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Project/File: 304600135

The NSW Planning Manager
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Attention: Grace Macdonald
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RESPONSES TO SYDNEY WATER COMMENTS ON THE STAGE 2 FLOOD IMPACT ASSESSMENT, WESTLINK INDUSTRIAL ESTATE AT 290-308 ALDINGTON ROAD, 59-62 ABBOTTS ROAD & 63 ABBOTTS ROAD, KEMPS CREEK

Dear Grace,

Sydney Water has provided a number of comments on the collective flood impact of Stage 1 and Stage 2 of the Masterplan for the proposed development of 290-308 Aldington Road, 59-62 Abbotts Road, and 63 Abbotts Road, Kemps Creek detailed in the Flood Impact Assessment prepared by Stantec and dated 30 October 2023. Additional information is provided in response to these comments as follows.

1. BACKGROUND

1.1 2022 Flood Risk Assessment (FRA)

The 2022 Flood Risk Assessment[1] provided a high-level understanding of the opportunities and constraints of the site due to flooding based on an assessment of flooding under pre-development conditions on 290-308 Aldington Road, 59-62 Abbotts Road, and 63 Abbotts Road, Kemps Creek.

Hydrology

The 2015 South Creek flood study identified the critical storm burst duration for mainstream flooding in South Creek downstream of Bringelly Road to be 36 hours and for the lower reach of Kemps Creek up to 600 m downstream of Elizabeth drive. 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.

[1] Cardno now Stantec (2022) "Flood Risk Assessment, Westlink Industrial Estate, 290-308 Aldington Road, Kemps Creek", Draft Final Report, prepared for ESR Investment Management 1 Pty Ltd, September, 26 pp + Apps

The hydrological model assembled by WorleyParsons in 2015 and updated by Advisian in 2020 was based on ARR1987 IFD. Consequently, a local hydrological model was created to assess runoff under benchmark conditions based on ARR1987 IFD.

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

Design rainfall and storm burst patterns were obtained from ARR1987 for 20 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 20 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.

Hydraulics

A local TUFLOW model of the drainage lines through the site was assembled. The Digital Elevation Model (DEM) was created by combining available survey and ALS data.

The roughness zones for the floodplain are mapped in Figure 8 in Cardno now Stantec, 2022.

Existing local drainage crossings of Mamre Road were also included in the floodplain model based on supplied survey.

Inflows to the TUFLOW model were exported from the hydrological model and input at the locations of the subcatchment outlets (nodes). The downstream boundary condition was a free outfall. The flood extent in South Creek was overlaid over the results of the local TUFLOW model to identify where mainstream flooding takes over from overland flows.

The TUFLOW floodplain model was run for the critical storm burst durations for the 20 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.

1.2 2023 Flood Impact Assessment (FIA)

The aim of the 2023 Flood Impact Assessment report[2] was to evaluate the collective flood impact of Stage 1 and Stage 2 of the Masterplan for the proposed development of 290-308 Aldington Road, 59-62 Abbotts Road, and 63 Abbotts Road, Kemps Creek. The report will mainly focus on the flood impact of Stage 2 design modification, while maintaining the stage 1 approved earthwork and pipe arrangement.

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[2] Stantec (2023) "Flood Impact Assessment, Westlink Industrial Estate – Stage 2, 290-308 Aldington Road, Kemps Creek", Final Report Updated, Version 3, prepared for ESR Investment Management 1 Pty Ltd, October, 21 pp + Apps

Hydrology

The local hydrological model created to assess runoff under Benchmark Conditions was adjusted to represent Stage 1 and Stage 2 Conditions. The adopted imperviousness for the proposed development was 90%.

The approach proposed by AT&L to mitigate the impact of the Stage 1 and Stage 2 development is to construct one basin in Stage 1 and in Stage 2 to install On-Site Detention systems to limit peak flows to no greater than peak flows under Benchmark Conditions.

The results of the ARR1987 hydrological modelling of Stage 1 and Stage 2 Conditions without basins are summarised in Appendix B in Stantec, 2023.

Hydraulics

The DEM as updated based on the proposed platform levels, proposed roadworks, drainage network, basin and swales under Stage 2 Modification as provided by AT&L

The basins were included in the TUFLOW model as was all pipe drainage lines. Benchmark conditions were adopted external to the Stage 1 and Stage 2 development.

The TUFLOW floodplain model was run for the critical storm burst durations for the 20yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events. Flood levels and extent, depths, velocities and hazards under Stage 1 and Stage 2 Conditions were plotted for each of these events.

1.3 2024 Flood Impact Risk Assessment (FIRA)

The purpose of the 2024 Flood Impact Risk Assessment[3] was to provide a high-level understanding of the flooding in the vicinity of the Mamre Road – Abbotts Road intersection and to assess the impact of the proposed intersection upgrade to inform the preparation of a Statement of Environmental Effects for the proposed Mamre Road - Abbotts Road intersection upgrade (MAIU).

Hydrology

- A rain on grid modelling approach was adopted.
- Design rainfall and storm burst patterns were obtained from ARR1987 for 20 yr ARI, 100 yr ARI and 200 yr ARI events.
- For the 20 yr ARI, 100 yr ARI and 200 yr ARI events the adopted initial rainfall loss = 37.1 mm and continuing rainfall loss = 0.94 mm/h.

[3] Stantec (2024) "Flood Impact Risk Assessment, Mamre Road – Abborrs Road Intersection Upgrade, Kemps Creek", Final Report, Version 3, prepared for ESR Investment Management 1 Pty Ltd, Stockland Fife Kemps Creek Pty Ltd, Fife Land 3 Pty Ltd, Australand C&I Land Holdings Pty Lt, March, 35 pp + Apps

- Guided by the sensitivity assessment summarised in Appendix B in Stantec, 2024, a 9 hour critical storm burst duration was adopted for assessment purposes.

Hydraulics

Benchmark Conditions

- A local TUFLOW model of the wider study area was assembled. The Digital Elevation Model (DEM) was created by combining available survey and ALS data adopted for assessment of several proposed development sites adjacent to Mamre Road and Aldington Road.
- The roughness zones for the study area under Benchmark Conditions are mapped in **Figure 7**.
- Existing local drainage crossings of Mamre Road, Abbotts Road and Aldington Road were also included in the floodplain model based on supplied survey and/or details provided by AT&L.
- Separate to this project AT&L undertook a cross-drainage hydraulic assessment for the Mamre Road Upgrade Stage 2 (MRUS2) Strategic Design. This assessment considered potential blockage of cross drainage based on the ARR2019 guidelines and a TfNSW blockage scenario. Based on the outcomes of this assessment AT&L advised that cross drainage should be blocked as follows:
  - 25% blockage for RCP diameters / culvert widths < 1500 mm (width per pipe / per culvert)
  - 0% blockage for RCP diameters / culvert widths >= 1500 mm (width per pipe / per culvert)
- The downstream boundary condition was a free outfall. The flood extent in South Creek was overlaid over the results of the local TUFLOW model to identify where mainstream flooding takes over from overland flows.

Flood levels and extent, depths, velocities and hazards under Benchmark Conditions are plotted for the 20yr ARI, 100 yr ARI, and 200 yr ARI events.

Future Conditions

- Future Conditions was based on the proposed MAIU the roadworks, swales and cross drainage combined with the Westlink Industrial Estate Stage 1 works as approved in SSD 9138102 determined 21/04/2023.
- The DEM as updated based on the MAIU earthworks, swales and road grading and the Westlink Industrial Estate Stage 1 works both as provided by AT&L.
- The roughness zones for the study area under Future Conditions are mapped in Figure 9 in Stantec, 2024.
- The proposed drainage crossings in the vicinity of the Mamre Road and Abbotts Road intersection were also included in the floodplain model based on details provided by AT&L.
- Consistent with the conduit blockage adopted under Benchmark Conditions, the proposed cross drainage was blocked as follows:
  - 25% blockage for RCP diameters / culvert widths < 1500 mm (width per pipe / per culvert)
  - 0% blockage for RCP diameters / culvert widths >= 1500 mm (width per pipe / per culvert)

- The downstream boundary condition was a free outfall. The flood extent in South Creek was overlaid over the results of the local TUFLOW model to identify where mainstream flooding takes over from overland flows.
- The TUFLOW floodplain model was run for the 9 hour storm burst duration.

Flood levels and extent, depths, velocities and hazards under Future Conditions were plotted for the 20yr ARI, 100 yr ARI, and 200 yr ARI events.

2. FLOOD RISK ASSESSMENT (FRA) UPDATE

Given that the proposed upgrade of the Mamre Road – Abbotts Road intersection including regrading of Mamre Road and upgrades of Mamre Road cross drainage north and south of the intersection , ESR requested that Benchmark Conditions be updated to include Mamre Road - Abbotts Road intersection upgrade (MAIU) works and for Benchmark Conditions to be re-assessed.

Hydrology

- The 2022 hydrological model of benchmark conditions was retained.
- Design rainfall and storm burst patterns were obtained from ARR1987 for 2 yr ARI, 20 yr ARI, 100 yr ARI and 200 yr ARI events.
- The 2022 rainfall losses were retained, namely 2 yr ARI, 20 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.
- The adopted PMF rainfall losses were an initial loss = 1 mm and a continuing loss = 0 mm/h.
- The local hydrological model was run to provide local inflow hydrographs for the TUFLOW model for the 2 yr ARI, 20 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI and PMF events.

Hydraulics

- The 2022 local TUFLOW model was updated.
- The terrain was updated to include the MAIU works including the regrading of Mamre Road and Abbotts Road and the upgrades of Mamre Road cross drainage north and south of the intersection.
- Separate to this project AT&L undertook a cross-drainage hydraulic assessment for the Mamre Road Upgrade Stage 2 (MRUS2) Strategic Design. Based on the outcomes of this assessment AT&L advised that cross drainage should be blocked as follows:
  - 25% blockage for RCP diameters / culvert widths < 1500 mm (width per pipe / per culvert)
  - 0% blockage for RCP diameters / culvert widths >= 1500 mm (width per pipe / per culvert)
- The roughness zones for the floodplain are mapped in Figure 8 in Cardno now Stantec, 2022.
- Inflows to the TUFLOW model were exported from the hydrological model and input at the locations of the subcatchment outlets (nodes).
- The downstream boundary condition was a free outfall.
- The flood extent in South Creek was overlaid over the results of the local TUFLOW model to identify where mainstream flooding takes over from overland flows.

Updated flood levels and extent, depths, velocities and hazards categories under Benchmark Conditions are plotted for the 2 yr ARI, 20 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events in **Figures E1** to **E24** (see **Appendix A**)

3. FLOOD IMPACT ASSESSMENT (FIA) UPDATE

Given the inclusion of the MAIU works in the benchmark conditions, ESR requested that the Stage 1 and Stage 2 Conditions also be re-assessed.

Hydrology

- The 2023 hydrological model of Stage 1 and Stage 2 conditions was updated based on the revised subcatchment boundaries provided by AT&L (see Figure 1) and drainage system details provided by AT&L.
- The adopted imperviousness for the proposed development was 85%.
- Design rainfall and storm burst patterns were obtained from ARR1987 for 2 yr ARI, 20 yr ARI, 100 yr ARI, 200 yr ARI and 500 yr ARI events.
- The 2023 rainfall losses were retained, namely for the 2 yr ARI, 20 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.

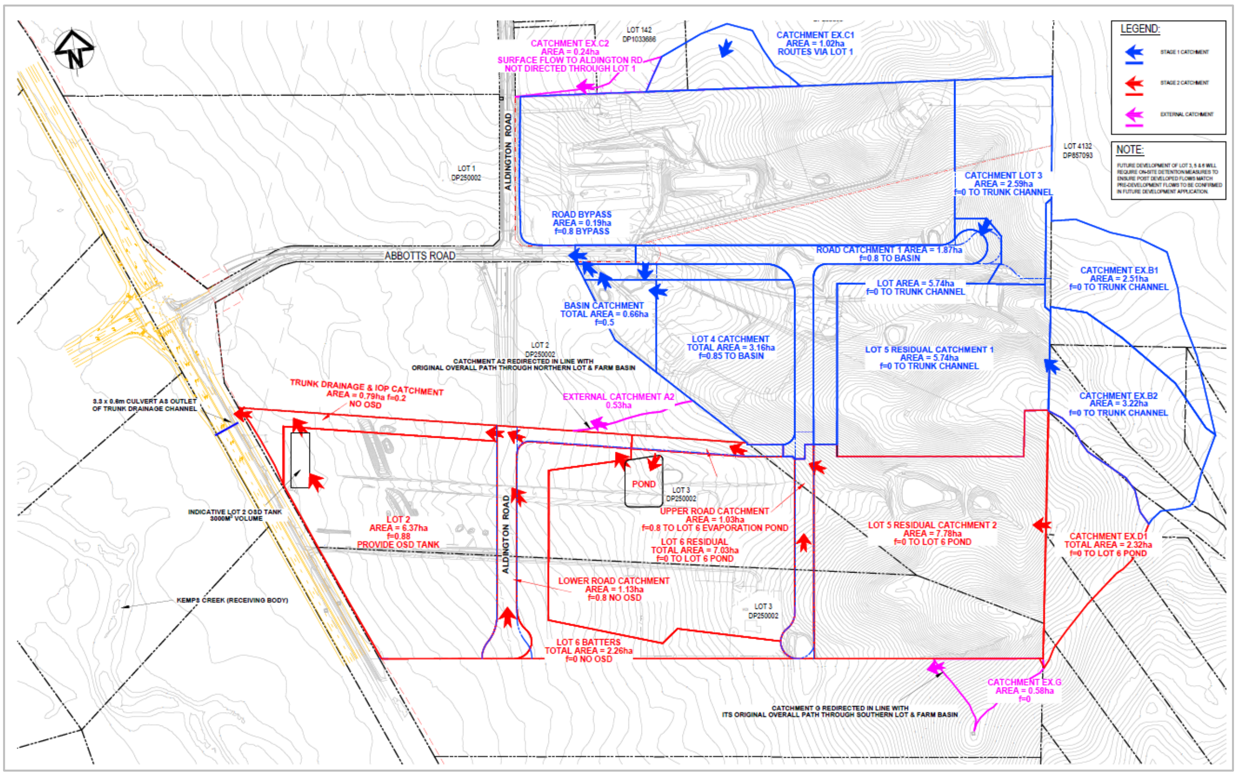

Figure 1 Revised Subcatchment Boundaries for Stage 1 and Stage 2 of the Westlink Industrial Estate (Source: AT&L, 2024)

- For the PMF the adopted rainfall losses were an initial loss = 1 mm and a continuing loss = 0 mm/h.
- The local hydrological model was run to provide local inflow hydrographs for the TUFLOW model for the 2 yr ARI, 20 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events.

Hydraulics

- The 2024 TUFLOW model of benchmark conditions was updated.
- The DEM as updated based on the proposed platform levels, proposed roadworks, basin and swales under Stage 1and Stage 2 Conditions as provided by AT&L.
- The Stage 1 basin was included in the TUFLOW model as was all pipe drainage lines.
- Stage 2 relies on On-Site Detention to limit peak flows to no greater than peak flows under Benchmark Conditions. In the case of Stage 2, the Stage 2 runoff under benchmark conditions was adopted as representative of OSD outflows under developed conditions.
- Benchmark conditions were adopted external to the Stage 1 and Stage 2 development.
- Mamre Road and Abbotts Road cross drainage was blocked as follows:
  - 25% blockage for RCP diameters / culvert widths < 1500 mm (width per pipe / per culvert)
  - 0% blockage for RCP diameters / culvert widths >= 1500 mm (width per pipe / per culvert)
- The roughness zones for the floodplain are mapped in Figure 4 in Stantec, 2023.
- Inflows to the TUFLOW model were exported from the hydrological model and input at the locations of the subcatchment outlets (nodes).
- The downstream boundary condition was a free outfall.
- The flood extent in South Creek was overlaid over the results of the local TUFLOW model to identify where mainstream flooding takes over from overland flows.

Updated flood levels and extent, depths, velocities and hazards categories under Stage 1 and Stage 2 Conditions are plotted for the 2 yr ARI, 20 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events in **Figures F1** to **F36** (see **Appendix B**).

Flood Level Impacts

The estimated impact of Stage 1 and Stage 2 on 2 yr ARI, 20 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 F5, F11, F17, F23** and **F29** and 35 respectively. These Figures disclose the following impacts:

- 2 yr ARI , 20 yr ARI floods – local increases are confined within the ESR development (which includes runoff partially conveyed north to Stage 1 along the internal road) while there are reductions in flood levels west of Mamre Road
- 100 yr ARI, 200 yr ARI floods - local increases are primarily confined within the ESR development (which includes runoff partially conveyed north to Stage 1 along the internal road) while there are reductions in flood levels west of Mamre Road. The zone of impact north of the Mamre Rd – Abbotts Rd intersection which are similar to the impacts of the MAIU works assessed in 2024.

- 500 yr ARI flood– There are local increases from flows spilling from the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are reductions west of Mamre Road.
- PMF – There are local increases from flows spilling from Stage 1 and the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are reductions west of Mamre Road.

Flood Velocity Impacts

The estimated impact of the Stage 1 and Stage 2 on 2 yr ARI, 20 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 F6, F12, F18, F24** and **F30** and **36** respectively. These Figures disclose the following impacts (noting the impact scale of the Figures):

- 2 yr ARI , 20 yr ARI floods – local increases are confined within the ESR development while there are minor reductions in flood velocities west of Mamre Road
- 100 yr ARI flood – any local increases are confined within the ESR development while there are minor reductions in flood velocities west of Mamre Road. The zone of minor impacts north of the Mamre Rd – Abbotts Rd intersection which are similar to the impacts of the MAIU works assessed in 2024.
- 200 yr ARI, 500 yr ARI flood– There are minor increases in velocity from flows spilling from the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are velocity reductions west of Mamre Road.
- PMF – There are local increases in velocities from flows spilling from Stage 1 and the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are reductions west of Mamre Road there are also local zones of increases south the ESR development which appear to be are associated with local reductions in flood depths.

4. SYDNEY WATER FLOOD COMMENTS

Sydney Water has provided a number of comments on the collective flood impact of Stage 1 and Stage 2 of the Masterplan for the proposed development of 290-308 Aldington Road, 59-62 Abbotts Road, and 63 Abbotts Road, Kemps Creek. Our responses to these comments are as follows.

> *The flood assessment report should take into consideration Council's Overland Overview Flood Study 2006 and ensure that there is no adverse impact on the adjoining properties because of the proposed development. Their report identifies that the degree of adverse impacts on the flood behaviour within the surrounding properties progressively reduces as the severity of the flooding increases. However, there should be no adverse impact in all flooding conditions on the surrounding properties and downstream of the site.*

The 2006 Penrith Overland Flow Flood "Overview Study is described in Section 2.1 of Stantec now Cardno, 2022. This study informed the 2022 assessment of benchmark conditions.

As described above, the 2022 FRA assessment and the 2023 FIA assessment have both been updated and updated flood levels and extent, depths, velocities and hazards categories under updated Benchmark Conditions and Stage 1 and Stage 2 Conditions are plotted for the 2 yr ARI, 20 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events respectively in **Appendix A** and **B**.

The estimated impact of Stage 1 and Stage 2 on 2 yr ARI, 20 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 F5, F11, F17, F23** and **F29** and 35 respectively. These Figures disclose the following impacts:

- 2 yr ARI , 20 yr ARI floods – local increases are confined within the ESR development (which includes runoff partially conveyed north to Stage 1 along the internal road) while there are reductions in flood levels west of Mamre Road
- 100 yr ARI, 200 yr ARI floods - local increases are primarily confined within the ESR development (which includes runoff partially conveyed north to Stage 1 along the internal road) while there are reductions in flood levels west of Mamre Road. The zone of impact north of the Mamre Rd – Abbotts Rd intersection which are similar to the impacts of the MAIU works assessed in 2024.
- 500 yr ARI flood– There are local increases from flows spilling from the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are reductions west of Mamre Road.
- PMF – There are local increases from flows spilling from Stage 1 and the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are reductions west of Mamre Road.

The estimated impact of the Stage 1 and Stage 2 on 2 yr ARI, 20 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 F6, F12, F18, F24** and **F30** and **36** respectively. These Figures disclose the following impacts (noting the impact scale of the Figures):

- 2 yr ARI , 20 yr ARI floods – local increases are confined within the ESR development while there are minor reductions in flood velocities west of Mamre Road
- 100 yr ARI flood – any local increases are confined within the ESR development while there are minor reductions in flood velocities west of Mamre Road. The zone of minor impacts north of the Mamre Rd – Abbotts Rd intersection which are similar to the impacts of the MAIU works assessed in 2024.

- 200 yr ARI, 500 yr ARI flood– There are minor increases in velocity from flows spilling from the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are velocity reductions west of Mamre Road.
- PMF – There are local increases in velocities from flows spilling from Stage 1 and the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are reductions west of Mamre Road there are also local zones of increases south the ESR development which appear to be are associated with local reductions in flood depths.

Flood emergency management consideration
As the development is a 24/7 warehouse and distribution centre, the development is to have a site-specific action plan in place for flooding. This will ensure the businesses is able to respond to flooding in extreme storm events consistent with responsibilities identified in NSW State Emergency Services's Local Flood Plan for the area.

In May 2022 a detailed Flood Emergency Response Plan (FERP) was prepared for the construction phase of the Aspect Industrial Estate development4.

This provides a comprehensive template for an operations FERP for Westlink Industrial Estate.

The Aspect Industrial Estate FERP describes:

- Flood behaviour on the site in floods up to a Probable Maximum Flood (PMF) at different stages of the site development,
- A Flood Emergency Response Plan for the construction phase, including:
  - Flood risks both on the project site and external to the project site;
  - Evacuation strategy, measures, procedures, and plan; and
  - A FloodSafe Plan

It identifies that actions that must be co-ordinated by the Flood Wardens.

- Monitoring rainfall and any runoff entering the site and any flooding on the site;
- Assessing if site operations can continue safely during inclement weather;
- Restricting any site operations that continue during inclement weather to areas well away from any flooding on the site;
- If it is unsafe for site operations to continue then directing workers on the site to retreat to the designated flood refuges located in the Site Compound; and

[4] Cardno now Stantec (2022) "*Flood Emergency Response Plan, Aspect Industrial Estate (AIE), Kemps Creek*", Revision 2, prepared for Mirvac, May, 33 pp + Apps

- Monitoring any regional flooding and road closures through Council's Disaster Dashboard and the Live Traffic Website and advising whether it is safe for workers to depart the site depending on their planned destination(s).

The Table of Contents of this FERP is given in Appendix C and provides a guide to the issues that should be addressed in an operations FERP for Westlink Industrial Estate.

The hydrology base model should adopt the same loss model as the adopted Wianamatta South Creek model

As noted in Section 3 Hydrology of the 2022 Flood Risk Assessment for Westlink Industrial Estate:

> *In the case of the recent assessment of the nearby Aspect Industrial Estate (immediately north of the subject property – see Figure 6) rainfall-runoff assessments applying data from both ARR1987 (for consistency with the 2015 South Creek Flood Study) and the 2019 version of ARR).*

As described in Section 3.3 of the Aspect Industrial Estate FRA report (Cardno, 2020[5]):

> *The sensitivity of the adopted pervious area rainfall losses was assessed for two sets of values as follows:*
>
> - *Initial loss = 37.1 mm and continuing loss = 0.94 mm/h (adopted by Worley Parsons, 2015 in the vicinity of the Mamre Road local catchment)* (Scenario 1)*; and*
> - *Initial loss = 15 mm and continuing loss = 1.5 mm/h (adopted by WMAwater, 2012 for the Upper South Creek catchment)* (Scenario 2)
>
> *The sensitivity of the 100 yr ARI peak flows to the roughness vale and BX value was assessed for two sets of values as follows:*
>
> - *Roughness value = 0.025 and BX = 1.3 (adopted by Worley Parsons, 2015)*(Scenario 3)*; and*
> - *Roughness value = 0.04 and BX = 1.0 (guided by the preliminary farm dam assessment by Cardno, 2015 for Upper South Creek catchment)* (Scenario 4)
>
> *Attachment B1 summarises the estimated 100 yr ARI peak flows at all nodes for storm burst durations ranging from 30 minutes to 36 hours for Scenarios 1, 2, 3 and 4* (refer **Appendix D**).

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

It was noted that

(i) *The rainfall losses adopted by Worley Parsons, 2015 give critical storm burst durations that range between 4.5 hours to 12 hours depending on location;*

(ii) *The rainfall losses adopted by WMAwater, 2012 give critical storm burst durations of 2 hours in almost all locations; and*

(iii) *The adjustment of BX and pervious roughness values only has a small impact on the estimated peak flows.*

It was also noted that the 1% AEP storm burst initial loss and continuing rainfall losses advised by the ARR2019 data hub are around 10 mm and 2.3 mm/h respectively. This suggested that greater weight should be given to the results of Scenarios 2 and 4.

For subsequent ARR1987 assessment purposes the benchmark conditions were based on Scenario 2.

It was concluded that the adopted hydrological model parameters gave:

- storm burst durations which were more uniform and aligned with the expected critical storm burst durations for small local catchments;
- conservative estimates of peak flows in comparison to the peak flows estimated using parameter values from Worley Parsons, 2015.

The Aspect Industrial Estate SSD-10448 was approved by the Director, Planning Assessments acting for the Minister of Planning on 24 May 2022.

Advisian, 2020[6] also reports a comparison between Australian Rainfall & Runoff 1987 vs 2019 in Section 4.4. Advisian, 20200 state, in part (refer **Appendix D**):

ARR2019 IFD and methodologies were applied to the South Creek XP-RAFTS hydrologic model. …..

An adjusted continuing rainfall loss rate was applied, and Probability Neutral Burst Initial Losses were adopted, as per ARR 2019 guidance for NSW catchments. This led to initial losses ranging between 7.9-17.2 mm/hour being adopted for pervious catchments for the range of storm durations assessed (i.e., 6-36 hours). The adopted impervious area rainfall initial and continuing losses were 1 mm and 0 mm/h, respectively.

[6] Advisian Pty Ltd (2020) Wianamatta (South) Creek Catchment Flood Study – Existing Conditions – Report, November, https://flooddata.ses.nsw.gov.au/related-dataset/wianamatta-south-creek-catchment-flood-study-existing- conditions-main-report

It is worth noting that the adopted initial losses for pervious catchments are lower than the losses determined through calibration and validation; typically, in the order of 37.1 mm/hour. Although initial modelling sought to adopt the calibrated losses, later comparisons of the peak flows generated against the FFA at Elizabeth Drive found that it produced a poorer comparison than the ARR2019 Probability Neutral Burst Initial Losses.

*The 1% AEP peak flows derived from simulations completed based on the ARR 2019 analysis procedures were compared to peak flows derived by FFA at Elizabeth Drive. A comparison was also made to the corresponding peak flows derived from the ARR 1987 results (refer **Table 4.5** and Appendix C).*

Table 4.5 Comparison of Peak 1% AEP Flows at Elizabeth Drive (South Creek) based on ARR 1987 and ARR 2019 Hydrology to FFA

Approach Adopted for Estimation of Design 1% AEP Flows		
Flood Frequency Analysis	ARR 1987	ARR 2019
538 m³/s ^	492 m³/s - 9%	381 m³/s - 29%

^ Value extracted from FFA curve provided as Appendix A49 – 'Review of ARR Design Inputs for NSW' (OEH, February 2019) prepared by WMA Water

Download link: https://data.arr-software.org/static/pdf/appendix.pdf

It is noted that the 1% AEP peak flow estimated using ARR1987 IFD and pervious rainfall losses of 37.1 mm and 0.94 mm/hr is 9% lower than the 1% AEP peak flow derived from Flood frequency Analysis.

It is concluded that adopting ARR1987 IFD and Initial loss = 37.1 mm and continuing loss = 0.94 mm/h (adopted by Worley Parsons, 2015 and 2020) is expected to underestimate peak flows.

The hydrological modelling approach adopted for the Westlink Industrial Estate was based on scenario 2 and is consistent with the hydrological modelling approach adopted for the Aspect Industrial Estate SSD-10448 approved by the NSW DPE.

The undeveloped case 50% AEP flood model shall be mapped to confirm upstream and downstream inflow and outflow points. These points shall be used to assess if the proposed development is maintaining status quo for developed flows. Peak flows shall be extracted at these points for comparison to developed flows.

As described above, the 2022 FRA assessment and the 2023 FIA assessment have both been updated and updated flood levels and extent, depths, velocities and hazards categories under updated Benchmark Conditions and Stage 1 and Stage 2 Conditions are plotted for the 2 yr ARI event respectively in **Appendix A** and **B**.

An impervious percentage of 90% was quoted in the modelling. This is contrary to the controls in the DCP requiring a maximum of 85% for a development site

The impervious percentage has been adjusted to 85%.

Mapping shows flood level increases on downstream properties post development. This is not acceptable and will require either written acceptance from the downstream property owner or additional attenuation of flows leaving the developed site.

As described above, the 2022 FRA assessment and the 2023 FIA assessment have both been updated and updated flood levels and extent, depths, velocities and hazards categories under updated Benchmark Conditions and Stage 1 and Stage 2 Conditions are plotted for the 2 yr ARI, 20 yr ARI, 100 yr ARI, 200 yr ARI, 500 yr ARI and PMF events respectively in **Appendix A** and **B**.

The estimated impact of Stage 1 and Stage 2 on 2 yr ARI, 20 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 F5, F11, F17, F23** and **F29** and **35** respectively. These Figures disclose the following impacts:

- 2 yr ARI , 20 yr ARI floods – local increases are confined within the ESR development (which includes runoff partially conveyed north to Stage 1 along the internal road) while there are reductions in flood levels west of Mamre Road
- 100 yr ARI, 200 yr ARI floods - local increases are primarily confined within the ESR development (which includes runoff partially conveyed north to Stage 1 along the internal road) while there are reductions in flood levels west of Mamre Road. The zone of impact north of the Mamre Rd – Abbotts Rd intersection which are similar to the impacts of the MAIU works assessed in 2024.
- 500 yr ARI flood– There are local increases from flows spilling from the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are reductions west of Mamre Road.
- PMF – There are local increases from flows spilling from Stage 1 and the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are reductions west of Mamre Road.

The estimated impact of the Stage 1 and Stage 2 on 2 yr ARI, 20 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 F6, F12, F18, F24** and **F30** and **36** respectively. These Figures disclose the following impacts (noting the impact scale of the Figures):

- 2 yr ARI , 20 yr ARI floods – local increases are confined within the ESR development while there are minor reductions in flood velocities west of Mamre Road
- 100 yr ARI flood – any local increases are confined within the ESR development while there are minor reductions in flood velocities west of Mamre Road. The zone of minor impacts north of the Mamre Rd – Abbotts Rd intersection which are similar to the impacts of the MAIU works assessed in 2024.

- 200 yr ARI, 500 yr ARI flood– There are minor increases in velocity from flows spilling from the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are velocity reductions west of Mamre Road.
- PMF – There are local increases in velocities from flows spilling from Stage 1 and the Abbotts Rd – Aldington Rd intersection spilling towards Mamre Rd and also north of the Mamre Rd – Abbotts Rd intersection which are similar to the zones of impacts associated with the MAIU works assessed in 2024. Opposite and south of Stage 2 there are reductions west of Mamre Road there are also local zones of increases south the ESR development which appear to be are associated with local reductions in flood depths.

The hydrological parameter shown in the flood report are inconsistent with those shown in Sydney Water's design guideline. With regard to this, please tabulate the parameters utilised in the hydrologic modelling for the site and justify any difference. This shall include full consistent catchment mapping, adopted loss rates, flowpath lengths, and locations and adopted rainfall information. This can be provided as a spreadsheet of the input data for the XP-RAFTS model with appropriate sketches.

Details on RAFTS model parameters are given in **Appendix E.**

Yours faithfully,

STANTEC AUSTRALIA PTY LTD

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Appendix A Updated Benchmark Conditions
Appendix B Updated Stage 1 and Stage 2 Conditions
Appendix C Indicative FERP table of Contents
Appendix D Rainfall Loss Sensitivity Assessments
Appendix E RAFTS Model Parameter Values

Appendix A
Updated Benchmark Conditions

2 Year ARI
Flood Extents & Flood Levels Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E1**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- 0.5m Water Level Contours (mAHD)
- Flood Extent

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

2 Year ARI Flood Depths Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E2**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

2 Year ARI Flood Velocities Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E3**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

2 Year ARI
Flood Hazard
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E4**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes

Hazard Category

- Low
- Transitional
- High

DRAFT - Not For Construction

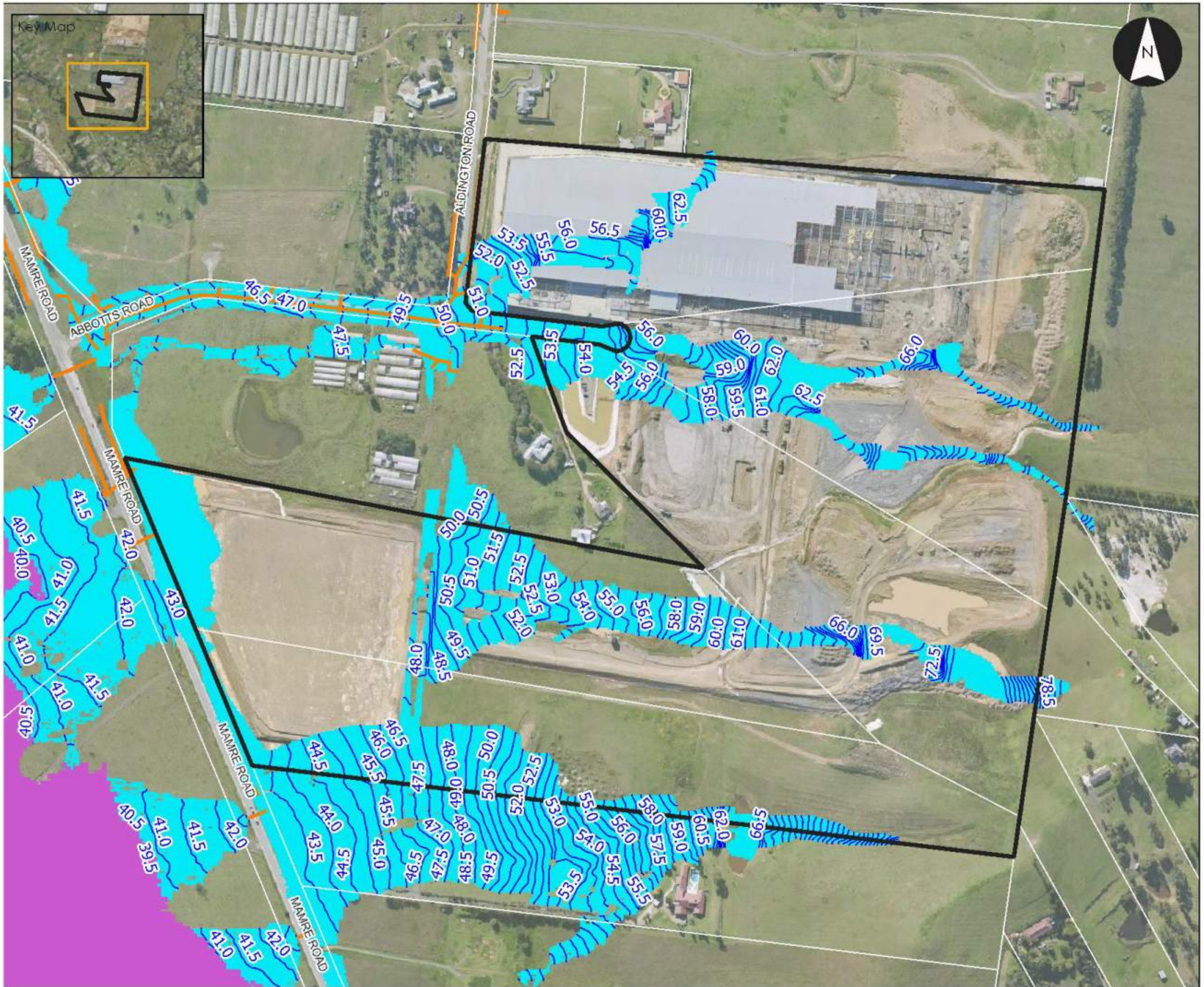
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



20 Year ARI
Flood Extents & Flood Levels
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E5**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- 0.5m Water Level Contours (mAHD)
- Flood Extent

DRAFT - Not For Construction

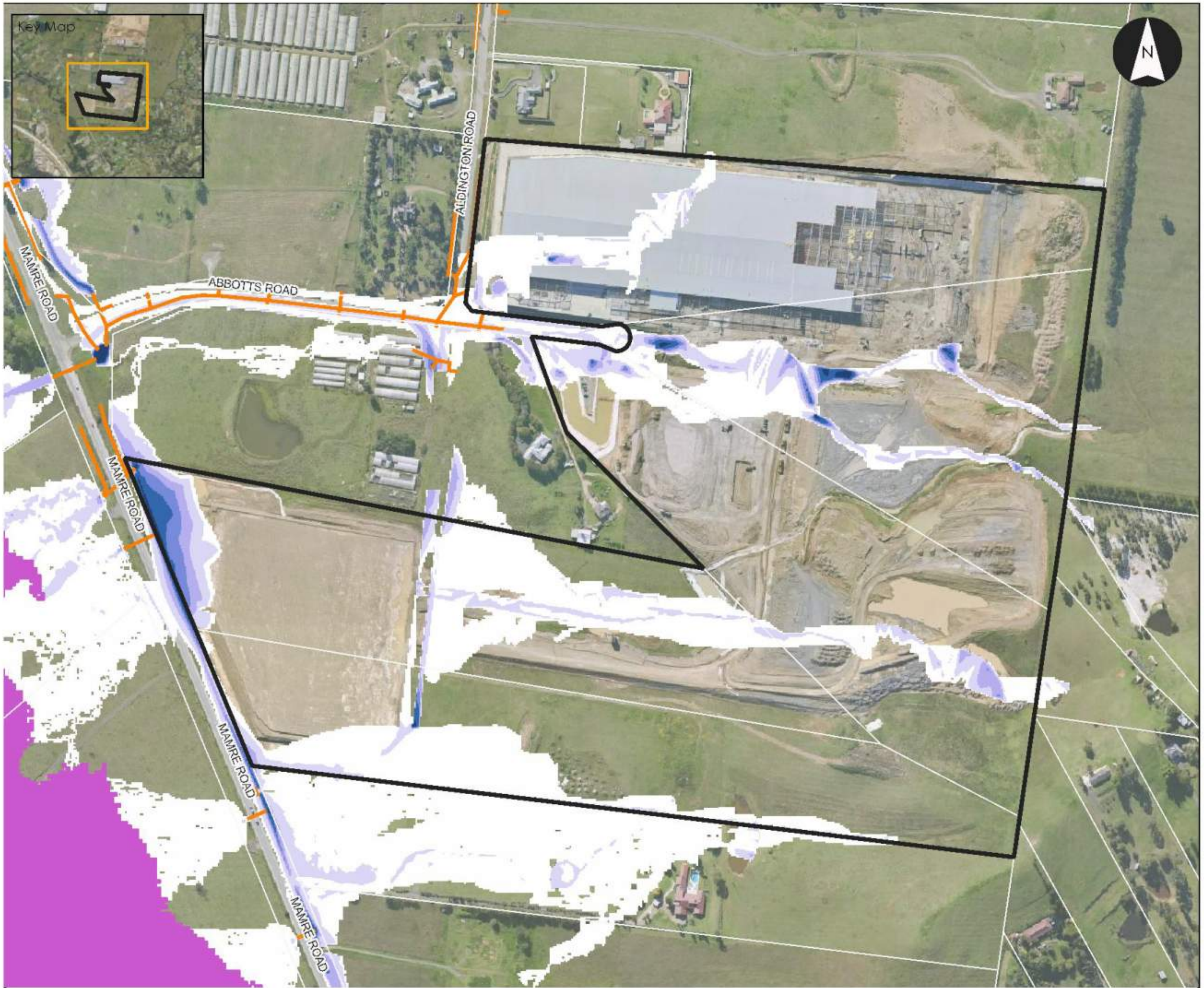
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



20 Year ARI
Flood Depths
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E6**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

Scale at A3: 1:6000

20 Year ARI
Flood Velocities
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E7**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

20 Year ARI
Flood Hazard
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E8**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes

Hazard Category

- Low
- Transitional
- High

DRAFT - Not For Construction

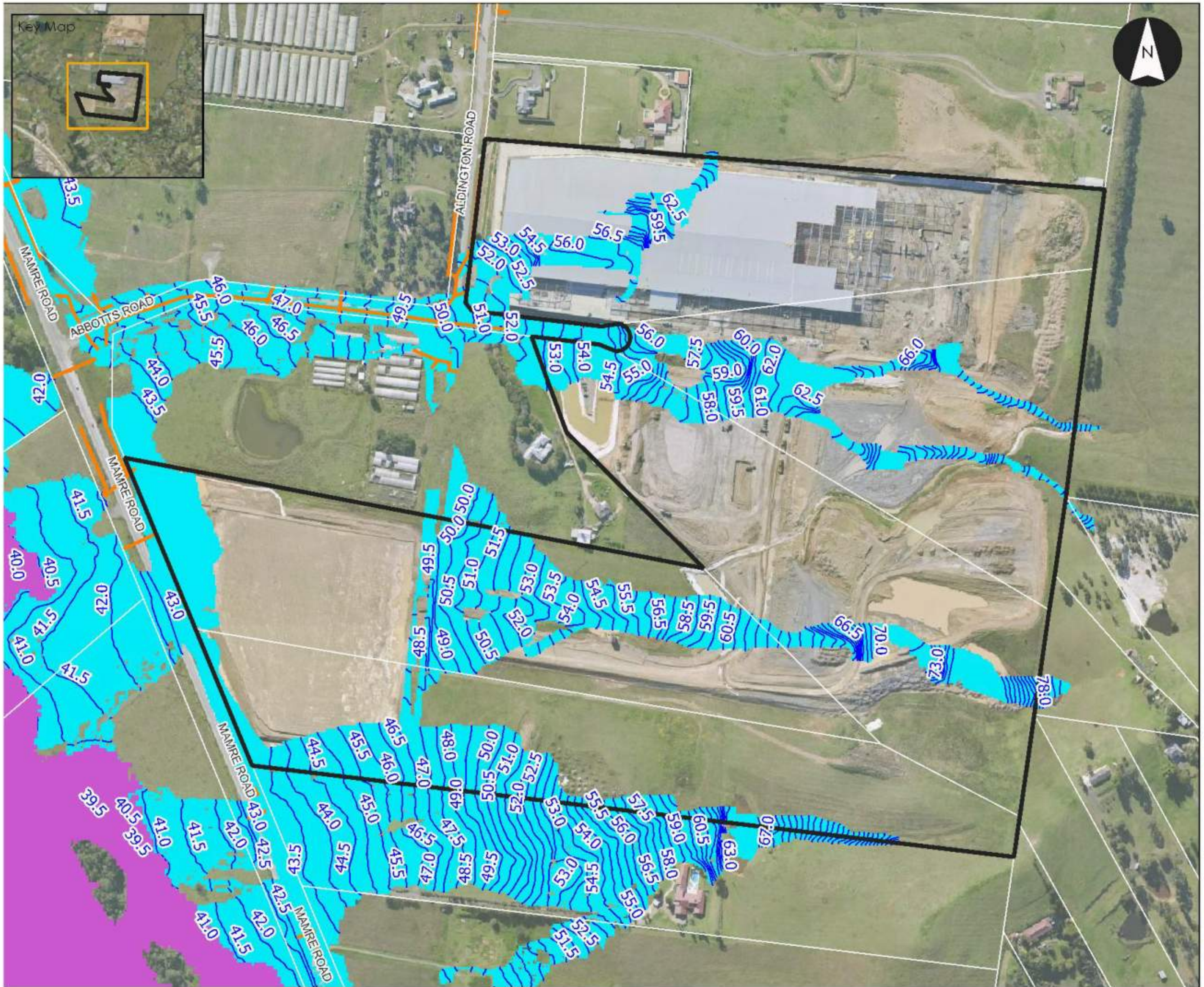
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



100 Year ARI Flood Extents & Flood Levels Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E9**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (100yr) Flood Extent
- Mamre Road Pipes
- 0.5m Water Level Contours (mAHD)
- Flood Extent

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

100 Year ARI Flood Depths Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia

Project Code: 304700730

Drawn By: SHP, Checked By: SY

Date: (2024-08-12)

Figure No: **E10**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (100yr) Flood Extent
- Mamre Road Pipes

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

100 Year ARI
Flood Velocities
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E11**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (100yr) Flood Extent
- Mamre Road Pipes

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

100 Year ARI
Flood Hazard
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E12**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (100yr) Flood Extent
- Mamre Road Pipes

Hazard Category

- Low
- Transitional
- High

DRAFT - Not For Construction

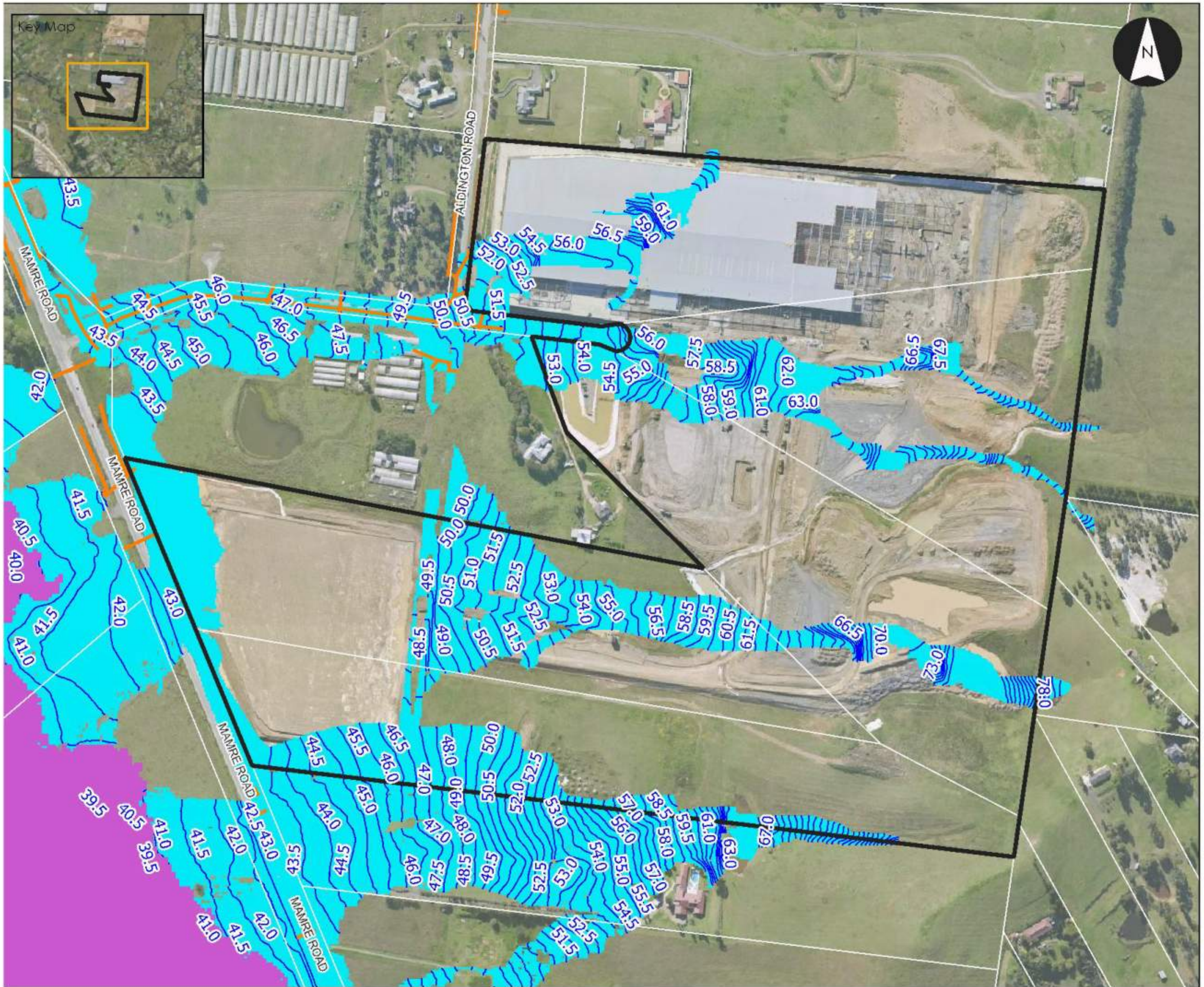
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



200 Year ARI
Flood Extents & Flood Levels
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E13**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (200yr) Flood Extent
- Mamre Road Pipes
- 0.5m Water Level Contours (mAHD)
- Flood Extent

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

200 Year ARI Flood Depths Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E14**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (200yr) Flood Extent
- Mamre Road Pipes

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

200 Year ARI
Flood Velocities
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E15**

Legend

Site Boundary
Cadastre
South Creek Flood Study (200yr) Flood Extent
Mamre Road Pipes

Flood Velocity (m/s)
0.00 to 0.50
0.50 to 1.00
1.00 to 1.50
1.50 to 2.00
2.00 to 3.00
> 3.00

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

200 Year ARI
Flood Hazard
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E16**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (200yr) Flood Extent
- Mamre Road Pipes

Hazard Category

- Low
- Transitional
- High

DRAFT - Not For Construction

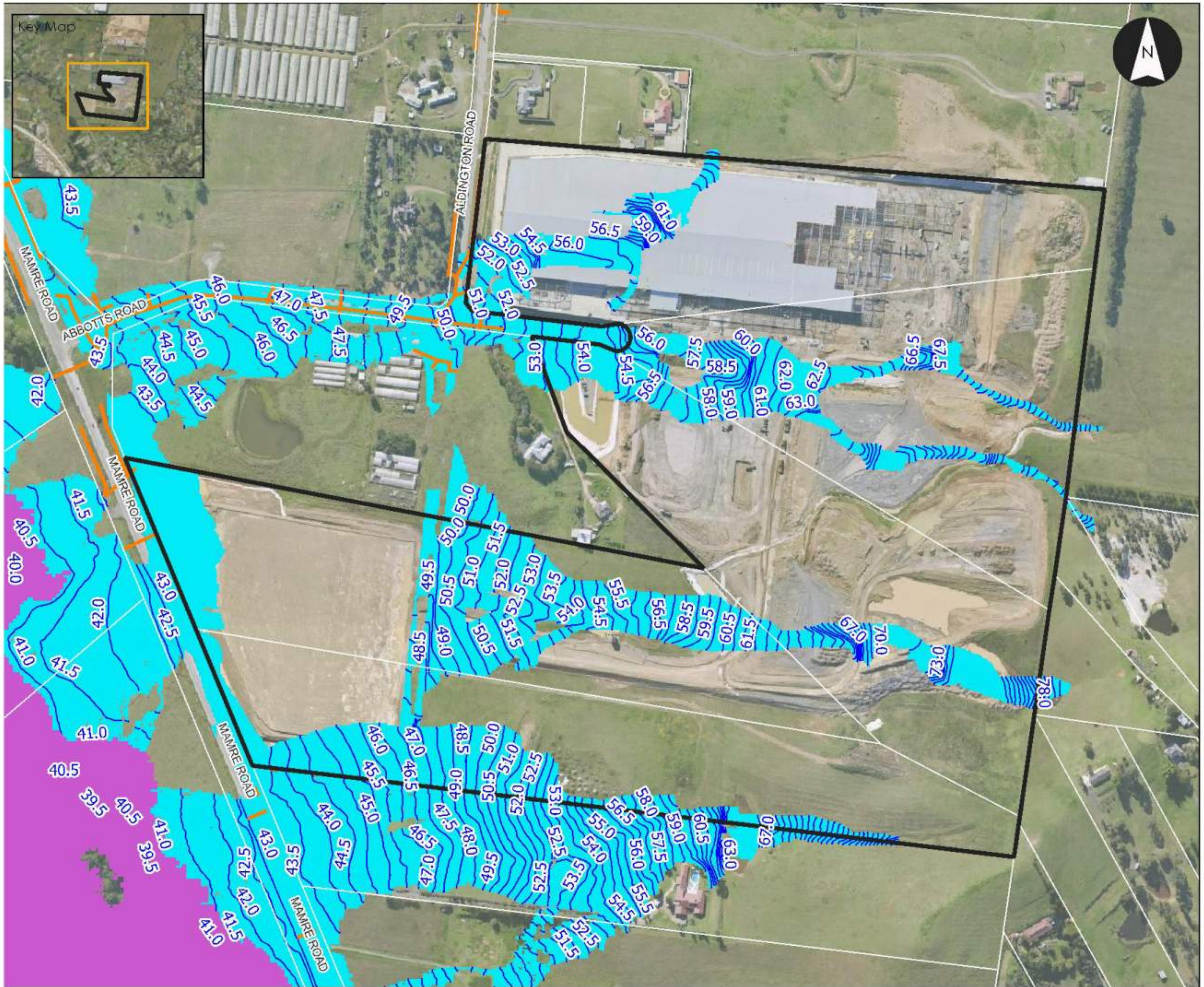
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



500 Year ARI
Flood Extents & Flood Levels
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E17**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (500yr) Flood Extent
- Mamre Road Pipes
- 0.5m Water Level Contours (mAHD)
- Flood Extent

DRAFT - Not For Construction

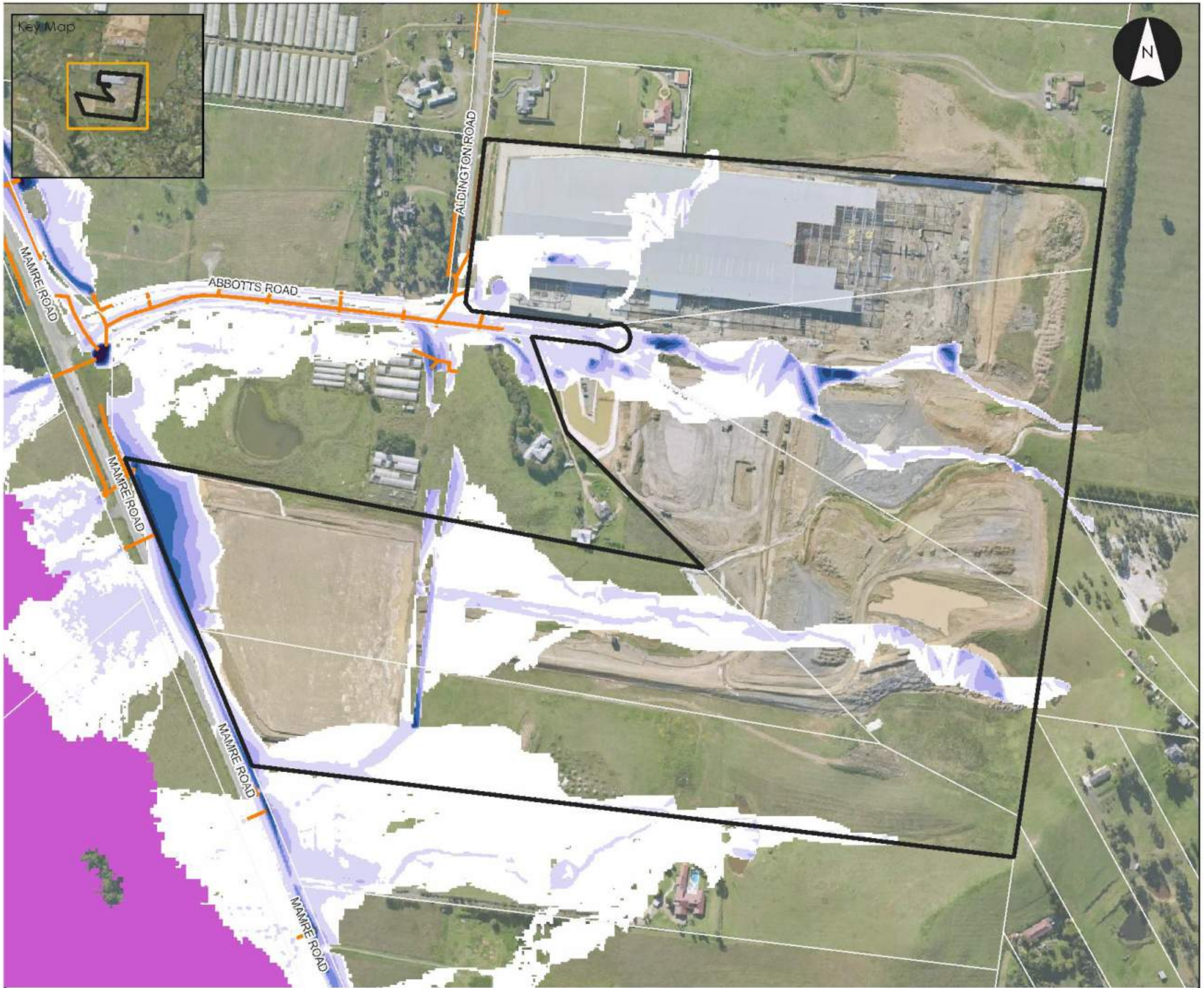
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



500 Year ARI
Flood Depths
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E18**

Legend

Site Boundary
Cadastre
South Creek Flood Study (500yr) Flood Extent
Mamre Road Pipes

Flood Depth (m)
0.00 to 0.10
0.10 to 0.30
0.30 to 0.50
0.50 to 0.70
0.70 to 1.00
1.00 to 1.50
> 1.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

500 Year ARI
Flood Velocities
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E19**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (500yr) Flood Extent
- Mamre Road Pipes

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

500 Year ARI
Flood Hazard
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E20**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (500yr) Flood Extent
- Mamre Road Pipes

Hazard Category
- Low
- Transitional
- High

DRAFT - Not For Construction

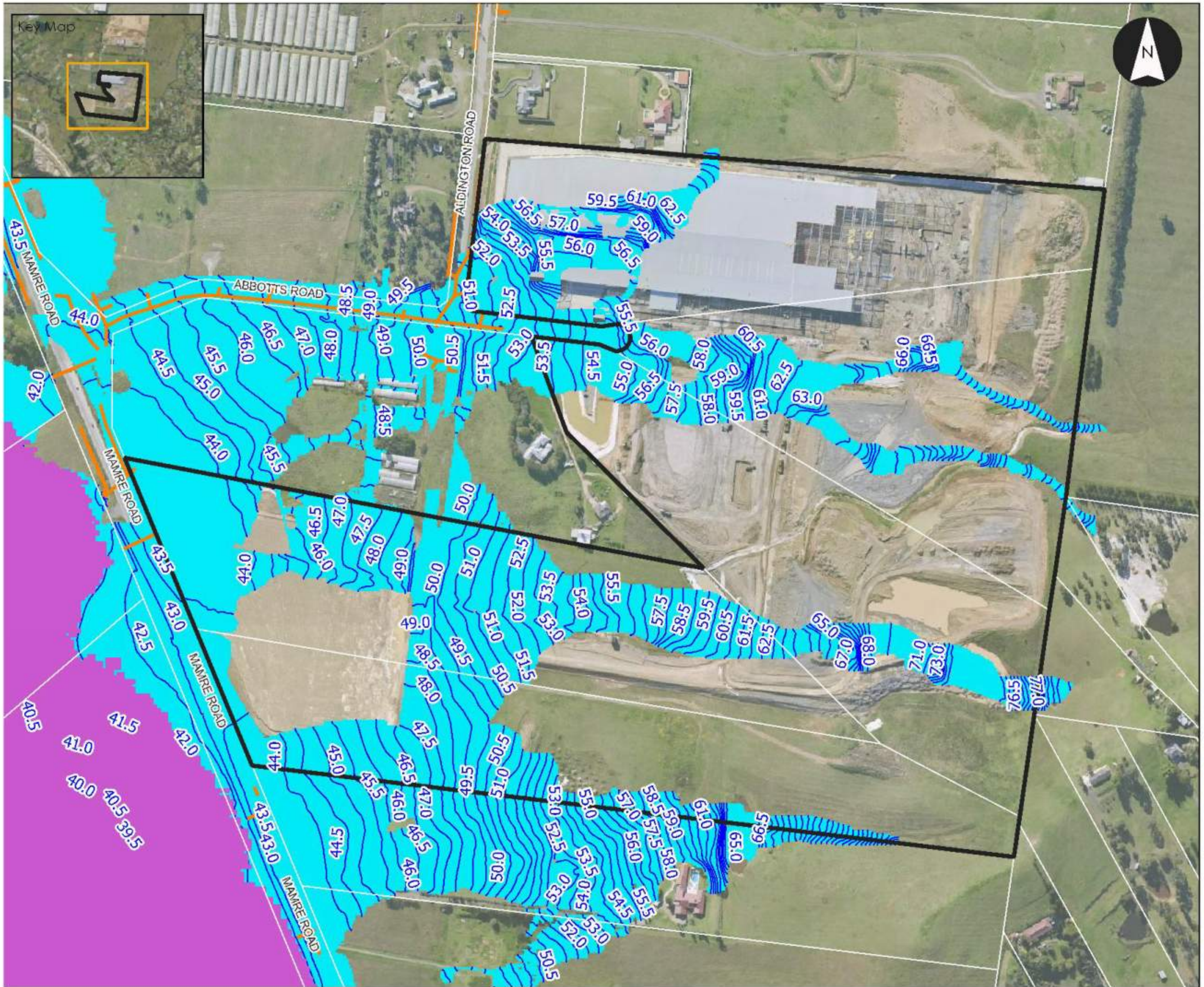
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



PMF
Flood Extents & Flood Levels Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E21**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (PMF) Flood Extent
- Mamre Road Pipes
- 0.5m Water Level Contours (mAHD)
- Flood Extent

DRAFT - Not For Construction

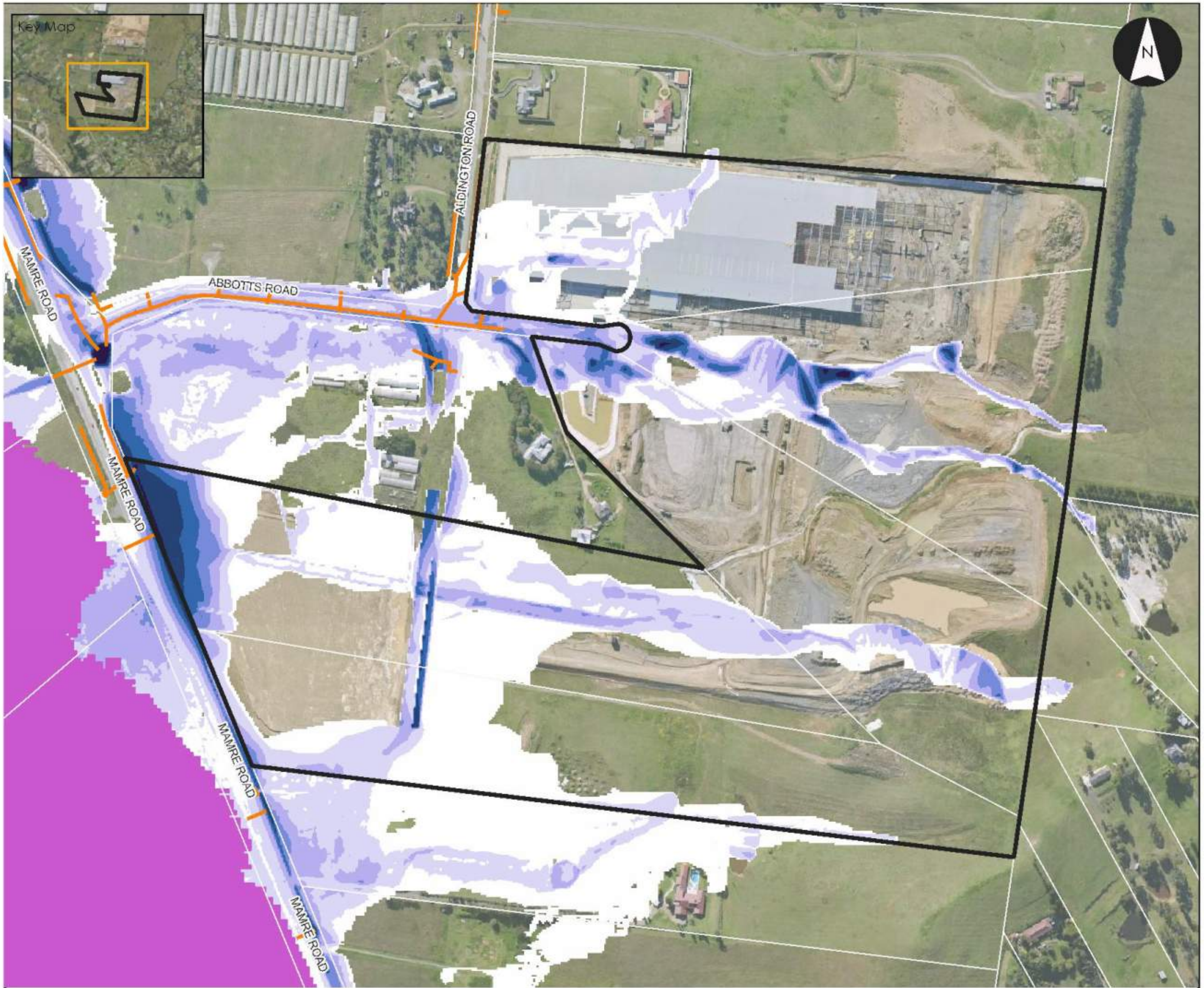
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



PMF
Flood Depths
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E22**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (PMF) Flood Extent
- Mamre Road Pipes

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

PMF
Flood Velocities
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E23**

Legend

- Site Boundary
- Cadastre
- South Creek Flood Study (PMF) Flood Extent
- Mamre Road Pipes

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

DRAFT - Not For Construction

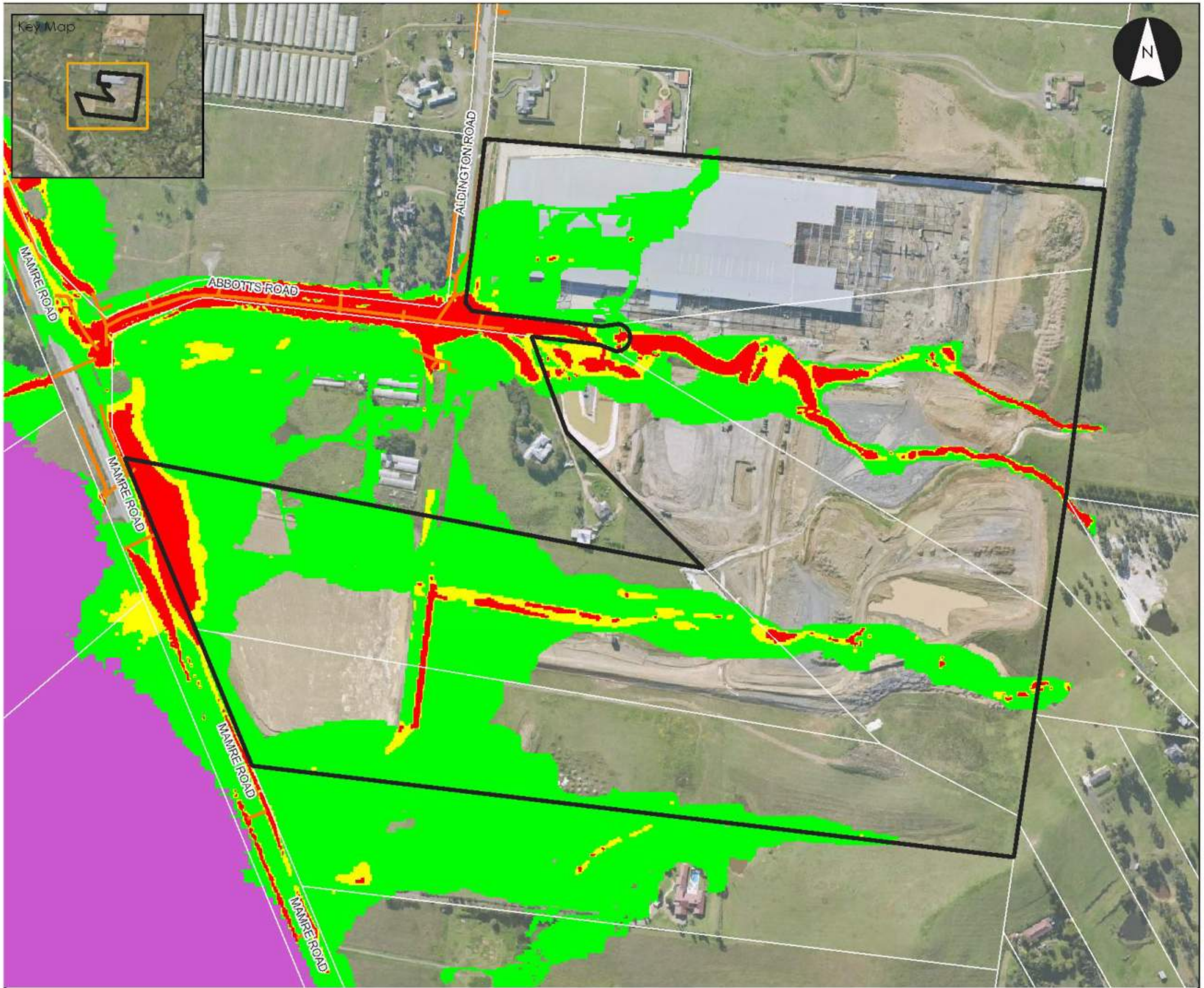
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



PMF
Flood Hazard
Benchmark Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-12)
Figure No: **E24**

Legend

Site Boundary
Cadastre
South Creek Flood Study (PMF) Flood Extent
Mamre Road Pipes
Hazard Category
Low
Transitional
High

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

Appendix B

Updated Stage 1 and Stage 2 Conditions

2 Year ARI
Flood Extents & Flood Levels
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F1**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre
- 0.5m Water Level Contours (mA HD)
- Flood Extent

DRAFT - Not For Construction

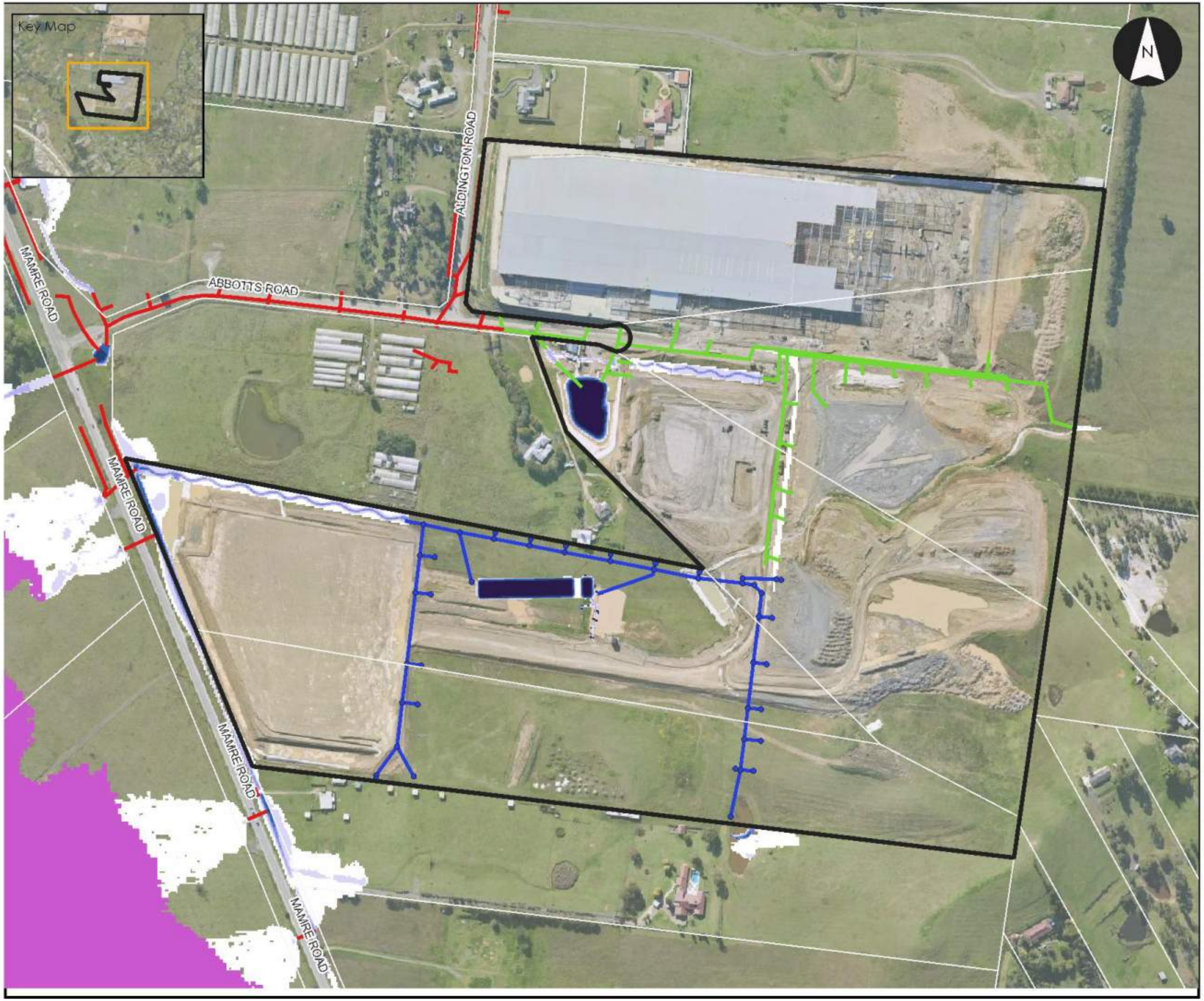
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



2 Year ARI
Flood Depths
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F2**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

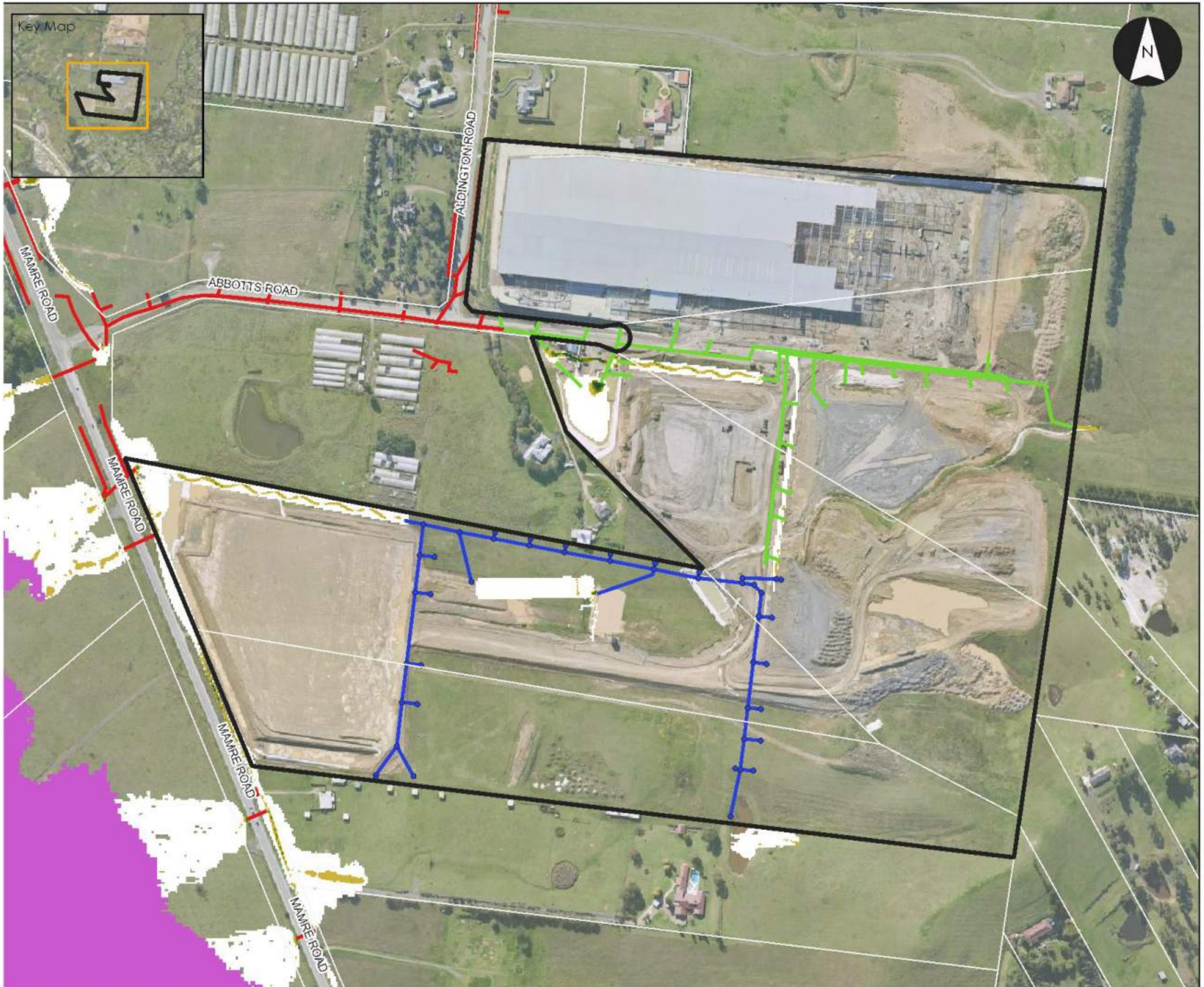
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



2 Year ARI
Flood Velocities
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F3**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

2 Year ARI Flood Hazard Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F4**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Hazard Category

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

DRAFT - Not For Construction

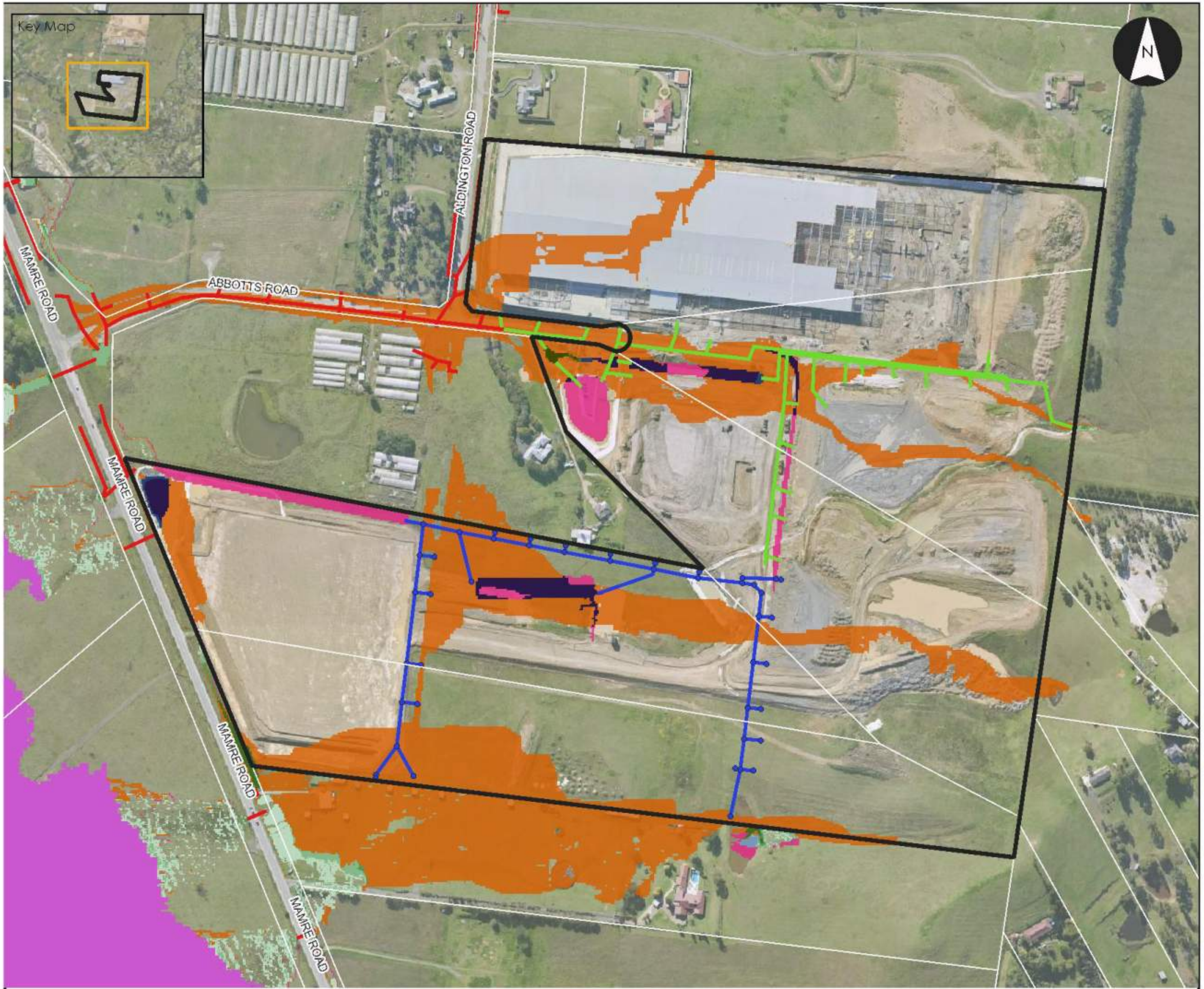
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



2 Year ARI
Water Level Difference
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F5**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Wet & Dry Analysis
- Was Wet, Now Dry
- Was Dry, Now Wet

Water Level Difference (m)
- < -0.50
- -0.50 to -0.10
- -0.10 to -0.05
- -0.05 to -0.02
- -0.02 to -0.01
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.10
- 0.10 to 0.50
- > 0.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

2 Year ARI Velocity Difference Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F6**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre

Velocity Difference (m/s)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

20 Year ARI
Flood Extents & Flood Levels
Stage 2 Proposed Conditions
Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F7**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre
- 0.5m Water Level Contours (mAHD)
- Flood Extent

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

20 Year ARI
Flood Depths
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F8**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

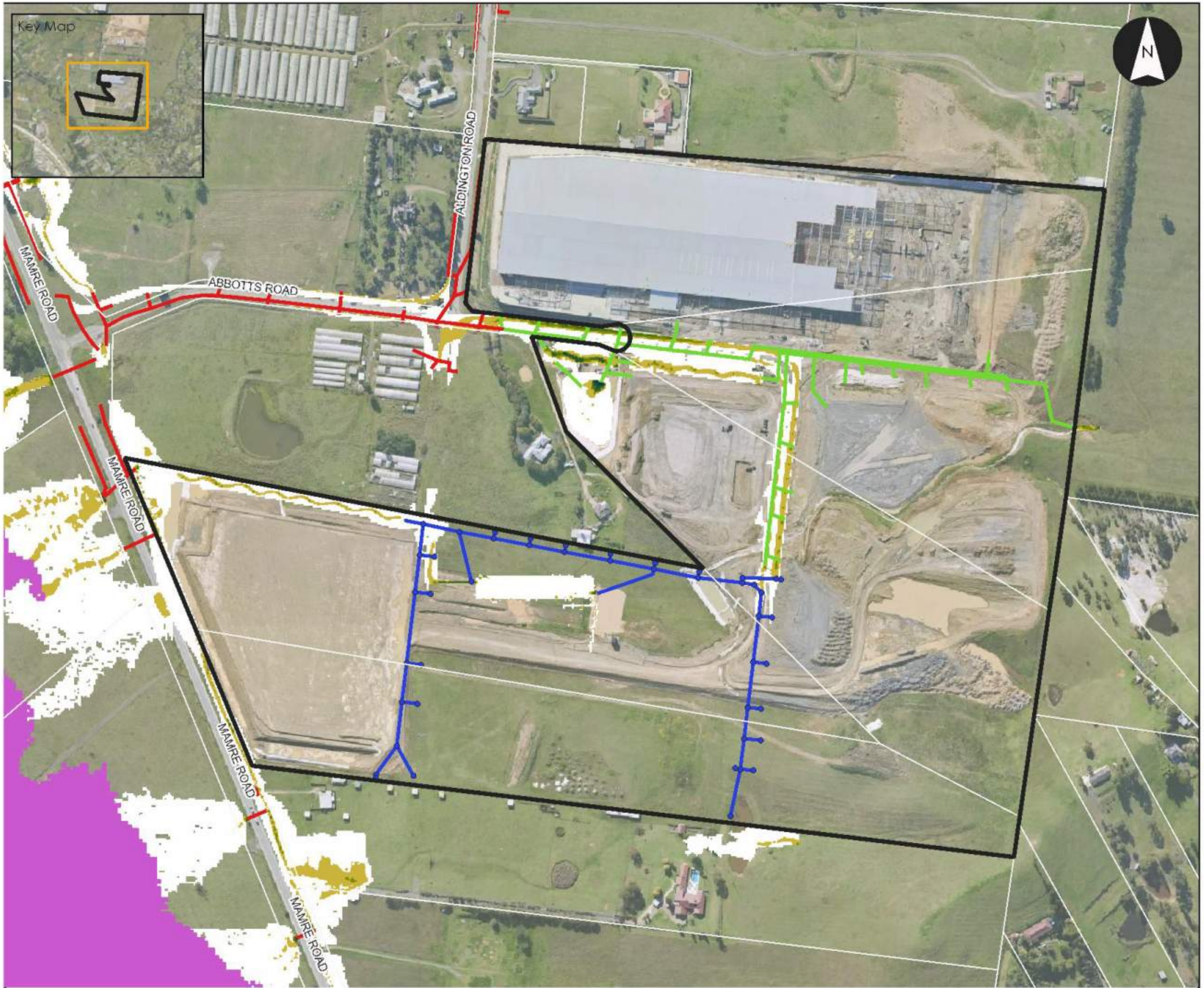
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



20 Year ARI
Flood Velocities
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F9**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

20 Year ARI
Flood Hazard
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F10**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

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

DRAFT - Not For Construction

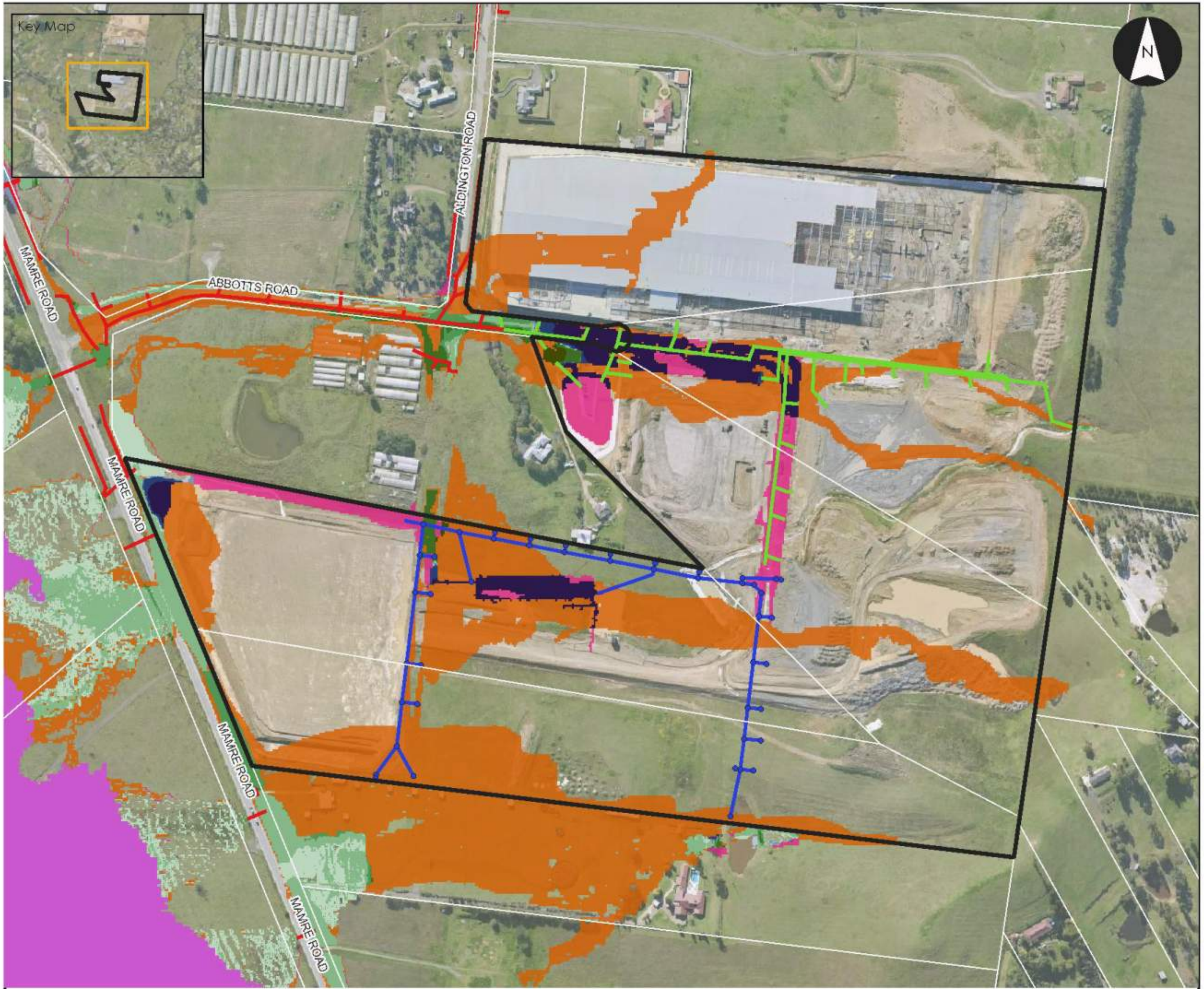
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



20 Year ARI
Water Level Difference
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F11**

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

Scale at A3: 1:6000

20 Year ARI
Velocity Difference
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F12**

Legend

- Site Boundary
- South Creek Flood Study (20yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre

Velocity Difference (m/s)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

DRAFT - Not For Construction

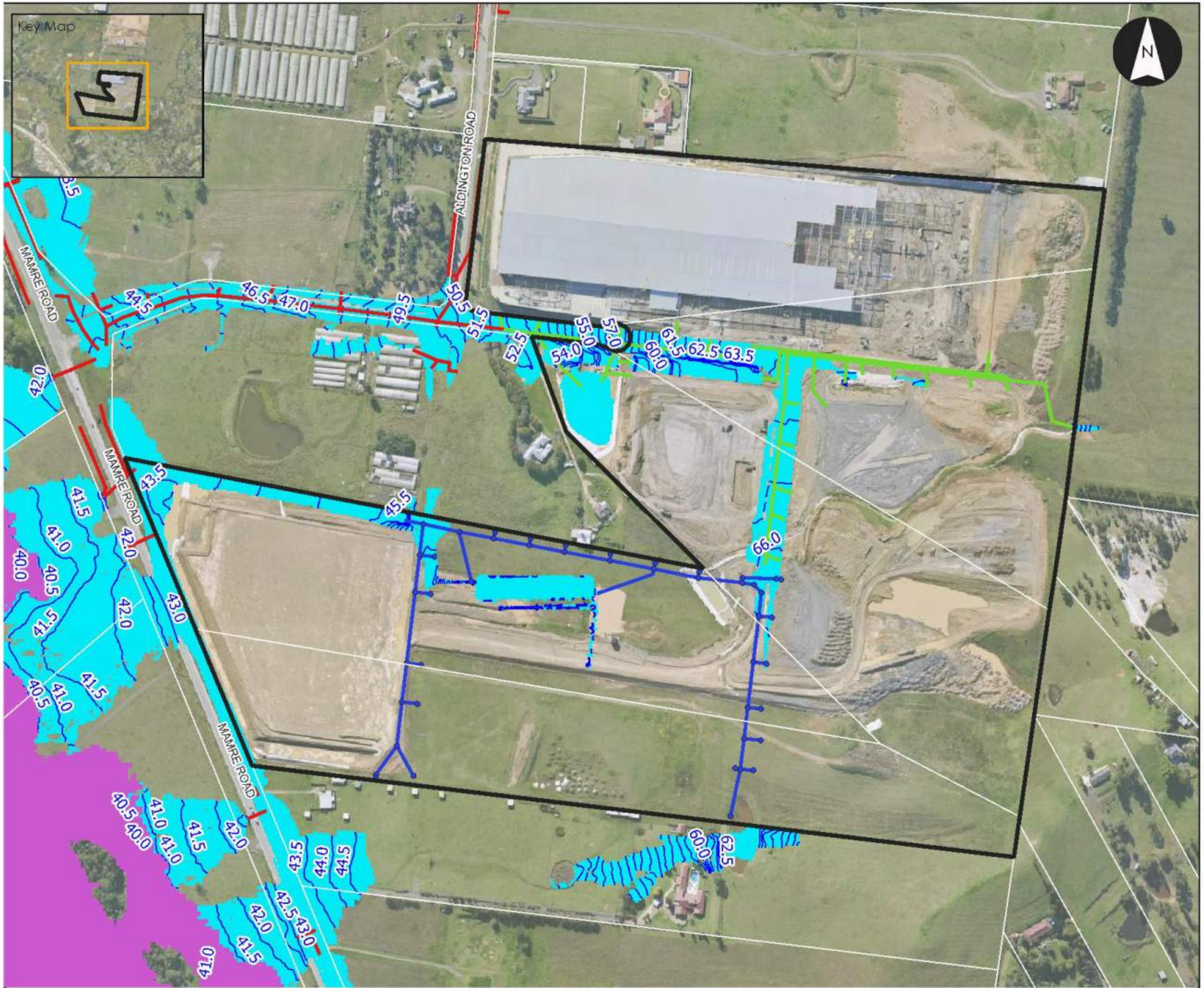
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



100 Year ARI
Flood Extents & Flood Levels
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F13**

Legend

- Site Boundary
- South Creek Flood Study (100yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre
- 0.5m Water Level Contours (mA HD)
- Flood Extent

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

100 Year ARI Flood Depths Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F14**

Legend

- Site Boundary
- South Creek Flood Study (100yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

100 Year ARI
Flood Velocities
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F15**

Legend

- Site Boundary
- South Creek Flood Study (100yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

100 Year ARI Flood Hazard Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F16**

Legend

- Site Boundary
- South Creek Flood Study (100yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Hazard Category

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

DRAFT - Not For Construction

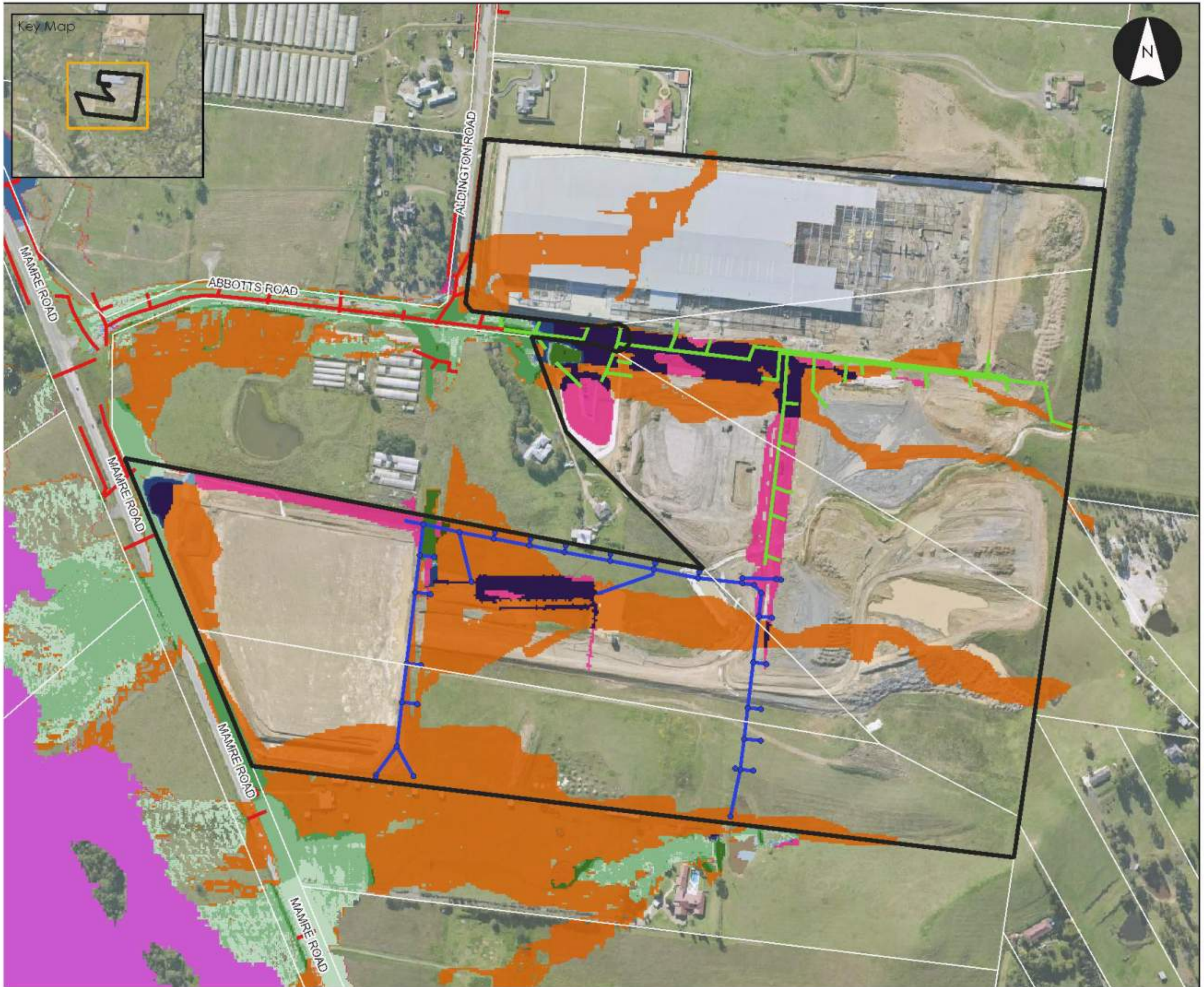
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



100 Year ARI
Water Level Difference
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F17**

Legend

- Site Boundary
- South Creek Flood Study (100yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Wet & Dry Analysis

- Was Wet, Now Dry
- Was Dry, Now Wet

Water Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to -0.05
- -0.05 to -0.02
- -0.02 to -0.01
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.10
- 0.10 to 0.50
- > 0.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

100 Year ARI Velocity Difference Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F18**

Legend

- Site Boundary
- South Creek Flood Study (100yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre

Velocity Difference (m/s)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

DRAFT - Not For Construction

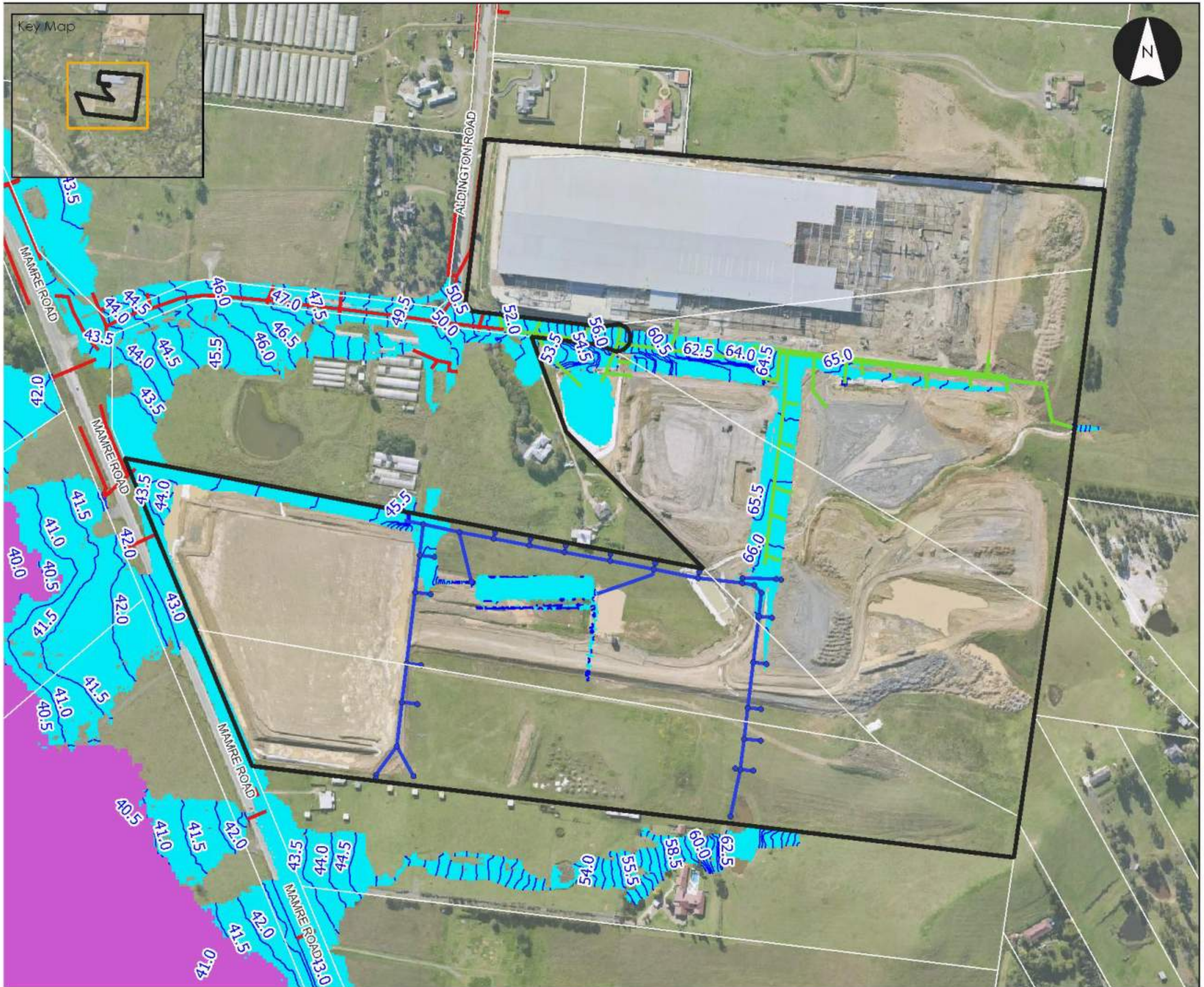
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



200 Year ARI
Flood Extents & Flood Levels
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F19**

Legend

- Site Boundary
- South Creek Flood Study (200yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre
- 0.5m Water Level Contours (mAHD)
- Flood Extent

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

200 Year ARI Flood Depths Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F20**

Legend

- Site Boundary
- South Creek Flood Study (200yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

200 Year ARI Flood Velocities Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F21**

Legend

- Site Boundary
- South Creek Flood Study (200yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

200 Year ARI Flood Hazard Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F22**

Legend

- Site Boundary
- South Creek Flood Study (200yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Hazard Category

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

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

200 Year ARI
Water Level Difference
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F23**

Legend

Site Boundary
South Creek Flood Study (200yr) Flood Extent
Mamre Road Pipes
Design Stage1 Drainage
Design Stage2 Drainage
Cadastre

Wet & Dry Analysis
Was Wet, Now Dry
Was Dry, Now Wet

Water Level Difference (m)
< -0.50
-0.50 to -0.10
-0.10 to -0.05
-0.05 to -0.02
-0.02 to -0.01
-0.01 to 0.01
0.01 to 0.02
0.02 to 0.05
0.05 to 0.10
0.10 to 0.50
> 0.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

200 Year ARI
Velocity Difference
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F24**

Legend

- Site Boundary
- South Creek Flood Study (200yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre

Velocity Difference (m/s)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

DRAFT - Not For Construction

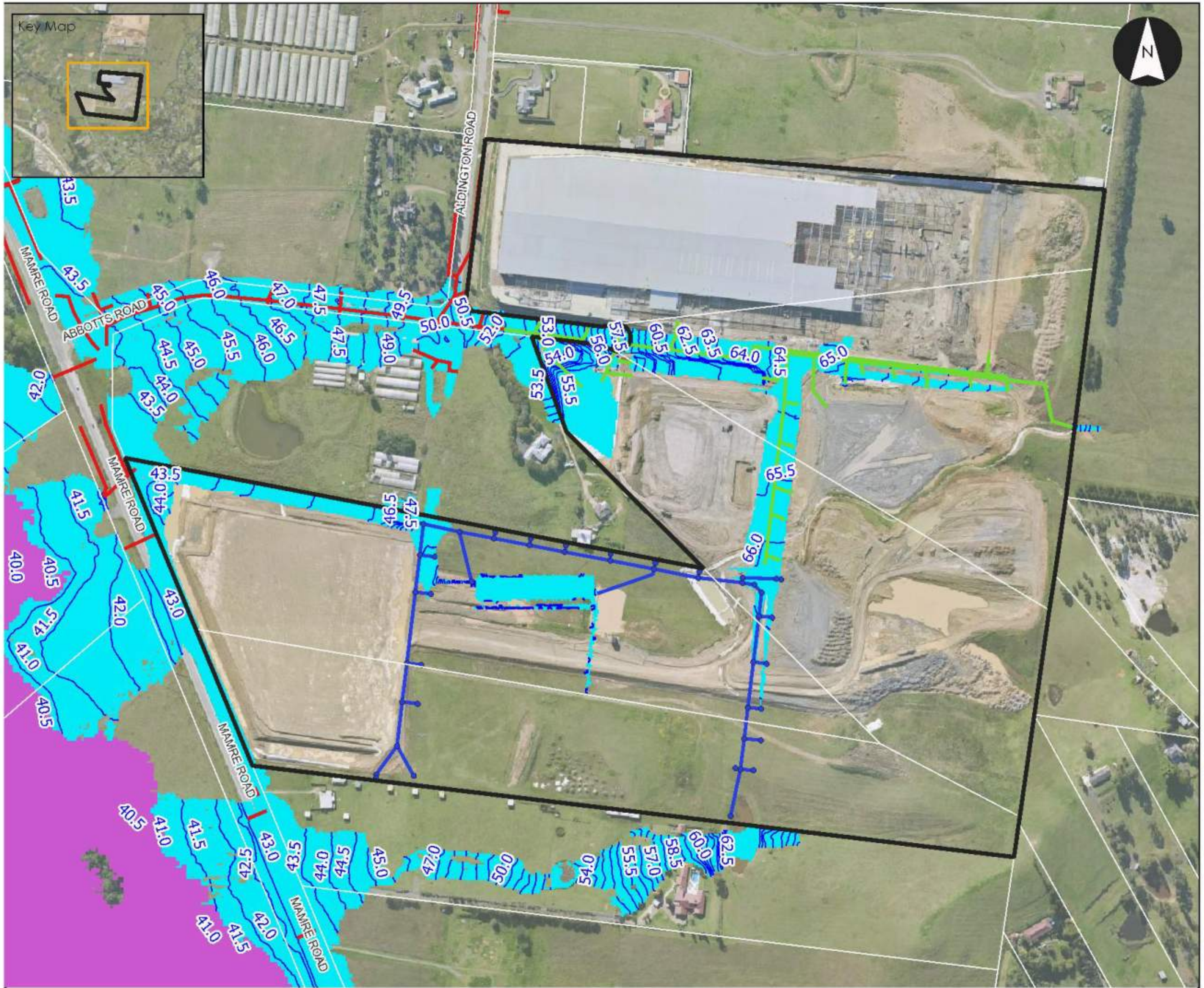
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



500 Year ARI
Flood Extents & Flood Levels
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F25**

Legend

- Site Boundary
- South Creek Flood Study (500yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre
- 0.5m Water Level Contours (mA HD)
- Flood Extent

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

500 Year ARI Flood Depths Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F26**

Legend

- Site Boundary
- South Creek Flood Study (500yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

500 Year ARI
Flood Velocities
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F27**

Legend

- Site Boundary
- South Creek Flood Study (500yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

500 Year ARI
Flood Hazard
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F28**

Legend

- Site Boundary
- South Creek Flood Study (500yr) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Hazard Category

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

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

500 Year ARI Water Level Difference Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F29**

Legend

- Site Boundary
- South Creek Flood Study (500yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre

Wet & Dry Analysis

- Was Wet, Now Dry
- Was Dry, Now Wet

Water Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to -0.05
- -0.05 to -0.02
- -0.02 to -0.01
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.10
- 0.10 to 0.50
- > 0.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

500 Year ARI
Velocity Difference
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F30**

Legend

- Site Boundary
- South Creek Flood Study (500yr) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre

Velocity Difference (m/s)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

PMF
Flood Extents & Flood Levels
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F31**

Legend

- Site Boundary
- South Creek Flood Study (PMF) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre
- 0.5m Water Level Contours (mA HD)
- Flood Extent

DRAFT - Not For Construction

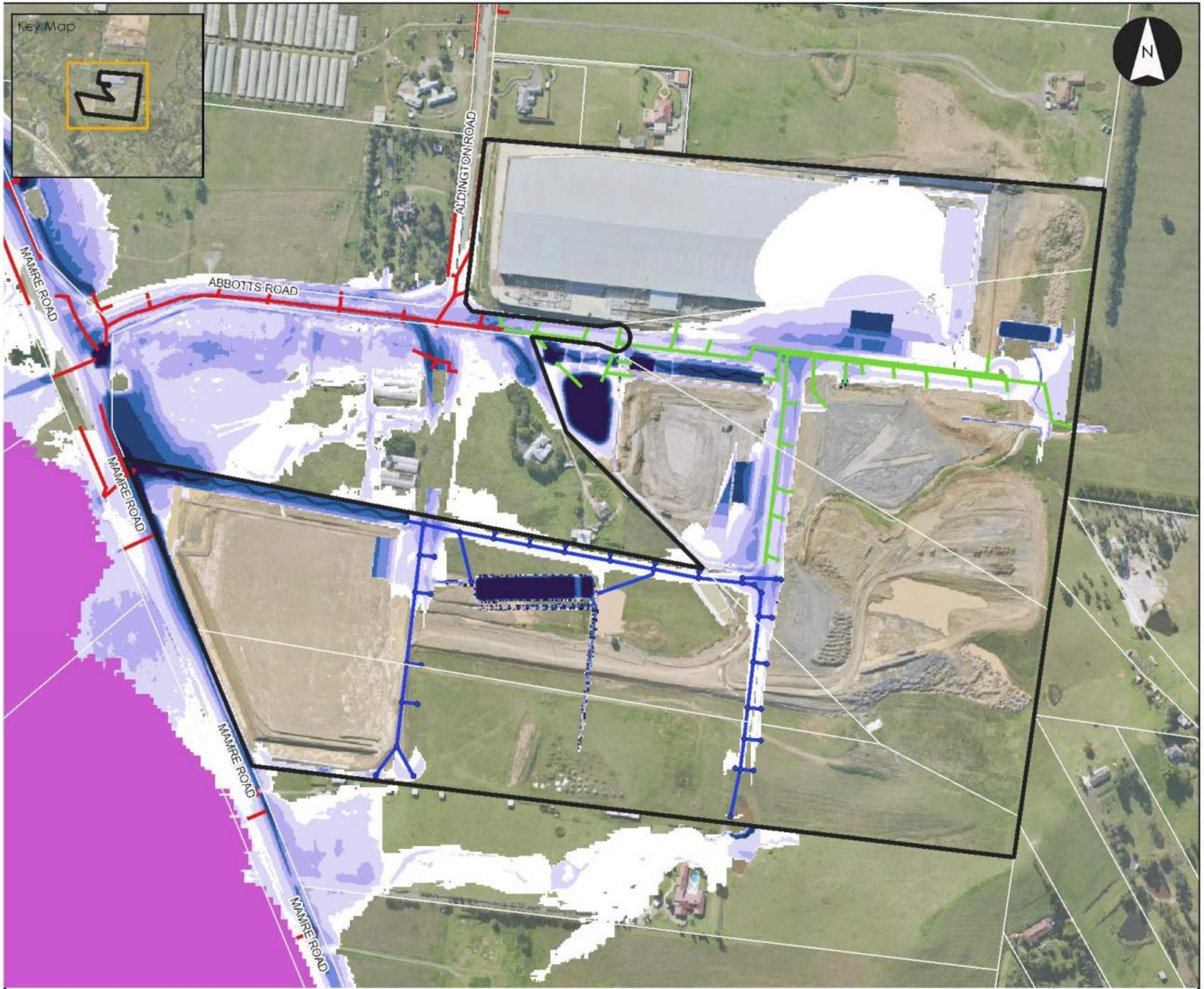
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



PMF
Flood Depths
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F32**

Legend

- Site Boundary
- South Creek Flood Study (PMF) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

PMF
Flood Velocities
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F33**

Legend

- Site Boundary
- South Creek Flood Study (PMF) Flood Extent
- Mamre Road Pipes
- Design Stage1 Drainage
- Design Stage2 Drainage
- Cadastre

Flood Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

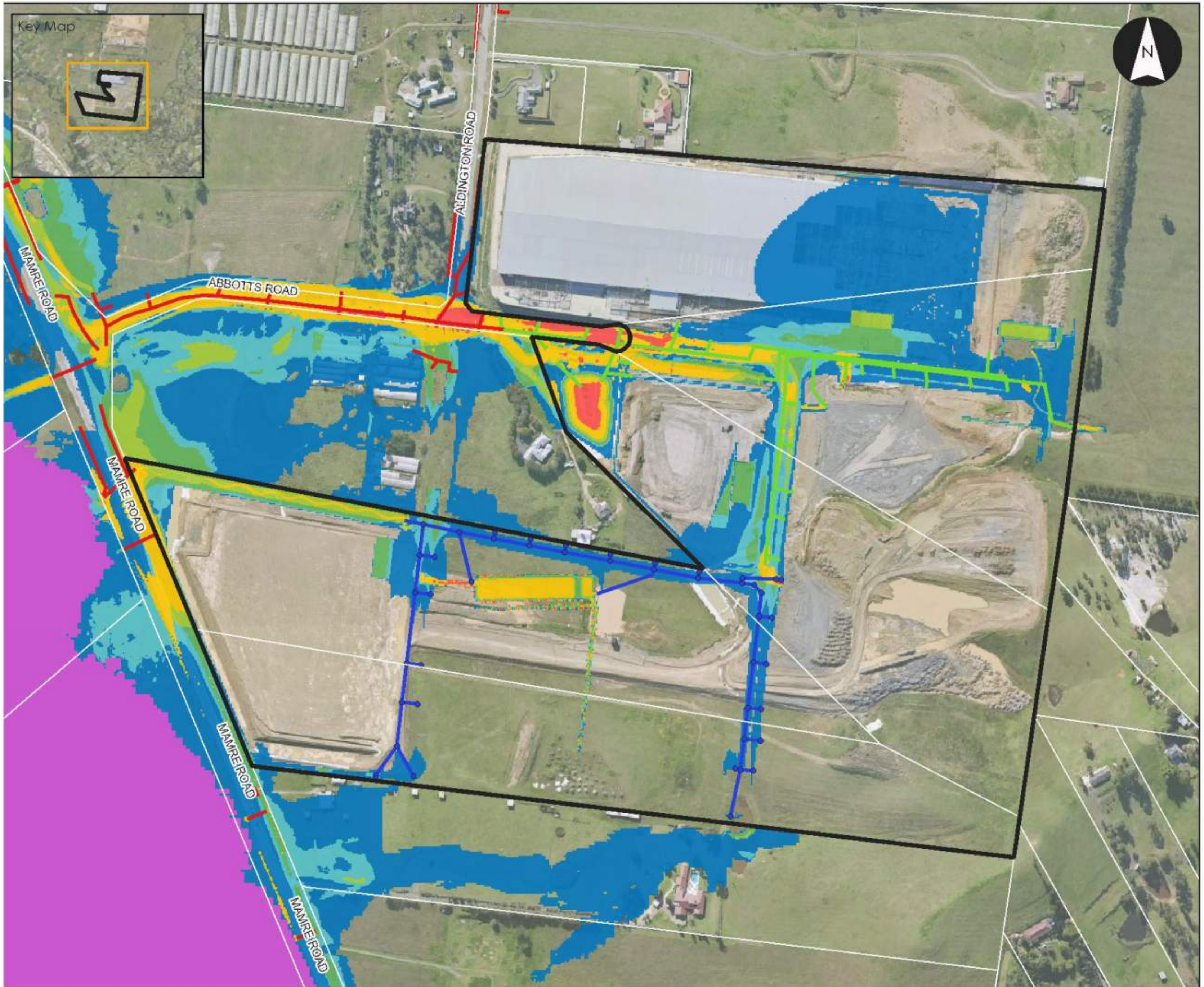
DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

Scale at A3: 1:6000



PMF
Flood Hazard
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F34**

Legend

- Site Boundary
- South Creek Flood Study (PMF) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre

Hazard Category

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

DRAFT - Not For Construction

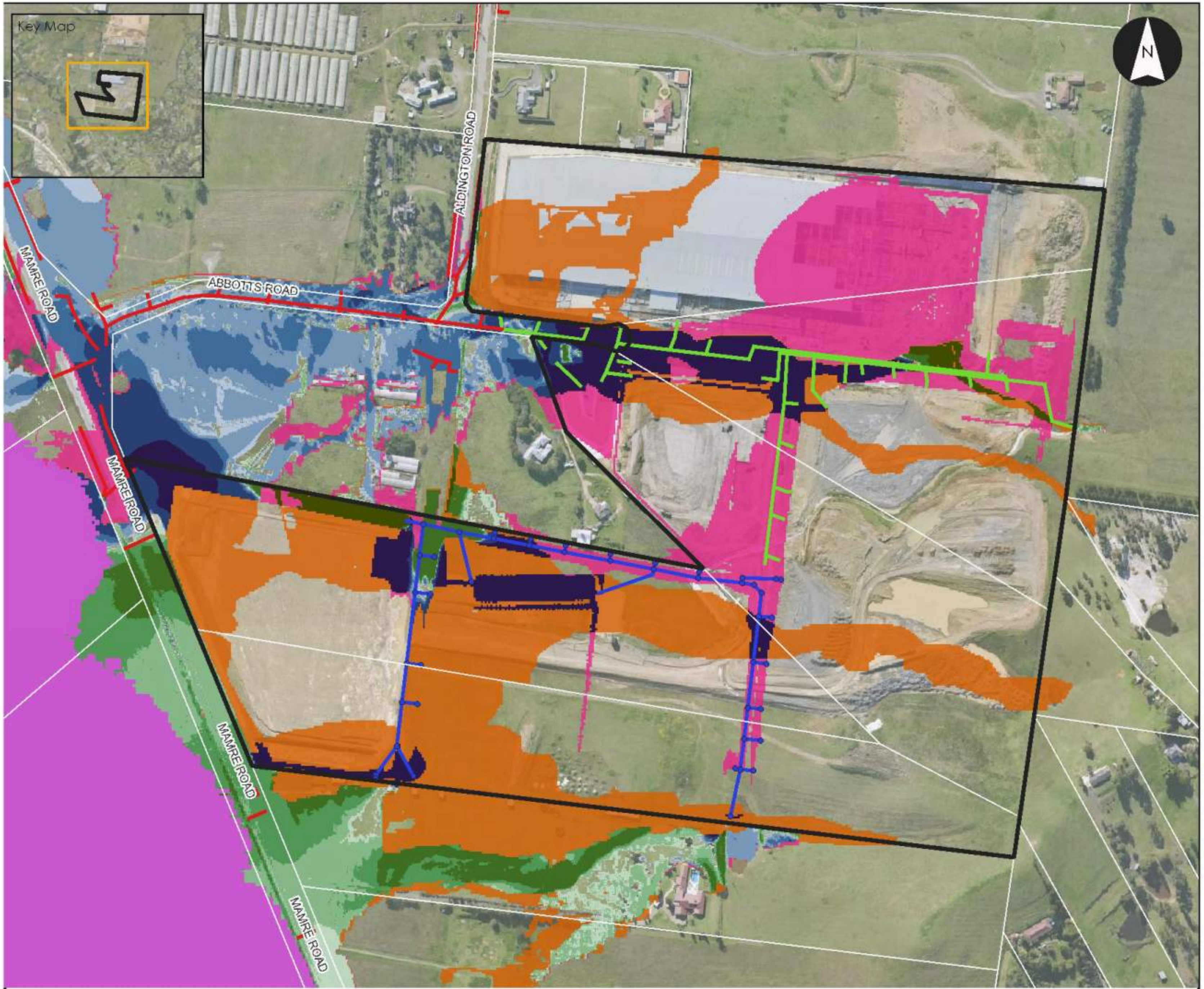
Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000



PMF
Water Level Difference
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F35**

Legend

Site Boundary
South Creek Flood Study (PMF) Flood Extent
Mamre Road Pipes
Design Stage 1 Drainage
Design Stage2 Drainage
Cadastre

Wet & Dry Analysis
Was Wet, Now Dry
Was Dry, Now Wet

Water Level Difference (m)
< -0.50
-0.50 to -0.10
-0.10 to -0.05
-0.05 to -0.02
-0.02 to -0.01
-0.01 to 0.01
0.01 to 0.02
0.02 to 0.05
0.05 to 0.10
0.10 to 0.50
> 0.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

PMF
Velocity Difference
Stage 2 Proposed Conditions

Project: Westlink ESR Industrial Estate

Client: ESR Australia
Project Code: 304700730
Drawn By: SHP, Checked By: SY
Date: (2024-08-15)
Figure No: **F36**

Legend

- Site Boundary
- South Creek Flood Study (PMF) Flood Extent
- Mamre Road Pipes
- Design Stage 1 Drainage
- Design Stage2 Drainage
- Cadastre

Velocity Difference (m/s)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

DRAFT - Not For Construction

Notes:
1. Map displayed in EPSG:28356

References:
1. Base map - Metromap

Stantec

48 0 48 96 144 192 m

Scale at A3: 1:6000

Appendix C

Indicative FERP table of Contents

Table of Contents

Appendices

Appendix D
Rainfall Loss Sensitivity Assessments

Scenario 1 ARR Edition **1987**

Pervious Area Losses
Initial Loss (mm) 37.1
Continuing (mm/h) 0.94

Source: 2015 Updated South Creek Flood Study (Worley Parsons)
BX 1.3
Roughness 0.025

ARI (yrs)	100	100	100	100	100	100	100	100	100	100	100	100		
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Critical Duration (mins)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
N3	0.32	0.71	0.82	0.79	0.81	0.77	0.96	0.86	0.91	0.92	0.62	0.49	0.96	4.5
N4	0.09	0.18	0.21	0.20	0.21	0.19	0.24	0.22	0.23	0.23	0.15	0.12	0.24	4.5
N34	0.41	0.90	1.03	0.98	1.02	0.96	1.20	1.08	1.14	1.15	0.78	0.61	1.20	4.5
N1	0.93	2.21	2.82	3.07	3.27	3.09	3.11	3.46	3.75	3.89	2.85	2.26	3.89	12
N2	1.49	3.15	3.76	4.04	4.32	4.09	4.27	4.51	4.99	5.12	3.74	2.97	5.12	12
S1	0.23	0.31	0.34	0.33	0.38	0.24	0.33	0.30	0.26	0.26	0.17	0.14	0.38	2
S2	0.75	1.45	1.74	1.96	2.08	1.99	2.02	2.20	2.44	2.52	1.84	1.46	2.52	12
S3	1.15	2.12	2.37	2.53	2.70	2.61	2.81	2.81	3.20	3.30	2.37	1.88	3.30	12
MRID3	0.27	0.64	0.81	0.88	0.94	0.87	0.90	0.96	1.06	1.09	0.78	0.62	1.09	12
MRID2	0.68	1.56	2.14	2.38	2.52	2.44	2.38	2.79	3.02	3.11	2.34	1.87	3.11	12
Junc	2.10	4.30	5.28	5.74	6.11	5.90	6.03	6.54	7.25	7.39	5.48	4.37	7.39	12
MRID1	0.29	0.72	1.08	1.47	1.64	1.74	1.62	1.86	2.41	2.32	1.92	1.66	2.41	9
MRd	4.18	8.66	10.75	11.88	12.71	12.32	12.30	13.70	15.51	15.42	11.77	9.62	15.51	9
Storm Burst (hrs)	0.5	0.75	1	1.5	2	3	4.5	6	9	12	24	36		

Scenario 3 ARR Edition **1987**

Pervious Area Losses
Initial Loss (mm) 37.1
Continuing (mm/h) 0.94

Source: 2015 Updated South Creek Flood Study (Worley Parsons)
BX 1.0
Roughness 0.04

ARI (yrs)	100	100	100	100	100	100	100	100	100	100	100	100		
Subcatchment ID	Storm Burst Duration (mins)												Peak Flow (m3/s)	Critical Duration (mins)
	30	45	60	90	120	180	270	360	540	720	1440	2160		
N3	0.30	0.67	0.76	0.76	0.80	0.76	0.90	0.83	0.90	0.91	0.62	0.49	0.91	12
N4	0.08	0.17	0.20	0.19	0.20	0.19	0.23	0.21	0.22	0.23	0.15	0.12	0.23	4.5
N34	0.37	0.85	0.96	0.96	1.00	0.95	1.13	1.05	1.12	1.13	0.78	0.61	1.13	12
N1	0.85	2.05	2.65	2.92	3.09	3.00	2.92	3.40	3.67	3.80	2.83	2.26	3.80	12
N2	1.35	2.96	3.56	3.88	4.14	3.96	3.96	4.43	4.87	5.03	3.72	2.97	5.03	12
S1	0.22	0.29	0.33	0.32	0.36	0.23	0.32	0.30	0.26	0.26	0.17	0.14	0.36	2
S2	0.68	1.35	1.64	1.86	1.95	1.92	1.84	2.17	2.39	2.48	1.83	1.46	2.48	12
S3	1.06	2.01	2.26	2.43	2.55	2.51	2.62	2.77	3.14	3.25	2.36	1.88	3.25	12
MRID3	0.23	0.58	0.76	0.84	0.88	0.84	0.84	0.95	1.03	1.07	0.78	0.62	1.07	12
MRID2	0.61	1.38	2.01	2.26	2.42	2.38	2.24	2.73	2.96	3.03	2.32	1.87	3.03	12
Junc	1.90	3.95	4.99	5.50	5.80	5.70	5.62	6.42	7.10	7.24	5.44	4.37	7.24	12
MRID1	0.26	0.64	1.00	1.39	1.55	1.68	1.59	1.76	2.35	2.24	1.87	1.65	2.35	9
MRd	3.79	8.01	10.12	11.36	12.11	11.87	11.51	13.32	15.18	15.13	11.69	9.61	15.18	9
Storm Burst (hrs)	0.5	0.75	1	1.5	2	3	4.5	6	9	12	24	36		

Scenario 2 ARR Edition **1987**

Pervious Area Losses
Initial 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		
ID	Storm Burst Duration (mins)												(m3/s)	Duration
	30	45	60	90	120	180	270	360	540	720	1440	2160		
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
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
N34	1.54	1.69	1.94	1.92	2.07	1.58	1.52	1.30	1.12	1.13	0.77	0.60	2.07	2
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
N2	5.51	6.48	7.10	7.04	7.43	5.60	6.63	5.72	4.92	5.05	3.67	2.91	7.43	2
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
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
MRID3	1.17	1.38	1.52	1.52	1.55	1.20	1.42	1.21	1.04	1.08	0.77	0.61	1.55	2
MRID2	2.89	3.62	4.01	3.96	4.03	3.36	3.93	3.36	2.97	3.07	2.30	1.83	4.03	2
Junc	7.67	9.04	9.93	9.96	10.40	8.06	9.41	8.19	7.15	7.29	5.38	4.28	10.40	2
MRID1	1.37	1.96	2.30	2.45	2.56	2.40	2.35	2.52	2.38	2.28	1.88	1.62	2.56	2
MRd	15.34	18.33	20.43	20.50	21.36	16.74	19.40	17.27	15.30	15.20	11.56	9.42	21.36	2
Storm Burst (hrs)	0.5	0.75	1	1.5	2	3	4.5	6	9	12	24	36		

Scenario 4 ARR Edition **1987**

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

Source: 2012 Upper South Creek Flood Study (WMAwater)
BX 1.0
Roughness 0.04

ARI (yrs)	100	100	100	100	100	100	100	100	100	100	100	100		
Subcatchment ID	Storm Burst Duration (mins)												Flow	Duration
	30	45	60	90	120	180	270	360	540	720	1440	2160		
N3	1.18	1.30	1.47	1.45	1.56	1.18	1.19	1.03	0.89	0.90	0.61	0.48	1.56	2
N4	0.30	0.33	0.38	0.37	0.40	0.30	0.30	0.26	0.22	0.22	0.15	0.12	0.40	2
N34	1.48	1.62	1.84	1.82	1.95	1.48	1.49	1.28	1.11	1.12	0.77	0.60	1.95	2
N1	3.68	4.60	5.03	4.98	5.02	4.11	4.90	4.14	3.62	3.75	2.78	2.22	5.03	1
N2	5.15	6.12	6.70	6.64	6.91	5.30	6.43	5.56	4.80	4.96	3.66	2.91	6.91	2
S1	0.54	0.53	0.66	0.70	0.67	0.47	0.40	0.30	0.26	0.26	0.17	0.13	0.70	1.5
S2	2.44	2.89	3.10	3.08	3.19	2.55	3.08	2.69	2.35	2.45	1.80	1.43	3.19	2
S3	3.47	3.87	4.28	4.47	4.67	3.60	4.01	3.55	3.09	3.21	2.32	1.84	4.67	2
MRID3	1.09	1.32	1.44	1.42	1.45	1.14	1.38	1.18	1.02	1.06	0.77	0.61	1.45	2
MRID2	2.64	3.40	3.74	3.72	3.86	3.29	3.74	3.26	2.92	2.99	2.28	1.83	3.86	2
Junc	7.12	8.54	9.34	9.32	9.72	7.57	9.04	7.96	7.00	7.14	5.35	4.28	9.72	2
MRID1	1.20	1.73	2.12	2.32	2.43	2.29	2.19	2.42	2.32	2.20	1.83	1.62	2.43	2
MRd	14.28	17.28	19.19	19.30	20.03	16.01	18.66	16.76	14.97	14.92	11.47	9.41	20.03	2
Storm Burst (hrs)	0.5	0.75	1	1.5	2	3	4.5	6	9	12	24	36		

Scenario 5 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
net probability loss: 11.2

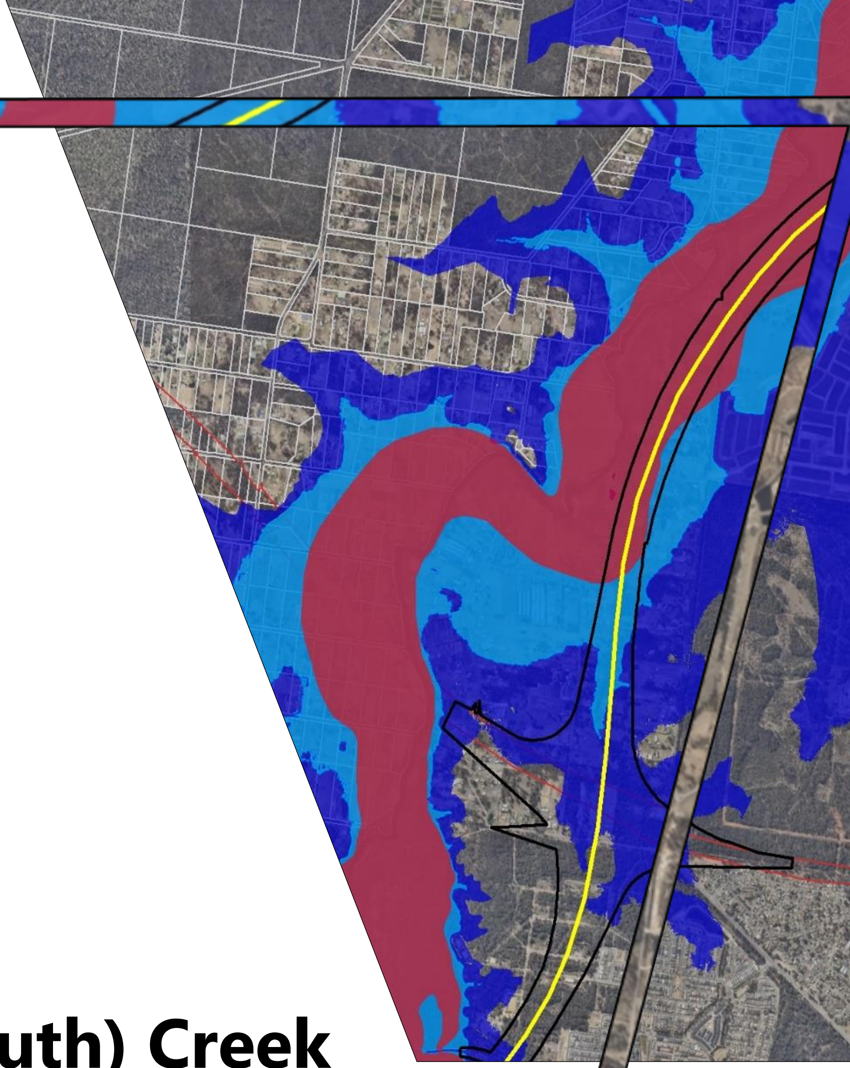
ARI (yrs)	100	100	100	100	100	100	100	100	100	100	100	100		
ID	Storm Burst Duration (mins)												(m3/s)	Duration
	30	45	60	90	120	180	270	360	540	720	1440	2160		
N3	1.81	1.74	1.59	1.32	1.28	1.00	0.84	0.84	0.69				1.81	0.5
N4	0.47	0.45	0.41	0.3410	0.3266	0.26	0.22	0.21	0.17				0.47	0.5
N34	2.28	2.18	2.00	1.66	1.60	1.26	1.06	1.05	0.86				2.28	0.5
N1	6.16	6.45	6.10	4.99	4.96	3.99	3.30	3.48	2.83				6.45	0.75
N2	8.33	8.55	8.09	6.72	6.61	5.33	4.39	4.64	3.77				8.55	0.75
S1	0.72	0.62	0.57	0.47	0.45	0.34	0.31	0.26	0.20				0.72	0.5
S2	3.97	4.11	3.90	3.25	3.20	2.58	2.12	2.26	1.83				4.11	0.75
S3	5.52	5.53	5.20	4.43	4.29	3.43	2.81	2.99	2.41				5.53	0.75
MRID3	1.79	1.84	1.73	1.41	1.40	1.13	0.93	0.97	0.79				1.84	0.75
MRID2	4.49	4.91	4.71	3.92	3.89	3.12	2.61	2.79	2.26				4.91	0.75
Junc	11.45	11.96	11.49	9.53	9.41	7.56	6.28	6.69	5.42				11.96	0.75
MRID1	2.12	2.62	2.85	2.84	2.66	2.26	1.90	2.11	1.76				2.85	1
MRd	22.78	24.15	23.41	19.74	19.38	15.74	13.20	14.22	11.51				24.15	0.75
Storm Burst (hrs)	0.5	0.75	1	1.5	2	3	4.5	6	9	12	24	36		

Scenario 6 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 1.0
Roughness 0.04
net probability loss: 11.2

ARI (yrs)	100	100	100	100	100	100	100	100	100	100	100	100		
Subcatchment ID	Storm Burst Duration (mins)												Flow	Duration
	30	45	60	90	120	180	270	360	540	720	1440	2160		
N3	1.73	1.68	1.54	1.27	1.24	0.98	0.82	0.82	0.68				1.73	0.5
N4	0.45	0.43	0.40	0.328	0.317	0.25	0.21	0.21	0.17				0.45	0.5
N34	2.18	2.11	1.93	1.60	1.55	1.23	1.03	1.03	0.85				2.18	0.5
N1	5.67	6.11	5.83	4.82	4.79	3.85	3.21	3.41	2.76				6.11	0.75
N2	7.82	8.15	7.78	6.48	6.39	5.16	4.27	4.55	3.69				8.15	0.75
S1	0.70	0.61	0.56	0.469	0.438	0.33	0.31	0.26	0.20				0.70	0.5
S2	3.69	3.89	3.74	3.14	3.10	2.49	2.06	2.21	1.79				3.89	0.75
S3	5.21	5.27	4.99	4.27	4.16	3.32	2.73	2.93	2.37				5.27	0.75
MRID3	1.66	1.75	1.66	1.36	1.353	1.087	0.90	0.95	0.77				1.75	0.75
MRID2	4.10	4.61	4.48	3.81	3.74	3.00	2.53	2.73	2.21				4.61	0.75
Junc	10.71	11.35	11.01	9.21	9.10	7.32	6.10	6.56	5.30				11.35	0.75
MRID1	1.91	2.37	2.62	2.70	2.54	2.19	1.84	2.04	1.71				2.70	1.5
MRd	21.35	22.88	22.43	19.05	18.72	15.25	12.81	13.93	11.28				22.88	0.75
Storm Burst (hrs)	0.5	0.75	1	1.5	2	3	4.5	6	9	12	24	36		



Wianamatta (South) Creek Catchment Flood Study

Existing Conditions

November 2020

Level 17, 141 Walker St
North Sydney NSW 2060
Australia

rp311015-00033rg_crt201120-Sth Ck Catchment FS (Rev H).docx

Revision H

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Worley Group

NSW GOVERNMENT

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In summary, the differences observed between the 2015 and 2020 flood model results are largely to be expected given the catchment and floodplain changes associated with recent development and the incorporation of more detailed topographic data. The updated flood models are considered to suitably represent the contemporary conditions across the South Creek floodplain and no further modification was made to the parameters adopted in the XP-RAFTS and RMA-2 models for the purpose of validation.

4.4 Australian Rainfall & Runoff 1987 vs 2019

Australian Rainfall & Runoff (ARR) 2019 has been released since completion of the *'Updated South Creek Flood Study'* in 2015. For flood estimation, ARR2019 provides guidelines for approaches relying on rainfall based methods (*runoff-routing modelling*) and At-site Flood Frequency Analysis (FFA).

As per ARR2019 guidelines, FFA is to be considered for flood estimation for all catchments where it is available or a sufficient length of reliable data is available for one to be derived. Design discharges derived through rainfall based methods should therefore be calibrated to the FFA and reflect recorded data. This may involve adjustments to design inputs such as initial and continuing losses, temporal patterns, pre-burst rainfall, IFD and areal reduction factors.

An FFA is available for the South Creek catchment for the Elizabeth Drive stream gauge (*Station Number 212320*). The FFA was derived for the gauge based on 49 years of records as part of work competed by WMAwater in preparation of the report titled *'Review of ARR Design Inputs for NSW'* (*OEH, 2019*). The corresponding FFA curve for the gauge (*note that it is incorrectly referred to as being located at Mulgoa Road*) is included within **Appendix C**.

The ARR 2019 IFD data and methodologies were applied to the South Creek XP-RAFTS hydrologic model as a means of assessing the "fit" between runoff-routing modelling based on ARR1987 and ARR2019, and the available FFA. This analysis and the findings are discussed in the following sections.

4.4.1 Application of ARR 2019 IFD and Methodologies

ARR2019 IFD and methodologies were applied to the South Creek XP-RAFTS hydrologic model. This involved the download of rainfall temporal patterns and other information for South Creek from the ARR 2019 Data Hub. IFD data was sourced from the Bureau of Meteorology (BOM).

Similar to the ARR 1987 approach, multiple sets of IFD data were applied across different parts of the catchment. The total catchment area is greater than 75 km^2 and therefore, the applicable *East Coast South* Areal Temporal Patterns (ATPs) were used. Point Temporal Patterns were used for storm durations less than 12 hours.

Appropriate Areal Reduction Factors were applied to the IFD data to account for the total catchment area of 415 km^2.

An adjusted continuing rainfall loss rate was applied, and Probability Neutral Burst Initial Losses were adopted, as per ARR 2019 guidance for NSW catchments. This led to initial losses ranging between 7.9-17.2 mm/hour being adopted for pervious catchments for the range of storm durations assessed (*i.e., 6-36 hours*). The adopted impervious area rainfall initial and continuing losses were 1 mm and 0 mm/hr, respectively.

It is worth noting that the adopted initial losses for pervious catchments are lower than the losses determined through calibration and validation; typically, in the order of 37.1 mm/hour. Although initial modelling sought to adopt the calibrated losses, later comparisons of the peak flows generated against the FFA at Elizabeth Drive found that it produced a poorer comparison than the ARR2019 Probability Neutral Burst Initial Losses.

As per ARR 2019 methodology, 10 temporal patterns were assessed for each storm duration. The adopted temporal pattern was selected as providing the closest peak flow to the mean on the higher side according to a bias factor of two; i.e., the peak flow from the selected pattern was not further from the mean by more than two times the difference from the mean flow to the closest lower flow.

The critical duration storm under ARR 2019 was found to be 12 hours in the upper part of the catchment and 18 hours in the lower reaches; i.e., downstream of the Ropes Creek confluence.

4.4.2 Findings and Conclusions

The 1% AEP peak flows derived from simulations completed based on the ARR 2019 analysis procedures were compared to peak flows derived by FFA at Elizabeth Drive. A comparison was also made to the corresponding peak flows derived from the ARR 1987 results (*refer* **Table 4.5** *and* **Appendix C**).

Table 4.5 Comparison of Peak 1% AEP Flows at Elizabeth Drive (South Creek) based on ARR 1987 and ARR 2019 Hydrology to FFA

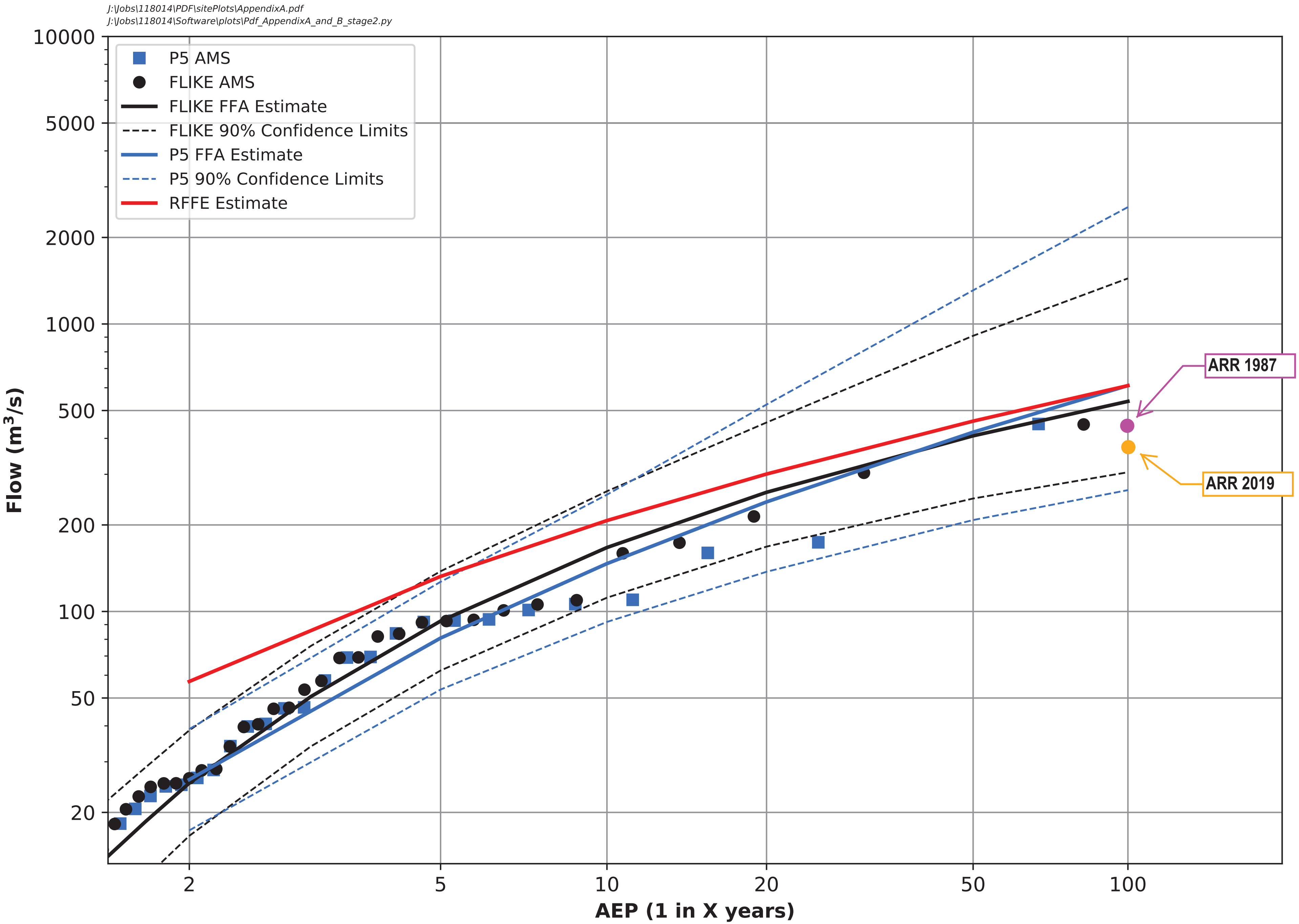
Approach Adopted for Estimation of Design 1% AEP Flows		
Flood Frequency Analysis	**ARR 1987**	**ARR 2019**
538 m^3/s ^	492 m^3/s - 9%	381 m^3/s - 29%

^ *Value extracted from FFA curve provided as Appendix A49 – 'Review of ARR Design Inputs for NSW' (OEH, February 2019) prepared by WMA Water*

Download link: https://data.arr-software.org/static/pdf/appendix.pdf

The comparison shows that the runoff-routing modelling based on ARR 1987 generates a peak flow for the 1% AEP event that matches more closely to the FFA than runoff-routing modelling based on ARR 2019. These findings indicate that in the absence of being able to improve the calibration of the XP-RAFTS model via adjustment of the adopted parameters (i.e., initial and continuing losses, temporal patterns, pre-burst rainfall, IFD and areal reduction factors), then the modelling based on ARR 1987 provides a better validation to the available FFA.

Based on the above findings, it is recommended that ARR 1987 temporal patterns and IFD data continue to be adopted to define the flood hydrology for the South Creek catchment. This is consistent with ARR 2019 guidelines which specify that flood hydrology should be based on observed data and FFA where possible and available.



MULGOA RD - 212320 [F4]

FFA VARIANTS

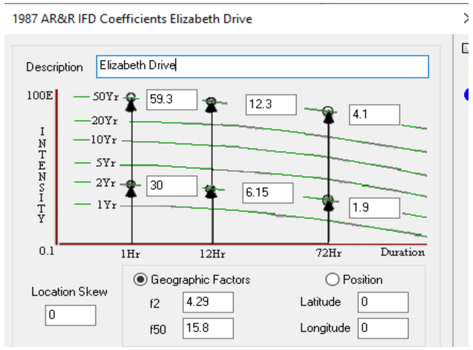
APPENDIX A49

Appendix E
RAFTS Model Parameter Values

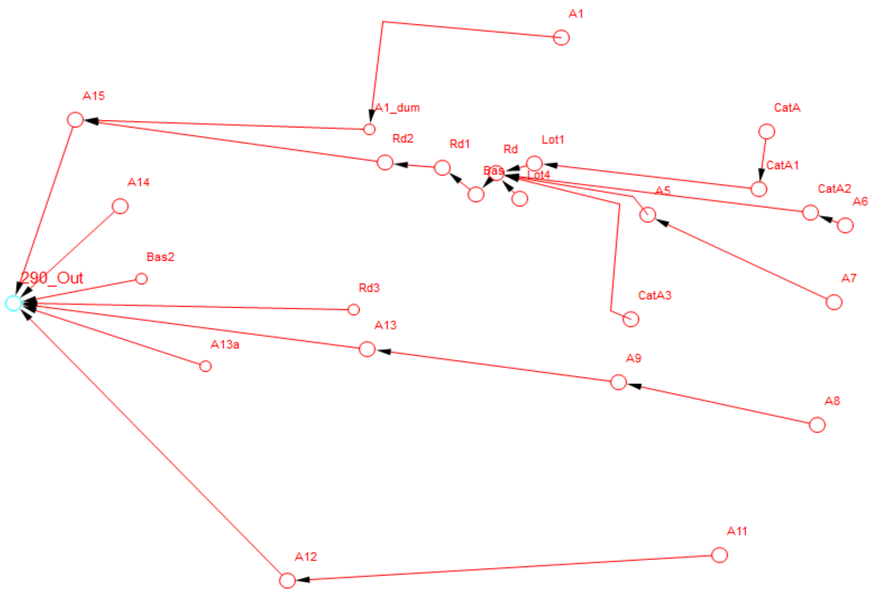
304600730 ESR Stage 2

IFD:	ARR1987				
Rainfall Losses	Pervious IL (mm)	15	Impervious IL(mm)	1	
	Pervious CL (mm/h)	1.5	Impervious CL (mm/h)	0	
BX	1.3				

Subcatchment ID	Total Area	Pervious		Impervious		Lag
		Area	PERN (n)	Area	PERN (n)	
	(ha)	(ha)		(ha)	(n)	(mins)
A6	2.30	2.30	0.025	0.000	0	1.00
CatA2	0.77	0.12	0.025	0.653	0.015	1.00
A7	3.33	3.33	0.025	0.000	0	2.00
A5	4.79	0.72	0.025	4.070	0.015	2.00
Lot4	3.24	0.49	0.025	2.757	0.015	3.00
CatA3	0.35	0.05	0.025	0.298	0.015	4.00
CatA	0.35	0.05	0.025	0.300	0.015	5.00
CatA1	1.71	0.26	0.025	1.457	0.015	5.00
Lot1	11.12	1.67	0.025	9.452	0.015	5.00
Rd	1.84	0.18	0.025	1.654	0.015	1.00
Bas	7.81	7.81	0.025	0.000	0	1.00
Rd1	0.18	0.02	0.025	0.166	0.015	1.00
Rd2	0.13	0.01	0.025	0.116	0.015	1.01
A1	1.26	1.26	0.025	0.000	0	6.00
A1_dum	0.00	0.00	0.025	0.000	0	6.00
A15	16.20	16.20	0.025	0.000	0	1.01
A14	10.15	10.15	0.025	0.000	0	7.00
A8	2.30	2.30	0.025	0.000	0	8.00
Lot5	7.78	1.17	0.025	6.613	0.015	8.00
Lot6	7.03	1.06	0.025	5.976	0.015	8.00
A11	0.58	0.58	0.025	0.000	0	9.00
A12	15.03	15.03	0.025	0.000	0	9.00
Lot2	6.37	0.96	0.025	5.415	0.015	10.00
Lot6B	2.26	2.26	0.025	0.000	0	11.00
LowRd	1.13	0.11	0.015	1.017	0	12.00
TrunkD	0.79	0.79	0.025	0.000	0	13.00
UpRd	1.03	0.10	0.015	0.927	0	14.00
290_Out	0.00	0.00	0.025	0.000	0	1.01



RAFTS Link-Node Diagram



Stage 1 and Stage 2 Subcatchment Boundaries