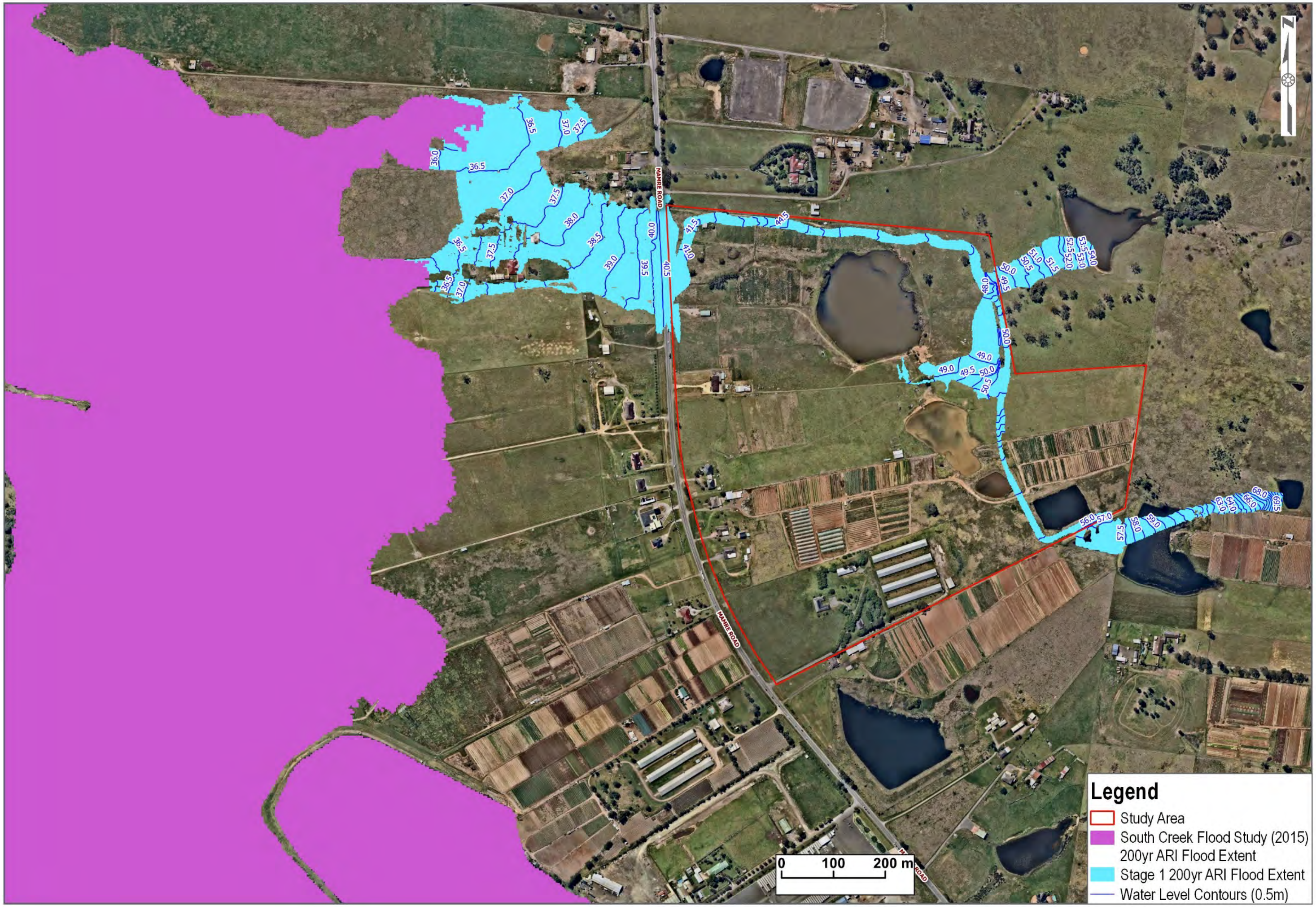

Figure 26 200 yr ARI Flood Extents and Flood Levels - Stage 1 Conditions

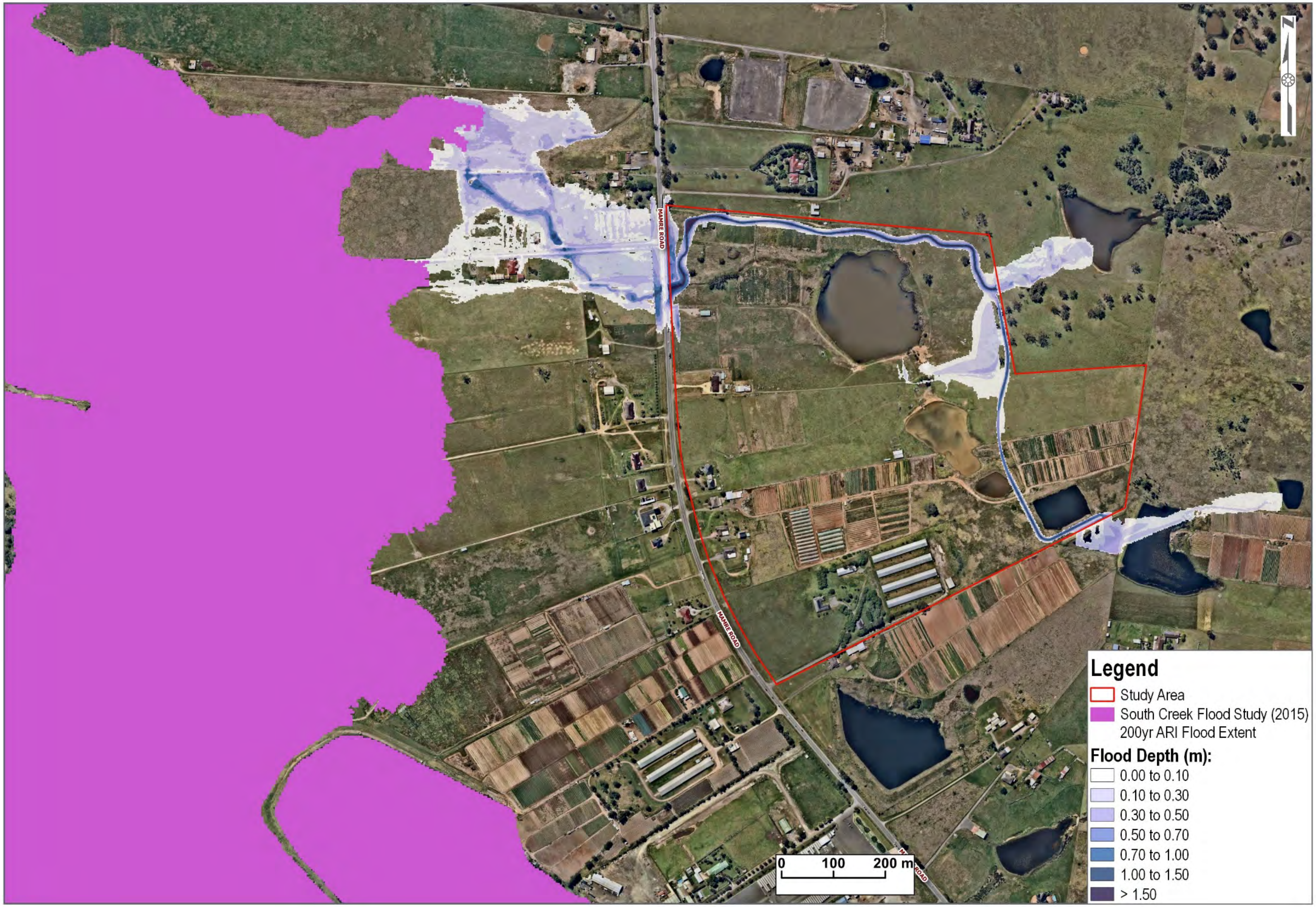

Figure 27 200 yr ARI Flood Depths - Stage 1 Conditions

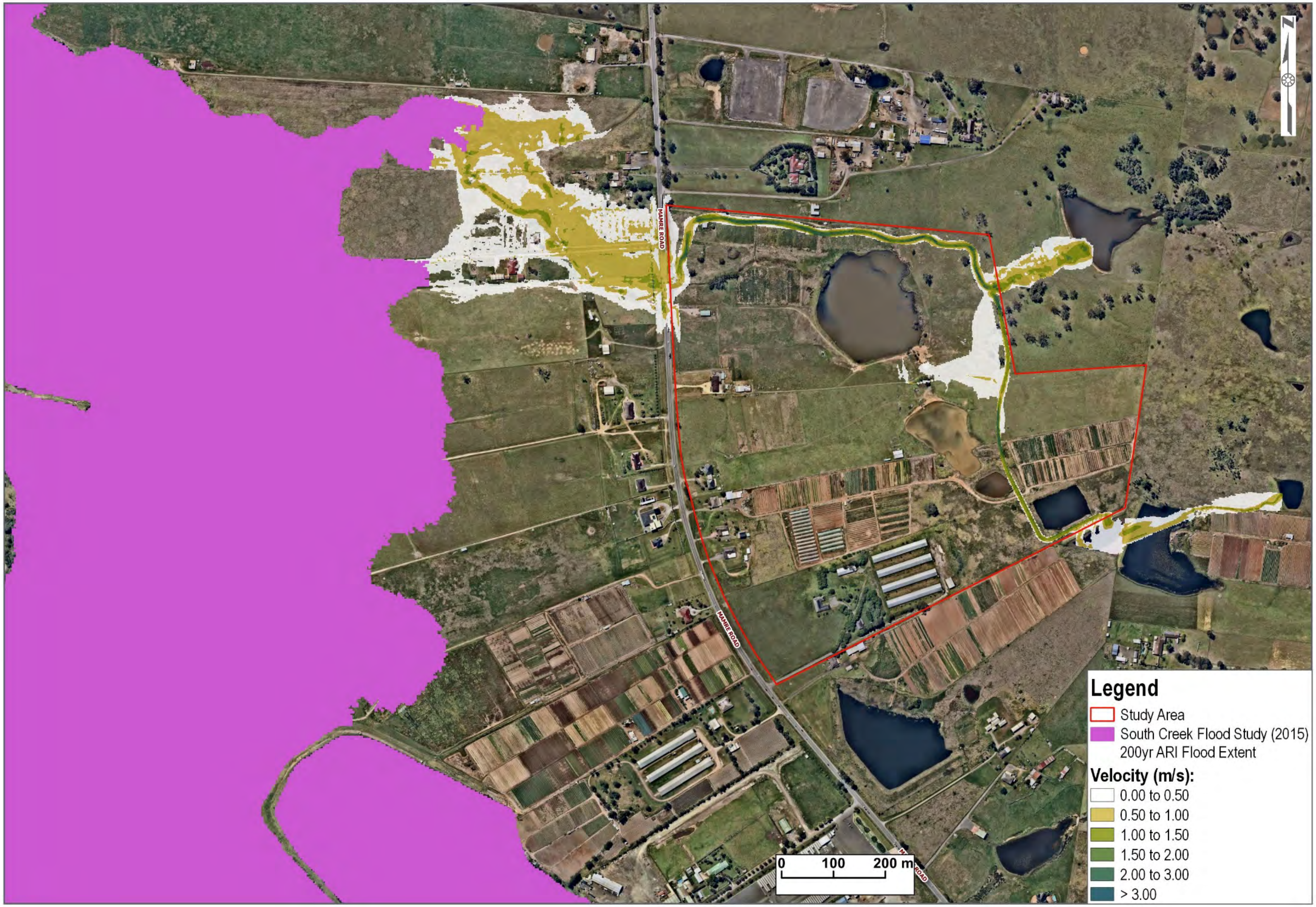

Figure 28 200 yr ARI Flood Velocities - Stage 1 Conditions

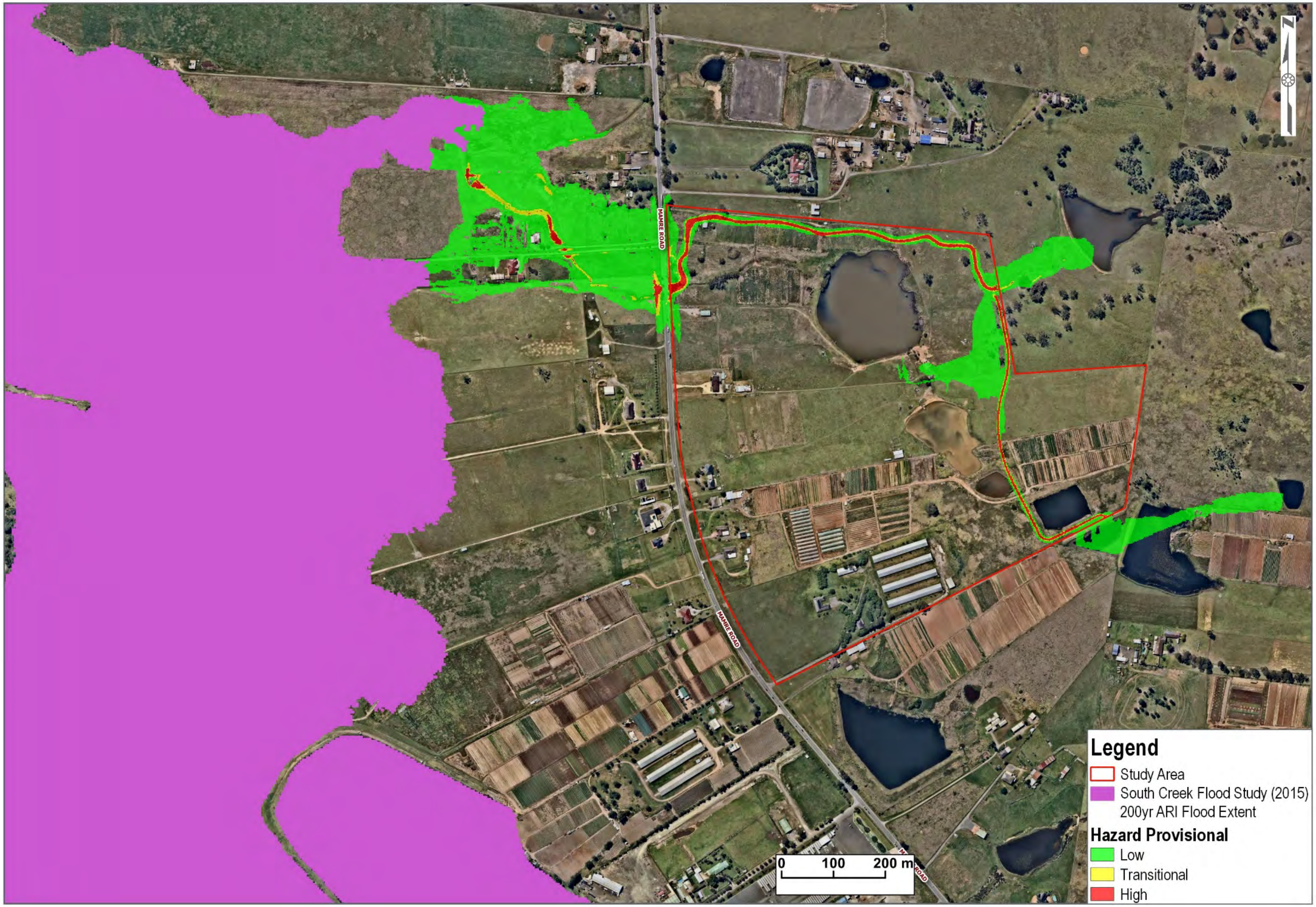

Figure 29 200 yr ARI Flood Hazards - Stage 1 Conditions

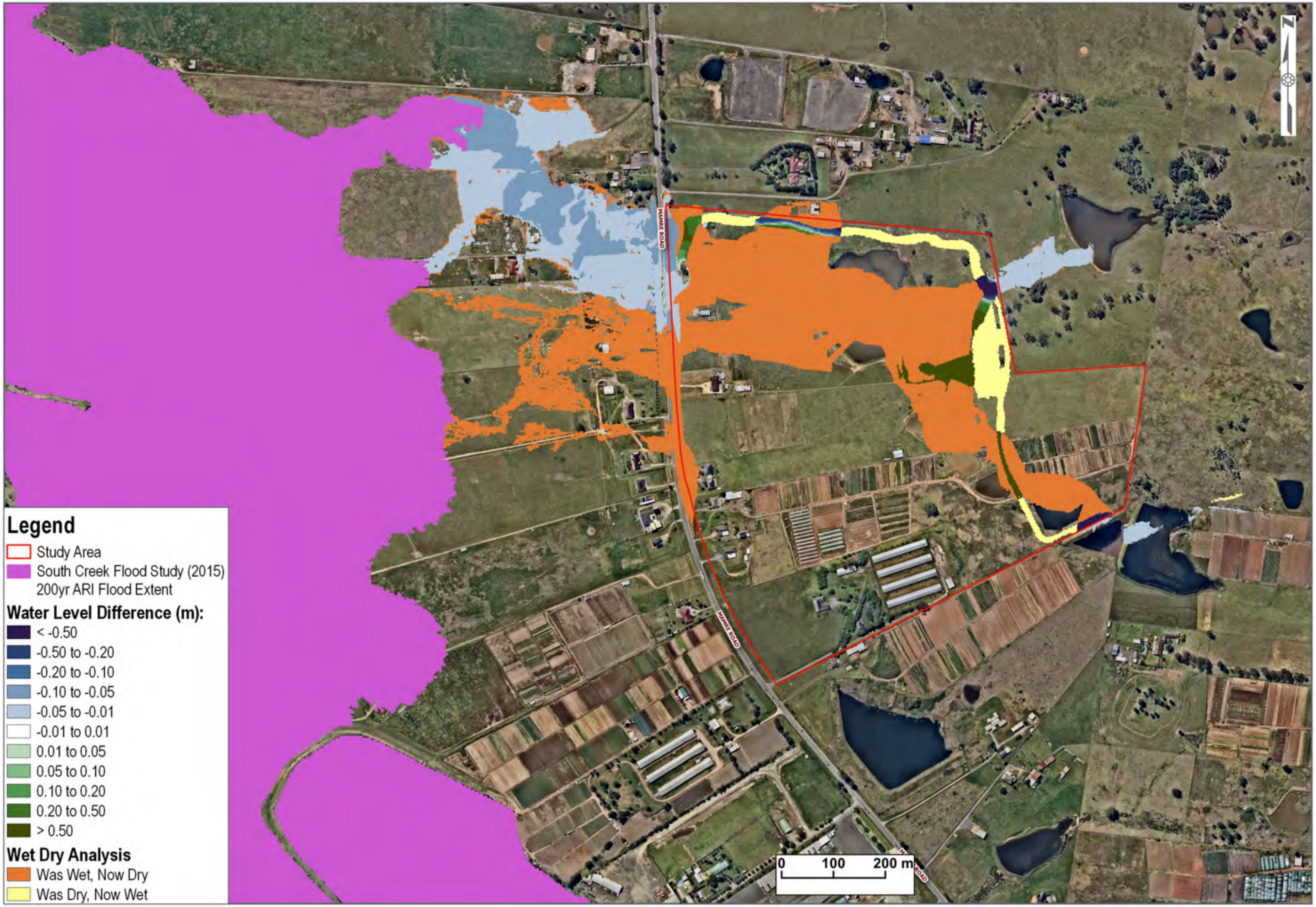

Figure 30 200 yr ARI Level Differences - (Stage 1 Conditions – Benchmark Conditions)

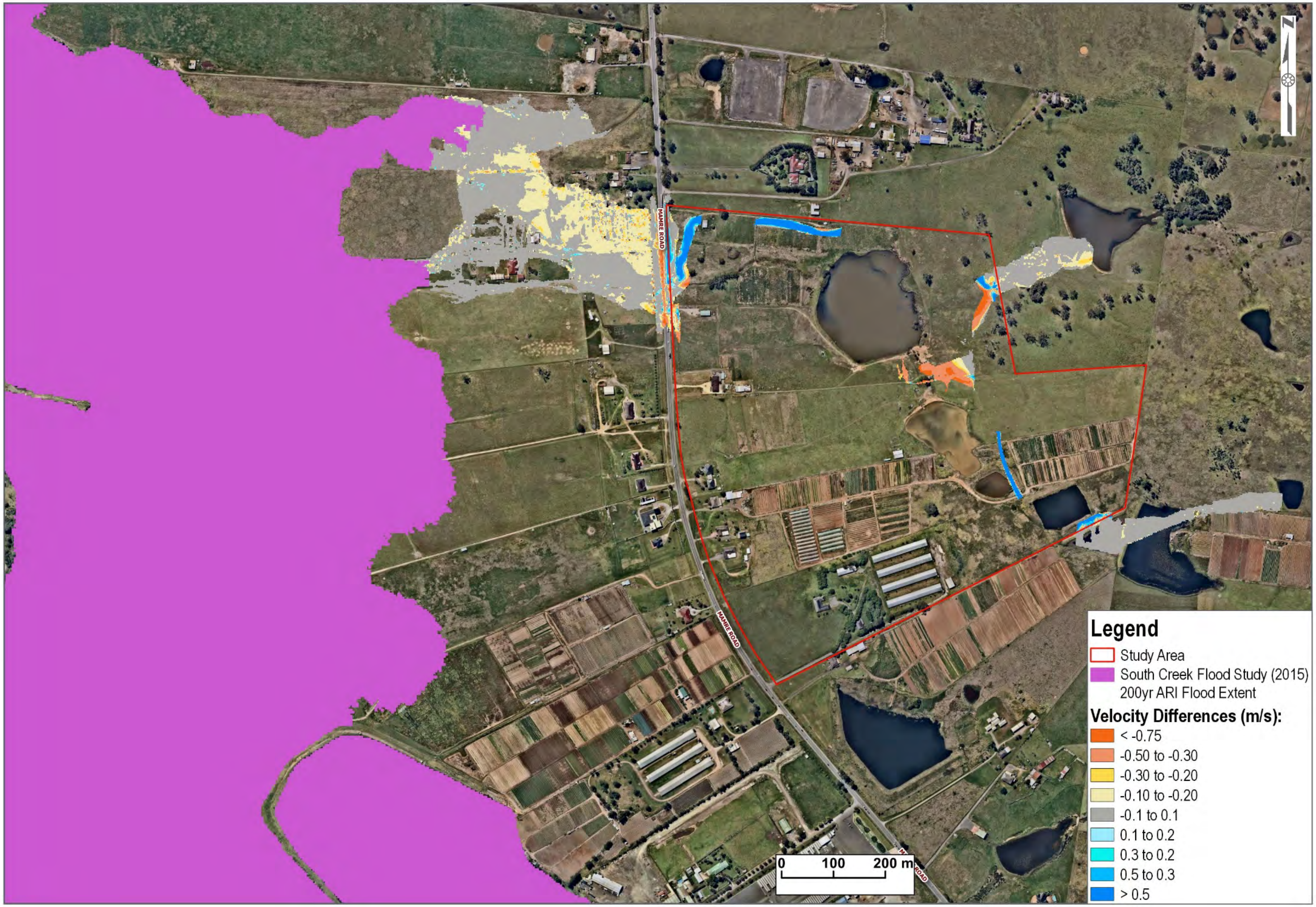

Figure 31 200 yr ARI Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)

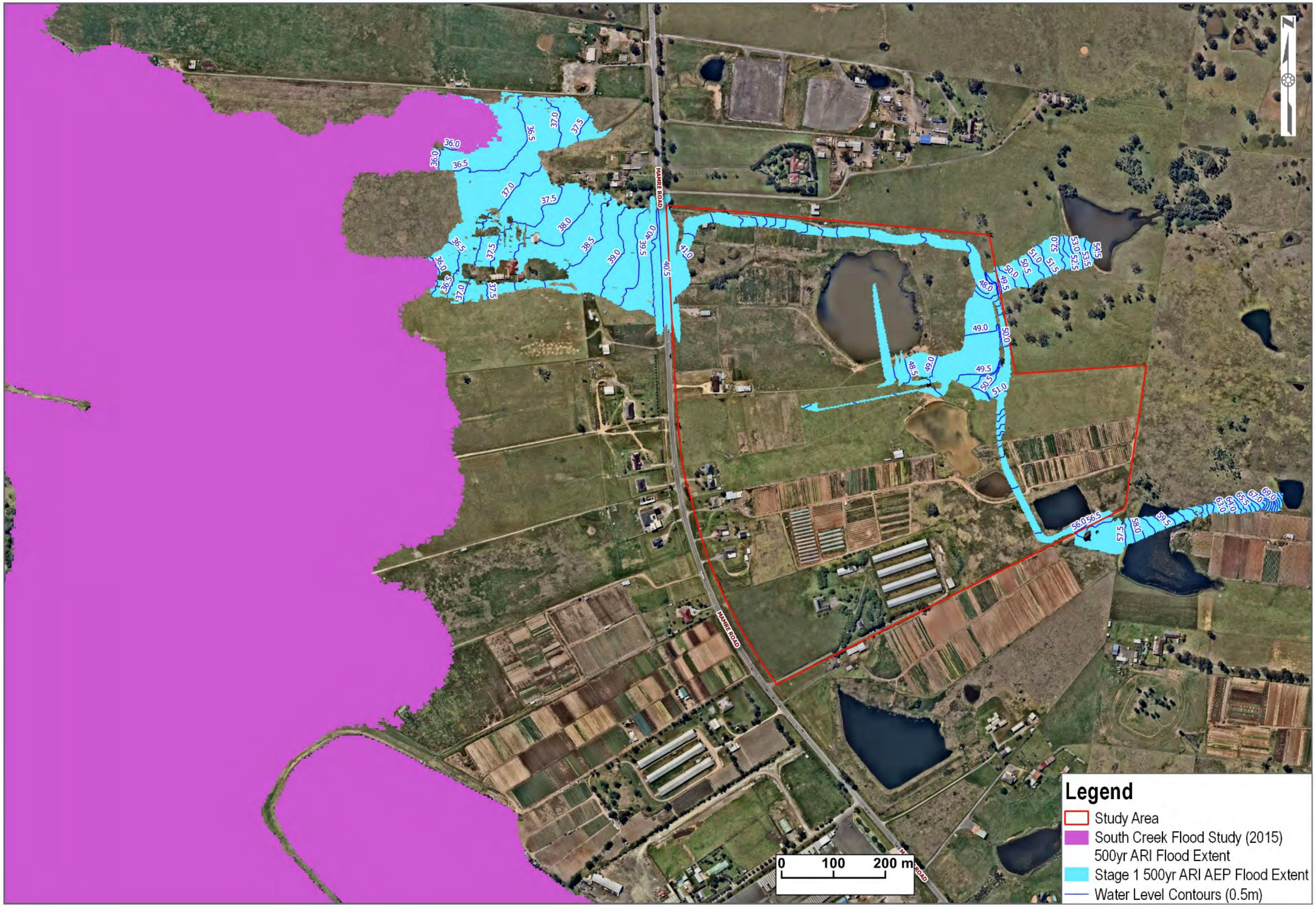

Figure 32 500 yr ARI Flood Extents and Flood Levels - Stage 1 Conditions

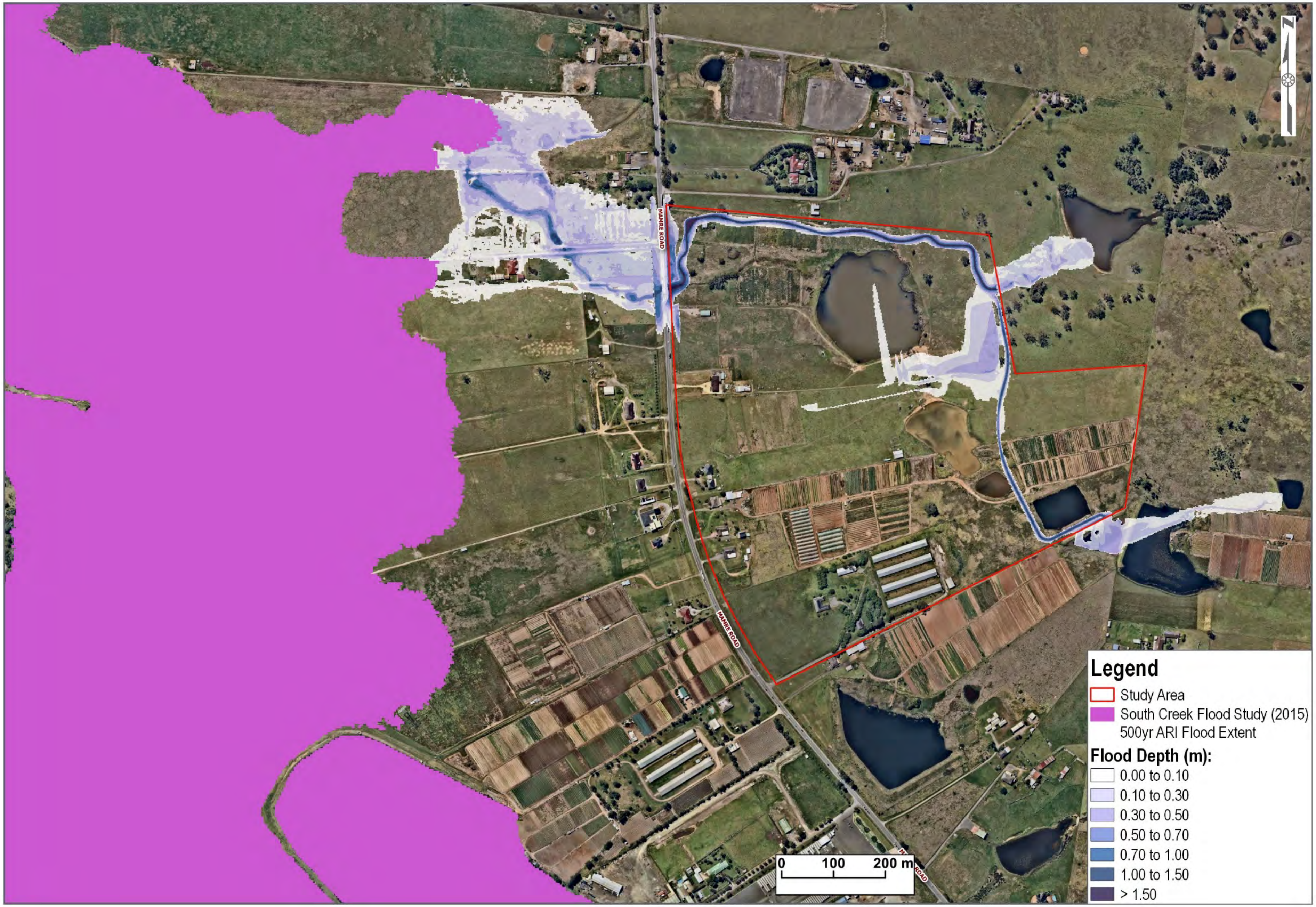

Figure 33 500 yr ARI Flood Depths - Stage 1 Conditions

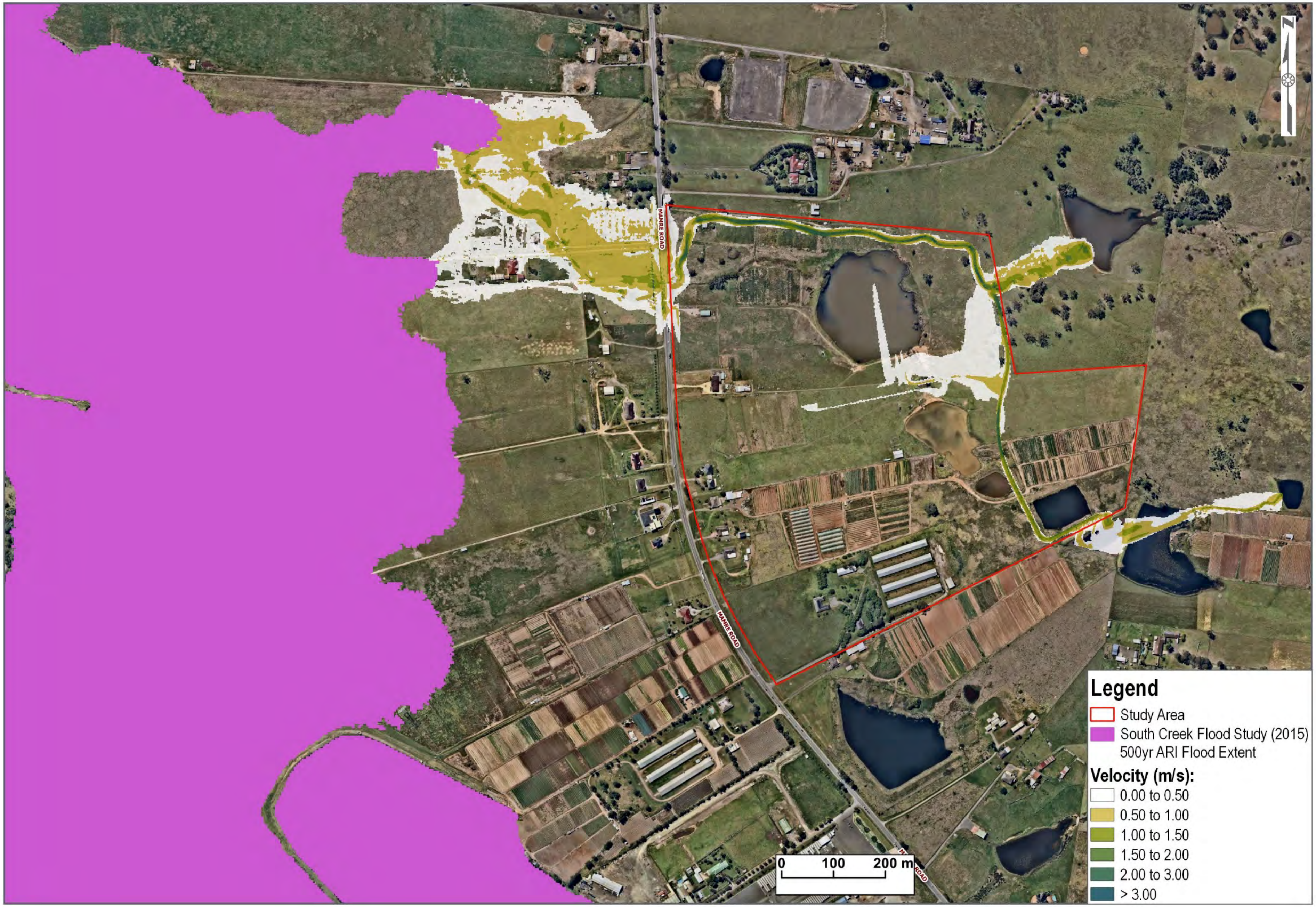

Figure 34 500 yr ARI Flood Velocities - Stage 1 Conditions

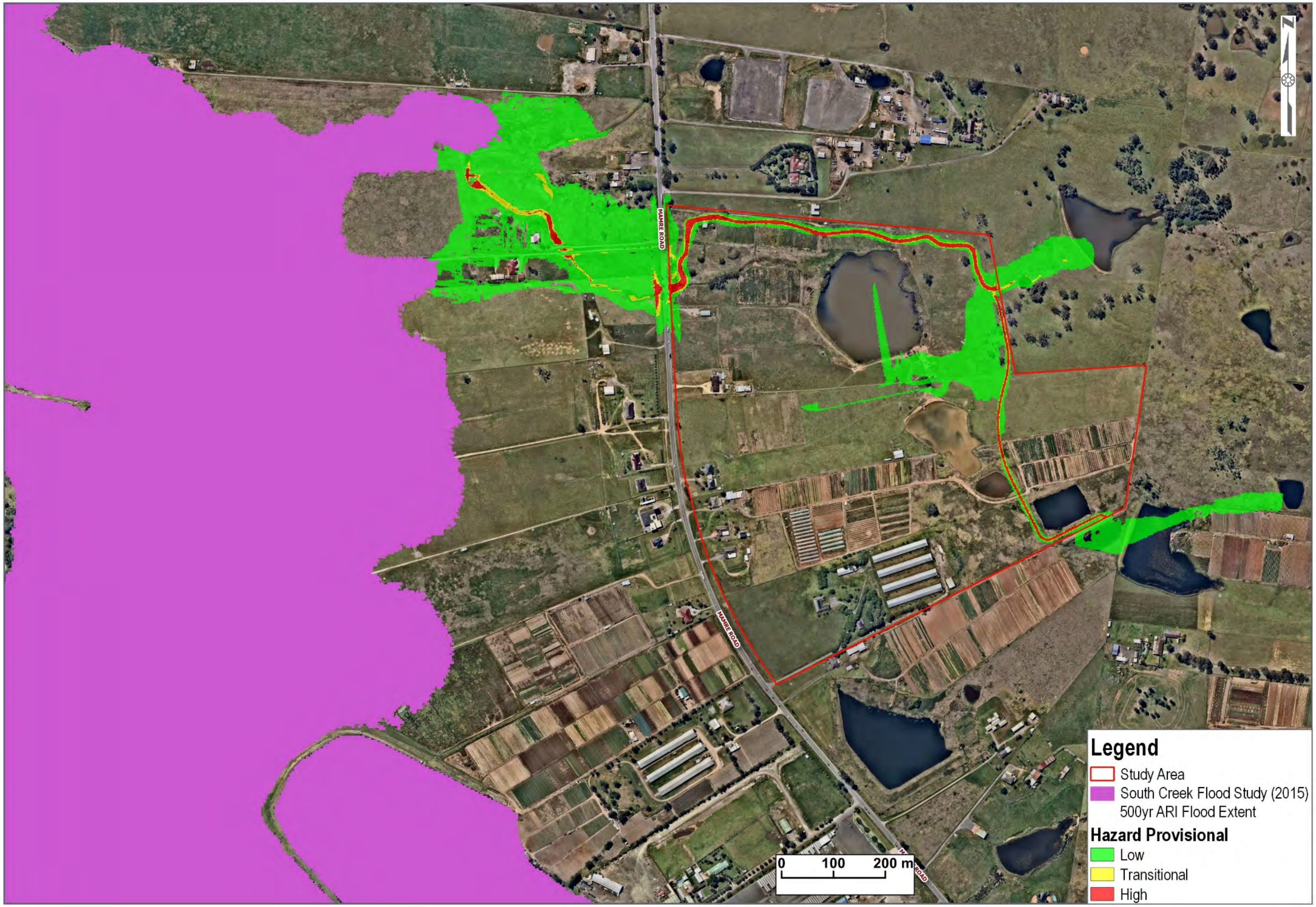

Figure 35 500 yr ARI Flood Hazards - Stage 1 Conditions

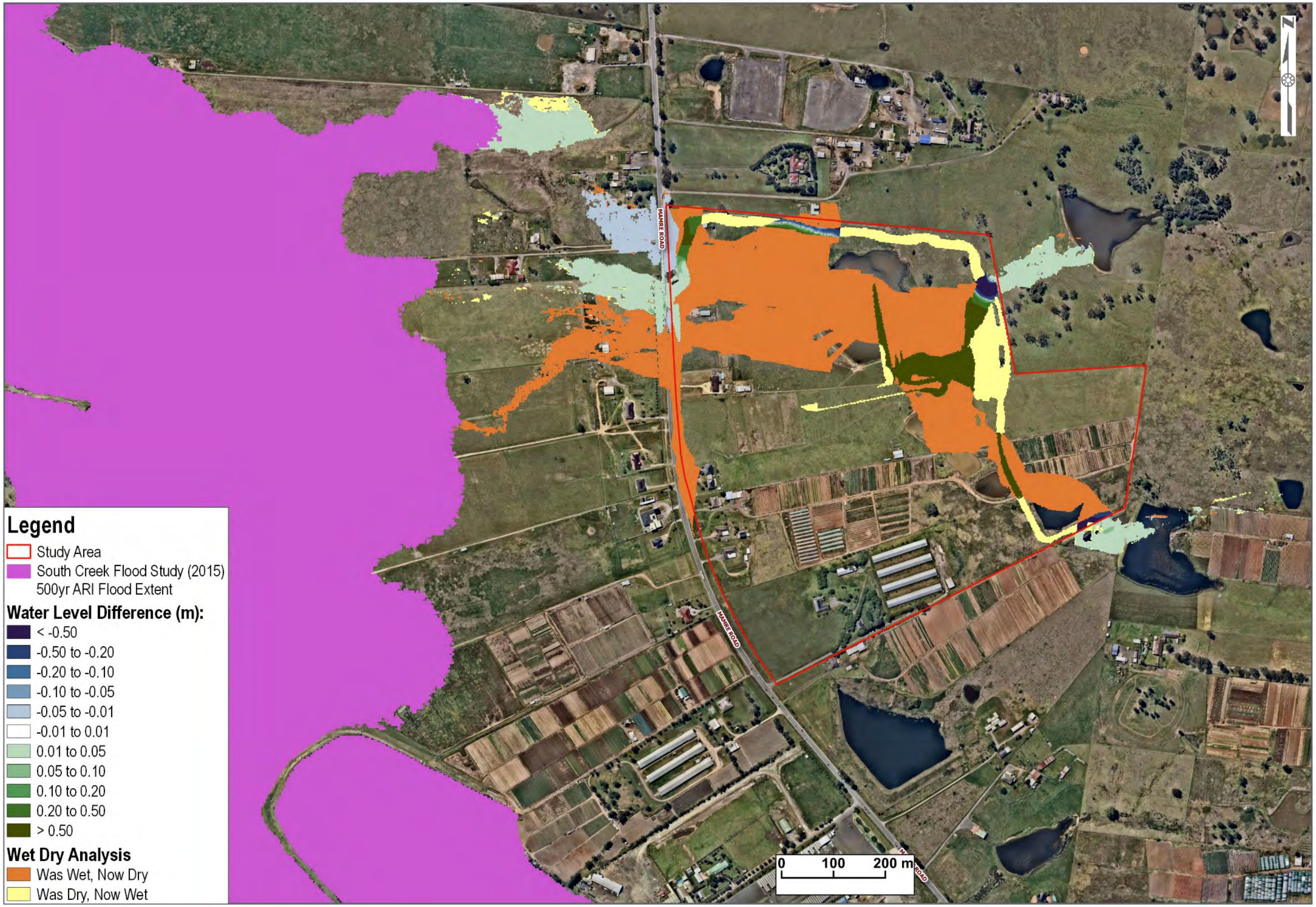

Figure 36 500 yr ARI Level Differences - (Stage 1 Conditions – Benchmark Conditions)

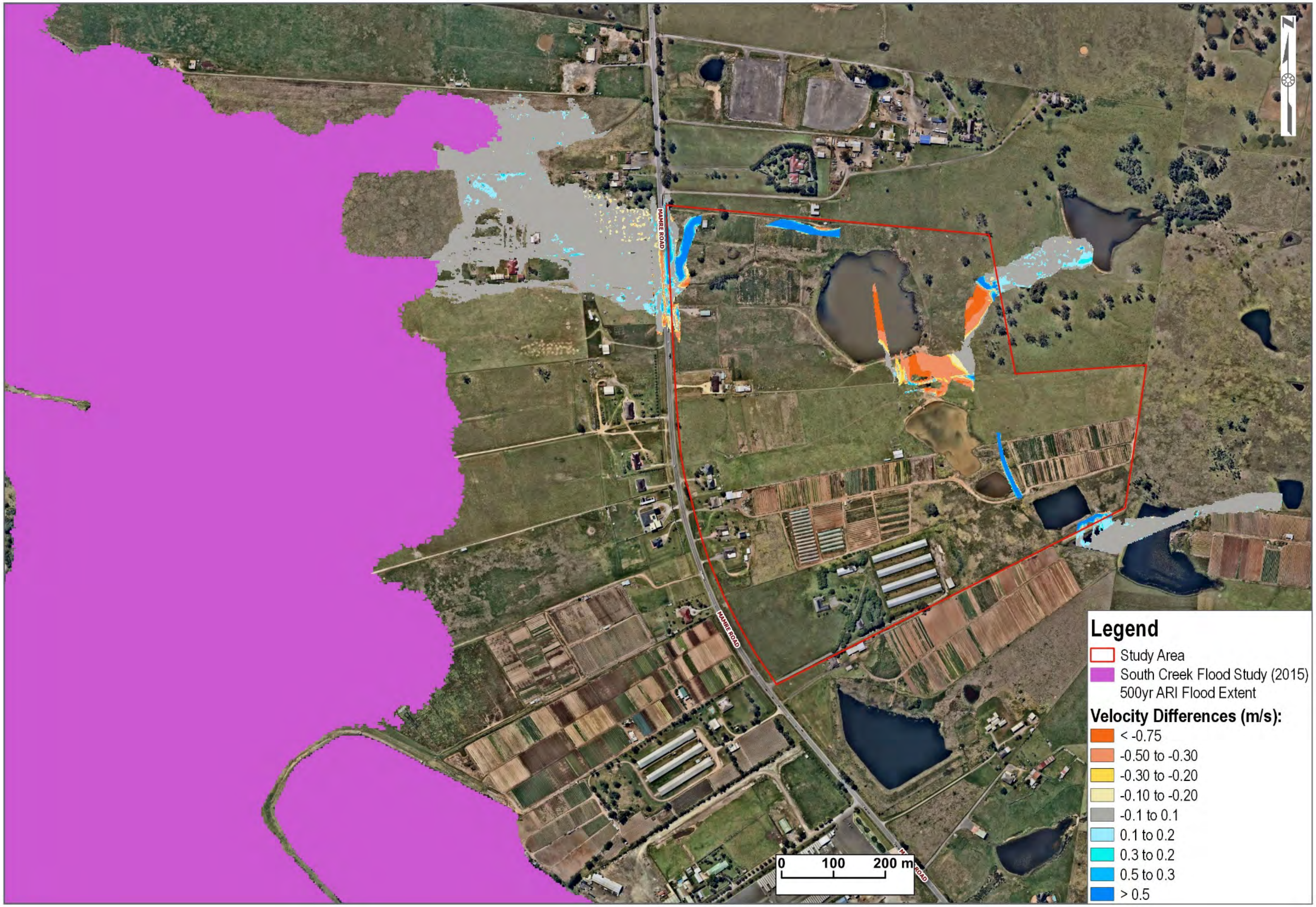

Figure 37 500 yr ARI Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)

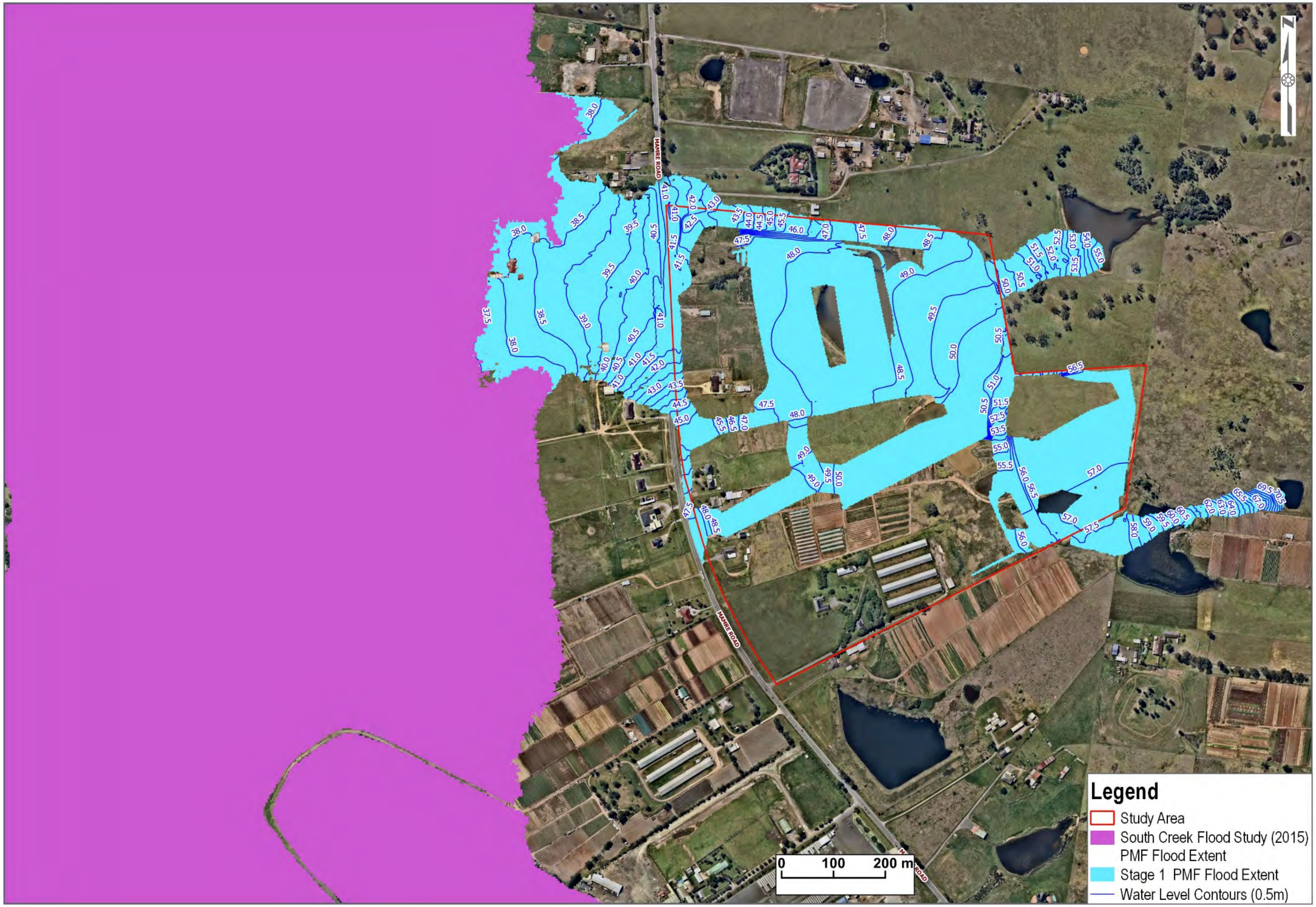

Figure 38 PMF Flood Extents and Flood Levels - Stage 1 Conditions

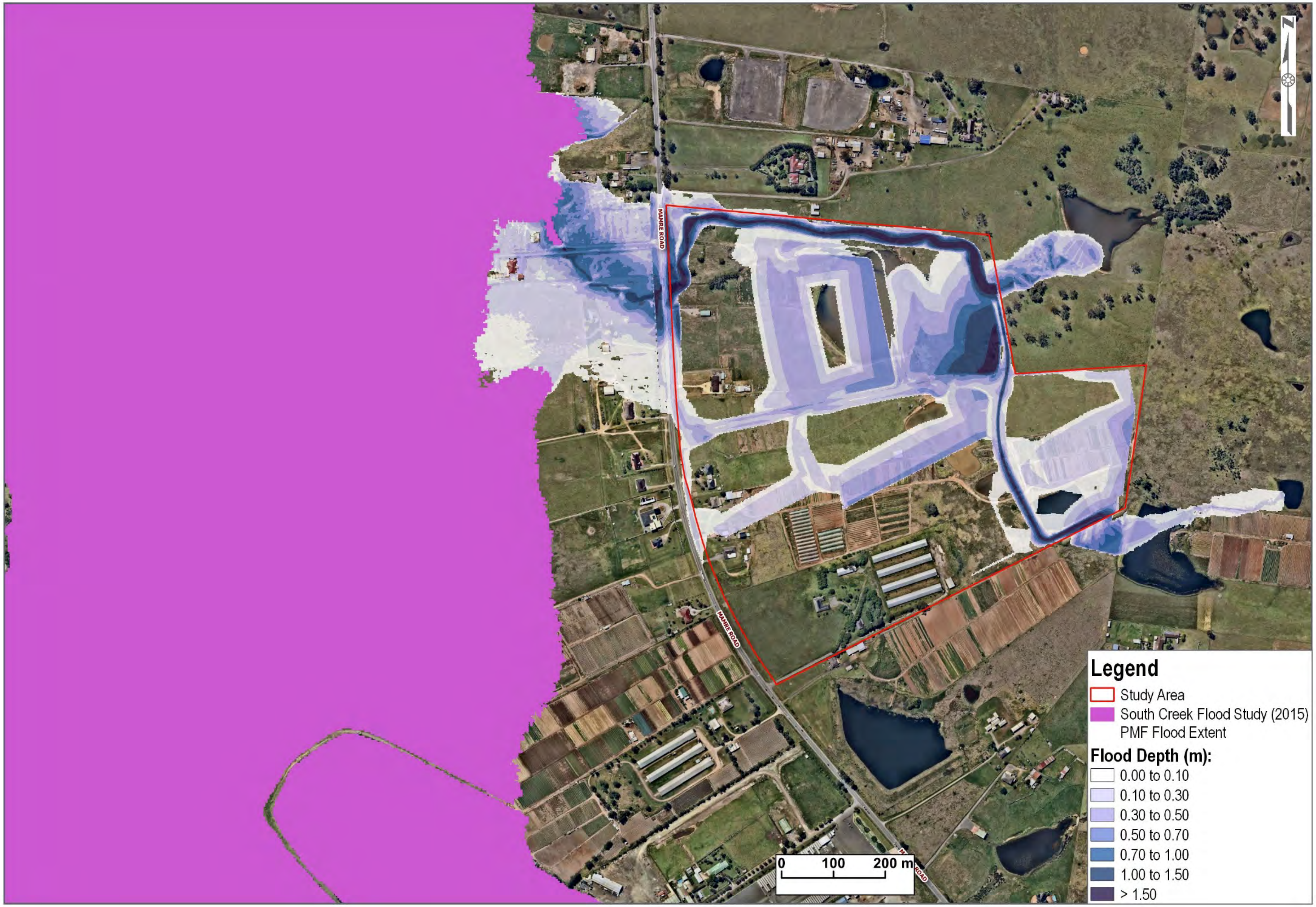

Figure 39 PMF Flood Depths - Stage 1 Conditions

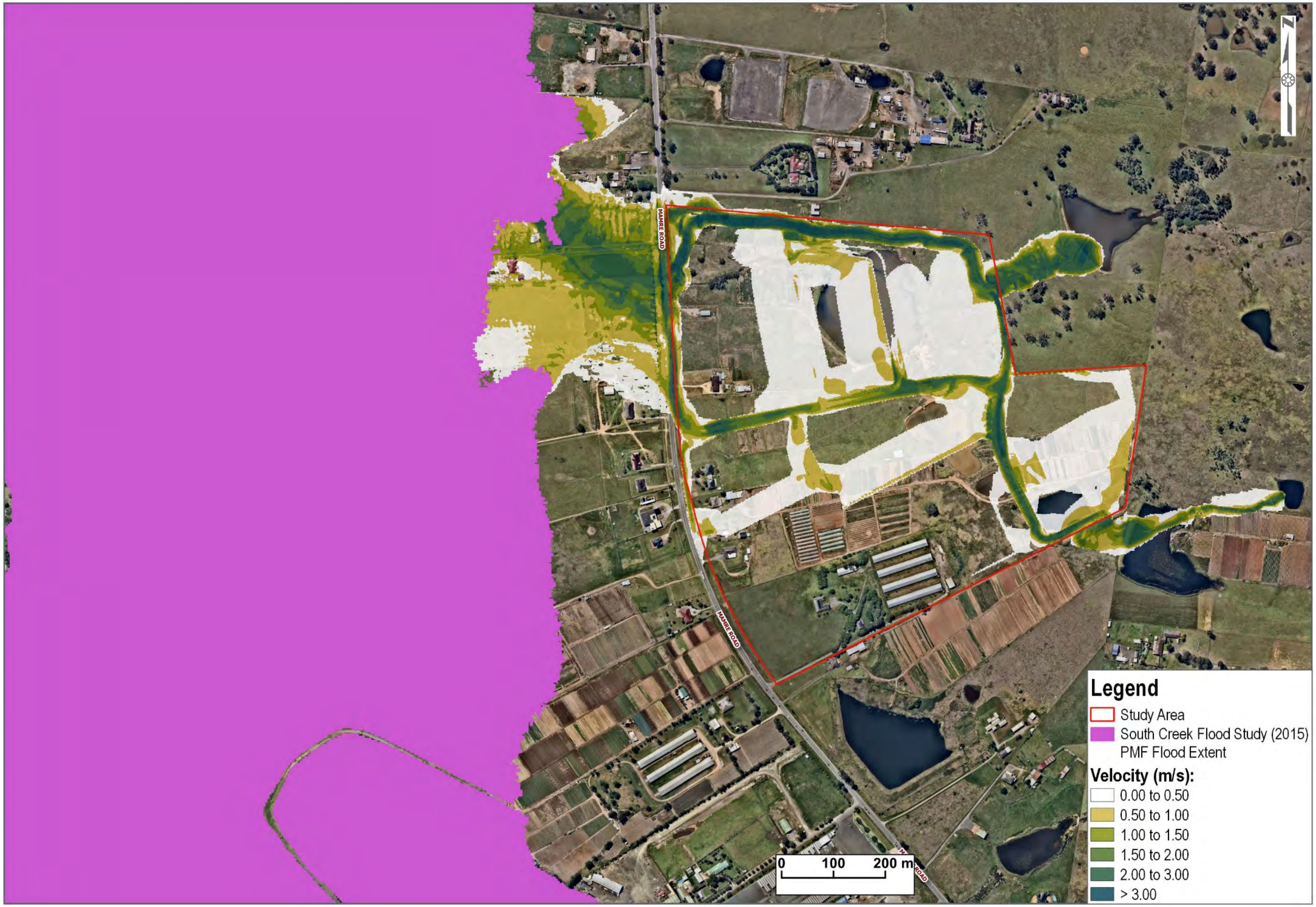

Figure 40 PMF Flood Velocities - Stage 1 Conditions

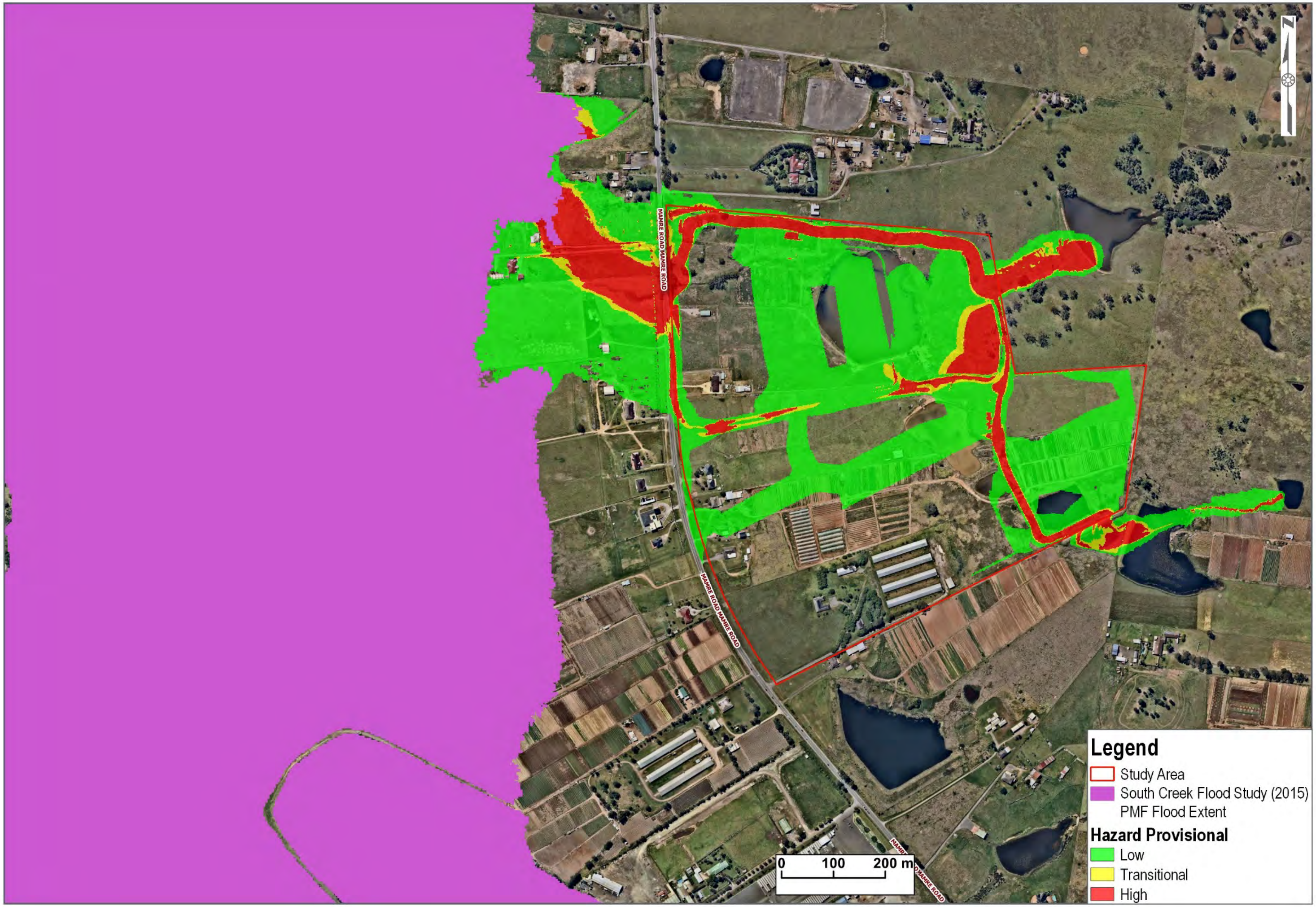

Figure 41 PMF Flood Hazards - Stage 1 Conditions

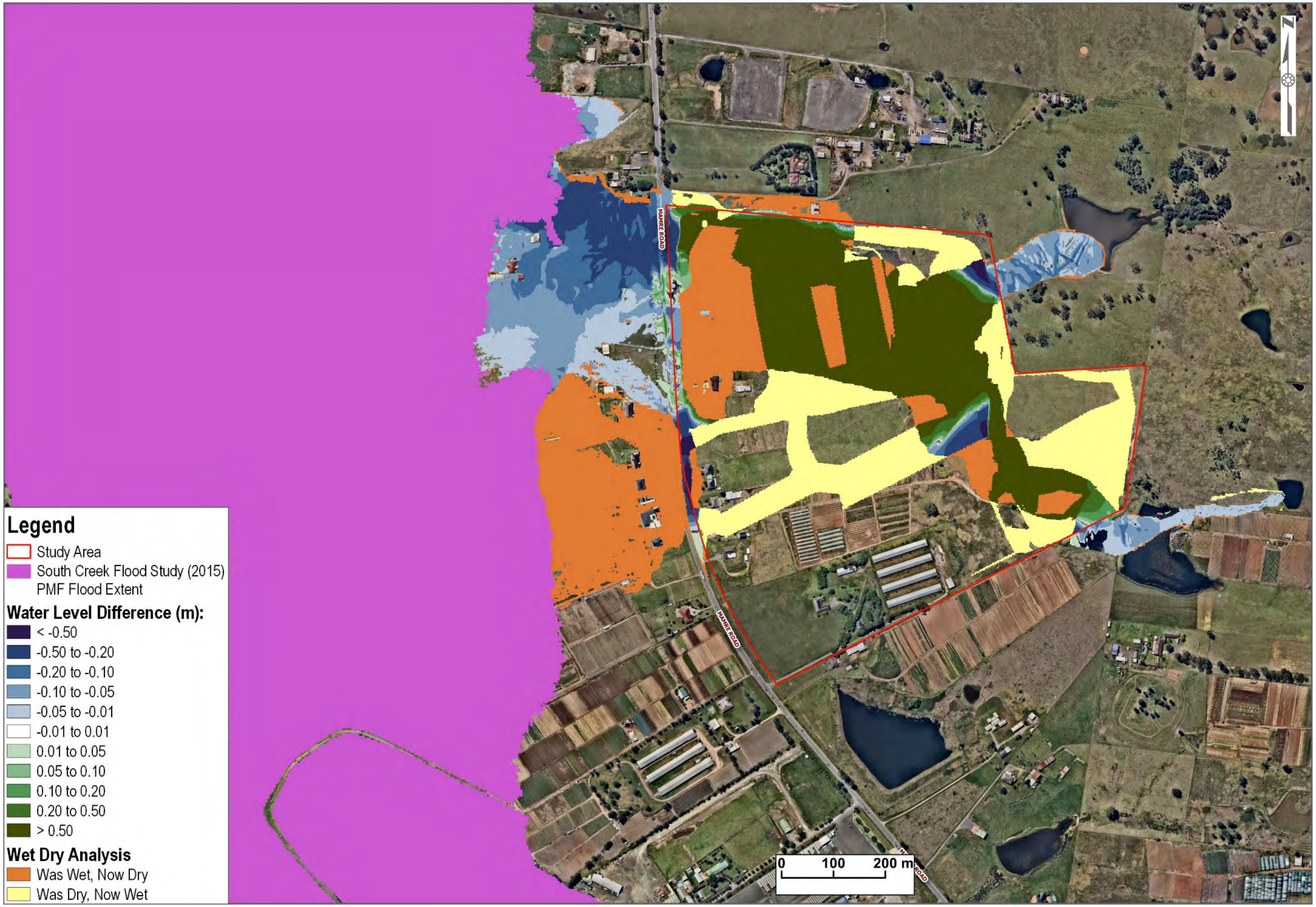

Figure 42 PMF Level Differences - (Stage 1 Conditions – Benchmark Conditions)

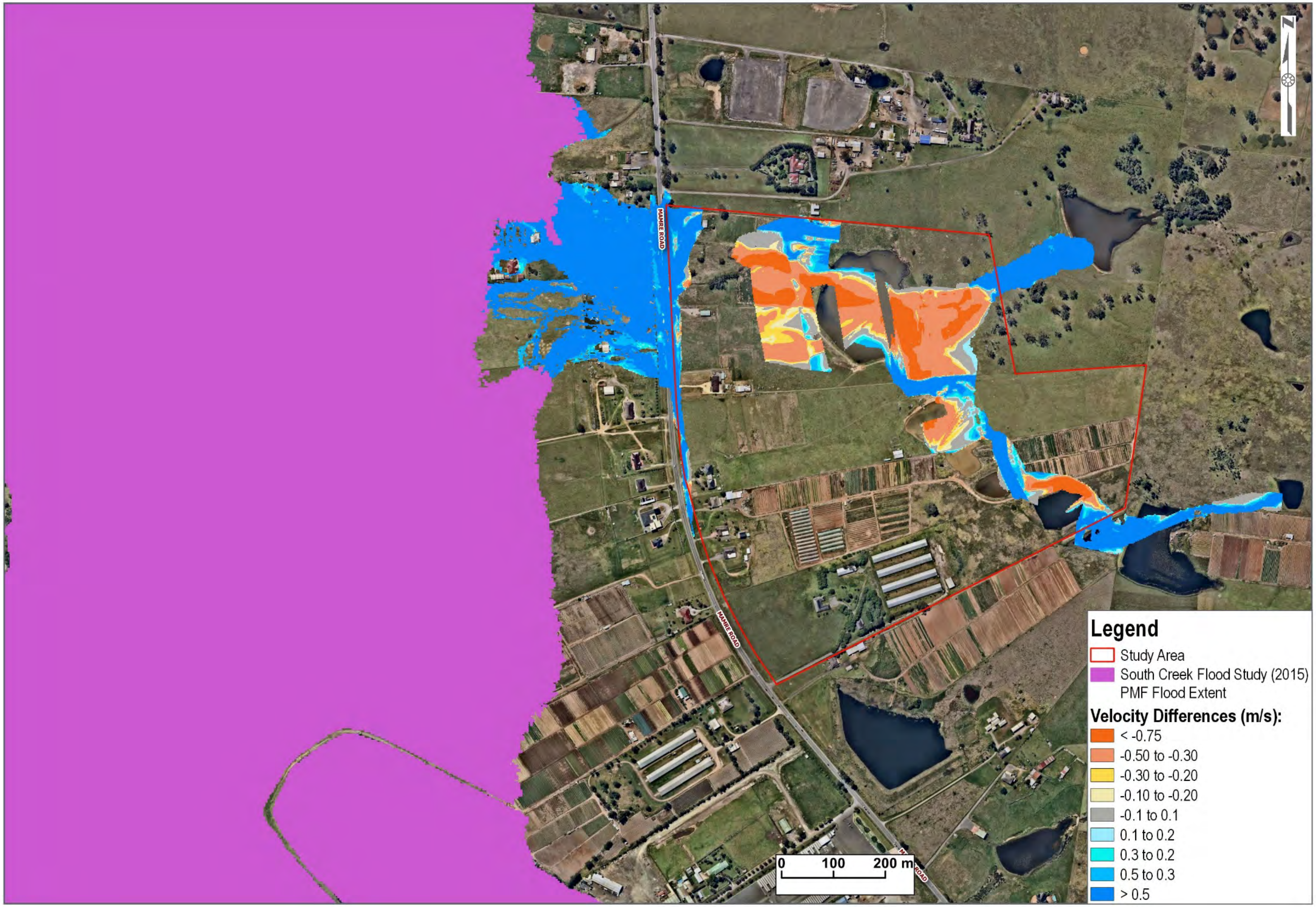

Figure 43 PMF Velocity Differences - (Stage 1 Conditions – Benchmark Conditions)

APPENDIX B
SUMMARIES OF 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)

	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

Attachment B0

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	0.29	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	0.65	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	22.89	21.87	18.65	19.50	15.73	13.35	15.03	12.10
PostDev+Basin - PreDev		-1.19	-0.59	-0.47	-0.43	-0.70	-0.38	0.82	0.57	0.63	1.36	1.04

ARR	Basin Footprint (m2)	Max 1% AEP Depth (m)	1% AEP Basin Volume (m3)	Max 50% AEP Depth (m)	50% AEP Basin Volume (m3)	Primary Outlet	Secondary Spillway Width (m)	Secondary Spillway Crest Level (m)	Embankment Crest Level above Primary Outlet IL (m)
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

2 yr ARI ARR Edition 1987

Pervious Area Losses
Initial Burst Loss (mm) 15
Continuing (mm/h) 1.5

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	2	2	2	2	2	2	2	2	2	2	2	2		Critical
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Duration (hrs)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
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
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
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
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
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
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
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
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
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
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
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
N4	0.05	0.08	0.10	0.10	0.10	0.09	0.11	0.10	0.10	0.10	0.07	0.05	0.11	4.5
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
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
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
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

5 yr ARI ARR Edition 1987

Pervious Area Losses
Initial Burst Loss (mm) 15
Continuing (mm/h) 1.5

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	5	5	5	5	5	5	5	5	5	5	5	5		Critical
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Duration (hrs)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
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
N1	0.42	0.56	0.65	0.66	0.69	0.51	0.69	0.61	0.54	0.55	0.37	0.28	0.69	4.5
N2	0.11	0.15	0.17	0.17	0.18	0.13	0.17	0.15	0.14	0.14	0.09	0.07	0.18	2.0
S1	0.54	0.71	0.81	0.83	0.87	0.65	0.86	0.76	0.67	0.69	0.46	0.35	0.87	2.0
S2	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
S3	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
MRID3	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
MRID2a	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
Junc	1.29	1.65	1.89	1.97	2.14	1.75	2.12	1.89	1.85	1.94	1.38	1.08	2.14	2.0
MRID1	0.35	0.53	0.62	0.64	0.68	0.60	0.71	0.65	0.61	0.64	0.46	0.36	0.71	4.5
N3	0.72	1.12	1.32	1.41	1.51	1.36	1.51	1.46	1.40	1.46	1.08	0.85	1.51	2.0
N4	2.36	3.27	3.75	3.80	3.99	3.67	4.30	3.96	3.84	3.97	2.90	2.29	4.30	4.5
N34	0.39	0.63	0.83	1.01	1.11	1.09	1.05	1.23	1.36	1.26	1.06	0.94	1.36	9.0
MRd	4.85	6.82	7.98	8.26	8.60	7.99	9.09	8.71	8.61	8.56	6.54	5.29	9.09	4.5
MRID2b	0.51	0.59	0.72	0.78	0.84	0.62	0.65	0.53	0.46	0.46	0.30	0.23	0.84	2.0
DSMRd	6.26	8.78	10.52	11.09	11.70	10.31	11.61	11.48	11.37	10.90	8.59	6.98	11.70	2.0

100 yr ARI ARR Edition 1987

Pervious Area Losses
Initial Burst Loss (mm) 15
Continuing (mm/h) 1.5

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	100	100	100	100	100	100	100	100	100	100	100	100		Critical
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Duration (hrs)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
N5	5.39	6.10	6.75	6.70	7.03	5.37	5.95	5.12	4.40	4.51	3.17	2.49	7.03	2.0
N1	4.15	4.95	5.40	5.34	5.47	4.29	5.09	4.34	3.73	3.87	2.80	2.22	5.47	2.0
N2	5.65	6.54	7.18	7.13	7.50	5.75	6.66	5.77	4.98	5.09	3.68	2.91	7.50	2.0
S1	0.59	0.56	0.69	0.72	0.69	0.47	0.41	0.30	0.26	0.26	0.17	0.13	0.72	1.5
S2	2.64	3.11	3.38	3.34	3.56	2.71	3.23	2.79	2.41	2.50	1.81	1.43	3.56	2.0
S3	3.65	4.09	4.61	4.79	5.05	3.81	4.17	3.67	3.16	3.26	2.33	1.84	5.05	2.0
MRID3	1.21	1.41	1.55	1.53	1.59	1.23	1.43	1.22	1.04	1.08	0.77	0.61	1.59	2.0
MRID2a	2.54	3.09	3.37	3.34	3.39	2.70	3.24	2.76	2.39	2.49	1.82	1.44	3.39	2.0
Junc	7.29	8.49	9.33	9.34	9.90	7.54	8.71	7.61	6.58	6.72	4.90	3.90	9.90	2.0
MRID1	1.40	1.98	2.33	2.49	2.59	2.42	2.38	2.55	2.39	2.29	1.87	1.62	2.59	2.0
N3	1.26	1.37	1.56	1.56	1.67	1.29	1.22	1.04	0.90	0.91	0.61	0.48	1.67	2.0
N4	0.33	0.36	0.40	0.41	0.44	0.34	0.31	0.26	0.23	0.23	0.15	0.12	0.44	2.0
N34	1.58	1.72	1.97	1.97	2.11	1.63	1.53	1.30	1.13	1.13	0.77	0.60	2.11	2.0
MRd	14.99	17.83	19.91	19.98	20.96	16.35	18.68	16.76	14.77	14.54	11.10	9.03	20.96	2.0
MRID2b	1.32	1.33	1.65	1.82	1.83	1.31	1.13	0.86	0.75	0.75	0.49	0.39	1.83	2.0
DSMRd	18.62	22.74	25.54	25.78	26.99	21.53	23.78	21.70	19.34	18.69	14.67	11.91	26.99	2.0

200 yr ARI ARR Edition 1987

Pervious Area Losses
Initial Burst Loss (mm) 15
Continuing (mm/h) 1.5

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	200	200	200	200	200	200	200	200	200	200	200	200		Critical
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Duration (hrs)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
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	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	6.70	7.59	8.36	8.28	8.77	6.76	7.49	6.46	5.56	5.68	4.10	3.25	8.77	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	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	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	1.45	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	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	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	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	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	0.39	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	1.87	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	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	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	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

500 yr ARI ARR Edition 1987

Pervious Area Losses
Initial Burst Loss (mm) 15
Continuing (mm/h) 1.5

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	500	500	500	500	500	500	500	500	500	500	500	500		Critical
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Duration (hrs)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
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	1.78	1.88	2.12	2.18	2.31	1.78	1.56	1.31	1.14	1.14	0.78	0.61	2.31	2.0
N2	0.46	0.48	0.55	0.58	0.61	0.46	0.40	0.33	0.28	0.29	0.19	0.15	0.61	2.0
S1	2.24	2.36	2.66	2.75	2.92	2.24	1.96	1.64	1.42	1.43	0.97	0.77	2.92	2.0
S2	6.11	6.84	7.50	7.42	7.74	6.01	6.54	5.58	4.77	4.93	3.56	2.82	7.74	2.0
S3	8.13	9.03	9.99	9.90	10.51	8.19	8.57	7.38	6.35	6.47	4.67	3.71	10.51	2.0
MRID3	0.88	0.78	0.90	0.92	0.87	0.58	0.51	0.37	0.32	0.32	0.22	0.17	0.92	1.5
MRID2a	3.84	4.31	4.72	4.75	5.07	3.90	4.16	3.59	3.08	3.18	2.29	1.82	5.07	2.0
Junc	5.16	5.64	6.35	6.66	7.00	5.36	5.36	4.70	4.03	4.14	2.96	2.35	7.00	2.0
MRID1	1.77	1.96	2.15	2.13	2.25	1.73	1.82	1.56	1.34	1.37	0.98	0.78	2.25	2.0
N3	3.76	4.30	4.69	4.63	4.78	3.75	4.21	3.58	3.06	3.17	2.31	1.84	4.78	2.0
N4	10.46	11.78	13.03	13.16	13.88	10.69	11.30	9.76	8.40	8.53	6.23	4.97	13.88	2.0
N34	2.15	2.91	3.30	3.48	3.61	3.28	3.31	3.30	3.05	2.97	2.42	2.08	3.61	2.0
MRd	21.60	24.83	27.70	27.85	29.24	22.93	24.42	21.60	18.85	18.48	14.15	11.52	29.24	2.0
MRID2b	1.93	1.89	2.26	2.38	2.35	1.66	1.43	1.07	0.94	0.93	0.62	0.49	2.38	1.5
DSMRd	26.48	31.53	35.07	35.34	36.93	29.57	31.65	27.77	24.57	23.86	18.71	15.19	36.93	2.0

PMF

Pervious Area Losses
Initial Burst Loss (mm) 1
Continuing (mm/h) 0

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)										Critical
Subcatchment ID	Storm Burst Duration (mins)								Peak Flow (m3/s)	Duration (hrs)
	15	30	45	60	90	120	180	240		
N5	73.12	74.86	70.52	64.53	54.98	47.72	38.47	33.27	74.86	0.50
N1	17.90	15.92	14.38	12.99	10.75	9.41	7.67	6.68	17.90	0.25
N2	4.61	4.02	3.60	3.23	2.68	2.35	1.92	1.68	4.61	0.25
S1	22.47	19.93	17.96	16.22	13.42	11.76	9.59	8.36	22.47	0.25
S2	61.31	65.23	60.94	56.90	48.67	42.42	33.96	29.28	65.23	0.50
S3	79.21	84.36	79.70	73.59	63.63	55.71	44.50	38.40	84.36	0.50
MRID3	6.49	5.00	4.25	3.77	3.21	2.85	2.30	1.95	6.49	0.25
MRID2a	40.08	41.76	39.21	36.51	31.30	27.37	21.86	18.86	41.76	0.50
Junc	53.21	53.35	50.28	46.91	40.30	35.22	28.06	24.35	53.35	0.50
MRID1	17.78	18.26	17.12	15.75	13.43	11.67	9.37	8.09	18.26	0.50
N3	38.13	41.66	39.36	36.81	31.53	27.63	22.07	19.02	41.66	0.50
N4	105.47	111.06	105.64	98.23	84.62	74.43	59.40	51.35	111.06	0.50
N34	22.50	32.72	36.38	35.30	32.09	29.70	24.43	20.80	36.38	0.75
MRd	203.74	230.73	232.52	218.69	191.71	170.54	136.93	117.68	232.52	0.75
MRID2b	17.40	14.04	12.11	10.65	8.97	7.99	6.51	5.59	17.40	0.25
DSMRd	221.49	270.18	290.87	278.52	248.24	222.83	180.15	154.27	290.87	0.75

2 yr ARI | **ARR Edition** **1987**

Pervious Area Losses
Initial Burst Loss (mm) 15
Continuing (mm/h) 1.5

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	2	2	2	2	2	2	2	2	2	2	2	2		Critical
Subcatchment ID					Storm Burst Duration (mins)								Peak Flow (m3/s)	Duration (hrs)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
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
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
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
N3	0.16	0.28	0.34	0.35	0.37	0.34	0.42	0.38	0.39	0.40	0.27	0.21	0.42	4.5
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
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
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
S2	0.33	0.57	0.71	0.80	0.86	0.84	0.86	0.97	1.02	1.08	0.78	0.61	1.08	12.0
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
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
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
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
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
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
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
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
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
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

5 yr ARI | **ARR Edition** **1987**

Pervious Area Losses
Initial Burst Loss (mm) 15
Continuing (mm/h) 1.5

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	5	5	5	5	5	5	5	5	5	5	5	5		Critical
Subcatchment ID					Storm Burst Duration (mins)								Peak Flow (m3/s)	Duration (hrs)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
N5													0.00	4.5
N1													0.00	4.5
N2													0.00	4.5
N3													0.00	4.5
N4													0.00	2.0
N34													0.00	4.5
S1													0.00	2.0
S2													0.00	4.5
S3													0.00	2.0
MRID3													0.00	1.5
MRID2													0.00	1.5
Junc2													0.00	1.5
MRID1													0.00	1.5
Junc													0.00	2.0
Dummy1													0.00	0.5
MRIDBas													0.00	0.5
MRd													0.00	2.0
DSMRd													0.00	2.0

100 yr ARI | **ARR Edition** **1987**

Pervious Area Losses
Initial Burst Loss (mm) 15
Continuing (mm/h) 1.5

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	100	100	100	100	100	100	100	100	100	100	100	100		Critical
Subcatchment ID					Storm Burst Duration (mins)								Peak Flow (m3/s)	Duration (hrs)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
N5	5.34	6.05	6.68	6.60	6.95	5.30	5.93	5.11	4.36	4.49	3.17	2.49	6.95	2.0
N1	4.04	4.91	5.33	5.27	5.37	4.20	5.06	4.30	3.70	3.84	2.80	2.22	5.37	2.0
N2	9.16	10.50	11.62	11.75	12.33	9.38	10.70	9.27	8.06	8.21	5.99	4.75	12.33	2.0
N3	1.23	1.35	1.55	1.53	1.65	1.26	1.22	1.04	0.90	0.91	0.61	0.48	1.65	2.0
N4	0.31	0.34	0.39	0.39	0.42	0.32	0.31	0.26	0.22	0.22	0.15	0.12	0.42	2.0
N34	10.20	11.77	13.17	13.29	13.95	10.64	11.93	10.41	9.07	9.13	6.72	5.35	13.95	1.5
S1	0.58	0.55	0.68	0.72	0.69	0.47	0.41	0.30	0.26	0.26	0.17	0.13	0.72	1.5
S2	2.63	3.06	3.31	3.26	3.45	2.67	3.20	2.77	2.41	2.49	1.81	1.43	3.45	2.0
S3	3.65	4.04	4.53	4.71	4.94	3.79	4.13	3.64	3.16	3.26	2.33	1.84	4.94	2.0
MRID3	3.32	3.08	3.33	3.56	3.35	1.88	1.66	1.22	1.07	1.07	0.72	0.57	3.56	1.5
MRID2	11.66	10.79	11.57	12.26	11.68	6.45	5.74	4.28	3.74	3.74	2.53	2.00	12.26	1.5
Junc2	14.98	13.85	14.88	15.77	15.00	8.33	7.40	5.50	4.80	4.80	3.24	2.57	15.77	1.5
MRID1	10.06	9.29	9.91	10.47	9.98	5.48	4.88	3.66	3.20	3.21	2.18	1.73	10.47	1.5
Junc	3.65	4.04	4.53	4.71	4.94	3.79	4.13	3.64	3.16	3.26	2.33	1.84	4.94	2.0
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	0.0
MRIDBas	21.92	20.96	19.62	19.15	22.17	13.61	12.13	9.13	7.97	7.99	5.41	4.30	22.17	2.0
MRd	22.20	21.54	23.69	25.56	25.95	18.54	20.72	18.18	15.91	16.60	12.09	9.65	25.95	2.0
DSMRd	24.55	26.34	29.17	31.79	31.92	23.83	26.64	23.29	20.22	21.10	15.26	12.15	31.92	2.0
	0.5	0.75	1	1.5	2	3	4.5	6	9	12	24	36		

200 yr ARI | **ARR Edition** **1987**

Pervious Area Losses
Initial Burst Loss (mm) 15
Continuing (mm/h) 1.5

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	200	200	200	200	200	200	200	200	200	200	200	200		Critical
Subcatchment ID					Storm Burst Duration (mins)								Peak Flow (m3/s)	Duration (hrs)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
N5													0.00	2.0
N1													0.00	2.0
N2													0.00	2.0
N3													0.00	2.0
N4													0.00	2.0
N34													0.00	2.0
S1													0.00	1.5
S2													0.00	2.0
S3													0.00	2.0
MRID3													0.00	1.5
MRID2													0.00	1.5
Junc2													0.00	1.5
MRID1													0.00	2.0
Junc													0.00	1.5
Dummy1													0.00	2.0
MRIDBas													0.00	0.5
MRd													0.00	2.0
DSMRd													0.00	2.0

500 yr ARI | **ARR Edition** **1987**

Pervious Area Losses
Initial Burst Loss (mm) 15
Continuing (mm/h) 1.5

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	500	500	500	500	500	500	500	500	500	500	500	500		Critical
Subcatchment ID					Storm Burst Duration (mins)								Peak Flow (m3/s)	Duration (hrs)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
N5													0.00	2.0
N1													0.00	2.0
N2													0.00	2.0
N3													0.00	2.0
N4													0.00	2.0
N34													0.00	2.0
S1													0.00	1.5
S2													0.00	2.0
S3													0.00	2.0
MRID3													0.00	1.5
MRID2													0.00	1.5
Junc2													0.00	1.5
MRID1													0.00	1.5
Junc													0.00	2.0
Dummy1													0.00	2.0
MRIDBas													0.00	2.0
MRd													0.00	2.0
DSMRd													0.00	2.0

PMF

Pervious Area Losses
Initial Burst Loss (mm) 1
Continuing (mm/h) 0

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)										Critical
Subcatchment ID				Storm Burst Duration (mins)					Peak Flow (m3/s)	Duration (hrs)
	15	30	45	60	90	120	180	240		
N5									0.00	0.5
N1									0.00	0.5
N2									0.00	0.5
N3									0.00	0.3
N4									0.00	0.3
N34									0.00	0.3
S1									0.00	0.3
S2									0.00	0.5
S3									0.00	0.5
MRID3									0.00	0.3
MRID2									0.00	0.3
Junc2									0.00	0.3
MRID1									0.00	0.5
Junc									0.00	0.3
Dummy1									0.00	0.5
MRIDBas									0.00	0.3
MRd									0.00	0.5
DSMRd									0.00	0.5

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: Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5 | Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs): 2 — Storm Burst Duration (mins)

Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	Peak Flow (m3/s)	Critical Duration (hrs)
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
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
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
N3	0.16	0.28	0.34	0.35	0.37	0.34	0.42	0.38	0.39	0.40	0.27	0.21	0.42	4.5
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
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
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
S2	0.33	0.57	0.71	0.80	0.86	0.84	0.86	0.97	1.02	1.08	0.78	0.61	1.08	12.0
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
MRID3	1.83	1.66	1.77	1.88	1.79	0.96	0.85	0.64	0.57	0.57	0.38	0.29	1.88	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
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
MRID1	5.44	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
Junc	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
Dummy1														
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
MRd	3.15	4.52	5.26	5.43	5.72	5.49	5.85	5.98	6.19	6.27	4.93	4.14	6.27	12.0
DSMRd	3.73	5.63	6.70	6.99	7.34	7.01	7.52	7.69	8.01	7.96	6.25	5.20	8.01	9.0
Peak Inflow (m3/s)	10.97	10.27	9.44	9.18	10.77	6.62	5.84	4.35	3.95	3.97	2.61	2.03		
Peak Outflow (m3/s)	1.91	2.15	2.29	2.32	2.39	2.27	2.34	2.36	2.38	2.29	2.02	1.85		
Max Vol (m3)	8,811	9,956	10,705	10,882	11,247	10,624	10,962	11,085	11,196	10,718	9,312	8,536	11,247	
Max Stage (m)	1.10	1.24	1.34	1.36	1.41	1.33	1.37	1.39	1.40	1.34	1.16	1.07	1.41	

5 yr ARI | **ARR Edition** 1987 | Pervious Area Losses: Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5 | Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs): 5 — Storm Burst Duration (mins)

Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	Peak Flow (m3/s)	Critical Duration (hrs)
N5	1.58	2.32	2.71	2.73	2.88	2.48	3.06	2.73	2.56	2.66	1.89	1.47	3.06	4.5
N1	1.17	1.81	2.13	2.23	2.37	2.14	2.41	2.27	2.19	2.27	1.66	1.30	2.41	4.5
N2	2.99	4.13	4.79	4.87	5.11	4.46	5.29	4.85	4.74	4.88	3.55	2.79	5.29	4.5
N3	0.40	0.55	0.63	0.64	0.66	0.50	0.68	0.60	0.54	0.55	0.37	0.28	0.68	4.5
N4	0.11	0.14	0.16	0.17	0.18	0.13	0.17	0.15	0.14	0.14	0.09	0.07	0.18	2.0
N34	3.39	4.65	5.45	5.55	5.87	4.97	5.94	5.48	5.34	5.41	3.98	3.14	5.94	4.5
S1	0.20	0.22	0.29	0.34	0.36	0.25	0.24	0.18	0.16	0.16	0.10	0.08	0.36	2.0
S2	0.81	1.16	1.32	1.35	1.46	1.34	1.52	1.42	1.39	1.46	1.07	0.84	1.52	4.5
S3	1.26	1.63	1.88	1.92	2.11	1.72	2.08	1.85	1.83	1.93	1.38	1.08	2.11	2.0
MRID3	2.39	2.15	2.32	2.46	2.34	1.27	1.13	0.86	0.75	0.75	0.50	0.39	2.46	1.5
MRID2	7.20	6.46	6.92	7.36	7.03	3.81	3.39	2.55	2.25	2.26	1.49	1.17	7.36	1.5
Junc2	9.59	8.62	9.23	9.82	9.37	5.08	4.52	3.41	3.00	3.01	1.99	1.56	9.82	1.5
MRID1	7.11	6.36	6.79	7.22	6.85	3.72	3.29	2.47	2.19	2.20	1.46	1.15	7.22	1.5
Junc	1.26	1.63	1.88	1.92	2.11	1.72	2.08	1.85	1.83	1.93	1.38	1.08	2.11	2.0
Dummy1														
MRIDBas	14.35	13.37	12.36	12.07	14.17	8.69	7.71	5.83	5.17	5.20	3.45	2.71	14.35	0.5
MRd	5.79	7.35	8.32	8.43	8.77	7.84	8.84	8.28	8.09	8.20	6.50	5.50	8.84	4.5
DSMRd	7.24	9.52	10.93	11.15	11.65	10.07	11.58	10.91	10.58	10.57	8.31	6.95	11.65	2.0
Peak Inflow (m3/s)	14.35	13.37	12.36	12.07	14.17	8.69	7.71	5.83	5.17	5.20	3.45	2.71		
Peak Outflow (m3/s)	2.45	2.72	2.87	2.92	2.99	2.87	2.90	2.94	2.91	2.79	2.52	2.36		
Max Vol (m3)	11,610	13,234	14,275	14,607	15,115	14,292	14,483	14,772	14,564	13,698	12,034	11,083	15,115	
Max Stage (m)	1.45	1.65	1.78	1.83	1.89	1.79	1.81	1.85	1.82	1.71	1.50	1.39	1.89	

100 yr ARI | **ARR Edition** 1987 | Pervious Area Losses: Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5 | Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs): 100 — Storm Burst Duration (mins)

Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	Peak Flow (m3/s)	Critical Duration (hrs)
N5	5.34	6.05	6.68	6.60	6.95	5.30	5.93	5.11	4.36	4.49	3.17	2.49	6.95	2.0
N1	4.04	4.91	5.33	5.27	5.37	4.20	5.06	4.30	3.70	3.84	2.80	2.22	5.37	2.0
N2	9.16	10.50	11.62	11.75	12.33	9.38	10.70	9.27	8.06	8.21	5.99	4.75	12.33	2.0
N3	1.23	1.35	1.55	1.53	1.65	1.26	1.22	1.04	0.90	0.91	0.61	0.48	1.65	2.0
N4	0.31	0.34	0.39	0.39	0.42	0.32	0.31	0.26	0.22	0.22	0.15	0.12	0.42	2.0
N34	10.20	11.77	13.17	13.29	13.95	10.64	11.93	10.41	9.07	9.13	6.72	5.35	13.95	2.0
S1	0.58	0.55	0.68	0.72	0.69	0.47	0.41	0.30	0.26	0.26	0.17	0.13	0.72	1.5
S2	2.63	3.06	3.31	3.26	3.45	2.67	3.20	2.77	2.41	2.49	1.81	1.43	3.45	2.0
S3	3.65	4.04	4.53	4.71	4.94	3.79	4.13	3.64	3.16	3.26	2.33	1.84	4.94	2.0
MRID3	3.74	3.46	3.74	3.97	3.77	2.11	1.86	1.38	1.20	1.20	0.81	0.64	3.97	1.5
MRID2	11.23	10.41	11.17	11.82	11.25	6.21	5.53	4.12	3.60	3.60	2.43	1.93	11.82	1.5
Junc2	14.96	13.86	14.90	15.78	14.98	8.32	7.40	5.50	4.80	4.80	3.23	2.57	15.78	1.5
MRID1	11.07	10.26	10.93	11.54	10.96	6.02	5.35	4.01	3.50	3.51	2.38	1.89	11.54	1.5
Junc	3.65	4.04	4.53	4.71	4.94	3.79	4.13	3.64	3.16	3.26	2.33	1.84	4.94	2.0
Dummy1														
MRIDBas	22.92	21.71	20.10	19.51	22.87	14.14	12.60	9.47	8.27	8.29	5.61	4.46	22.92	0.5
MRd	14.59	17.67	19.70	19.60	20.37	15.46	18.27	15.77	14.31	14.44	10.83	9.03	20.37	2.0
DSMRd	18.96	23.00	25.80	25.58	26.61	20.07	23.45	20.29	18.37	18.30	13.80	11.48	26.61	2.0
Peak Inflow (m3/s)	22.92	21.71	20.10	19.51	22.87	14.14	12.60	9.47	8.27	8.29	5.61	4.46		
Peak Outflow (m3/s)	4.40	5.90	6.56	6.37	6.58	6.07	6.34	5.96	5.79	5.31	4.13	3.70		
Max Vol (m3)	20,565	22,666	23,459	23,238	23,483	22,874	23,197	22,739	22,526	21,904	20,107	19,248	23,483	
Max Stage (m)	2.57	2.83	2.93	2.90	2.94	2.86	2.90	2.84	2.82	2.74	2.51	2.41	2.94	

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

2 yr ARI | **ARR Edition** 1987 | Pervious Area Losses: Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5 | Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs): 2 — Storm Burst Duration (mins)

Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	Peak Flow (m3/s)	Critical Duration (hrs)
N5														
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
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
N3	0.16	0.28	0.34	0.35	0.37	0.34	0.42	0.38	0.39	0.40	0.27	0.21	0.42	4.5
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
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
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
S2	0.33	0.57	0.71	0.80	0.86	0.84	0.86	0.97	1.02	1.08	0.78	0.61	1.08	12.0
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
MRID3	1.83	1.66	1.77	1.88	1.79	0.96	0.85	0.64	0.57	0.57	0.38	0.29	1.88	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
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
MRID1	5.44	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
Junc	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
Dummy1														
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
MRd	1.90	3.04	3.63	3.79	4.04	3.91	4.21	4.35	4.70	4.77	3.69	3.11	4.77	12.0
DSMRd														
Peak Inflow (m3/s)	10.97	10.27	9.44	9.18	10.77	6.62	5.84	4.35	3.95	3.97	2.61	2.03		
Peak Outflow (m3/s)	0.53	0.61	0.66	0.71	0.75	0.78	0.81	0.83	0.89	0.90	0.87	0.95		
Max Vol (m3)	10,384	12,439	13,984	15,730	16,942	18,364	19,353	20,326	22,660	23,142	21,623	24,505	24,505	
Max Stage (m)	1.30	1.55	1.75	1.97	2.12	2.30	2.42	2.54	2.83	2.89	2.70	3.06	3.06	

5 yr ARI | **ARR Edition** 1987 | Pervious Area Losses: Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5 | Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs): 5 — Storm Burst Duration (mins)

Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	Peak Flow (m3/s)	Critical Duration (hrs)
N5														
N1	1.17	1.81	2.13	2.23	2.37	2.14	2.41	2.27	2.19	2.27	1.66	1.30	2.41	4.5
N2	2.99	4.13	4.79	4.87	5.11	4.46	5.29	4.85	4.74	4.88	3.55	2.79	5.29	4.5
N3	0.40	0.55	0.63	0.64	0.66	0.50	0.68	0.60	0.54	0.55	0.37	0.28	0.68	4.5
N4	0.11	0.14	0.16	0.17	0.18	0.13	0.17	0.15	0.14	0.14	0.09	0.07	0.18	2.0
N34	0.20	0.22	0.29	0.34	0.36	0.25	0.24	0.18	0.16	0.16	0.10	0.08	0.36	2.0
S1	0.81	1.16	1.32	1.35	1.46	1.34	1.52	1.42	1.39	1.46	1.07	0.84	1.52	4.5
S2	1.26	1.63	1.88	1.92	2.11	1.72	2.08	1.85	1.83	1.93	1.38	1.08	2.11	2.0
S3	3.39	4.65	5.45	5.55	5.87	4.97	5.94	5.48	5.34	5.41	3.98	3.14	5.94	4.5
MRID3	2.39	2.15	2.32	2.46	2.34	1.27	1.13	0.86	0.75	0.75	0.50	0.39	2.46	1.5
MRID2	7.20	6.46	6.92	7.36	7.03	3.81	3.39	2.55	2.25	2.26	1.49	1.17	7.36	1.5
Junc2	9.59	8.62	9.23	9.82	9.37	5.08	4.52	3.41	3.00	3.01	1.99	1.56	9.82	1.5
MRID1	7.11	6.36	6.79	7.22	6.85	3.72	3.29	2.47	2.19	2.20	1.46	1.15	7.22	1.5
Junc	1.26	1.63	1.88	1.92	2.11	1.72	2.08	1.85	1.83	1.93	1.38	1.08	2.11	2.0
Dummy1														
MRIDBas	14.35	13.37	12.36	12.07	14.17	8.69	7.71	5.83	5.17	5.20	3.45	2.71	14.35	0.5
MRd	4.04	5.38	6.21	6.32	6.63	5.80	6.74	6.29	6.31	6.36	4.93	4.35	6.74	4.5
DSMRd														
Peak Inflow (m3/s)	14.35	13.37	12.36	12.07	14.17	8.69	7.71	5.83	5.17	5.20	3.45	2.71		
Peak Outflow (m3/s)	0.65	0.74	0.79	0.85	0.90	0.97	1.08	1.18	1.46	1.55	1.40	1.64		
Max Vol (m3)	13,822	16,633	18,731	21,133	22,818	24,796	26,074	26,951	29,099	29,681	28,639	30,230	30,230	
Max Stage (m)	1.73	2.08	2.34	2.64	2.85	3.10	3.26	3.37	3.64	3.71	3.58	3.78	3.78	

100 yr ARI | Pervious Area Losses: Initial Burst Loss (mm) 1; Continuing (mm/h) 0 | Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs): 100 — Storm Burst Duration (mins)

Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	Peak Flow (m3/s)	Critical Duration (hrs)
N5														
N1	4.04	4.91	5.33	5.27	5.37	4.20	5.06	4.30	3.70	3.84	2.80	2.22	5.37	2.0
N2	9.16	10.50	11.62	11.75	12.33	9.38	10.70	9.27	8.06	8.21	5.99	4.75	12.33	2.0
N3	1.23	1.35	1.55	1.53	1.65	1.26	1.22	1.04	0.90	0.91	0.61	0.48	1.65	2.0
N4	0.31	0.34	0.39	0.39	0.42	0.32	0.31	0.26	0.22	0.22	0.15	0.12	0.42	2.0
N34	10.20	11.77	13.17	13.29	13.95	10.64	11.93	10.41	9.07	9.13	6.72	5.35	13.95	2.0
S1	0.58	0.55	0.68	0.72	0.69	0.47	0.41	0.30	0.26	0.26	0.17	0.13	0.72	1.5
S2	2.63	3.06	3.31	3.26	3.45	2.67	3.20	2.77	2.41	2.49	1.81	1.43	3.45	2.0
S3	3.65	4.04	4.53	4.71	4.94	3.79	4.13	3.64	3.16	3.26	2.33	1.84	4.94	2.0
MRID3	3.74	3.46	3.74	3.97	3.77	2.11	1.86	1.38	1.20	1.20	0.81	0.64	3.97	1.5
MRID2	11.23	10.41	11.17	11.82	11.25	6.21	5.53	4.12	3.60	3.60	2.43	1.93	11.82	1.5
Junc2	14.96	13.86	14.90	15.78	14.98	8.32	7.40	5.50	4.80	4.80	3.23	2.57	15.78	1.5
MRID1	11.07	10.26	10.93	11.54	10.96	6.02	5.35	4.01	3.50	3.51	2.38	1.89	11.54	1.5
Junc	3.65	4.04	4.53	4.71	4.94	3.79	4.13	3.64	3.16	3.26	2.33	1.84	4.94	2.0
Dummy1														
MRIDBas	22.92	21.71	20.10	19.51	22.87	14.14	12.60	9.47	8.27	8.29	5.61	4.46	22.92	0.5
MRd	11.15	13.14	14.62	14.71	15.39	11.66	13.76	12.15	12.78	12.78	10.15	9.04	15.39	2.0
DSMRd														
Peak Inflow (m3/s)	22.92	21.71	20.10	19.51	22.87	14.14	12.60	9.47	8.27	8.29	5.61	4.46		
Peak Outflow (m3/s)	0.95	1.49	1.99	2.50	2.77	3.06	3.02	3.04	4.36	3.65	3.70	3.70		
Max Vol (m3)	24,608	29,296	32,260	34,928	36,197	37,511	37,362	37,457	42,881	40,043	40,252	40,268	42,881	
Max Stage (m)	3.08	3.66	4.03	4.37	4.52	4.69	4.67	4.68	5.36	5.01	5.03	5.03	5.36	

50% AEP ARR Edition 2019

Pervious Area Losses
Initial Burst Loss (mm) 28.5
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%		
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Critical Duration (hrs)
	15	20	25	30	45	60	90	120	180	270	360	540		
N5				0.00	0.00	0.00	0.08	0.31	0.67	0.88	1.03	0.90	1.03	6.0
N1				0.00	0.00	0.00	0.06	0.22	0.52	0.71	0.83	0.76	0.83	6.0
N2				0.00	0.00	0.00	0.10	0.36	0.73	0.97	1.14	1.02	1.14	6.0
S1				0.00	0.00	0.00	0.02	0.06	0.07	0.08	0.09	0.07	0.09	6.0
S2				0.00	0.00	0.00	0.05	0.18	0.34	0.46	0.54	0.49	0.54	6.0
S3				0.00	0.00	0.00	0.08	0.28	0.49	0.64	0.75	0.67	0.75	6.0
MRID3				0.00	0.00	0.00	0.02	0.07	0.15	0.20	0.24	0.21	0.24	6.0
MRID2a				0.00	0.00	0.00	0.04	0.14	0.32	0.44	0.52	0.48	0.52	6.0
Junc				0.00	0.00	0.00	0.14	0.48	0.94	1.27	1.50	1.34	1.50	6.0
MRID1				0.00	0.00	0.00	0.02	0.07	0.18	0.31	0.40	0.40	0.40	6.0
N3				0.00	0.00	0.00	0.02	0.08	0.16	0.20	0.23	0.19	0.23	6.0
N4				0.00	0.00	0.00	0.01	0.02	0.04	0.05	0.06	0.05	0.06	6.0
N34				0.00	0.00	0.00	0.03	0.11	0.20	0.25	0.29	0.24	0.29	6.0
MRd				0.00	0.00	0.00	0.29	1.00	1.99	2.72	3.23	2.91	3.23	6.0
MRID2b				0.00	0.00	0.00	0.04	0.12	0.17	0.20	0.23	0.19	0.23	6.0
DSMRd				0.00	0.00	0.00	0.40	1.35	2.64	3.62	4.26	3.82	4.26	6.0

20% AEP ARR Edition 2019

Pervious Area Losses
Initial Burst Loss (mm) 16
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Critical Duration (hrs)
	15	20	25	30	45	60	90	120	180	270	360	540		
N5				1.58	2.24	2.47	2.45	2.48	2.09	1.92	1.86	1.60	2.48	2.00
N1				1.16	1.67	1.92	2.03	2.00	1.75	1.59	1.56	1.33	2.03	1.50
N2				1.81	2.44	2.71	2.70	2.75	2.35	2.16	2.10	1.79	2.75	2.00
S1				0.24	0.25	0.25	0.20	0.23	0.16	0.15	0.15	0.11	0.25	0.75
S2				0.87	1.13	1.28	1.30	1.32	1.13	1.04	1.01	0.86	1.32	2.00
S3				1.37	1.69	1.84	1.76	1.84	1.53	1.42	1.36	1.15	1.84	1.00
MRID3				0.35	0.49	0.56	0.57	0.57	0.49	0.45	0.44	0.38	0.57	1.50
MRID2a				0.70	1.01	1.18	1.27	1.26	1.11	1.01	0.99	0.85	1.27	1.50
Junc				2.41	3.18	3.51	3.49	3.63	3.09	2.85	2.75	2.34	3.63	2.00
MRID1				0.38	0.55	0.68	0.85	0.95	0.93	0.87	0.85	0.75	0.95	2.00
N3				0.43	0.56	0.59	0.54	0.57	0.44	0.41	0.40	0.34	0.59	1.00
N4				0.12	0.15	0.15	0.14	0.15	0.11	0.11	0.10	0.09	0.15	1.00
N34				0.54	0.71	0.74	0.68	0.71	0.56	0.52	0.50	0.43	0.74	1.00
MRd				4.91	6.57	7.28	7.41	7.73	6.74	6.21	6.01	5.13	7.73	2.00
MRID2b				0.57	0.63	0.63	0.53	0.58	0.42	0.41	0.39	0.30	0.63	0.75
DSMRd				6.38	8.44	9.29	9.57	10.08	8.78	8.10	7.83	6.67	10.08	2.00

1% AEP ARR Edition 2019

Pervious Area Losses
Initial Burst Loss (mm) 10
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%		
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Critical Duration (hrs)
	15	20	25	30	45	60	90	120	180	270	360	540		
N5		6.69	7.59	7.90	7.93	7.35	6.02	5.92	4.77	3.93	4.07	3.34	7.93	0.75
N1		4.94	5.72	6.16	6.45	6.10	4.99	4.96	3.99	3.30	3.48	2.83	6.45	0.75
N2		7.34	8.05	8.33	8.55	8.09	6.72	6.61	5.33	4.39	4.64	3.77	8.55	0.75
S1		0.78	0.75	0.72	0.62	0.57	0.47	0.45	0.34	0.31	0.26	0.20	0.78	0.33
S2		3.46	3.80	3.97	4.11	3.90	3.25	3.20	2.58	2.12	2.26	1.83	4.11	0.75
S3		5.19	5.47	5.52	5.53	5.20	4.43	4.29	3.43	2.81	2.99	2.41	5.53	0.75
MRID3		1.47	1.69	1.79	1.84	1.73	1.41	1.40	1.13	0.93	0.97	0.79	1.84	0.75
MRID2a		2.98	3.47	3.78	4.04	3.85	3.17	3.15	2.53	2.11	2.23	1.81	4.04	0.75
Junc		9.51	10.37	10.73	11.11	10.62	8.80	8.68	6.98	5.79	6.13	4.98	11.11	0.75
MRID1		1.61	1.89	2.12	2.62	2.85	2.84	2.66	2.26	1.90	2.11	1.76	2.85	1.00
N3		1.75	1.86	1.81	1.74	1.59	1.32	1.28	1.00	0.84	0.84	0.69	1.86	0.42
N4		0.47	0.49	0.47	0.45	0.41	0.34	0.33	0.26	0.22	0.21	0.17	0.49	0.42
N34		2.22	2.34	2.28	2.18	2.00	1.66	1.60	1.26	1.06	1.05	0.86	2.34	0.42
MRd		19.10	21.12	22.07	23.32	22.57	19.03	18.68	15.16	12.72	13.67	11.07	23.32	0.75
MRID2b		2.02	1.93	1.85	1.66	1.52	1.29	1.19	0.93	0.82	0.74	0.57	2.02	0.33
DSMRd		23.47	25.85	27.09	29.14	28.71	24.47	24.04	19.53	16.60	17.77	14.37	29.14	0.75

0.5% AEP ARR Edition 2019

Pervious Area Losses
Initial Burst Loss (mm) 10
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%		
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Critical Duration (hrs)
	15	20	25	30	45	60	90	120	180	270	360	540		
N5	6.13	7.70	8.64	8.91	8.87	8.17	6.70	6.55	5.26	4.33	4.40		8.91	0.50
N1	4.50	5.70	6.55	7.00	7.25	6.81	5.56	5.50	4.42	3.64	3.76		7.25	0.75
N2	6.90	8.38	9.13	9.40	9.59	9.01	7.47	7.31	5.88	4.84	5.02		9.59	0.75
S1	0.87	0.86	0.82	0.79	0.69	0.62	0.52	0.49	0.37	0.34	0.28		0.87	0.25
S2	3.33	3.95	4.32	4.50	4.63	4.35	3.61	3.55	2.85	2.33	2.44		4.63	0.75
S3	5.10	5.87	6.16	6.20	6.19	5.81	4.92	4.76	3.78	3.10	3.23		6.20	0.50
MRID3	1.34	1.69	1.93	2.03	2.07	1.92	1.57	1.55	1.24	1.02	1.05		2.07	0.75
MRID2a	2.72	3.45	3.98	4.31	4.55	4.31	3.53	3.50	2.81	2.32	2.42		4.55	0.75
Junc	9.09	10.83	11.74	12.11	12.48	11.85	9.79	9.61	7.70	6.39	6.63		12.48	0.75
MRID1	1.46	1.86	2.18	2.45	3.01	3.25	3.17	2.96	2.49	2.10	2.29		3.25	1.00
N3	1.65	1.99	2.08	2.02	1.93	1.77	1.47	1.41	1.10	0.93	0.91		2.08	0.42
N4	0.45	0.53	0.54	0.52	0.50	0.45	0.38	0.36	0.28	0.24	0.23		0.54	0.42
N34	2.10	2.53	2.62	2.54	2.43	2.23	1.85	1.77	1.38	1.17	1.14		2.62	0.42
MRd	18.09	21.74	23.91	24.91	26.23	25.23	21.17	20.72	16.76	14.02	14.79		26.23	0.75
MRID2b	2.14	2.24	2.14	2.06	1.84	1.68	1.42	1.32	1.02	0.91	0.80		2.24	0.33
DSMRd	22.29	26.54	29.09	30.48	32.69	32.10	27.14	26.63	21.54	18.29	19.20		32.69	0.75

0.2% AEP ARR Edition 2019

Pervious Area Losses
Initial Burst Loss (mm) 10
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%		
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Critical Duration (hrs)
	15	20	25	30	45	60	90	120	180	270	360	540		
N5	7.62	9.46	10.42	10.57	10.37	9.51	7.82	7.57	6.03	5.02	5.03	4.14	10.57	0.50
N1	5.60	7.03	7.98	8.39	8.52	7.94	6.49	6.35	5.09	4.21	4.30	3.53	8.52	0.75
N2	8.48	10.17	10.94	11.15	11.26	10.48	8.70	8.44	6.76	5.60	5.73	4.68	11.26	0.75
S1	1.01	0.99	0.95	0.91	0.79	0.71	0.59	0.56	0.42	0.39	0.32	0.24	1.01	0.25
S2	4.07	4.79	5.21	5.38	5.46	5.08	4.21	4.10	3.29	2.69	2.79	2.27	5.46	0.75
S3	6.19	7.03	7.31	7.32	7.25	6.78	5.72	5.50	4.34	3.58	3.69	2.99	7.32	0.50
MRID3	1.67	2.08	2.34	2.42	2.42	2.24	1.83	1.78	1.43	1.18	1.20	0.99	2.42	0.75
MRID2a	3.38	4.26	4.87	5.19	5.36	5.04	4.11	4.04	3.24	2.69	2.76	2.26	5.36	0.75
Junc	11.14	13.09	14.05	14.41	14.67	13.82	11.40	11.11	8.85	7.39	7.58	6.17	14.67	0.75
MRID1	1.82	2.30	2.68	3.00	3.67	3.89	3.70	3.44	2.87	2.43	2.65	2.19	3.89	1.00
N3	2.03	2.40	2.46	2.37	2.25	2.06	1.71	1.63	1.26	1.08	1.04	0.84	2.46	0.42
N4	0.55	0.64	0.64	0.61	0.57	0.53	0.44	0.41	0.32	0.28	0.26	0.21	0.64	0.33
N34	2.59	3.04	3.09	2.98	2.82	2.59	2.15	2.04	1.58	1.35	1.30	1.06	3.09	0.42
MRd	22.10	26.26	28.64	29.62	30.86	29.52	24.66	23.98	19.29	16.23	16.92	13.72	30.86	0.75
MRID2b	2.54	2.59	2.49	2.39	2.12	1.93	1.63	1.51	1.16	1.05	0.91	0.70	2.59	0.33
DSMRd	26.96	31.76	34.53	36.06	38.33	37.56	31.43	30.70	24.76	21.14	21.92	17.79	38.33	0.75

PMF

Pervious Area Losses
Initial Burst Loss (mm) 1
Continuing (mm/h) 0

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)										
Subcatchment ID	Storm Burst Duration (mins)								Peak Flow (m3/s)	Critical Duration (hrs)
	15	30	45	60	90	120	180	240		
N5	73.12	74.86	70.52	64.53	54.98	47.72	38.47	33.27	74.86	0.50
N1	17.90	15.92	14.38	12.99	10.75	9.41	7.67	6.68	17.90	0.25
N2	4.61	4.02	3.60	3.23	2.68	2.35	1.92	1.68	4.61	0.25
S1	22.47	19.93	17.96	16.22	13.42	11.76	9.59	8.36	22.47	0.25
S2	61.31	65.23	60.94	56.90	48.67	42.42	33.96	29.28	65.23	0.50
S3	79.21	84.36	79.70	73.59	63.63	55.71	44.50	38.40	84.36	0.50
MRID3	6.49	5.00	4.25	3.77	3.21	2.85	2.30	1.95	6.49	0.25
MRID2a	40.08	41.76	39.21	36.51	31.30	27.37	21.86	18.86	41.76	0.50
Junc	53.21	53.35	50.28	46.91	40.30	35.22	28.06	24.35	53.35	0.50
MRID1	17.78	18.26	17.12	15.75	13.43	11.67	9.37	8.09	18.26	0.50
N3	38.13	41.66	39.36	36.81	31.53	27.63	22.07	19.02	41.66	0.50
N4	105.47	111.06	105.64	98.23	84.62	74.43	59.40	51.35	111.06	0.50
N34	22.50	32.72	36.38	35.30	32.09	29.70	24.43	20.80	36.38	0.75
MRd	203.74	230.73	232.52	218.69	191.71	170.54	136.93	117.68	232.52	0.75
MRID2b	17.40	14.04	12.11	10.65	8.97	7.99	6.51	5.59	17.40	0.25
DSMRd	221.49	270.18	290.87	278.52	248.24	222.83	180.15	154.27	290.87	0.75

50% AEP | ARR Edition 2019

Pervious Area Losses
Initial Burst Loss (mm) 28.5
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%		Critical
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Duration (hrs)
	15	20	25	30	45	60	90	120	180	270	360	540		
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

20% AEP | ARR Edition 2019

Pervious Area Losses
Initial Burst Loss (mm) 16
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		Critical
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Duration (hrs)
	15	20	25	30	45	60	90	120	180	270	360	540		
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
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
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
N3	0.20	0.36	0.50	0.58	0.69	0.70	0.61	0.65	0.49	0.47	0.45		0.70	1.00
N4	0.06	0.10	0.14	0.16	0.18	0.18	0.16	0.17	0.12	0.12	0.11		0.18	1.00
N34	1.75	3.02	3.97	4.56	5.69	5.98	5.57	5.88	4.76	4.41	4.22		5.98	1.00
S1	0.16	0.26	0.29	0.27	0.28	0.27	0.22	0.25	0.16	0.16	0.15		0.29	0.42
S2	0.46	0.80	1.03	1.17	1.49	1.61	1.51	1.58	1.27	1.17	1.13		1.61	1.00
S3	0.72	1.22	1.57	1.75	2.09	2.24	2.02	2.14	1.69	1.58	1.51		2.24	1.00
MRID3	2.44	2.44	2.28	2.21	1.89	1.78	1.39	1.50	0.86	0.78	0.74		2.58	0.17
MRID2	7.29	7.28	6.75	6.55	5.63	5.30	4.13	4.47	2.56	2.32	2.21		7.69	0.17
Junc2	9.72	9.71	9.00	8.74	7.51	7.04	5.51	5.95	3.42	3.10	2.95		10.27	0.17
MRID1	7.17	7.17	6.63	6.45	5.55	5.13	4.03	4.37	2.50	2.27	2.15		7.56	0.17
Junc	0.72	1.22	1.57	1.75	2.09	2.24	2.02	2.14	1.69	1.58	1.51		2.24	1.00
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	0.17
MRIDBas	14.25	14.22	13.47	12.79	12.04	10.17	8.07	8.22	5.88	5.32	5.06		15.58	0.17
MRd	14.25	14.25	13.59	12.91	12.36	12.20	11.16	11.20	8.85	8.25	7.95		15.58	0.17
DSMRd	14.51	14.69	14.18	13.74	13.76	14.97	13.66	14.09	11.09	10.39	10.00		15.62	0.17

1% AEP | ARR Edition 2019

Pervious Area Losses
Initial Burst Loss (mm) 10
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%		Critical
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Duration (hrs)
	15	20	25	30	45	60	90	120	180	270	360	540		
N5	7.57	9.21	9.72	9.47	9.07	8.32	6.90	6.66	5.22	4.40	4.36	3.56	9.72	0.42
N1	5.60	6.98	7.69	7.73	7.54	6.91	5.71	5.56	4.43	3.68	3.74	3.07	7.73	0.50
N2	13.07	15.11	16.10	16.04	15.88	14.73	12.23	11.97	9.42	7.94	8.01	6.52	16.10	0.42
N3	1.96	2.22	2.17	2.08	1.94	1.77	1.50	1.40	1.09	0.94	0.89	0.71	2.22	0.33
N4	0.52	0.58	0.56	0.54	0.49	0.45	0.38	0.36	0.28	0.24	0.22	0.18	0.58	0.33
N34	14.19	16.39	17.25	17.12	17.26	16.10	13.49	13.16	10.46	8.87	8.95	7.27	17.26	0.75
S1	0.86	0.85	0.80	0.77	0.66	0.59	0.49	0.48	0.35	0.33	0.27	0.20	0.86	0.25
S2	3.92	4.60	4.94	4.96	4.84	4.46	3.71	3.61	2.85	2.37	2.42	1.97	4.96	0.50
S3	5.77	6.49	6.66	6.58	6.37	5.90	4.97	4.79	3.78	3.14	3.18	2.57	6.66	0.42
MRID3	4.77	4.50	4.02	3.79	3.12	2.87	2.53	2.51	1.63	1.53	1.30	0.95	4.96	0.17
MRID2	14.12	13.38	11.97	11.29	9.27	8.51	7.51	7.48	4.86	4.54	3.90	2.86	14.64	0.17
Junc2	18.79	17.85	15.99	15.08	12.39	11.37	10.02	9.97	6.49	6.07	5.20	3.81	19.48	0.17
MRID1	13.85	13.07	11.70	11.03	9.03	8.30	7.35	7.33	4.74	4.42	3.81	2.79	14.43	0.17
Junc	5.77	6.49	6.66	6.58	6.37	5.90	4.97	4.79	3.78	3.14	3.18	2.57	6.66	0.42
Dummy1	0.00	0.09	0.57	0.92	0.51	0.43	0.04	0.19	0.00	0.00	0.00	0.00	0.92	0.50
MRIDBas	27.68	25.37	24.53	23.00	20.01	18.25	15.61	15.35	11.12	10.36	8.95	6.58	29.66	0.17
MRd	29.10	29.58	29.90	30.54	30.47	28.50	24.24	23.92	18.63	15.65	16.19	13.29	30.54	0.50
DSMRd	35.1274	37.8274	38.859	39.884	39.2056	36.4548	30.9279	30.3542	23.81	20.0078	20.5161	16.8469	39.88	0.50

0.5% AEP | ARR Edition 2019

Pervious Area Losses
Initial Burst Loss (mm) 10
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%		Critical
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Duration (hrs)
	15	20	25	30	45	60	90	120	180	270	360	540		
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	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	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	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	0.71	0.76	0.73	0.70	0.63	0.57	0.49	0.45	0.35	0.31			0.76	0.33
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	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	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	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	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	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	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	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	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	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	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	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	45.42	49.68	51.39	52.93	51.80	47.41	39.32	38.33	29.83	25.25			52.93	0.50

0.2% AEP | ARR Edition 2019

Pervious Area Losses
Initial Burst Loss (mm) 10
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%		Critical
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Duration (hrs)
	15	20	25	30	45	60	90	120	180	270	360	540		
N5	8.71	10.49	10.90	10.57	10.09	9.25	7.67	7.36	5.74				10.90	0.42
N1	6.47	8.01	8.69	8.65	8.41	7.70	6.36	6.17	4.88				8.69	0.42
N2	14.82	16.95	17.78	17.64	17.54	16.17	13.52	13.17	10.37				17.78	0.42
N3	2.23	2.49	2.42	2.32	2.14	1.97	1.66	1.54	1.20				2.49	0.33
N4	0.59	0.65	0.62	0.60	0.55	0.50	0.42	0.39	0.30				0.65	0.33
N34	16.06	17.82	18.26	18.31	18.41	17.27	14.70	14.39	11.50				18.41	0.75
S1	0.95	0.93	0.88	0.85	0.72	0.65	0.54	0.53	0.38				0.96	0.17
S2	4.47	5.23	5.56	5.57	5.41	4.97	4.13	3.99	3.14				5.57	0.50
S3	6.53	7.31	7.46	7.34	7.11	6.56	5.51	5.30	4.15				7.46	0.42
MRID3	5.18	4.89	4.38	4.13	3.41	3.13	2.76	2.73	1.77				5.38	0.17
MRID2	15.29	14.55	13.03	12.30	10.13	9.30	8.19	8.14	5.28				15.84	0.17
Junc2	20.39	19.42	17.40	16.42	13.53	12.42	10.93	10.86	7.05				21.16	0.17
MRID1	15.03	14.20	12.71	12.00	9.87	9.07	8.01	7.98	5.14				15.65	0.17
Junc	6.53	7.31	7.46	7.34	7.11	6.56	5.51	5.30	4.15				7.46	0.42
Dummy1	0.07	1.48	2.41	2.31	1.86	1.33	0.41	0.38	0.00				2.41	0.42
MRIDBas	30.00	27.57	26.68	25.04	21.86	19.93	17.03	16.71	12.07				32.12	0.17
MRd	31.80	32.72	33.12	34.00	33.91	31.75	26.76	26.26	20.42				34.00	0.50
DSMRd	38.87	42.16	43.29	44.39	43.56	40.44	34.12	33.39	26.15				44.39	0.50

PMF

Pervious Area Losses
Initial Burst Loss (mm) 1
Continuing (mm/h) 0

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)										Critical
Subcatchment ID	Storm Burst Duration (mins)								Peak Flow (m3/s)	Duration (hrs)
	15	30	45	60	90	120	180	240		
N5	73.12	74.86	70.52	64.53	54.98	47.72	38.47		74.86	0.5
N1	61.31	65.23	60.94	56.90	48.67	42.42	33.96		65.23	0.5
N2	84.15	89.30	84.64	78.53	68.57	60.65	49.44		89.30	0.5
N3	17.90	15.92	14.38	12.99	10.75	9.41	7.67		17.90	0.3
N4	4.61	4.02	3.60	3.23	2.68	2.35	1.92		4.61	0.3
N34	34.80	32.26	30.29	28.55	25.75	24.09	21.92		34.80	0.3
S1	6.49	5.00	4.25	3.77	3.21	2.85	2.30		6.49	0.3
S2	40.08	41.76	39.21	36.51	31.30	27.37	21.86		41.76	0.5
S3	53.21	53.35	50.28	46.91	40.30	35.22	28.06		53.35	0.5
MRID3	31.17	23.26	19.95	17.99	14.85	13.07	10.40		31.17	0.3
MRID2	91.73	68.41	59.25	53.59	44.15	38.76	31.06		91.73	0.3
Junc2	90.75	66.27	57.32	51.76	42.99	37.44	30.18		90.75	0.3
MRID1	53.21	53.35	50.28	46.91	40.30	35.22	28.06		53.35	0.5
Junc	122.90	91.67	79.20	71.57	59.01	51.83	41.46		122.90	0.3
Dummy1	119.65	125.02	117.64	108.06	91.44	78.59	60.23		125.02	0.5
MRIDBas	193.02	153.24	132.54	118.27	97.52	85.66	71.25		193.02	0.3
MRd	232.21	257.89	257.84	241.88	207.44	183.07	145.50		257.89	0.5
DSMRd	305.33	332.35	325.63	302.41	259.95	230.61	183.19		332.35	0.5

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
Initial Burst Loss (mm) 28.5
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	Peak Flow (m3/s)	Critical Duration (hrs)
Subcatchment ID	Storm Burst Duration (mins)													
	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
N1		0.00	0.00	0.00	0.00	0.00	0.09	0.32	0.66	0.85	0.99	0.85	0.99	6.0
N2		0.00	0.00	0.00	0.00	0.00	0.26	0.87	1.47	1.89	2.18	1.86	2.18	6.0
N3		0.00	0.00	0.00	0.00	0.00	0.03	0.12	0.19	0.23	0.26	0.22	0.26	6.0
N4		0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.06	0.07	0.06	0.07	6.0
N34		0.00	0.00	0.00	0.00	0.00	0.30	0.99	1.65	2.12	2.44	2.08	2.44	6.0
S1		0.00	0.00	0.00	0.00	0.00	0.03	0.07	0.08	0.08	0.09	0.07	0.09	6.0
S2		0.00	0.00	0.00	0.00	0.00	0.08	0.25	0.42	0.55	0.64	0.55	0.64	6.0
S3		0.00	0.00	0.00	0.00	0.00	0.12	0.38	0.59	0.76	0.87	0.74	0.87	6.0
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
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
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
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
Junc		0.00	0.00	0.00	0.00	0.00	0.12	0.38	0.59	0.76	0.87	0.74	0.87	6.0
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
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
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
Peak Inflow (m3/s)														
Peak Outflow (m3/s)														
Max Vol (m3)														
Max Stage (m)														

ARR Edition **2019**

Pervious Area Losses
Initial Burst Loss (mm) 28.5
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	Peak Flow (m3/s)	Critical Duration (hrs)
Subcatchment ID	Storm Burst Duration (mins)													
	15	20	25	30	45	60	90	120	180	270	360	540		
N5														
N1														
N2														
N3														
N4														
N34														
S1														
S2														
S3														
MRID3														
MRID2														
Junc2														
MRID1														
Junc														
Dummy														
MRIDBas														
MRd														
DSMRd														
Peak Inflow (m3/s)														
Peak Outflow (m3/s)														
Max Vol (m3)														
Max Stage (m)														

20% AEP **ARR Edition** **2019**

Pervious Area Losses
Initial Burst Loss (mm) 16
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	Peak Flow (m3/s)	Critical Duration (hrs)
Subcatchment ID	Storm Burst Duration (mins)													
	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
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
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
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
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
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
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
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
S3	0.00	0.00	0.00	0.06	0.56	0.99	1.26	1.48	1.39	1.31	1.38		1.48	2.0
MRID3	2.67	2.44	2.27	2.20	1.87	1.75	1.36	1.47	0.85	0.76	0.73		2.67	0.3
MRID2	7.88	7.27	6.74	6.52	5.59	5.21	4.06	4.39	2.53	2.26	2.17		7.88	0.3
Junc2	10.54	9.70	8.99	8.71	7.43	6.92	5.41	5.83	3.37	3.02	2.89		10.54	0.3
MRID1	7.78	7.16	6.62	6.43	5.51	5.07	3.97	4.31	2.47	2.22	2.12		7.78	0.3
Junc	0.00	0.00	0.00	0.06	0.56	0.99	1.26	1.48	1.39	1.31	1.38		1.48	2.0
Dummy														
MRIDBas	12.44	14.20	13.43	12.76	11.98	10.02	7.90	8.05	5.81	5.21	4.99		14.20	0.3
MRd	0.54	0.60	0.63	0.81	2.13	3.27	4.33	5.33	5.60	5.62	6.08		6.08	6.0
DSMRd	0.54	0.60	0.63	0.87	2.69	4.27	5.73	6.99	7.23	7.21	7.73		7.73	6.0
Peak Inflow (m3/s)														
Peak Outflow (m3/s)														
Max Vol (m3)														
Max Stage (m)														

ARR Edition **2019**

Pervious Area Losses
Initial Burst Loss (mm) 16
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	Peak Flow (m3/s)	Critical Duration (hrs)
Subcatchment ID	Storm Burst Duration (mins)													
	15	20	25	30	45	60	90	120	180	270	360	540		
N5														
N1														
N2														
N3														
N4														
N34														
S1														
S2														
S3														
MRID3														
MRID2														
Junc2														
MRID1														
Junc														
Dummy														
MRIDBas														
MRd														
DSMRd														
Peak Inflow (m3/s)														
Peak Outflow (m3/s)														
Max Vol (m3)														
Max Stage (m)														

1% AEP **ARR Edition** **2019**

Pervious Area Losses
Initial Burst Loss (mm) 10
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

AEP	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	Peak Flow (m3/s)	Critical Duration (hrs)
Subcatchment ID	Storm Burst Duration (mins)													
	15	20	25	30	45	60	90	120	180	270	360	540		
N5		9.21	9.72	9.47	9.07	8.32	6.90	6.66	5.22	4.40	4.36	3.56	9.72	0.42
N1		6.98	7.69	7.73	7.54	6.91	5.71	5.56	4.43	3.68	3.74	3.07	7.73	0.50
N2		15.11	16.10	16.04	15.88	14.73	12.23	11.97	9.42	7.94	8.01	6.52	16.10	0.42
N3		2.22	2.17	2.08	1.94	1.77	1.50	1.40	1.09	0.94	0.89	0.71	2.22	0.33
N4		0.58	0.56	0.54	0.49	0.45	0.38	0.36	0.28	0.24	0.22	0.18	0.58	0.33
N34		16.39	17.25	17.12	17.26	16.10	13.49	13.16	10.46	8.87	8.95	7.27	17.26	0.75
S1		0.85	0.80	0.77	0.66	0.59	0.49	0.48	0.35	0.33	0.27	0.20	0.85	0.33
S2		4.60	4.94	4.96	4.84	4.46	3.71	3.61	2.85	2.37	2.42	1.97	4.96	0.50
S3		6.49	6.66	6.58	6.37	5.90	4.97	4.79	3.78	3.14	3.18	2.57	6.66	0.42
MRID3		4.50	4.02	3.79	3.12	2.87	2.53	2.51	1.63	1.53	1.30	0.95	4.50	0.33
MRID2		13.38	11.97	11.29	9.27	8.51	7.51	7.48	4.86	4.54	3.90	2.86	13.38	0.33
Junc2		17.85	15.99	15.08	12.39	11.37	10.02	9.97	6.49	6.07	5.20	3.81	17.85	0.33
MRID1		13.07	11.70	11.03	9.03	8.30	7.35	7.33	4.74	4.42	3.81	2.79	13.07	0.33
Junc		6.49	6.66	6.58	6.37	5.90	4.97	4.79	3.78	3.14	3.18	2.57	6.66	0.42
Dummy		0.09	0.57	0.92	0.51	0.43	0.04	0.19	0.00	0.00	0.00	0.00	0.92	0.50
MRIDBas		25.37	24.53	23.00	20.01	18.25	15.61	15.35	11.12	10.36	8.95	6.58	25.37	0.33
MRd		17.91	20.54	21.59	22.89	21.87	18.65	19.50	15.73	13.35	15.03	12.10	22.89	0.75
DSMRd		23.31	26.56	28.09	29.42	28.31	23.83	24.82	19.86	16.89	18.95	15.29	29.42	0.75
Peak Inflow (m3/s)														
Peak Outflow (m3/s)														
Max Vol (m3)														
Max Stage (m)														

ARR Edition **2019**

Pervious Area Losses
Initial Burst Loss (mm) 10
Continuing (mm/h) 2.3

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.3
Roughness 0.025

ARI (yrs)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	Peak Flow (m3/s)	Critical Duration (hrs)
Subcatchment ID	Storm Burst Duration (mins)													
	15	30	45	60	90	120	180	240						
N5														
N1														
N2														
N3														
N4														
N34														
S1														
S2														
S3														
MRID3														
MRID2														
Junc2														
MRID1														
Junc														
Dummy														
MRIDBas														
MRd														
DSMRd														
Peak Inflow (m3/s)														
Peak Outflow (m3/s)														
Max Vol (m3)														
Max Stage (m)														

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 — Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5
Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs)	2	2	2	2	2	2	2	2	2	2	2	2		Critical
	Storm Burst Duration (mins)												Peak Flow	Duration
Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	(m3/s)	(hrs)
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
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
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
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
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
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
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
S2	0.33	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
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
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
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
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
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
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
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
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
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
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
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
MRd	1.90	3.34	4.15	4.57	4.89	4.78	4.93	5.45	6.23	6.01	4.74	4.00	6.23	9.0
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
Peak Inflow (m3/s)	1.89	1.59	2.32	2.22	2.15	1.49	1.33	1.14	1.38	1.49	1.11	0.94		
Peak Outflow (m3/s)	0.22	0.31	0.39	0.48	0.53	0.55	0.55	0.64	0.93	0.77	0.84	0.73		
Max Vol (m3)	2,224	2,712	3,116	3,681	4,091	4,561	4,778	4,969	5,496	5,179	5,313	5,109	5,496	
Max Stage (m)	0.28	0.34	0.39	0.46	0.51	0.57	0.60	0.62	0.69	0.65	0.66	0.64	1	

5 yr ARI **ARR Edition** **1987**

Pervious Area Losses — Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5
Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs)	5	5	5	5	5	5	5	5	5	5	5	5		Critical
	Storm Burst Duration (mins)												Peak Flow	Duration
Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	(m3/s)	(hrs)
N5	1.58	2.32	2.71	2.73	2.88	2.48	3.06	2.73	2.56	2.66	1.89	1.47	3.06	4.5
N1	1.17	1.81	2.13	2.23	2.37	2.14	2.41	2.27	2.19	2.27	1.66	1.30	2.41	4.5
N2	3.24	4.57	5.35	5.44	5.68	4.95	5.86	5.42	5.28	5.41	3.95	3.11	5.86	2.0
N3	0.41	0.55	0.63	0.64	0.66	0.50	0.68	0.60	0.54	0.55	0.37	0.28	0.68	4.5
N4	0.11	0.14	0.16	0.17	0.18	0.13	0.17	0.15	0.14	0.14	0.09	0.07	0.18	2.0
N34	3.55	4.94	5.81	6.00	6.32	5.42	6.35	5.99	5.84	5.81	4.35	3.46	6.35	
S1	0.20	0.22	0.29	0.34	0.36	0.25	0.24	0.18	0.16	0.16	0.10	0.08	0.36	2.0
S2	0.81	1.16	1.32	1.35	1.46	1.34	1.52	1.42	1.39	1.46	1.07	0.84	1.52	4.5
S3	1.26	1.63	1.88	1.92	2.11	1.72	2.08	1.85	1.83	1.93	1.38	1.08	2.11	2.0
MRID3	0.30	0.47	0.55	0.57	0.59	0.53	0.63	0.57	0.54	0.57	0.41	0.32	0.63	4.5
MRID2a	0.17	0.27	0.37	0.46	0.52	0.51	0.49	0.58	0.64	0.60	0.51	0.45	0.64	9.0
MRID2b	0.45	0.72	0.89	1.00	1.05	0.98	1.01	1.12	1.10	1.11	0.86	0.70	1.12	6.0
Junc2	3.24	4.57	5.35	5.44	5.68	4.95	5.86	5.42	5.28	5.41	3.95	3.11	5.86	4.5
MRID1	2.62	2.19	3.15	3.00	2.91	2.08	1.90	1.75	1.89	2.06	1.52	1.28	3.15	1.0
MRID1b	1.45	1.28	1.38	1.47	1.37	0.77	0.69	0.53	0.52	0.53	0.37	0.30	1.47	1.5
Junc1	1.55	2.09	2.44	2.48	2.67	2.21	2.67	2.42	2.37	2.43	1.77	1.40	2.67	2.0
Stage1	0.37	0.50	0.55	0.86	0.98	1.08	1.08	1.14	1.38	1.18	1.21	1.13	1.38	9.0
Node6	0.63	0.99	1.25	1.40	1.52	1.46	1.44	1.67	1.74	1.70	1.36	1.14	1.74	9.0
MRIDBas	2.62	2.19	3.15	3.00	2.91	2.08	1.90	1.75	1.89	2.06	1.52	1.28	3.15	1.0
MRd	4.55	6.38	7.47	7.65	8.07	7.52	8.23	8.29	8.71	8.70	6.86	5.71	8.71	9.0
DSMRd	5.79	7.95	9.64	10.12	10.66	9.47	10.51	10.57	11.05	10.50	8.50	7.16	11.05	6.0
Peak Inflow (m3/s)	2.61	2.19	3.15	3.00	2.91	2.08	1.90	1.75	1.89	2.06	1.52	1.28		
Peak Outflow (m3/s)	0.37	0.50	0.55	0.85	0.98	1.08	1.08	1.14	1.38	1.18	1.21	1.13		
Max Vol (m3)	3,051	3,837	4,589	5,347	5,618	5,868	5,860	6,026	6,738	6,136	6,215	5,985	6,738	
Max Stage (m)	0.38	0.48	0.57	0.67	0.70	0.73	0.73	0.75	0.84	0.77	0.78	0.75	1	

100 yr ARI **ARR Edition** **1987**

Pervious Area Losses — Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5
Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs)	100	100	100	100	100	100	100	100	100	100	100	100		Critical
	Storm Burst Duration (mins)												Peak Flow	Duration
Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	(m3/s)	(hrs)
N5	5.34	6.05	6.68	6.60	6.95	5.30	5.93	5.11	4.36	4.49	3.17	2.49	6.95	2.0
N1	4.04	4.91	5.33	5.27	5.37	4.20	5.06	4.30	3.70	3.84	2.80	2.22	5.37	2.0
N2	9.16	10.50	11.62	11.75	12.33	9.38	10.70	9.27	8.06	8.21	5.99	4.75	12.33	2.0
N3	1.23	1.35	1.55	1.53	1.65	1.26	1.22	1.04	0.90	0.91	0.61	0.48	1.65	2.0
N4	0.31	0.34	0.39	0.39	0.42	0.32	0.31	0.26	0.22	0.22	0.15	0.12	0.42	2.0
N34	10.20	11.77	13.17	13.29	13.95	10.64	11.93	10.41	9.07	9.13	6.72	5.35	13.95	2.0
S1	0.58	0.55	0.68	0.72	0.69	0.47	0.41	0.30	0.26	0.26	0.17	0.13	0.72	1.5
S2	2.63	3.06	3.31	3.26	3.45	2.67	3.20	2.77	2.41	2.49	1.81	1.43	3.45	2.0
S3	3.65	4.04	4.53	4.71	4.94	3.79	4.13	3.64	3.16	3.26	2.33	1.84	4.94	2.0
MRID3	3.32	3.08	3.33	3.56	3.35	1.88	1.66	1.22	1.07	1.07	0.72	0.57	3.56	1.5
MRID2	11.66	10.79	11.57	12.26	11.68	6.45	5.74	4.28	3.74	3.74	2.53	2.00	12.26	1.5
Junc2	14.98	13.85	14.88	15.77	15.00	8.33	7.40	5.50	4.80	4.80	3.24	2.57	15.77	1.5
MRID1	10.06	9.29	9.91	10.47	9.98	5.48	4.88	3.66	3.20	3.21	2.18	1.73	10.47	1.5
Junc	3.65	4.04	4.53	4.71	4.94	3.79	4.13	3.64	3.16	3.26	2.33	1.84	4.94	2.0
Stage 1	1.11	1.52	1.78	2.00	2.10	2.10	2.04	2.14	2.27	2.07	2.01	1.88	2.27	9.0
MRIDBas	4.68	4.17	5.48	5.27	5.06	3.84	3.75	3.44	3.23	3.47	2.59	2.16	5.48	1.0
MRd	14.12	16.89	18.72	18.81	19.52	15.39	17.92	16.09	14.84	14.87	11.60	9.71	19.52	2.0
DSMRd	17.12	20.52	23.44	23.66	24.72	19.86	21.83	20.31	18.74	17.92	14.49	12.19	24.72	2.0
Peak Inflow (m3/s)	4.68	4.17	5.48	5.27	5.06	3.84	3.75	3.44	3.23	3.47	2.59	2.16		
Peak Outflow (m3/s)	1.11	1.52	1.78	2.00	2.10	2.10	2.04	2.14	2.27	2.07	2.01	1.88		
Max Vol (m3)	5,950	7,208	8,231	9,232	9,699	9,721	9,442	9,918	10,572	9,565	9,268	8,667	10,572	
Max Stage (m)	0.74	0.90	1.03	1.15	1.21	1.22	1.18	1.24	1.32	1.20	1.16	1.08	1	

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

200 yr ARI **ARR Edition** **1987**

Pervious Area Losses — Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5
Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs)	2	2	2	2	2	2	2	2	2	2	2	2		Critical
	Storm Burst Duration (mins)												Peak Flow	Duration
Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	(m3/s)	(hrs)
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	4.91	5.69	6.23	6.12	6.32	4.92	5.68	4.87	4.13	4.29	3.12	2.47	6.32	2.0
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	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	0.37	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	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	0.70	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	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	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	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	0.80	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	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	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	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	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	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	1.35	1.75	2.01	2.23	2.33	2.32	2.27	2.36	2.46	2.25	2.20	2.06	2.46	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	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	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	20.25	24.02	27.01	27.22	28.46	22.94	24.69	22.76	20.78	19.83	16.13	13.58	28.46	2.0
Peak Inflow (m3/s)	5.30	4.72	6.13	5.91	5.67	4.37	4.32	3.95	3.61	3.88	2.90	2.40		
Peak Outflow (m3/s)	1.35	1.75	2.01	2.23	2.33	2.32	2.26	2.36	2.46	2.25	2.20	2.06		
Max Vol (m3)	6,631	8,124	9,254	10,371	10,912	10,892	10,570	11,106	11,668	10,507	10,248	9,529	11,668	
Max Stage (m)	0.83	1.02	1.16	1.30	1.36	1.36	1.32	1.39	1.46	1.31	1.28	1.19	1.46	

500 yr ARI **ARR Edition** **1987**

Pervious Area Losses — Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5
Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs)	2	2	2	2	2	2	2	2	2	2	2	2		Critical
	Storm Burst Duration (mins)												Peak Flow	Duration
Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	(m3/s)	(hrs)
N5	7.64	8.41	9.35	9.20	9.80	7.57	7.56	6.51	5.60	5.71	4.01	3.18	9.80	2.0
N1	6.04	6.78	7.45	7.37	7.70	5.93	6.51	5.57	4.76	4.94	3.55	2.82	7.70	2.0
N2	14.63	16.07	17.98	18.17	19.14	14.64	15.43	13.15	11.38	11.59	8.46	6.75	19.14	2.0
N3	1.75	1.88	2.10	2.17	2.30	1.77	1.56	1.31	1.14	1.14	0.78	0.61	2.30	2.0
N4	0.45	0.48	0.54	0.57	0.60	0.45	0.39	0.33	0.28	0.28	0.19	0.15	0.60	4.5
N34	15.55	17.26	19.48	19.60	20.63	15.94	16.66	14.44	12.55	12.46	9.32	7.51	20.63	2.0
S1	0.87	0.77	0.89	0.92	0.87	0.58	0.51	0.37	0.32	0.32	0.22	0.17	0.92	1.5
S2	3.72	4.20	4.59	4.60	4.95	3.78	4.14	3.55	3.06	3.15	2.29	1.82	4.95	2.0
S3	5.03	5.51	6.17	6.49	6.86	5.22	5.32	4.66	4.00	4.12	2.95	2.35	6.86	2.0
MRID3	1.58	1.75	1.93	1.90	2.03	1.55	1.62	1.39	1.19	1.23	0.87	0.69	2.03	2.0
MRID2a	1.02	1.38	1.56	1.65	1.72	1.55	1.56	1.57	1.45	1.41	1.15	0.99	1.72	2.0
MRID2b	2.44	3.01	3.29	3.24	3.30	2.76	3.16	2.71	2.39	2.46	1.88	1.51	3.30	2.0
Junc2	14.63	16.07	17.98	18.17	19.14	14.63	15.43	13.15	11.38	11.59	8.46	6.75	19.14	12.0
MRID1	6.10	5.50	7.03	6.81	6.52	5.07	5.06	4.62	4.14	4.42	3.31	2.74	7.03	1.0
MRID1b	2.85	2.61	2.85	3.03	2.85	1.63	1.47	1.18	1.05	1.08	0.77	0.63	3.03	1.5
Junc1	6.60	7.16	8.04	8.38	8.83	6.74	6.91	5.97	5.17	5.18	3.81	3.04	8.83	2.0
Stage1	1.62	2.04	2.30	2.53	2.62	2.61	2.55	2.65	2.72	2.49	2.46	2.31	2.72	9.0
Node6	3.44	4.34	4.72	4.72	4.88	4.23	4.65	4.16	3.77	3.85	3.02	2.50	4.88	2.0
MRIDBas	6.10	5.50	7.03	6.81	6.52	5.07	5.06	4.62	4.14	4.42	3.31	2.74	7.03	1.0
MRd	20.40	23.18	25.68	25.95	27.06	21.31	23.34	20.67	18.70	18.75	14.66	12.29	27.06	2.0
DSMRd	24.32	28.47	31.80	32.08	33.05	27.00	28.60	26.00	23.56	22.50	18.36	15.46	33.05	2.0
Peak Inflow (m3/s)	6.10	5.50	7.03	6.81	6.51	5.07	5.06	4.62	4.14	4.42	3.31	2.74		
Peak Outflow (m3/s)	1.62	2.04	2.30	2.52	2.62	2.61	2.55	2.65	2.72	2.49	2.46	2.30		
Max Vol (m3)	7,601	9,413	10,747	12,048	12,656	12,562	12,185	12,805	13,255	11,815	11,671	10,787	13,255	
Max Stage (m)	0.95	1.18	1.34	1.51	1.58	1.57	1.52	1.60	1.66	1.48	1.46	1.35	1.66	

PMF **ARR Edition** **1987**

Pervious Area Losses — Initial Burst Loss (mm) 15; Continuing (mm/h) 1.5
Source: 2012 Upper South Creek Flood Study (WMAwater); BX 1.3; Roughness 0.025

ARI (yrs)	2	2	2	2	2	2	2	2	2	2	2	2		Critical
	Storm Burst Duration (mins)												Peak Flow	Duration
Subcatchment ID	30	45	60	90	120	180	270	360	540	720	1440	2160	(m3/s)	(hrs)
N5	73.12	74.86	70.52	64.53	54.98	47.72	38.47	33.27					74.86	0.5
N1	57.08	63.58	60.10	56.18	48.31	42.23	33.73	29.08					63.58	0.5
N2	126.85	143.95	139.52	129.78	112.77	100.48	80.09	69.16					143.95	0.5
N3	17.07	15.58	14.27	12.89	10.69	9.35	7.62	6.65					17.07	0.3
N4	4.37	3.91	3.56	3.21	2.66	2.33	1.91	1.67					4.37	0.3
N34	129.52	149.94	149.98	142.01	124.17	111.27	89.10	76.77					149.98	0.8
S1	6.34	4.98	4.23	3.75	3.20	2.84	2.29	1.94					6.34	0.3
S2	37.34	40.66	38.62	35.98	31.02	27.26	21.71	18.71					40.66	0.5
S3	50.01	52.03	49.32	46.36	39.94	35.09	27.88	24.11					52.03	0.5
MRID3	15.26	15.95	14.96	13.90	11.87	10.32	8.28	7.15					15.95	0.5
MRID2a	9.89	15.19	16.97	16.60	15.14	14.05	11.55	9.85					16.97	0.8
MRID2b	23.89	30.20	29.92	28.20	25.10	22.42	17.88	15.27					30.20	0.5
Junc2	126.85	143.95	139.52	129.78	112.77	100.48	80.09	69.16					143.95	0.5
MRID1	43.14	47.12	48.27	45.95	43.11	39.01	31.64	26.83					48.27	0.8
MRID1b	18.53	13.42	11.99	11.48	10.15	8.95	7.14	6.04					18.53	0.3
Junc1	61.03	65.19	63.04	59.08	51.33	45.21	36.03	31.17					65.19	0.5
Stage1	18.51	31.85	38.63	40.14	37.98	35.46	30.04	26.26					40.14	1.0
Node6	33.36	43.97	45.60	43.40	39.63	35.64	29.32	24.88					45.60	0.8
MRIDBas	43.14	47.12	48.27	45.95	43.11	39.01	31.64	26.83					48.27	0.8
MRd	180.44	222.47	231.98	222.76	200.38	181.14	146.70	125.74					231.98	0.8
DSMRd	192.51	246.93	273.61	272.29	245.42	224.91	183.19	157.24					273.61	0.8
Peak Inflow (m3/s)	43.14	47.12	48.27	45.95	43.11	39.01	31.64	26.83						
Peak Outflow (m3/s)	18.51	31.85	38.63	40.14	37.98	35.46	30.04	26.26						
Max Vol (m3)	33,743	42,225	46,020	46,831	45,667	44,277	41,164	38,874						
Max Stage (m)	4.22	5.28	5.75	5.85	5.71	5.53	5.15	4.86						