BARKER RYAN STEWART

ALDA | ROSE | URBAN VILLAGER

Flood Impact Assessment Report

285-325 Pacific Highway, Lake Munmorah

August 2022

ENGINEERING
PLANNING
SURVEYING
CERTIFICATION

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Table of Contents

List of Figures

Appendices

1 Introduction

This Flood Impact Assessment (FIA) report has been prepared for Alda, Rose Group and Urban Villager to support a Planning Proposal application to the NSW Department of Planning and Central Coast Council for a proposed residential subdivision at 285-325 Pacific Highway, Lake Munmorah.

The planning proposal involves the rezoning of land at 285-325 Pacific Highway, Lake Munmorah to permit a residential development. The proposal is likely to yield in the order of 300 residential lots.

This FIA has been prepared to address Council requirements as advised at a teleconference held 8 December 2021 and confirmed via email on 9 December 2021. The report considers the critical 1% AEP and PMF storm events.

Two (2) scenarios have been modelled to simulate the existing condition and proposed development conditions.

Scenario 1: Existing scenario; and
Scenario 2: Proposed scenario based on the proposed development layout.

Figure 1 shows the location of the proposed development site.

Figure 1: Location of Subject Site (source maps.six.maps.nsw.gov.au)

Revision 2 of this report has been updated to address changes to the stormwater strategy and site arrangement due to requirements outlined in the Department of Planning and Environment email correspondence dated 8 July 2022 and correspondence dated 2 August 2022.

2 Site Location and Development Proposal

2.1 Existing Site & Location

The subject land is in Lake Munmorah within the Central Coast Council Local Government Area. The property addresses are 285-305, 315, 325 and 335 Pacific Highway, Lake Munmorah and include the following lots:

a. Lot 1 DP 626787;
b. Lot 2 DP 626787;
c. Lot 437 DP 755266;
d. Lot 438 DP 755266;
e. Lot 27 DP 755266;
f. Lot 12 DP 771284; and
g. Lot 83 DP 650114.

The total area of the subject sites is approximately 27.2 ha.

The site includes a natural ridge that approximately follows the boundary of Lot 1 and Lot 438. This divides the site into an Eastern and Western catchment. The site generally falls from north to south.

The site is traversed by two (2) unnamed water courses. A farm dam exists in the eastern water course. A Coastal Wetland as defined by SEPP (Coast Management) 2018, exists to the west of the site.

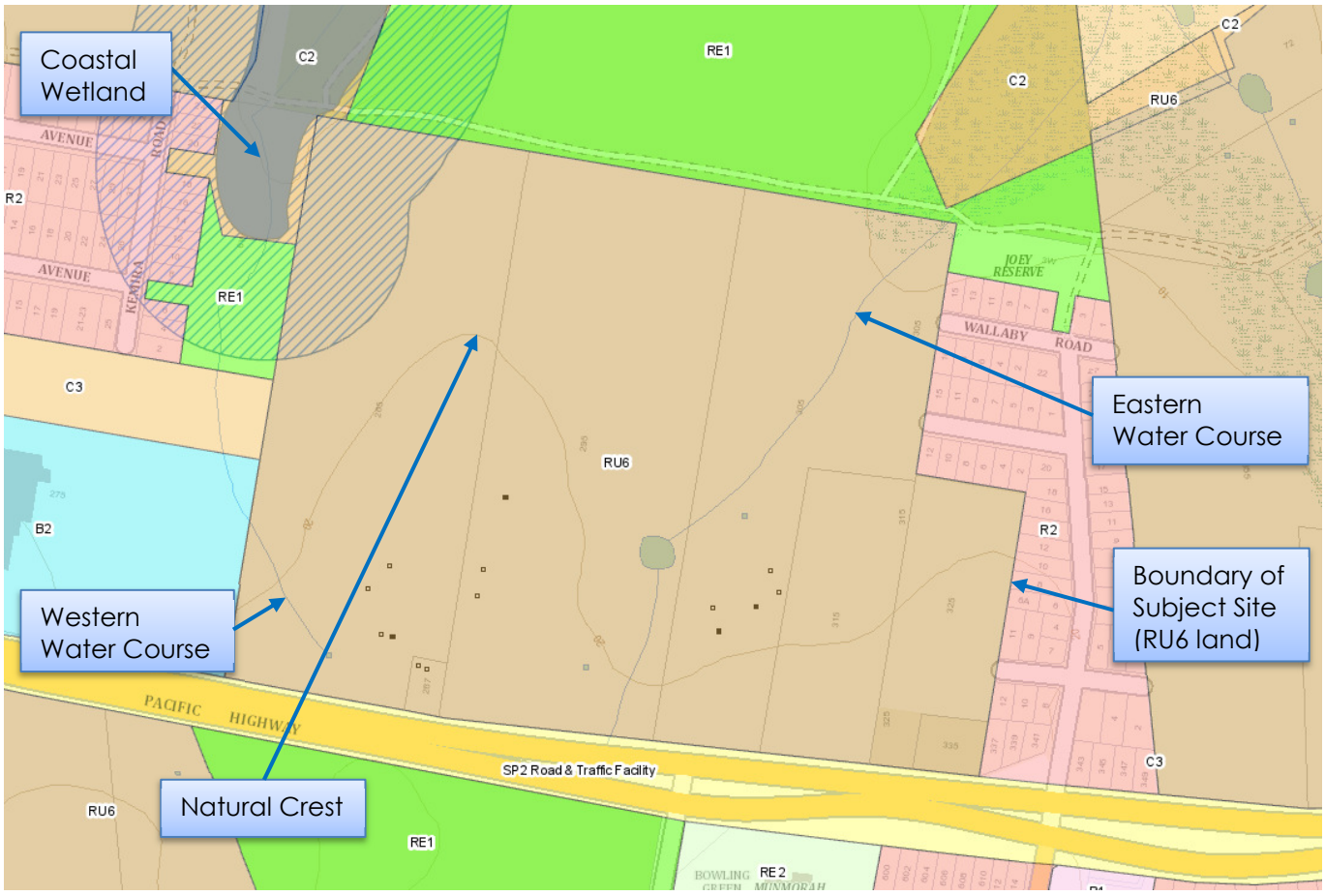


Figure 2: Existing Water Courses and Features (source ePlanning Spatial Viewer)

2.2 Proposed Development

The planning proposal involves the rezoning of land at 285-325 Pacific Highway, Lake Munmorah to permit a residential development. The proposal is likely to yield in the order of 300 residential lots. Primary vehicular access is proposed from the west and east via existing access points from the Pacific Highway. Potential staging of the development will be considered as part of future design stages (ie following Planning Proposal approval).

A Biodiversity Certification Assessment Report (BCAR) has been prepared for the site by Kleinfelder. The report concludes, in part, that:

a. The western watercourse was determined to be largely historic, with no existing watercourse occurring within the south-western corner of the subject site.
b. The eastern watercourse was determined to be largely retained within the proposed eastern corridor conservation area, with the southern extent of the mapped watercourse reduced as a result of historic development and earthworks.

Preliminary stormwater management requirements for the development have been assessed by Barker Ryan Stewart and reported separately. The preliminary requirements considered probable land take to facility combined water quality and water quantity (ie on-site detention) basins for the western and eastern catchments.

The proposed DCP Staging Plan by Peter Andrews and Associates has been prepared with consideration to the recommendations of the BCAR report and preliminary stormwater assessment. The DCP Staging Plan is presented below.

It is noted that the layout is indicative only and has been prepared to demonstrate the feasibility of the Planning Proposal. Final layout and lot configuration and yield is subject to further development as part of the next stage of the design after Planning Proposal approval.

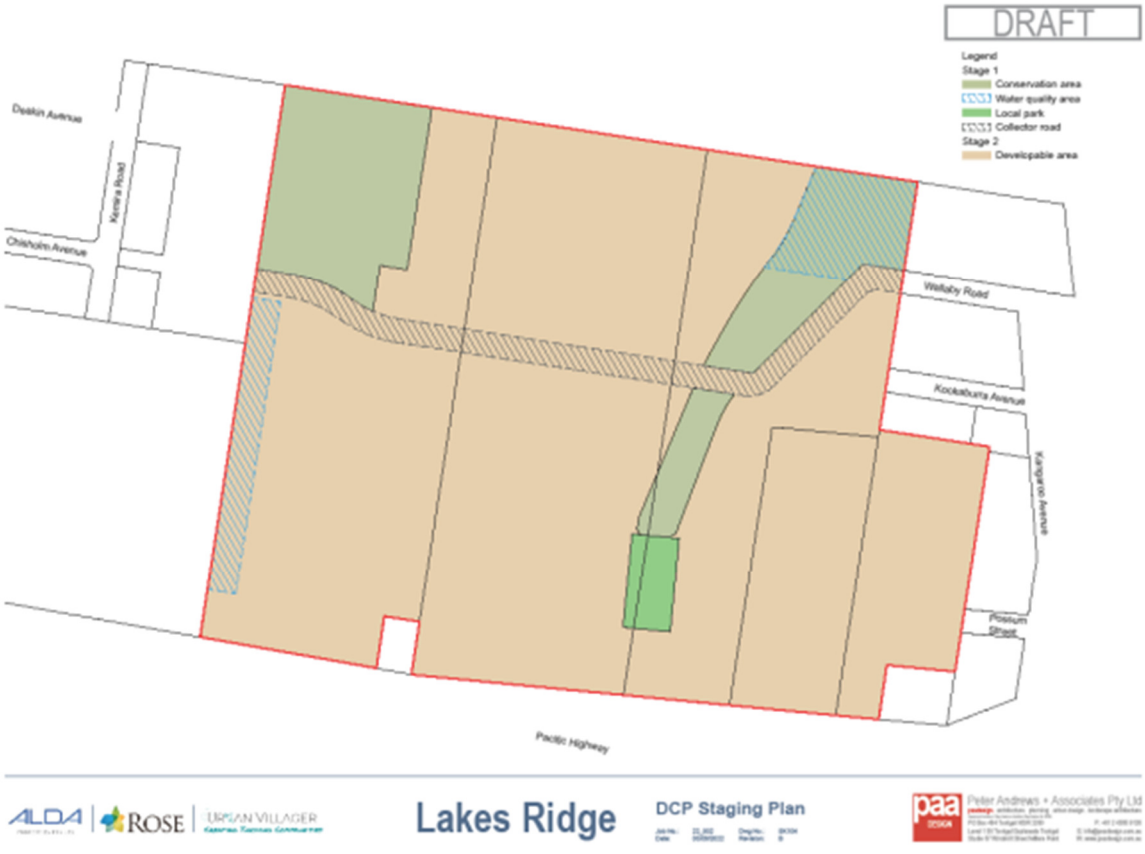


Figure 3: Concept Site Master Plan

3 Study Requirements

Requirements for the Flood Impact Assessment (FIA) were received from Central Coast Council via email on 1 September 2021. A copy of the correspondence is included in Appendix C.

A meeting to discuss and confirm FIA requirements to support the Planning Proposal was attended by Council and developer representatives on 8 December 2021. Following this meeting a list of updated requirements was prepared and agreed with Council. Email correspondence dated 9 December 2021 is presented in Appendix D.

A summary of the agreed requirements is presented below:

a. FIA to be prepared to the requirements of ARR2016.
b. Flood model to utilise a 2m grid or smaller.
c. Assess critical 1% AEP and PMF events.
d. Existing and developed scenario mapping to present velocity magnitudes, flood depth, level difference, hazard map (H1 to H6).

This Flood Impact Assessment report has been prepared to meet the requirements as agreed with Council.

4 Flood Model Development

The purpose of this Flood Impact Assessment is to investigate the existing flood behaviour on the development site and to assess the impacts of the proposed development on the flood behaviour and adjoining properties.

The critical 1% AEP (Annual Exceedance Probability) and the PMF (Probably Maximum Flood) has been modelled for the hydrologic and hydraulic assessment of the proposed development.

4.1 Hydrological Modelling

Hydrological modelling was carried out using DRAINS software. Catchment areas were estimated based upon the detailed site survey across the development site prepared by Barker Ryan Stewart (CC18099-DET-A refer Appendix B) and supplemented with LIDAR information obtained from the ICSM 'ELVIS' website.

The site's upstream catchment consists of open space south of the Pacific Highway and the Pacific Highway corridor. The site is subject to an external urban catchment from the east. An external catchment to the west comprises urban, commercial and open space areas.

The development site has been assessed as rural residential development.

The site and its upstream catchments has been delineated into smaller sub-catchments for hydrologic analysis and to ascertain the inflow boundaries in the hydraulic model.

The design parameters used in the DRAINS model (Software Version 2022.012) are presented in Table 1 below.

Table 1– Existing Hydrological Design Parameters

Parameters	Pervious	Impervious
Initial Loss (mm)	49	1
Continuing Loss (mm)	1	0
AMC	3	3

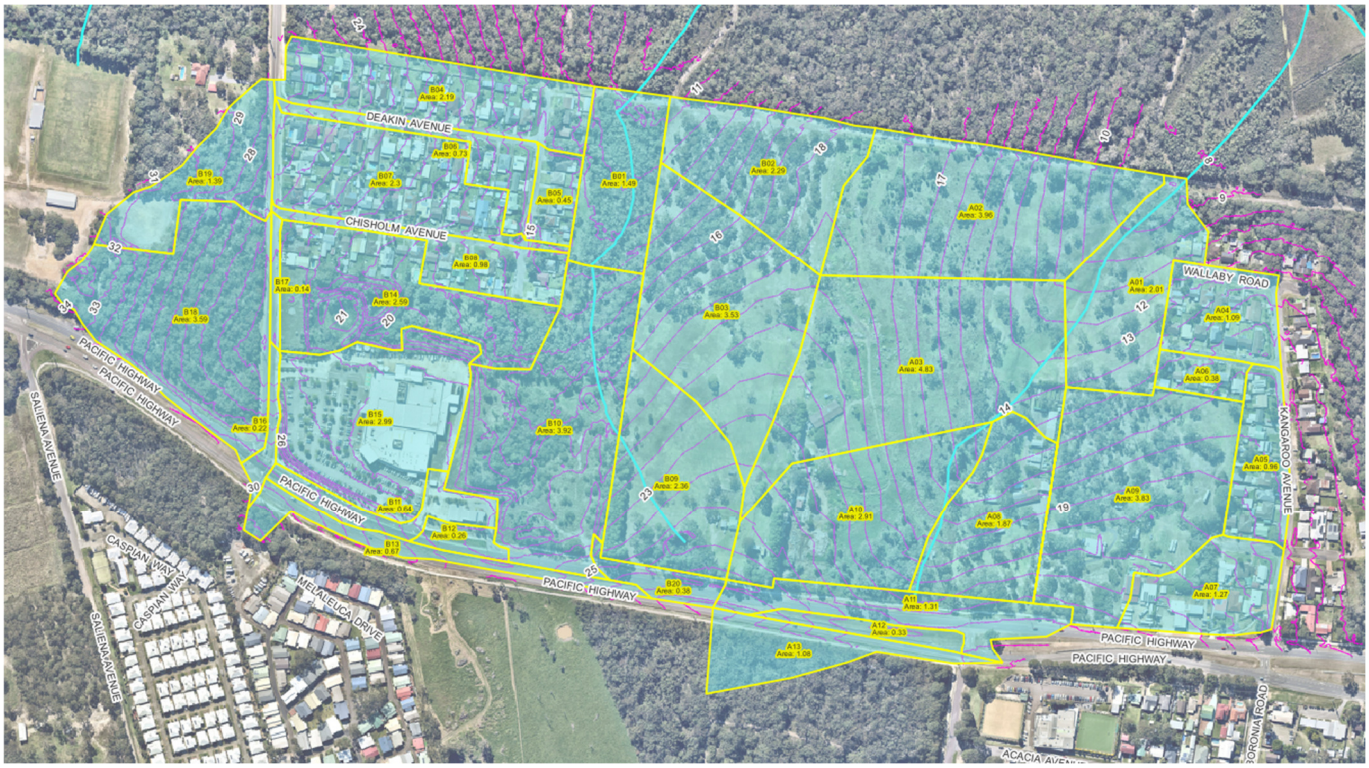
Rainfall data was adopted from the Bureau of Meteorology (BoM) website in accordance with the requirements of Australian Rainfall and Runoff, 2019.

Peak flow results for the sub-catchments were calculated using the IL-CL (Initial Loss-Continuing Loss) hydrological model and are presented below in Table 2.

Table 2– Existing Peak Flows

Parameters	Western Catchment	Eastern Catchment
1% AEP Peak Discharge (m^3/s)	17.60	12.40
1% AEP Median Peak Storm	15min Duration, Storm 8	25min Duration, Storm 1
PMF Peak Discharge (m^3/s)	55.50	38.50
PMF Peak Duration	15min Duration	30min Duration

Peak hydrographs for each of these sub-catchments were extracted from the DRAINS model and utilised in the hydraulic model.



4.2 Hydraulic Modelling

Hydraulic modelling was undertaken using TUFLOW software (Software Version: 2020-10-AD). TUFLOW is a powerful computational engine that provides one-dimensional (1D) and two-dimensional (2D) solutions of the free surface flow equations to simulate flood propagation. In TUFLOW, surface flows are represented in the model through a two-dimensional grid covering the entire site.

Key design parameters used in the hydraulic modelling are:

a. Peak hydrographs from the DRAINS model described in Section 4.1 were applied as internal flow boundary's for the hydraulic model;
b. A three-dimensional surface was created using detailed site survey supplemented with LiDAR data for the site;
c. The adopted grid size for this study is 1m. This provides an appropriate level of resolution and detail across the site, while keeping model simulation times reasonable;
d. 2D Hydraulic modelling has been carried out consistent with AR&R revision Project 15: Two-Dimensional Modelling in Urban and Rural Floodplains.

5 Existing Scenario Modelling

5.1 Hydraulic Roughness

Roughness coefficients represent the resistance to flood flows in channels and floodplains. The land use delineation for the study area is based upon aerial photography and site observations. The hydraulic roughness of the ground surface is represented in the flood model using Manning's 'n' roughness coefficients. Refer Figure U and V in Appendix A for roughness coefficients used in existing and proposed scenarios.

A summary of adopted Manning's 'n' roughness coefficients for the model are presented below.

Table 3 – Mannings 'n' Roughness Co-Efficients

Land Use	Mannings 'n' Roughness
Rural Residential – Grassed, Light Vegetation	0.05
Road Reserve	0.02
Residential Lot	0.20
Thick Vegetation	0.10

5.2 Existing Scenario Model

The existing scenario model represents the site in its existing condition. No 1D culverts/elements were included within the existing scenario.

The downstream boundary condition was modelled as a normal depth free outflow, where a water surface slope is assigned to automatically calculate a head vs. discharge relationship. The eastern catchment downstream boundary was applied a water surface slope of 1.7% and the western catchment a water surface slope of 2%.

5.3 Existing Scenario Results

Mapped results for the 1% AEP and PMF event are presented in Appendix A for the existing scenario flooding:

- **Figure C**: Existing 1% AEP Flood Level and Depth Map;
- **Figure D**: Existing PMF Flood Level and Depth Map;
- **Figure E**: Existing 1% AEP Flood Velocity Map;
- **Figure F**: Existing PMF Flood Velocity Map;
- **Figure G**: Existing 1% AEP Flood Hazard Vulnerability Classification Map;
- **Figure H**: Existing PMF Flood Hazard Vulnerability Classification Map;

5.4 Results Discussion

Figure C showing existing the 1% AEP flood levels and flood depths is presented in Figure 4.

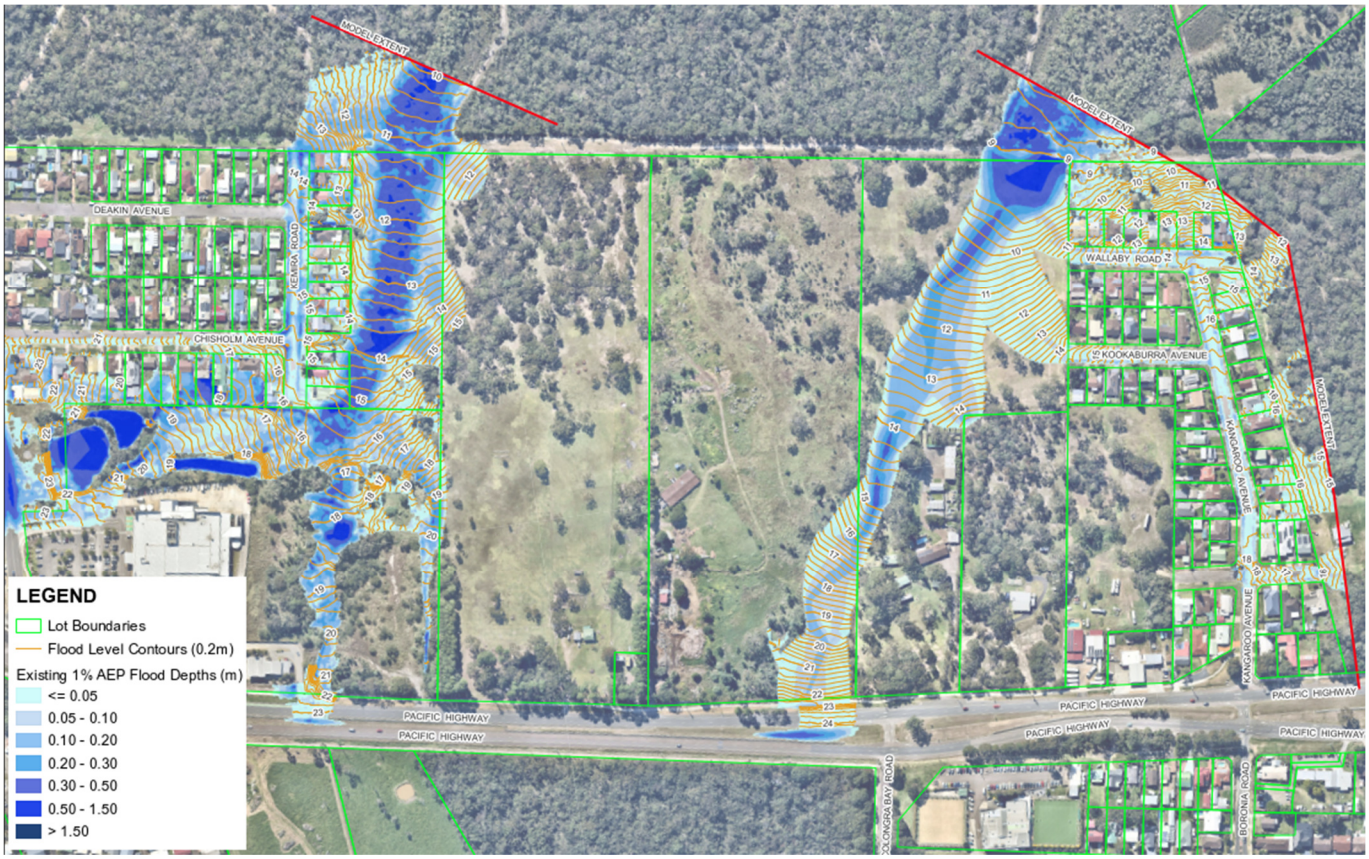


Figure 4: Existing 1% AEP Flood Levels and Depth

With consideration to the above Figure:

a. The Western Water Course on the site does not have a defined channel and limited upstream catchment.
b. The Coastal Wetland to the west of the development site accepts runoff from the development site, the Pacific Highway, the commercial area at corner of Pacific Highway and Tall Timbers Road, and the residential area at Chisholm Ave and Kemira Road.
c. The 1% AEP flow leaving the Coastal Wetland is approximately 17.8m³/s.
d. The Eastern Water Course is subject to flows from the development site, the Pacific Highway, and the existing residential area at Kookaburra Avenue and Wallaby Road.
e. The 1% AEP flow leaving the Eastern Water Course at the site's northern boundary is approximately 12.3m³/s.
f. During the 1% AEP storm event, inundation of residential properties appears to occur along Chisholm Avenue, Kemira Road, Kangaroo Avenue and Wallaby Road.

6 Proposed Scenario Modelling

6.1 Proposed Development

The development proposes in the order of 300 residential lots. The Concept Site Master Plan has been presented previously in Figure 3.

6.2 Catchments

To inform catchments to the proposed stormwater basins, a preliminary grading of the proposed internal development roads was prepared. Preliminary proposed site contours are presented in Figure B in Appendix A.

Based upon the proposed site grading, the existing scenario catchments were adjusted to reflect the proposed development scenario.

The proposed development scenario catchment parameters where unchanged from Table 1, the proposed catchments were modelled as 85% Impervious with adjusted time of concentrations.

Peak flow results for the sub-catchments are presented below in Table 5.

Table 4 – Proposed Peak 1% AEP Flows – Note that these flows have been attenuated through the proposed OSD basins included within the development.

Parameters	Western Catchment	Eastern Catchment
1% AEP Peak Discharge (m³/s)	16.9	11.1
1% AEP Median Peak Storm	15min Duration, Storm 8	25min Duration, Storm 3
PMF Peak Discharge (m³/s)	58.0	48.1
PMF Peak Duration	15min Duration	15min Duration

Peak hydrographs for each of these sub-catchments were extracted from the DRAINS model and utilised in the hydraulic model.

6.3 Hydraulic Roughness

The existing scenario model roughness layers as presented in Table 3 form the basis of the proposed condition model. The roughness layers in the proposed scenario have been adjusted to suit the proposed development layout, Refer Figure V in Appendix A.

6.4 2D Model Domain

The existing scenario model forms the basis of the proposed condition model ground surface grid. The grid has been modified to account for the planned future changes in ground elevations for the proposed roads, stormwater basins and associated works.

6.5 Hydraulic Structures and Features

The following hydraulic structures and features have been modelled within the proposed scenario model:

a. Eastern Basin: Levels and configuration as presented in Table 6.
b. Western Basin: Levels and configuration as presented in Table 6.
c. Proposed road extension from the west of the development site to existing Chisholm Avenue. Under road culvert as presented in Table 6.
d. Proposed discharge from Pacific Highway to southern end of Eastern Channel as presented in Table 6.
e. Proposed road crossing over the middle of the Eastern Channel as presented in Table 6.
f. A 'virtual' drainage line has been implemented at the intersection of Chisholm Avenue and Kemira Road in addition to the sag point adjacent to the proposed box culverts under the extension of Chisholm Avenue. This virtual drainage line has been sized to take the 10% AEP design flow (Approx. 1.67m3/s) and convey this flow into the downstream head wall of the 10no. RCBC under Chisholm Avenue.

Table 5 – Basin Configuration Summary

Basin	Top of Media/Infiltration Zone	EDD Depth/Level	TWL Depth/Level	Weir RL	Storage Vol in 1% AEP Event
Eastern	RL9.40	0.3m / RL9.70	1.6m / RL10.90	RL10.70	6,200m³
Western					Total = 1,966m³
W1	RL21.50	0.6m / RL22.10	0.9m / RL23.00	RL23.00	434m³
W2	RL20.00	0.6m / RL20.60	0.6m / RL21.20	RL21.50	389m³
W3	RL18.90	0.3m / RL19.20	0.95m / RL20.15	RL20.10	474m³
W4	RL17.30	0.6m / RL17.70	0.8m / RL18.50	RL18.50	425m³
W5	RL16.40	0.3m / RL16.70	0.65m / RL17.35	RL17.20	353m³

Table 6 – Proposed Culvert Configuration

Culvert	Configuration	U/S IL	D/S IL	Blockage
Eastern Basin Outlet	4 x DN900 RCPs	RL8.65	RL8.40	Nil
Western Basin Outlet (W5)	DN675 RCP	RL15.50	RL15.3	Nil
Culvert Near Chisholm Ave	10 x 2400W x 600H RCBCs	RL12.950	RL12.70	50%
Culvert from Pacific Highway	DN1200 RCP	RL19.80	RL15.50	50%
Culvert Crossing Eastern Channel	4 x 2400W x 600H RCBCs	RL12.750	RL12.50	50%

The proposed basins as presented in Table 6 have been included within the preliminary site regrading model and imported into the Tuflow model. Basins have been included to restrict flows from the development site for a range of storm events up to and including the 1% AEP event. Refer to BRS Stormwater Management Report for additional details.

A blockage factor of 50% has been applied to relevant culverts in accordance with the requirements of Australian Rainfall and Runoff, 2019. No blockage factor has been applied to the basin outlet control pipes as these are designed to limit flows in the post-development scenario, additionally these pipes will be downstream of water quality treatment devices such as a GPT and so are very unlikely to block.

The proposed culverts as presented in Table 7 have been included as 1D elements within the Tuflow model.

6.6 Proposed Scenario Modelling Results

Mapped results for the 1% AEP and PMF events are presented in Appendix A for the proposed scenario flooding. These maps include:

- **Figure I**: Proposed 1% AEP Flood Level and Depth Map;
- **Figure J**: Proposed PMF Flood Level and Depth Map;
- **Figure K**: Proposed 1% AEP Flood Velocity Map;
- **Figure L**: Proposed PMF Flood Velocity Map;
- **Figure M**: Proposed 1% AEP Flood Hazard Vulnerability Classification Map;
- **Figure N**: Proposed PMF Flood Hazard Vulnerability Classification Map;

7 Impact Assessment for 1% AEP Event

7.1 Flood Levels

Figure 5 presents a difference/impact map comparing the peak water levels between the existing scenario model and the proposed development scenario for the 1% AEP event. This map can also be found in Figure O of Appendix A.

Figure 5: 1% AEP Flood Level Difference Map

The above Figure identifies areas where:

a. Flooding previously occurred in the exiting scenario but no longer occurs in the proposed scenario (referenced "was wet now dry");
b. Flooding now occurs in the proposed scenario which was previously not flooded in the existing scenario (referenced "was dry now wet"); and
c. Extent and degree of change in the peak water levels.

The results of the proposed scenario modelling for a 1% AEP event (Figure 5) indicate that:

a. Within the site flows are contained within the proposed road reserves with large flood level differences resulting primarily from the raising of the site and ponding within the OSD basins.
b. The existing flows upstream of the eastern catchment are conveyed underground through a pipe network, with no overland flows through proposed lots. A berm proposed at the southern boundary of the properties backing onto the Pacific Highway provides sufficient head while only raising flood levels with the proposed site.
c. Downstream of Eastern Basin flood levels have been reduced due to attenuation provided by the proposed OSD basin.
d. Downstream of Western OSD Basin flood levels have been locally increased in the downstream nature reserve, primarily due to the concentration of flows created by the proposed OSD. These flood differences quickly equalise prior to discharge under the proposed culvert crossing.

e. Flood levels within the eastern external catchment are largely unaffected, some increased depths have been isolated within the existing road reserve at Wallaby Road, due to the raised road levels at the tie in with existing. Flood levels have not been impacted within private property however. Note that no drainage has been modelled at the sag point just upstream of the eastern basin and so ponding depths on Wallaby Road will be reduced on the introduction of piped drainage.
f. There is some minor overland sheet flow from the interface between Kookaburra Avenue and the proposed extension of Wallaby Road. This is due to the inaccuracy of the tie in with the existing un-kerbed road, it is believed that this minor impact can be resolved in future detailed design. Through properly interfacing with the existing road formation overland flows can be directed through the proposed internal roads into the eastern basin.
g. Flood levels within the western catchment have been improved due to a reduction of flows within the existing watercourse (flows now being managed internal to the proposed site) and due to the upgrade in drainage within Chisholm Avenue, as discussed in Section 6.5 e).
h. An increase in flood levels within the proposed connection with Chisholm Avenue, due to the raising of existing levels. There is a minor increase in flood levels on the edge of the lot south of the proposed connection, however it is believed this minor impact can be managed in future detailed designs.
i. Figure 6 below, shows the difference in flood depths between the proposed and existing scenarios. Increases in flood depths on the adjacent road reserves is less than 200mm.

Figure 6: 1% AEP Flood Depth Difference Map

7.2 Hazard Vulnerability Classification

With reference to Figure 6.7.9 and Table 6.7.3 of Australian Rainfall and Runoff 2019, Hazard Vulnerability Classification have been assessed for the proposed scenario.

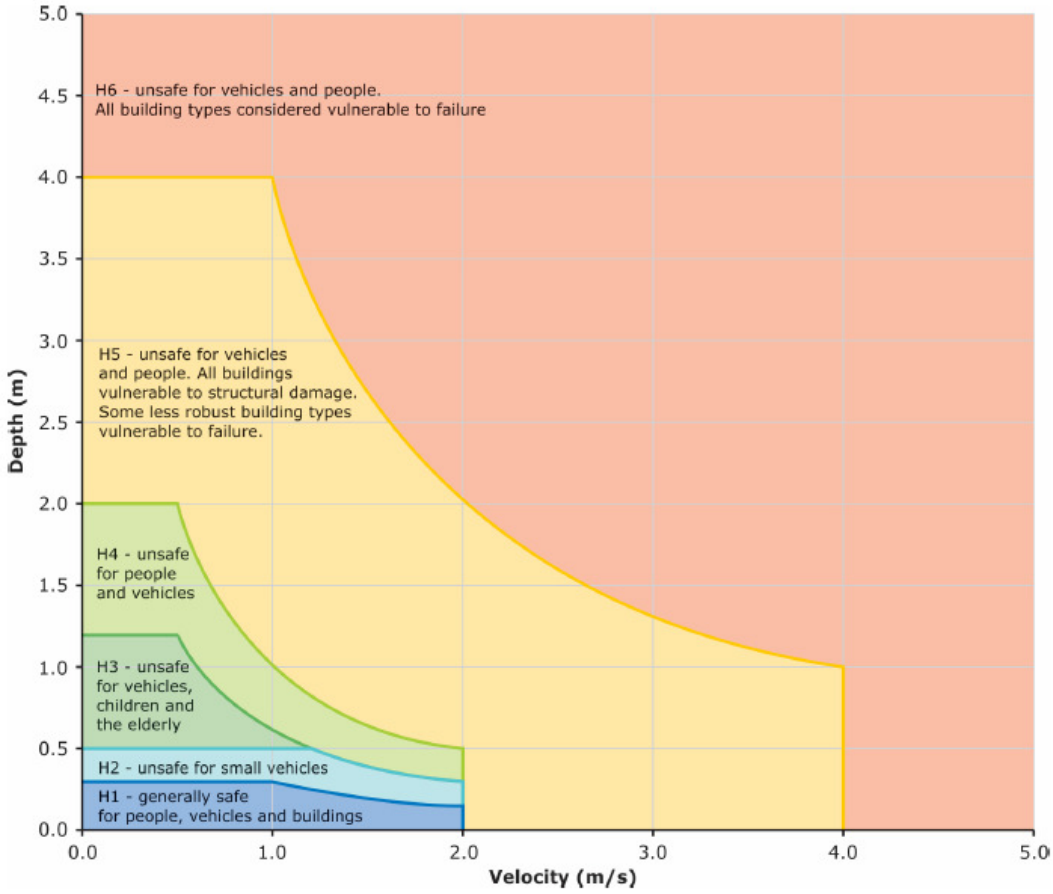


Figure 7: Combined Flood Hazard Curves (Source: ARR19)

Hazard Vulnerability Classification	Description
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.

Figure 8: Combined Hazard Curves – Vulnerability Thresholds (Source: ARR19)

Figure 9 below presents 1% AEP Hazard Vulnerability Classification map for the developed scenario. The Figure below is included as Figure M in Appendix A.

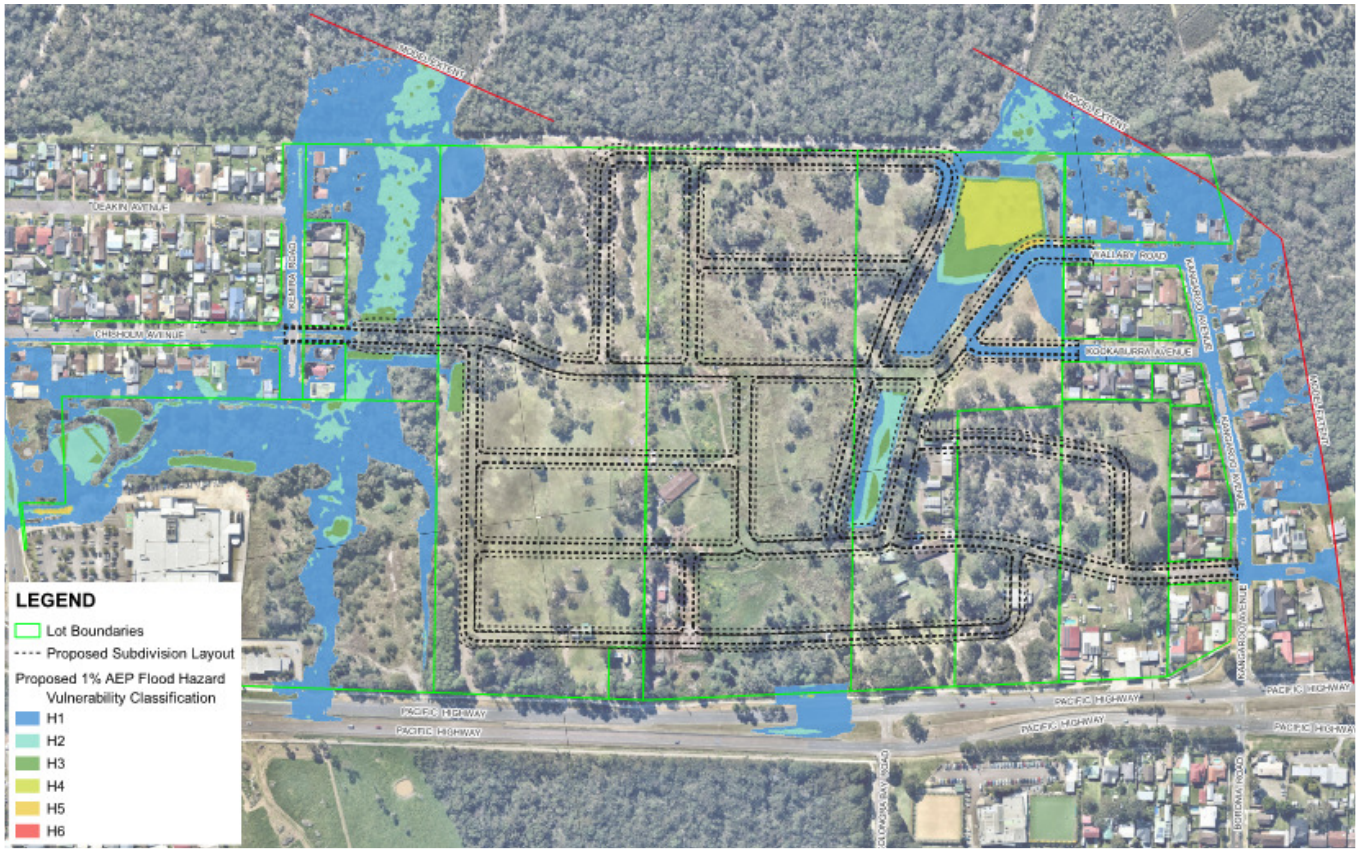


Figure 9: Developed 1% AEP Hazard Vulnerability Classification Map

With reference to Figure 9 it can be seen that the proposed and existing roads to service the development have a Vulnerability Classification of H1 in most cases. With reference to the Vulnerability Thresholds presented in Figure 7 above, H1 is generally safe for vehicles, people and buildings. Areas of higher hazard classifications are isolated along kerbs in the existing road network, however this has not been worsened due to the development.

Higher hazards can also be found at the sag points prior to discharge into the Eastern OSD basin. It is noted that upon further detailed design and inclusion of piped drainage, ponding within the sag points can be managed to reduce flood hazard.

On this basis it is considered that the flood hazard within the proposed development during a 1% AEP flood is acceptable and would not present undue to risk to vehicles or pedestrians.

8 Impact Assessment for PMF Event

8.1 Flood Levels

Figure 10 presents a difference/impact map comparing the peak water levels between the existing scenario model and the proposed development scenario for the PMF event. This map can also be found in Figure P of Appendix A.

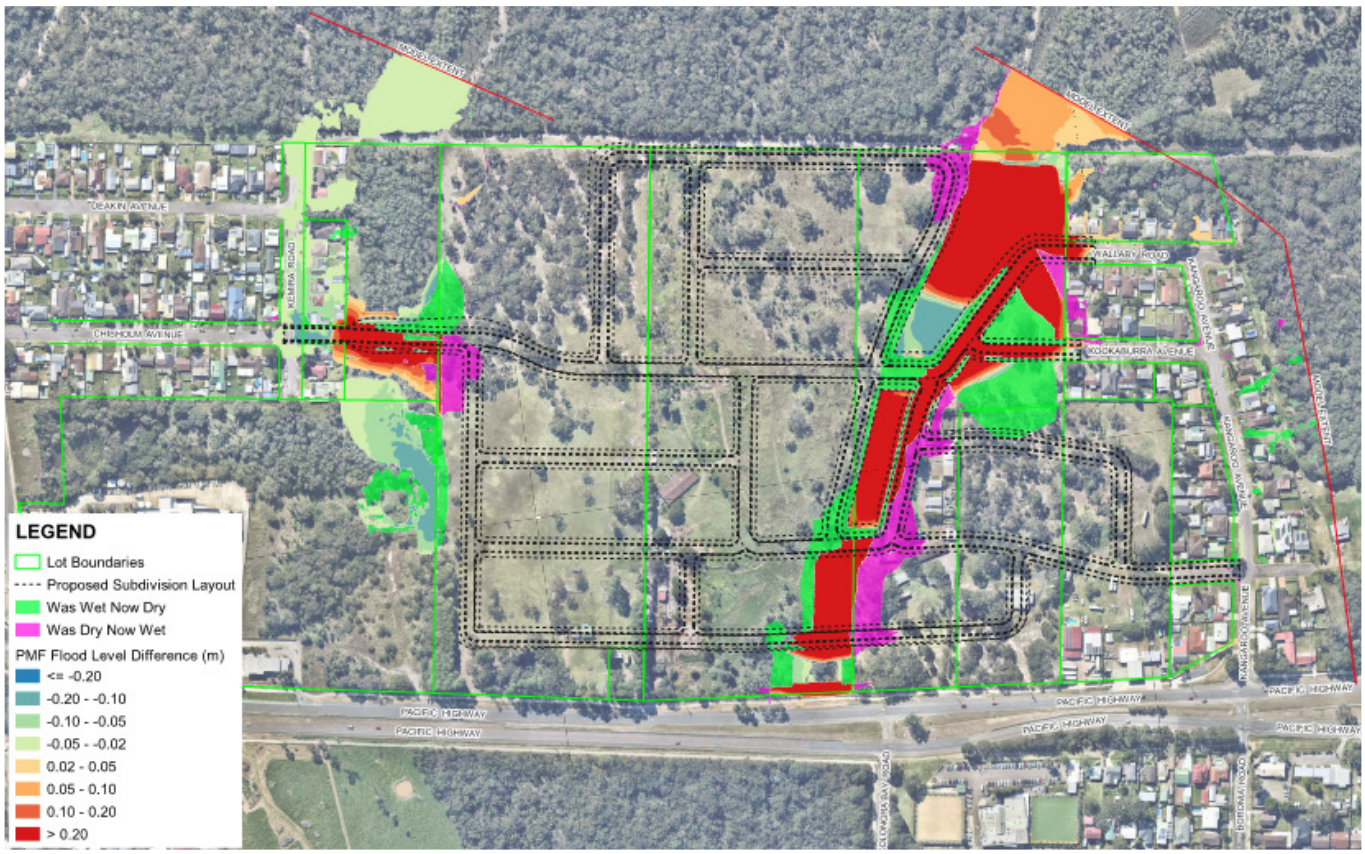


Figure 10: PMF Flood Level Difference Map

The above Figure identifies areas where:

d. Flooding previously occurred in the exiting scenario but no longer occurs in the proposed scenario (referenced "was wet now dry");
e. Flooding now occurs in the proposed scenario which was previously not flooded in the existing scenario (referenced "was dry now wet"); and
f. Extent and degree of change in the peak water levels.

The results of the proposed scenario modelling for the PMF event (Figure 5) indicate that:

a) Flood levels downstream of both basins are increased by the proposed development, due primarily to the increased peak runoff generated by the increased impervious area of the development. As the OSD basins are only designed to attenuate flows up the 1% AEP event it is expected that flows within the PMF would be increased.
b) Flood levels within the existing development to the West are reduced with localised increases in flood levels north and south of the proposed connection to Chisolm Avenue.
c) Flood levels within the development are increased within the overland flow route between Pacific Highway and the internal channel. This is due to the bund being overtopped in the PMF event.
d) Flood levels in the existing catchment to the East have been impacted in the some of the lots along the boundary of the development.

8.2 Hazard Vulnerability Classification

With reference to Figure 6.7.9 and Table 6.7.3 of Australian Rainfall and Runoff 2019, Hazard Vulnerability Classification have been assessed for the proposed scenario. Refer to Figure 6 and Figure 7 for details.

Figure 11 below presents PMF Hazard Vulnerability Classification map for the developed scenario. The Figure below is included as Figure N in Appendix A.

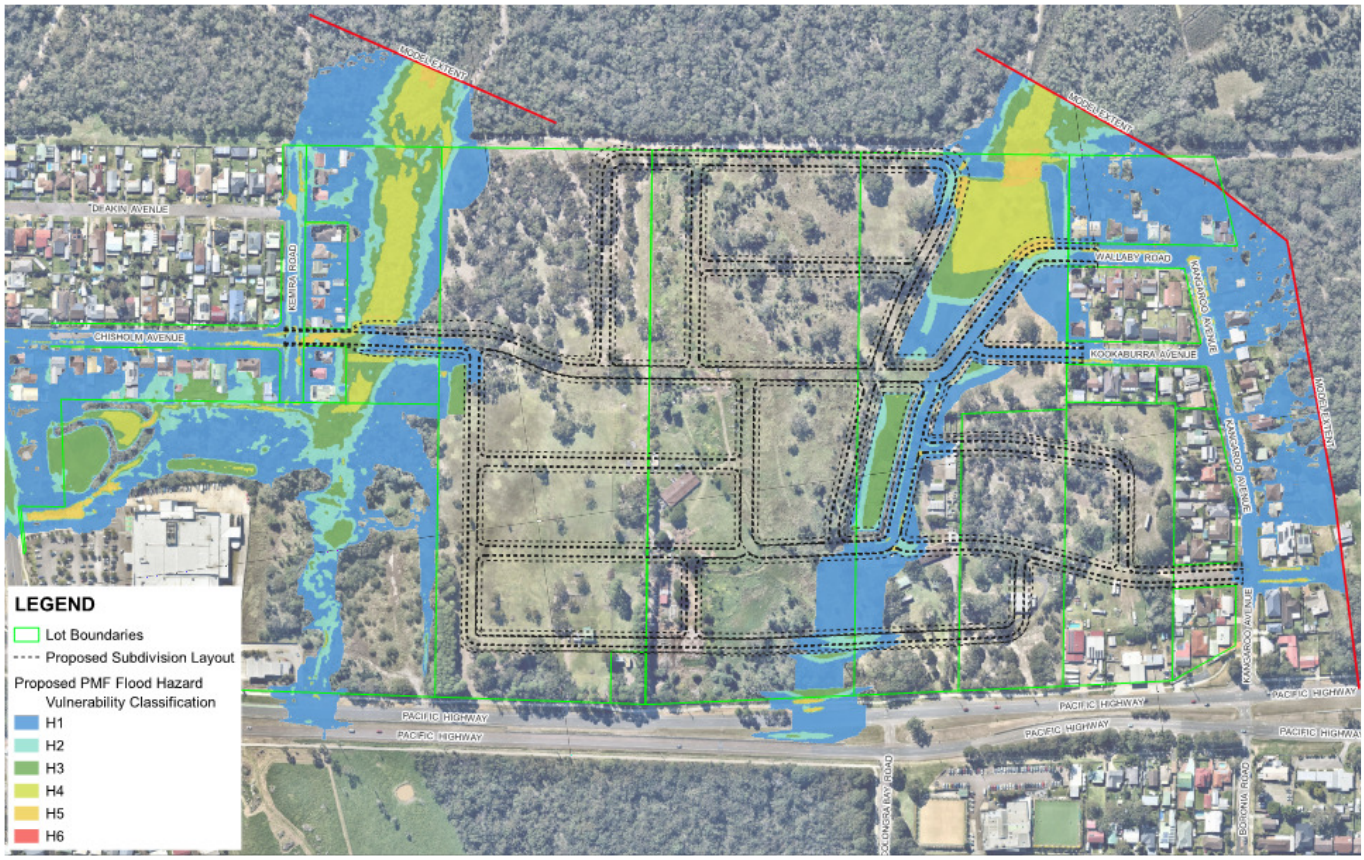


Figure 11: Developed 1% AEP Hazard Vulnerability Classification Map

With reference to Figure 11 it can be seen that high hazards within the development have been mostly contained within the road reserves with the exception of the overland flow easement draining the Pacific Highway upstream catchment to the south. High Hazards in this area can be managed upon further development of the design and the creation of a defined overland flow path to channelise flows away from proposed lots.

9 Conclusion and Recommendations

This Flood Impact Assessment (FIA) report has been prepared for Alda, Rose Group and Urban Villager to support a Planning Proposal to NSW Department of Planning and Central Coast Council for a proposed residential subdivision at 285-325 Pacific Highway, Lake Munmorah.

The purpose of the flood modelling for this flood impact assessment is to investigate the existing flood behaviour and assess the impacts of the proposed development on the flood behaviour on the development site and adjoining properties.

Two (2) scenarios have been modelled to simulate the existing condition and proposed development conditions.

Scenario 1: Existing scenario; and
Scenario 2: Proposed scenarios based on the proposed development lot layout.

The FIA has been prepared with consideration to:

a. Council's email requirements dated 9 December 2021
b. Australian Rainfall and Runoff, 2016

Hydrological modelling was carried out using IL-CL (Initial Loss-Continuing Loss) model in the DRAINS software and rainfall data obtained from the Bureau of Meteorology (BoM) website in accordance with the requirements of Australian Rainfall and Runoff, 2016.

Hydraulic modelling was undertaken using TUFLOW software with detailed site survey information supplemented with LIDAR ground level information. The proposed development scenario considered the proposed Eastern and Western Basins as well as proposed culverts near Chisholm Avenue and from the Pacific Highway.

A comparison of existing condition and proposed scenario flood results showed that:

a. While flood level increases are experienced in a localised areas external to the development, due primarily to raised levels in the proposed development, the impact on adjacent private property is negligible in the 1% AEP event.
b. Flood levels have been reduced in the existing development to the west, due to improved drainage and reduced flows within the existing water course adjacent to the site.

The site has for the most part a hazard vulnerability classification of H1 which is generally safe for vehicles, people and buildings.

It is therefore concluded that the proposed development has an acceptable flood impact on existing flood water behaviour and levels.

Appendix A – Flood Mapping Results

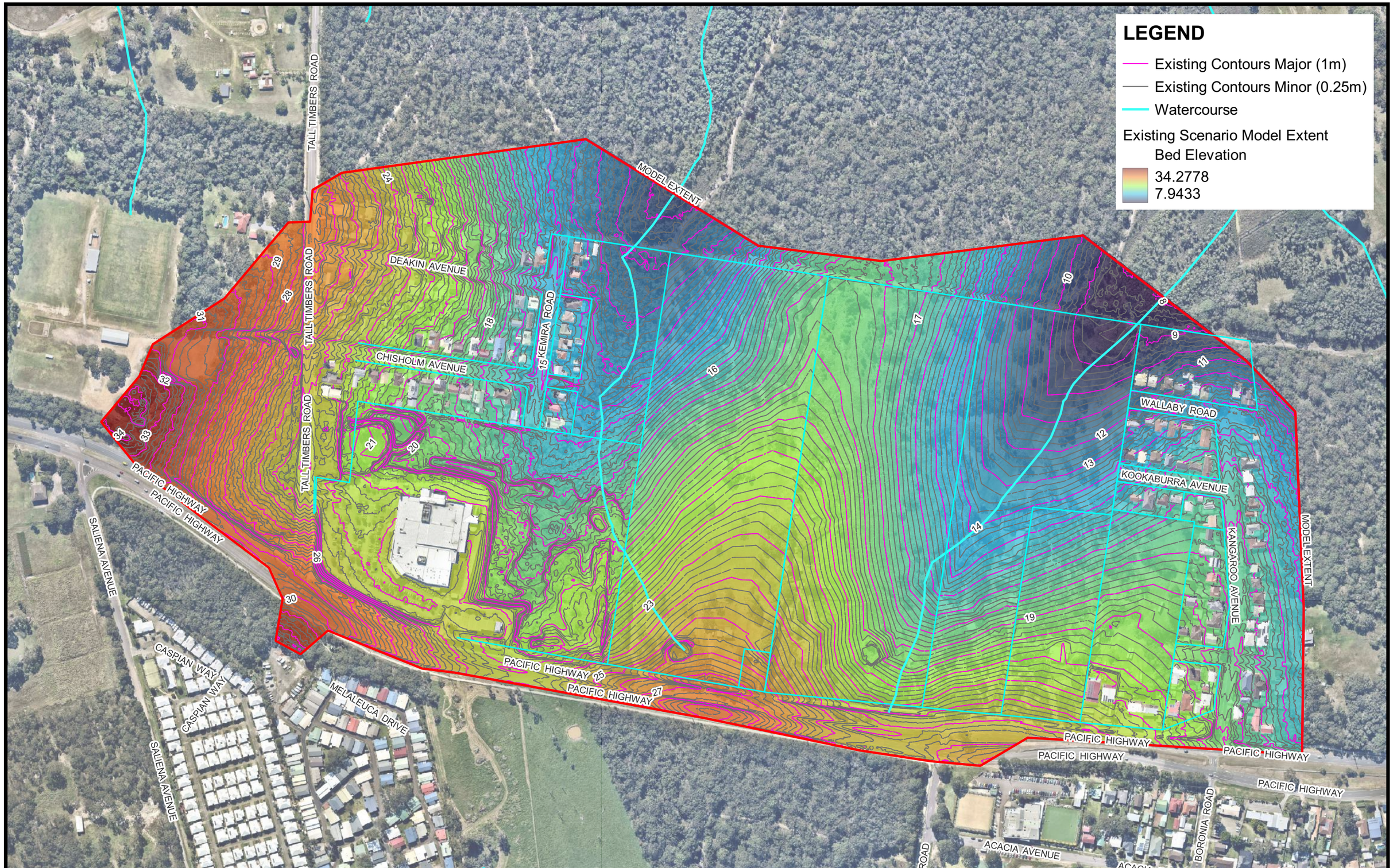


FIGURE A
EXISTING SCENARIO MODEL EXTENTS

0 100 200 m

SCALE 1:4000 (A3)

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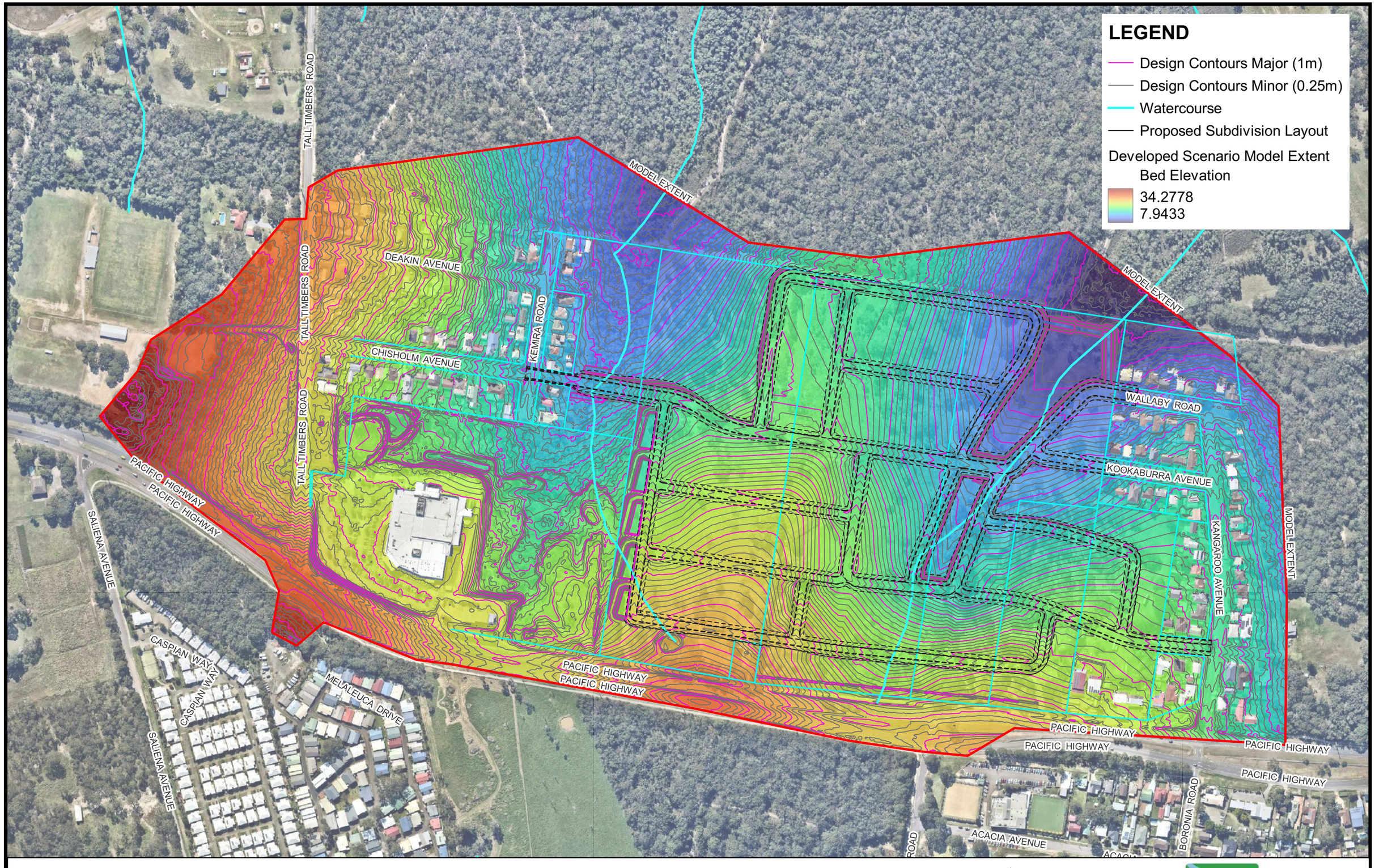

FIGURE B
PROPOSED SCENARIO MODEL EXTENTS

0 100 200 m

SCALE 1:4000 (A3)

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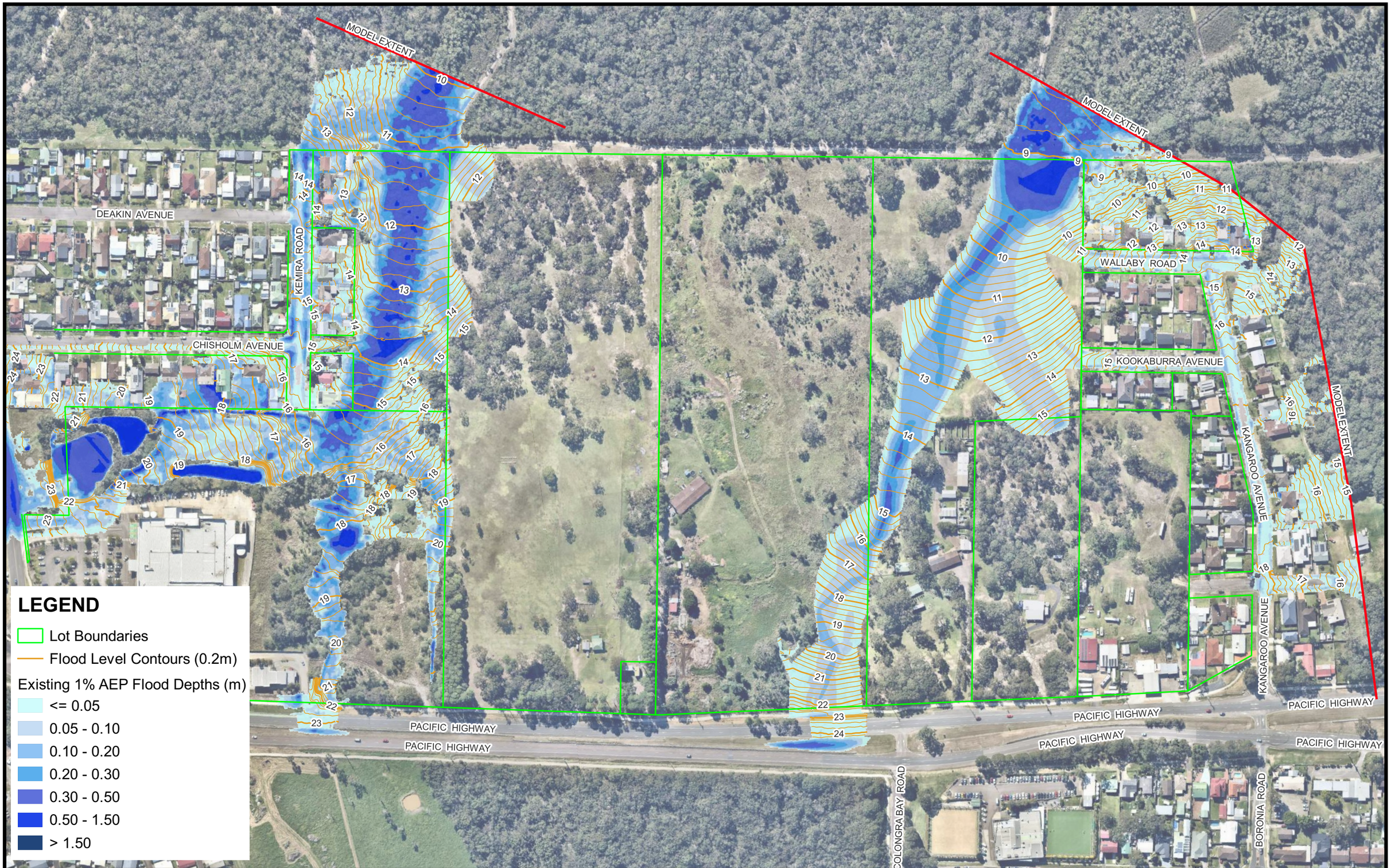


FIGURE C
EXISTING SCENARIO 1% AEP FLOOD LEVEL AND DEPTH MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

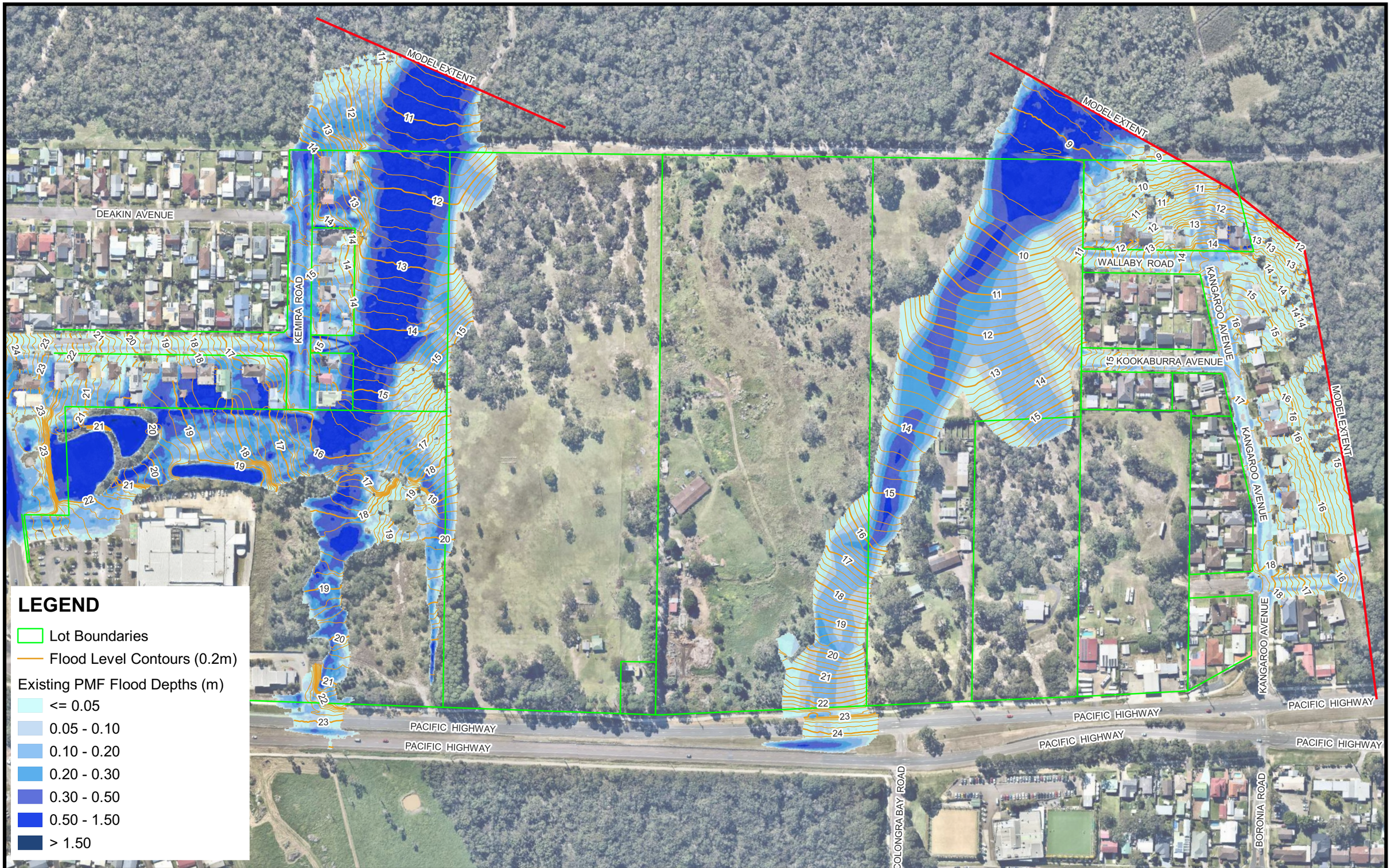


FIGURE D
EXISTING SCENARIO PMF FLOOD LEVEL AND DEPTH MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

MODEL EXTENT

MODEL EXTENT

MODEL EXTENT

DEAKIN AVENUE

CHISHOLM AVENUE

KEMIRA ROAD

WALLABY ROAD

KOOKABURRA AVENUE

KANGAROO AVENUE

KANGAROO AVENUE

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

COLONGRA BAY ROAD

BORONIA ROAD

LEGEND

Lot Boundaries

Existing 1% AEP Flood Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- > 1.5

FIGURE E
EXISTING SCENARIO 1% AEP FLOOD VELOCITY MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

MODEL EXTENT

MODEL EXTENT

MODEL EXTENT

DEAKIN AVENUE

KEMIRA ROAD

CHISHOLM AVENUE

WALLABY ROAD

KANGAROO AVENUE

KOOKABURRA AVENUE

KANGAROO AVENUE

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

COLONGRA BAY ROAD

BORONIA ROAD

LEGEND

Lot Boundaries

Existing PMF Flood Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- > 1.5

FIGURE F
EXISTING SCENARIO PMF FLOOD VELOCITY MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

MODEL EXTENT

MODEL EXTENT

MODEL EXTENT

DEAKIN AVENUE

CHISHOLM AVENUE

KEMIRA ROAD

WALLABY ROAD

KANGAROO AVENUE

KOOKABURRA AVENUE

KANGAROO AVENUE

KANGAROO AVENUE

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

COLONGRA BAY ROAD

BORONIA ROAD

LEGEND

Lot Boundaries

Existing 1% AEP Flood Hazard Vulnerability Classification

- H1
- H2
- H3
- H4
- H5
- H6

FIGURE G
EXISTING SCENARIO 1% AEP FLOOD HAZARD VULNERABILITY CLASSIFICATION MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

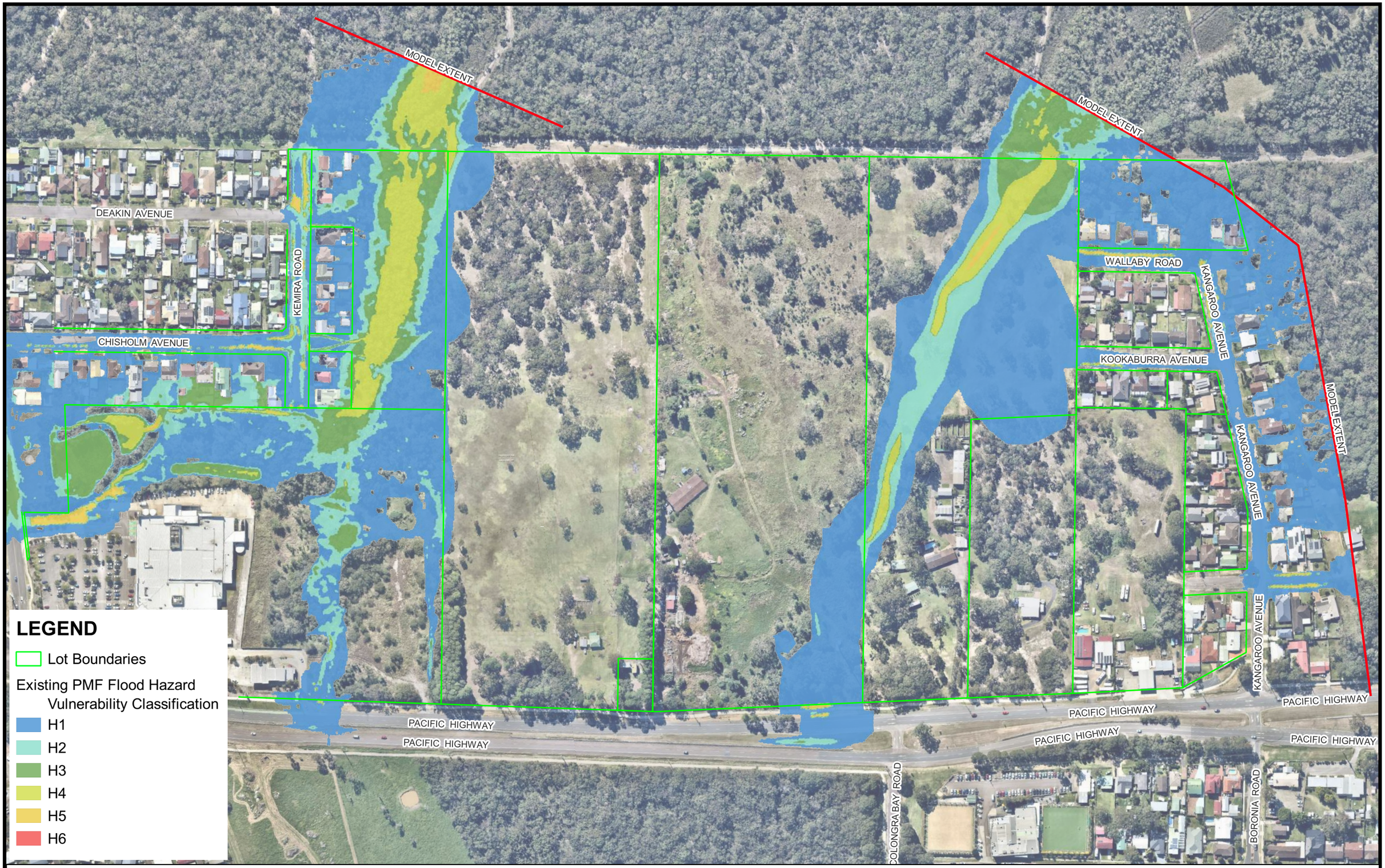


FIGURE H
EXISTING SCENARIO PMF FLOOD HAZARD VULNERABILITY CLASSIFICATION MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

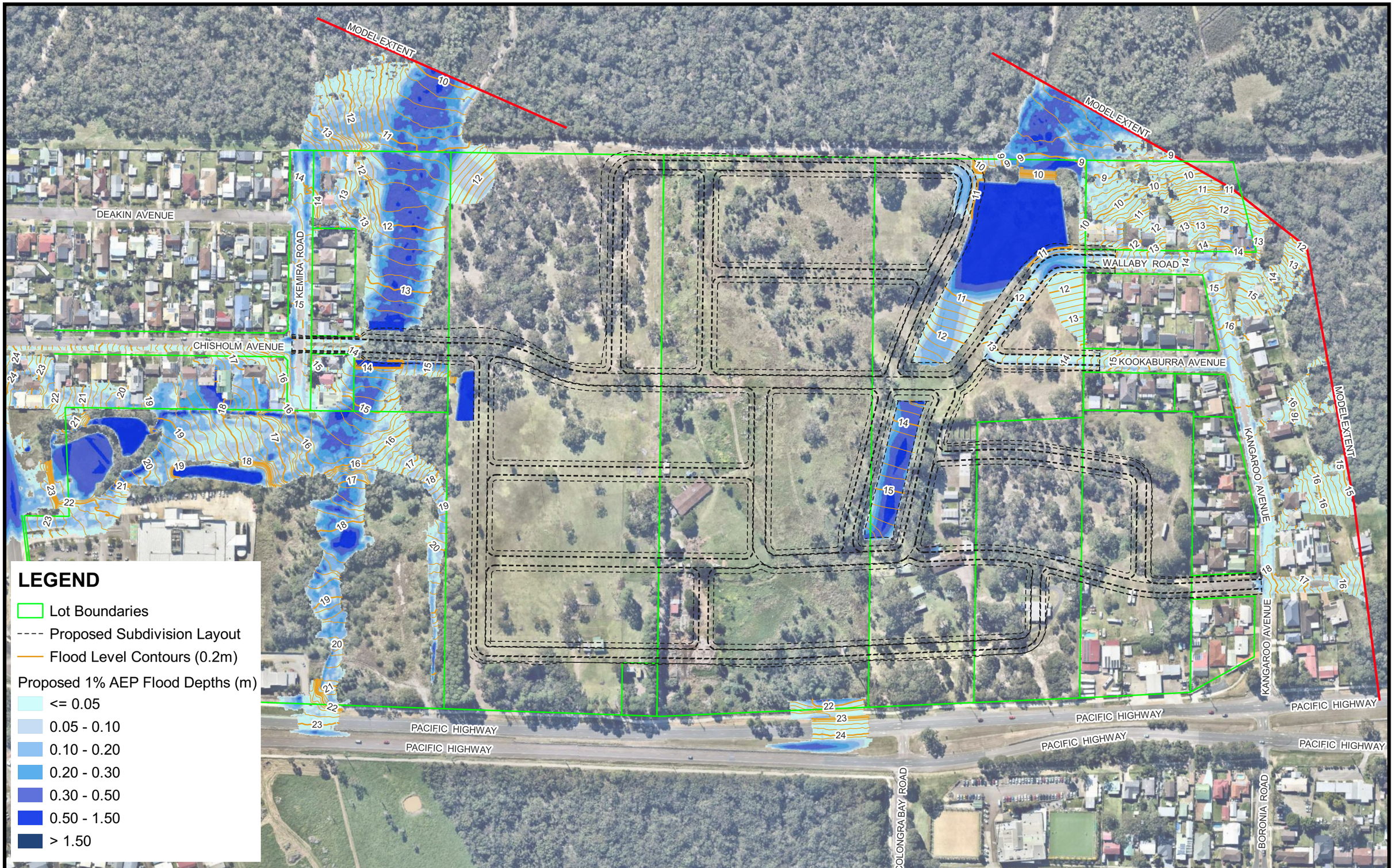


FIGURE I
PROPOSED SCENARIO 1% AEP FLOOD LEVEL AND DEPTH MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

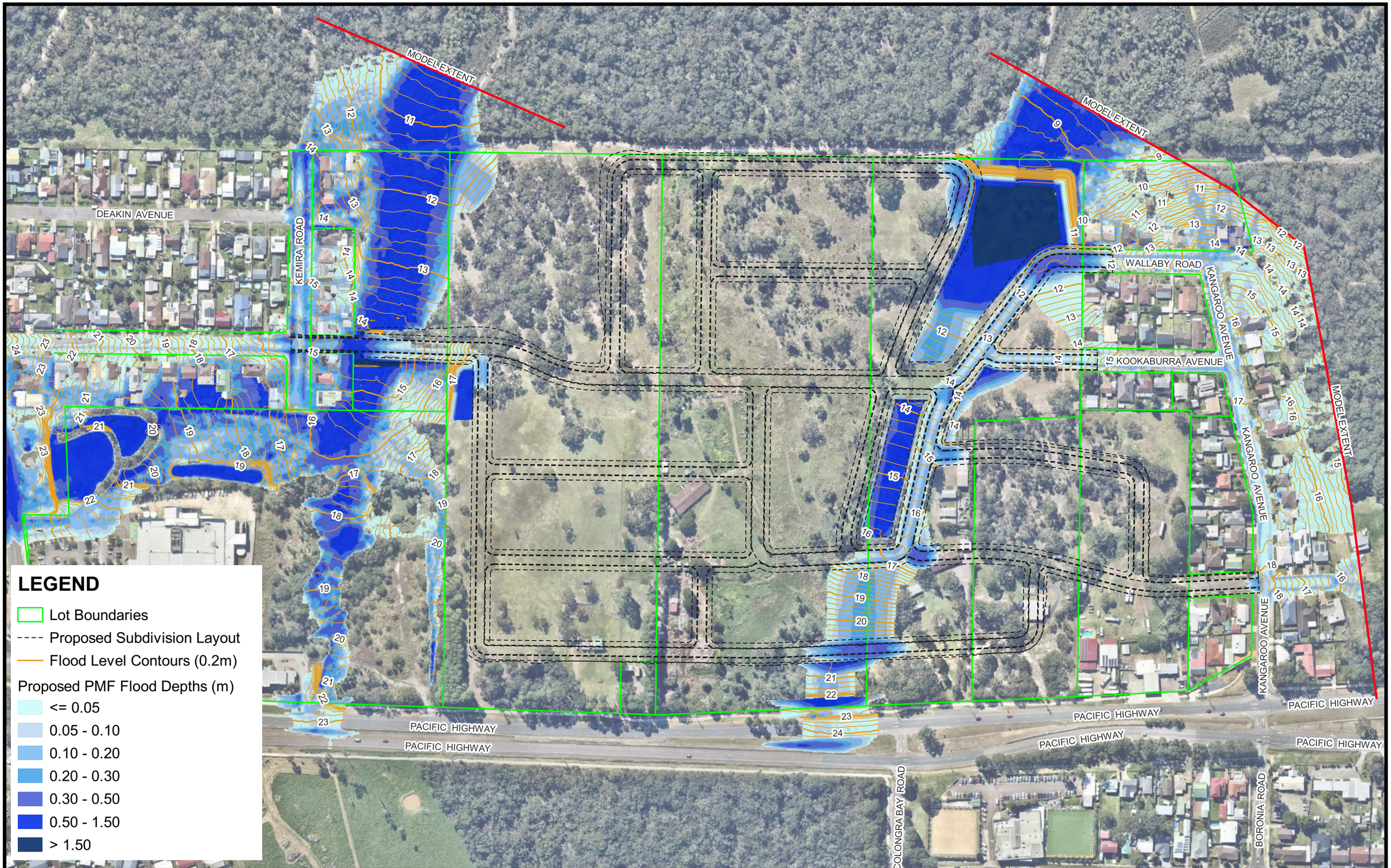


FIGURE J
PROPOSED SCENARIO PMF FLOOD LEVEL AND DEPTH MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

MODEL EXTENT

MODEL EXTENT

MODEL EXTENT

DEAKIN AVENUE

CHISHOLM AVENUE

KEMIRA ROAD

WALLABY ROAD

KOOKABURRA AVENUE

KANGAROO AVENUE

KANGAROO AVENUE

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

COLONGRA BAY ROAD

BORONIA ROAD

LEGEND

- Lot Boundaries
- Proposed Subdivision Layout

Proposed 1% AEP Flood Velocity (m/s)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- > 1.5

0 100 200 m

SCALE 1:3000 (A3)

FIGURE K
PROPOSED SCENARIO 1% AEP VELOCITY MAP

BARKER RYAN STEWART

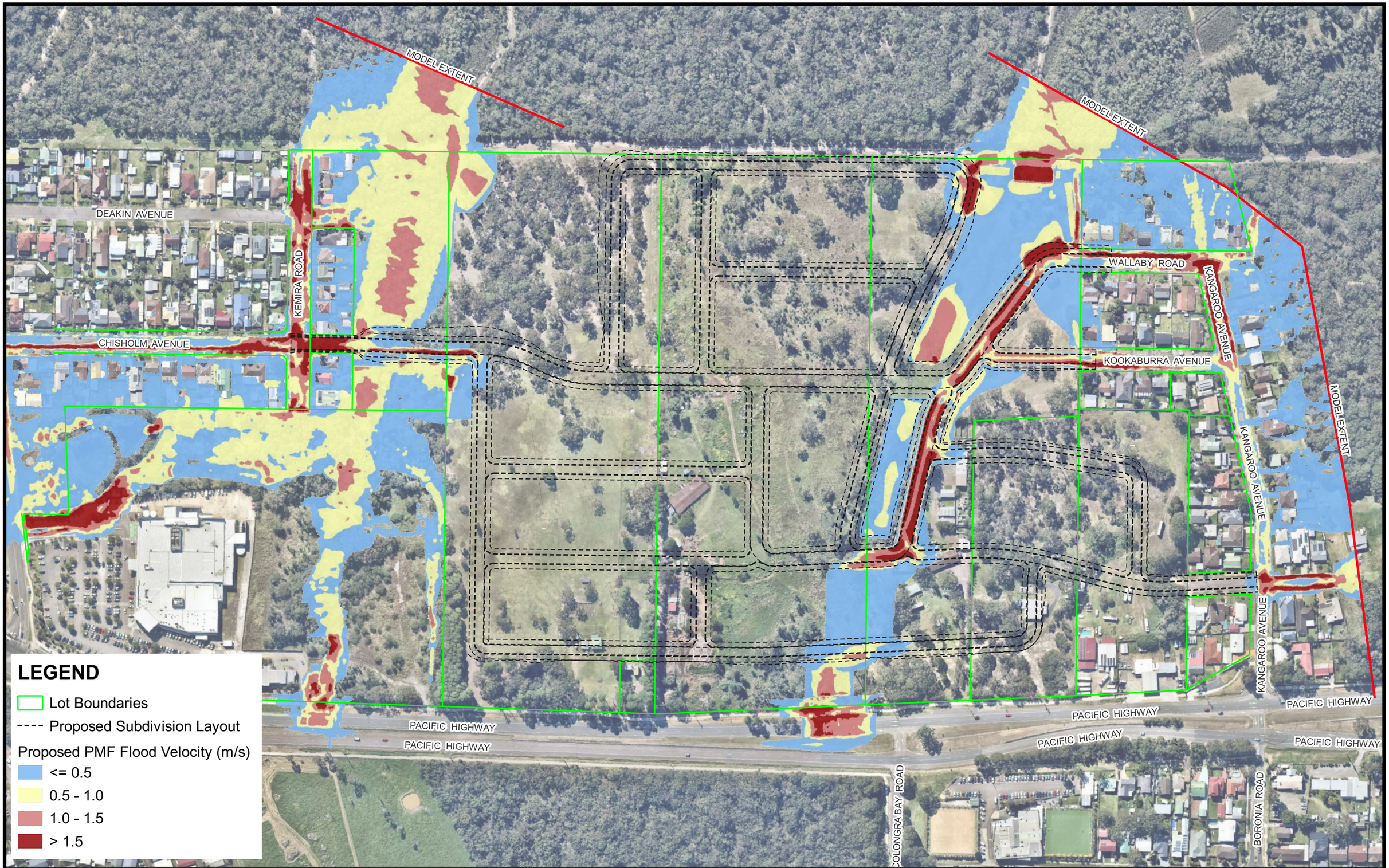


FIGURE L
PROPOSED SCENARIO PMF VELOCITY MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

MODEL EXTENT

MODEL EXTENT

MODEL EXTENT

DEAKIN AVENUE

CHISHOLM AVENUE

KEMIRA ROAD

WALLABY ROAD

KANGAROO AVENUE

KOOKABURRA AVENUE

KANGAROO AVENUE

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

COLONGRA BAY ROAD

BORONIA ROAD

LEGEND

- Lot Boundaries
- Proposed Subdivision Layout

Proposed 1% AEP Flood Hazard Vulnerability Classification

- H1
- H2
- H3
- H4
- H5
- H6

FIGURE M
PROPOSED SCENARIO 1% AEP FLOOD HAZARD VULNERABILITY CLASSIFICATION MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

MODEL EXTENT

MODEL EXTENT

MODEL EXTENT

DEAKIN AVENUE

KEMIRA ROAD

CHISHOLM AVENUE

WALLABY ROAD

KANGAROO AVENUE

KOOKABURRA AVENUE

KANGAROO AVENUE

KANGAROO AVENUE

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

COLONGRA BAY ROAD

BORONIA ROAD

LEGEND

- Lot Boundaries
- Proposed Subdivision Layout

Proposed PMF Flood Hazard Vulnerability Classification

- H1
- H2
- H3
- H4
- H5
- H6

FIGURE N
PROPOSED SCENARIO PMF FLOOD HAZARD VULNERABILITY CLASSIFICATION MAP

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

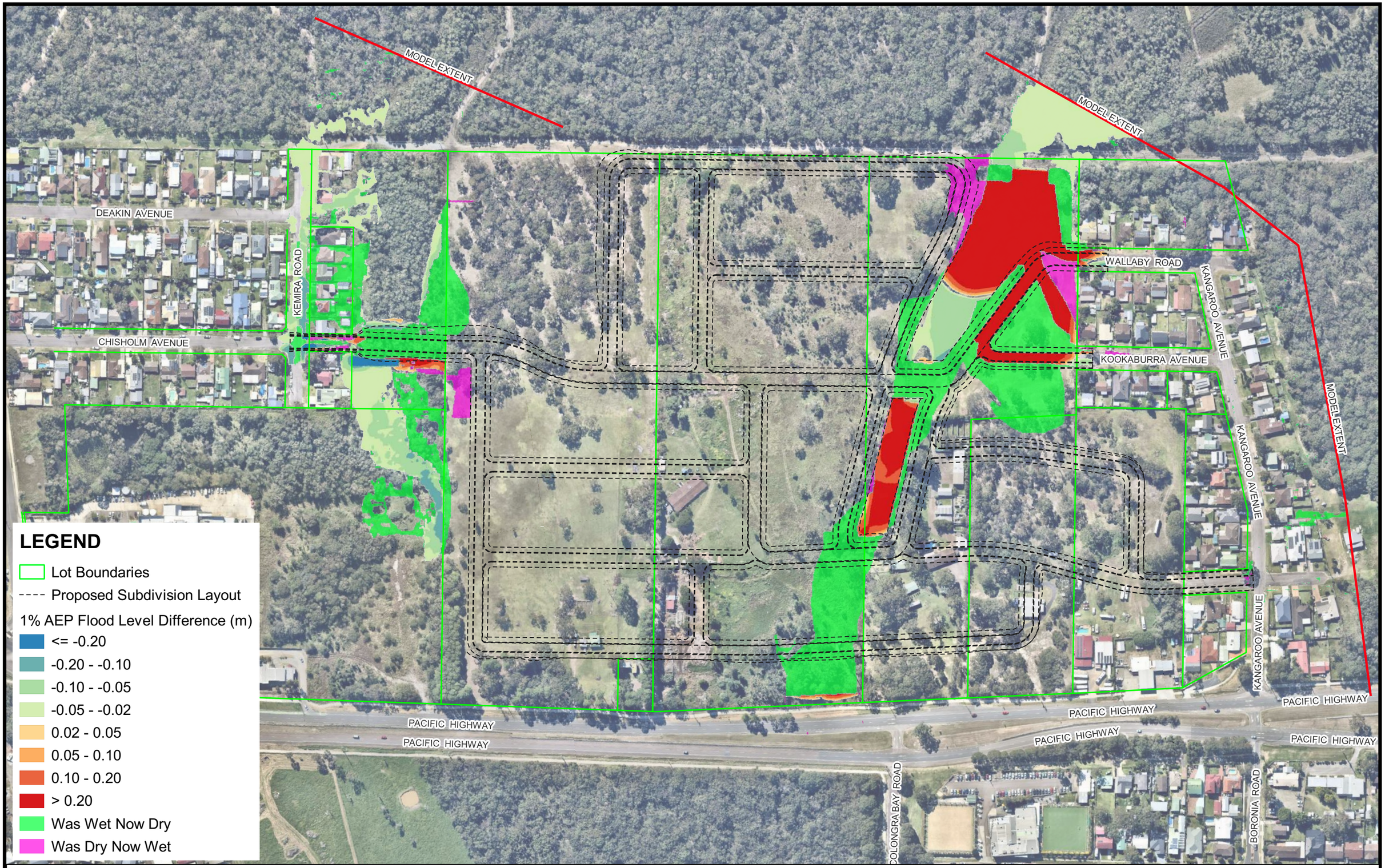


FIGURE O
1% AEP FLOOD LEVEL DIFFERENCE MAP
(PROPOSED MINUS EXISTING)

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

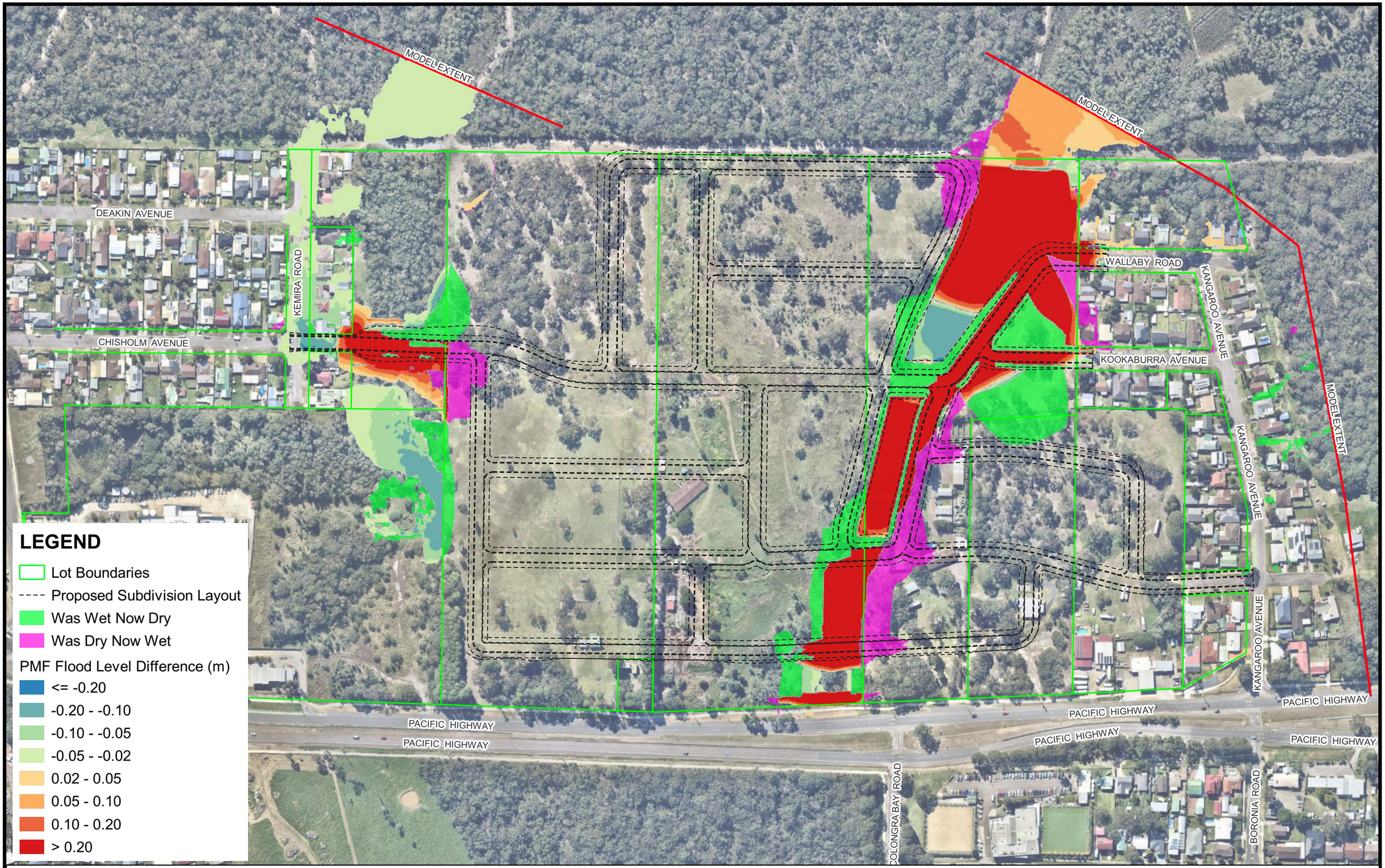


FIGURE P
PMF FLOOD LEVEL DIFFERENCE MAP
(PROPOSED MINUS EXISTING)

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

MODEL EXTENT

MODEL EXTENT

MODEL EXTENT

DEAKIN AVENUE

CHISHOLM AVENUE

KEMIRA ROAD

WALLABY ROAD

KOOKABURRA AVENUE

KANGAROO AVENUE

KANGAROO AVENUE

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

COLONGRA BAY ROAD

BORONIA ROAD

LEGEND

- Lot Boundaries
- Proposed Subdivision Layout

1% AEP Flood Depth Difference (m)

- <= -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- > 0.20
- Was Wet Now Dry
- Was Dry Now Wet

FIGURE Q
1% AEP FLOOD DEPTH DIFFERENCE MAP
(PROPOSED MINUS EXISTING)

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

MODEL EXTENT

MODEL EXTENT

MODEL EXTENT

DEAKIN AVENUE

CHISHOLM AVENUE

KEMIRA ROAD

WALLABY ROAD

KOOKABURRA AVENUE

KANGAROO AVENUE

KANGAROO AVENUE

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

PACIFIC HIGHWAY

COLONGRA BAY ROAD

BORONIA ROAD

LEGEND

- Lot Boundaries
- Proposed Subdivision Layout

PMF Flood Depth Difference (m)

- <= -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- > 0.20
- Was Wet Now Dry
- Was Dry Now Wet

FIGURE R
PMF FLOOD DEPTH DIFFERENCE MAP
(PROPOSED MINUS EXISTING)

0 100 200 m

SCALE 1:3000 (A3)

BARKER RYAN STEWART

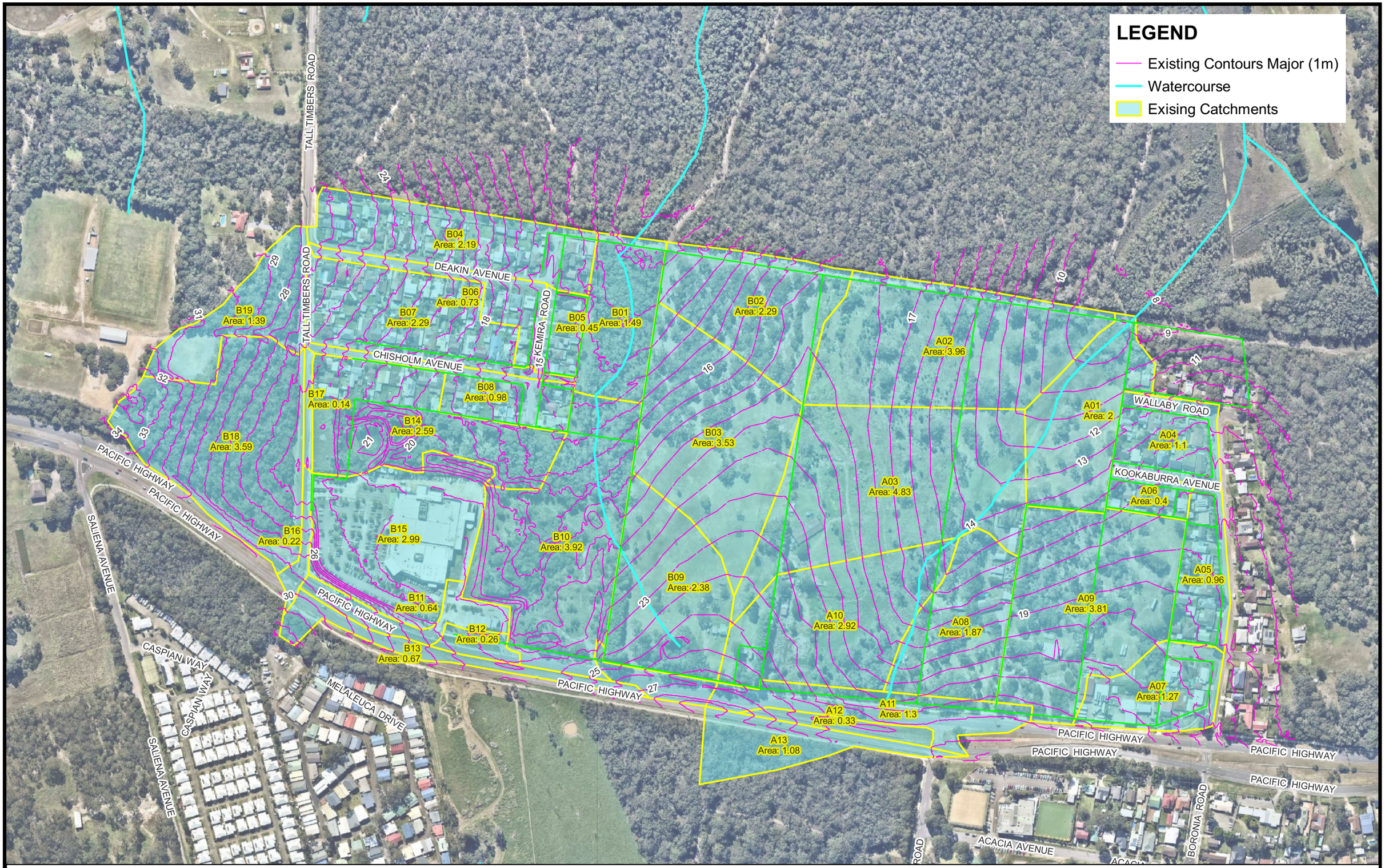


FIGURE S
EXISTING SCENARIO CATCHMENTS

0 100 200 m

SCALE 1:4000 (A3)

BARKER RYAN STEWART

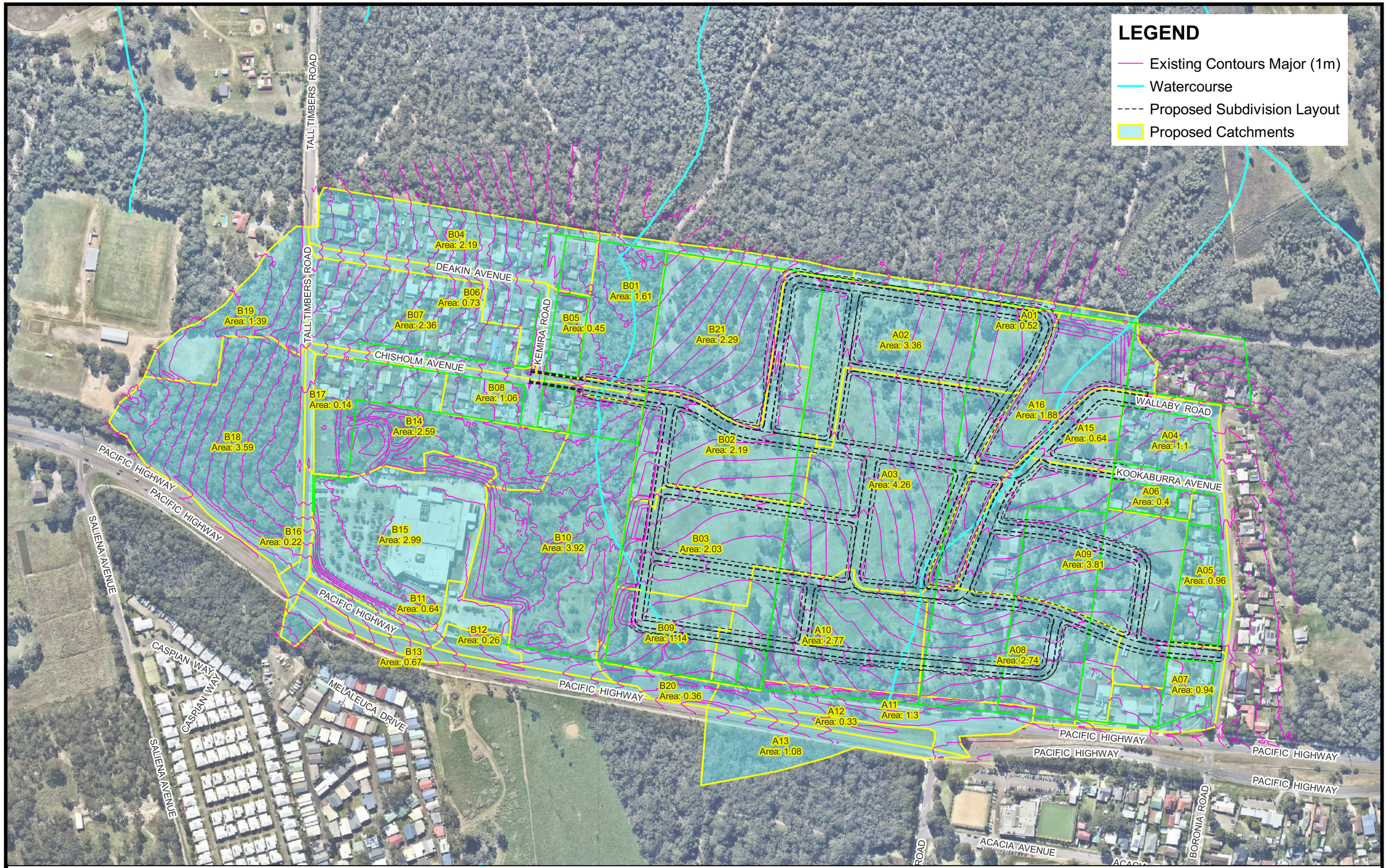


FIGURE T
PROPOSED SCENARIO CATCHMENTS

0 100 200 m

SCALE 1:4000 (A3)

BARKER RYAN STEWART

LEGEND

Surface Roughness Classification

- Rural Residential (n = 0.05)
- Thick Vegetation (n = 0.10)
- Road Reserve (n = 0.02)
- Residential Lot (n = 0.20)

TALL TIMBERS ROAD
DEAKIN AVENUE
KEMIRA ROAD
CHISHOLM AVENUE
WALLABY ROAD
KOOKABURRA AVENUE
KANGAROO AVENUE
PACIFIC HIGHWAY
SALIENA AVENUE
CASPIAN WAY
MELALEUCA DRIVE
ACACIA AVENUE
BORONIA ROAD

FIGURE U
EXISTING SCENARIO ROUGHNESS CLASSIFICATION

0 100 200 m

SCALE 1:4000 (A3)

BARKER RYAN STEWART

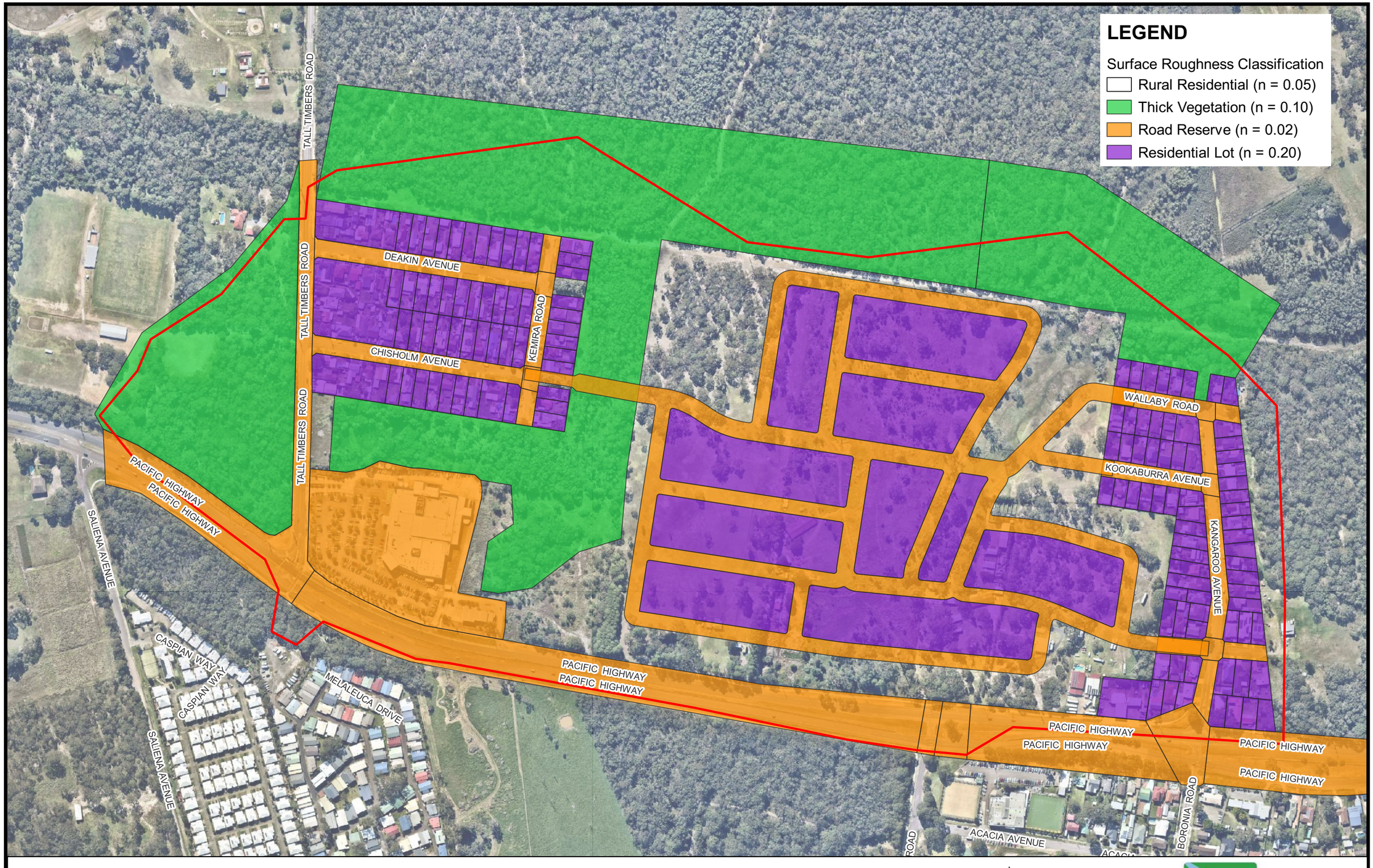


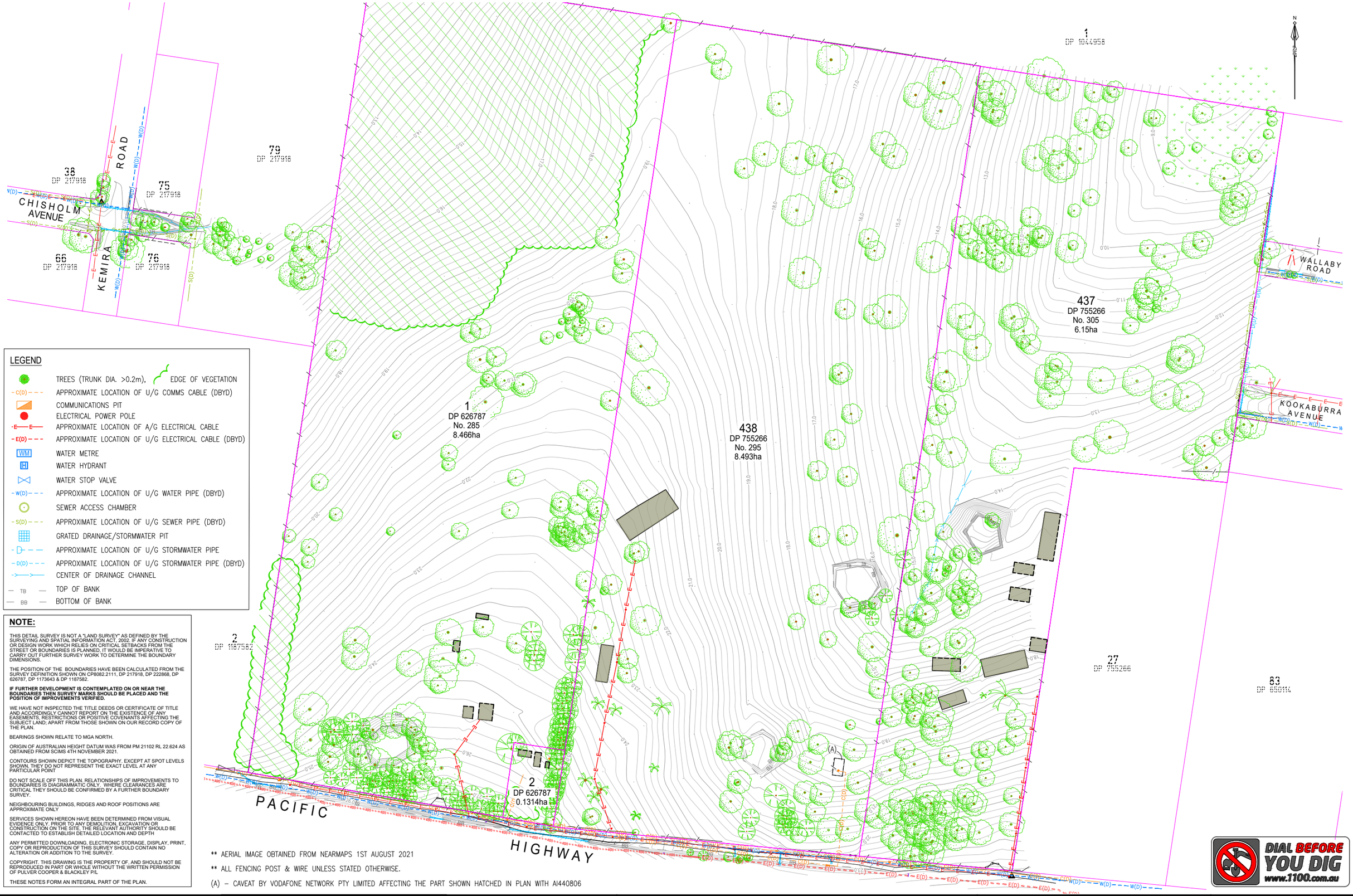
FIGURE V
PROPOSED SCENARIO ROUGHNESS CLASSIFICATION

0 100 200 m

SCALE 1:4000 (A3)

BARKER RYAN STEWART

Appendix B – Detail Survey



LEGEND

- TREES (TRUNK DIA. >0.2m), EDGE OF VEGETATION
- C(D) — APPROXIMATE LOCATION OF U/G COMMS CABLE (DBYD)
- COMMUNICATIONS PIT
- ELECTRICAL POWER POLE
- E — E — APPROXIMATE LOCATION OF A/G ELECTRICAL CABLE
- E(D) — APPROXIMATE LOCATION OF U/G ELECTRICAL CABLE (DBYD)
- WM — WATER METRE
- H — WATER HYDRANT
- WATER STOP VALVE
- W(D) — APPROXIMATE LOCATION OF U/G WATER PIPE (DBYD)
- SEWER ACCESS CHAMBER
- S(D) — APPROXIMATE LOCATION OF U/G SEWER PIPE (DBYD)
- GRATED DRAINAGE/STORMWATER PIT
- D — APPROXIMATE LOCATION OF U/G STORMWATER PIPE
- D(D) — APPROXIMATE LOCATION OF U/G STORMWATER PIPE (DBYD)
- CENTER OF DRAINAGE CHANNEL
- TB — TOP OF BANK
- BB — BOTTOM OF BANK

NOTE:

THIS DETAIL SURVEY IS NOT A "LAND SURVEY" AS DEFINED BY THE SURVEYING AND SPATIAL INFORMATION ACT, 2002. IF ANY CONSTRUCTION OR DESIGN WORK WHICH RELIES ON CRITICAL SETBACKS FROM THE STREET OR BOUNDARIES IS PLANNED, IT WOULD BE IMPERATIVE TO CARRY OUT FURTHER SURVEY WORK TO DETERMINE THE BOUNDARY DIMENSIONS.

THE POSITION OF THE BOUNDARIES HAVE BEEN CALCULATED FROM THE SURVEY DEFINITION SHOWN ON CP8082.2111, DP 217918, DP 222868, DP 626787, DP 1173643 & DP 1187582.

IF FURTHER DEVELOPMENT IS CONTEMPLATED ON OR NEAR THE BOUNDARIES THEN SURVEY MARKS SHOULD BE PLACED AND THE POSITION OF IMPROVEMENTS VERIFIED.

WE HAVE NOT INSPECTED THE TITLE DEEDS OR CERTIFICATE OF TITLE AND ACCORDINGLY CANNOT REPORT ON THE EXISTENCE OF ANY EASEMENTS, RESTRICTIONS OR POSITIVE COVENANTS AFFECTING THE SUBJECT LAND; APART FROM THOSE SHOWN ON OUR RECORD COPY OF THE PLAN.

BEARINGS SHOWN RELATE TO MGA NORTH.

ORIGIN OF AUSTRALIAN HEIGHT DATUM WAS FROM PM 21102 RL 22.624 AS OBTAINED FROM SCIMS 4TH NOVEMBER 2021.

CONTOURS SHOWN DEPICT THE TOPOGRAPHY. EXCEPT AT SPOT LEVELS SHOWN, THEY DO NOT REPRESENT THE EXACT LEVEL AT ANY PARTICULAR POINT

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NEIGHBOURING BUILDINGS, RIDGES AND ROOF POSITIONS ARE APPROXIMATE ONLY

SERVICES SHOWN HEREON HAVE BEEN DETERMINED FROM VISUAL EVIDENCE ONLY. PRIOR TO ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE, THE RELEVANT AUTHORITY SHOULD BE CONTACTED TO ESTABLISH DETAILED LOCATION AND DEPTH

ANY PERMITTED DOWNLOADING, ELECTRONIC STORAGE, DISPLAY, PRINT, COPY OR REPRODUCTION OF THIS SURVEY SHOULD CONTAIN NO ALTERATION OR ADDITION TO THE SURVEY.

THESE NOTES FORM AN INTEGRAL PART OF THE PLAN.

** AERIAL IMAGE OBTAINED FROM NEARMAPS 1ST AUGUST 2021

** ALL FENCING POST & WIRE UNLESS STATED OTHERWISE.

(A) – CAVEAT BY VODAFONE NETWORK PTY LIMITED AFFECTING THE PART SHOWN HATCHED IN PLAN WITH AI440806

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REV	AMENDMENT	ISSUED	DATE
A	INITIAL ISSUE	LH	6/12/2021

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
ENGINEERING | PLANNING | PROJECT MANAGEMENT | SURVEYING | CERTIFICATION

SYDNEY P: 02 9659 0005
CENTRAL COAST P: 02 4325 5255
HUNTER P: 02 4966 8388
ABN: 26 134 067 842
www.brs.com.au
mail@brs.com.au

Client:

ALDA - Properties Pty Ltd

DETAIL SURVEY PLAN OF 285-305 PACIFIC HIGHWAY LAKE MUNMORAH LGA: CENTRAL COAST

Surveyed: LH
Drawn: LH
Checked: TS
Datum: AHD
Contour Interval: 0.2m

20 10 0 20 40 60
Horizontal Scale 1:1000 (A1)
1:2000 (A3)

Plan No. -
Sheet No. 1/5
File Ref. CC180099-DET-A
REV. A

SEE SHEET 4

SEE SHEET 3

1
DP 626787
No. 285
8.466ha

438
DP 755266
No. 295
8.493ha

437
DP 755266
No. 305
6.15ha

27
DP 755266

BRICK HOUSE
BK SHED
BK HOUSE
S/M SHED
S/M SHED
S/M SHED
S/M SHED
S/M SHED
DAM
DAM
DAM
COVER
STABLE
GRAVEL DRIVEWAY
FENCE
MESH
WIRE
FENCE
MESH
WIRE
BITUMEN DRIVEWAY
COMMUNICATION TOWER
(A)
CONCRETE
FOOTPATH
EDGE
OF
BITMEN
POST
&
RAIL
FENCE
PACIFIC
HIGHWAY

8°42'50" 432.49
8°42'50" 467.615
8°42'50" 238.585
8°42'50" 176.645
95°28'50"
99°54' 3.33
30 °00'40"
95°28'50" 90.023
ø0.1 ASBESTOS

TBM TRIANGLE CUT IN PATH RL 23.83 AHD

LEGEND

- TREES (TRUNK DIA. >0.2m), EDGE OF VEGETATION
- C(D) — APPROXIMATE LOCATION OF U/G COMMS CABLE (DBYD)
- COMMUNICATIONS PIT
- ELECTRICAL POWER POLE
- E — E — APPROXIMATE LOCATION OF A/G ELECTRICAL CABLE
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- GRATED DRAINAGE/STORMWATER PIT
- APPROXIMATE LOCATION OF U/G STORMWATER PIPE
- D(D) — APPROXIMATE LOCATION OF U/G STORMWATER PIPE (DBYD)
- CENTER OF DRAINAGE CHANNEL
- TB — TOP OF BANK
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mail@brs.com.au

Client:

ALDA - Properties Pty Ltd

DETAIL SURVEY PLAN OF 285-305 PACIFIC HIGHWAY LAKE MUNMORAH LGA: CENTRAL COAST

Surveyed: LH
Drawn: LH
Checked: TS
Datum: AHD
Contour Interval: 0.2m

10 5 0 10 20 30
Horizontal Scale 1:500 (A1)
1:1000 (A3)

Plan No. -
Sheet No. 2/5
File Ref. CC180099-DET-A
REV. A

SEE SHEET 4

SEE SHEET 2

1
DP 1044858

1
DP 626787
No. 285
8.466ha

438
DP 755266
No. 295
8.493ha

2
DP 626787
0.1314ha

8°42'50"
473.41

8°42'50"
432.49

29.99
98°42'50"

44.32
8°42'50"

45.15
8°42'50"

151.26
100°00'40"

30
100°00'40"

99°54'
3.33

176.645
95°28'50"

FENCE
MESH
WIRE
PINE TREES
BRICK HOUSE
GRAVEL DRIVEWAY
COVER
SHED
BK SHED
GARAGE
W/B HOUSE
DAM
DEMOUNTABLE
CONCRETE
FOOTPATH
EDGE OF BITMEN
PACIFIC HIGHWAY

LEGEND

- TREES (TRUNK DIA. >0.2m), EDGE OF VEGETATION
- C(D) — APPROXIMATE LOCATION OF U/G COMMS CABLE (DBYD)
- COMMUNICATIONS PIT
- ELECTRICAL POWER POLE
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- BB — BOTTOM OF BANK

NOTE:

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BEARINGS SHOWN RELATE TO MGA NORTH.

ORIGIN OF AUSTRALIAN HEIGHT DATUM WAS FROM PM 21102 RL 22.624 AS OBTAINED FROM SCIMS 4TH NOVEMBER 2021.

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** ALL FENCING POST & WIRE UNLESS STATED OTHERWISE.

(A) – CAVEAT BY VODAFONE NETWORK PTY LIMITED AFFECTING THE PART SHOWN HATCHED IN PLAN WITH AI440806

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REV	AMENDMENT	ISSUED	DATE
A	INITIAL ISSUE	LH	6/12/2021

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
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SYDNEY P: 02 9659 0005
CENTRAL COAST P: 02 4325 5255
HUNTER P: 02 4966 8388
ABN: 26 134 067 842
www.brs.com.au
mail@brs.com.au

Client:
ALDA - Properties Pty Ltd

DETAIL SURVEY PLAN OF 285-305 PACIFIC HIGHWAY LAKE MUNMORAH LGA: CENTRAL COAST

Surveyed: LH
Drawn: LH
Checked: TS
Datum: AHD
Contour Interval: 0.2m

10 5 0 10 20 30
Horizontal Scale 1:500 (A1) 1:1000 (A3)

Plan No. -
Sheet No. 3/5
File Ref. CC180099-DET-A
REV. A

** AERIAL IMAGE OBTAINED FROM NEARMAPS 1ST AUGUST 2021

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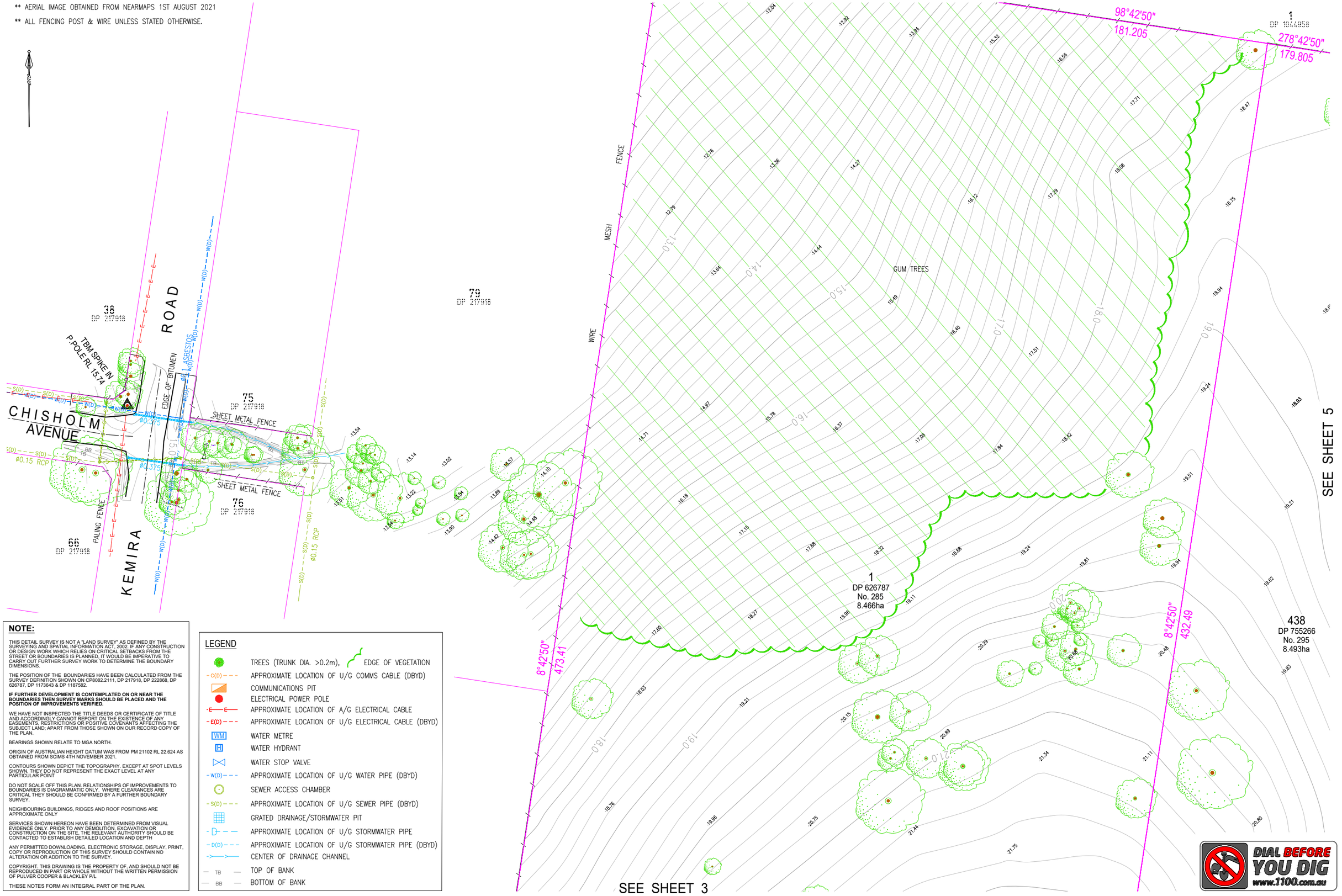

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LEGEND

- TREES (TRUNK DIA. >0.2m), EDGE OF VEGETATION
- C(D) — APPROXIMATE LOCATION OF U/G COMMS CABLE (DBYD)
- COMMUNICATIONS PIT
- ELECTRICAL POWER POLE
- E — E — APPROXIMATE LOCATION OF A/G ELECTRICAL CABLE
- E(D) — APPROXIMATE LOCATION OF U/G ELECTRICAL CABLE (DBYD)
- WM — WATER METRE
- H — WATER HYDRANT
- WATER STOP VALVE
- W(D) — APPROXIMATE LOCATION OF U/G WATER PIPE (DBYD)
- SEWER ACCESS CHAMBER
- S(D) — APPROXIMATE LOCATION OF U/G SEWER PIPE (DBYD)
- GRATED DRAINAGE/STORMWATER PIT
- APPROXIMATE LOCATION OF U/G STORMWATER PIPE
- D(D) — APPROXIMATE LOCATION OF U/G STORMWATER PIPE (DBYD)
- CENTER OF DRAINAGE CHANNEL
- TB — TOP OF BANK
- BB — BOTTOM OF BANK

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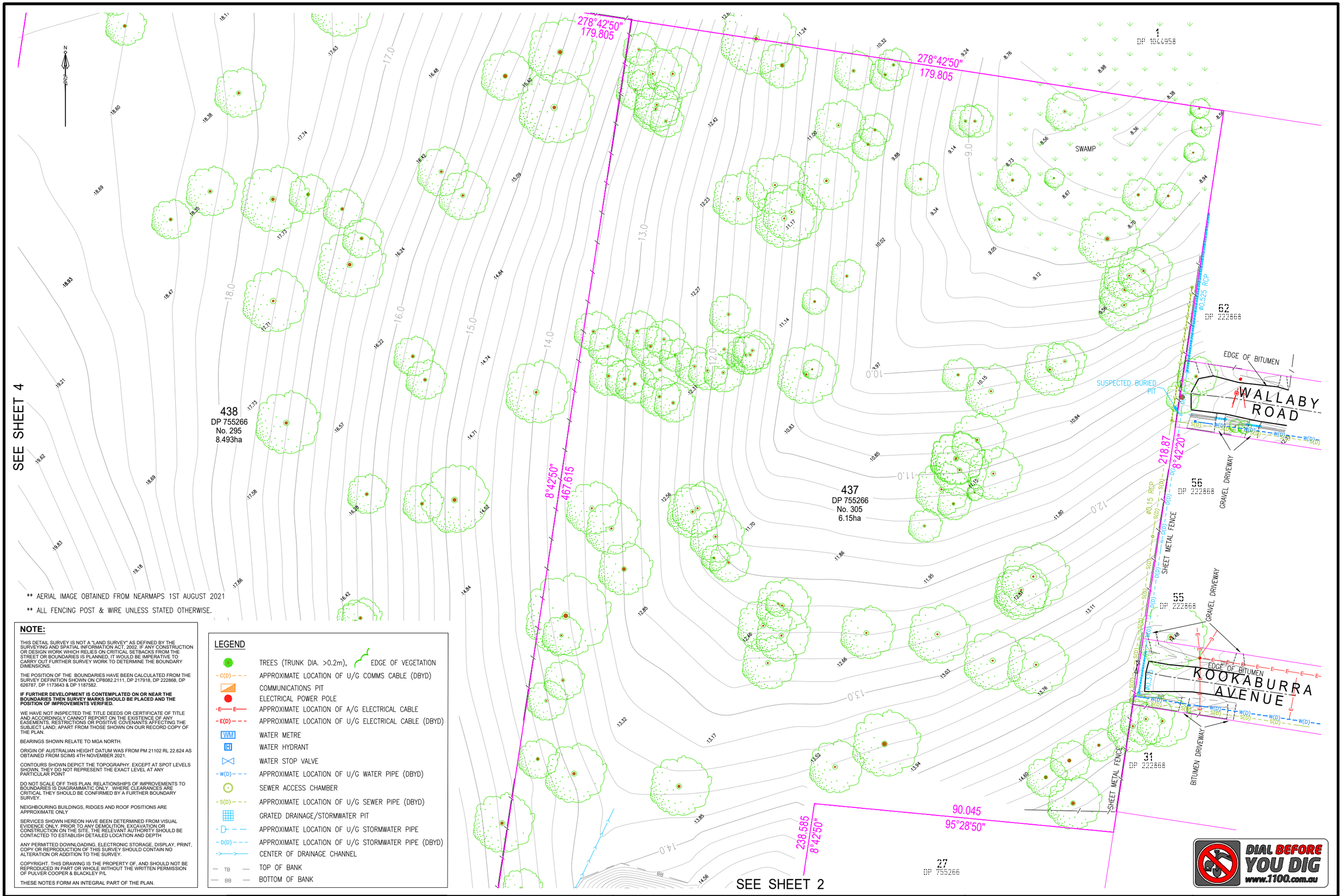
Plan No. -
Sheet No. 4/5
File Ref. CC180099-DET-A
REV. A



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Plan No. -
Sheet No. 5/5
File Ref. CC180099-DET-A
REV. A

Appendix C – Council Email 1st September 2021

Scott Brisbin

Subject: FW: Review of studies submitted to date - 285-335 Pacific Highway Lake Munmorah

From: Lucy Larkins <Lucy.Larkins@centralcoast.nsw.gov.au>
Sent: Wednesday, September 1, 2021 2:23 PM
To: edh1@bigpond.com
Cc: Lynda Hirst <Lynda.Hirst@centralcoast.nsw.gov.au>; David Milliken <David.Milliken@centralcoast.nsw.gov.au>; Ian Stewart <Ian@brs.com.au>; Matthew Hingee <Matthew.Hingee@centralcoast.nsw.gov.au>
Subject: Review of studies submitted to date

Dear Mark,

In relation to the preliminary Environmental Assessment lodged this week, please note that as all studies are required to be referred to Agency once reviewed and accepted by Council that this approach is unlikely to be supported by DPIE-BCD. The proposal triggers entry into the Biodiversity Offset Scheme (BOS) via impacting on areas highlighted on the biodiversity values map and exceeding the area clearing threshold. The site also has other constraints such as the presence of *Angophora inopina* (a state and federally listed threatened species), the site has potential for critically endangered orchids, and are Serious and Irreversible Impact (SAII) entities to occur and is also identified as important Swift Parrot Habitat. Swift Parrot habitat is listed as a (SAII) entity and any removal Swift Parrot Habitat has the potential to be serious and Irreversible. Any removal of SAII orchids would also constitute as Serious and Irreversible.

Currently proponents have typically identified biodiversity offsets via a BDAR. Then at the DA stage individual BDARs get submitted for each DA. However, this proposal has the potential of SAII orchid species occurring at the proposal site and is also known Swift Parrot habitat. If individual BDARs get submitted at the DA stage, DA consent may not be granted as a consent authority is not authorised under the BC Act to grant consent where the consent authority are of the opinion that an SAII will occur. So there is a risk here that Council could support a PP that may not get approval at the DA stage.

In addition, with consideration of the BC Act, avoid and minimise needs to be considered at each stage (i.e. at PP and the DA stage) and if proponents submit standard ecological assessments at the PP stage, it's unlikely that 100% lot yield won't be achievable at the DA stage. The benefit of biocertification is that all ecological matters including avoid and minimise are taken care of at the outset and won't need to be revisited at the DA stage for biocertified land.

Aboriginal Cultural Heritage Assessment
Has been reviewed and deemed to be acceptable for the purpose of referral to Agency prior to exhibition.

Flooding
Unclear if ARR 1987 or ARR 2016 has been used ?

RECOMMENDATIONS:
In order for Council to be able to appropriately assess the modelling the following should be provided based on the NSW Floodplain Development Manual guidelines, Australian Rainfall & Run off 2016 or 1987 and Handbook 7 (and the accompanying guideline: Australian Disaster Resilience Guideline 7-3 Flood Hazard (AIDR 2017)):

1. A flood study report should be provided for the subject site incorporating the following:

a. A brief description of the proposed development including site boundaries, proposed land uses, densities, population, infrastructure, development staging

b. Description of study objectives and summary of findings

a. A description of the features influencing the flooding patterns in the vicinity of the property and any site constraints

b. Identification of the catchments draining into the lots and inclusion of diagrams of the existing and proposed catchments draining to the site, drainage lines and features and receiving environments (both within and downstream of the site)

c. Recent ground survey (<1 year) carried out by a certified surveyor

d. Hydrological assessment and hydraulic assessment (in 2D- 2 meter grids as a minimum) {Finer for developments} to extract the flow depths, extents, levels, velocities and the like

e. A description of the modelling approach adopted in the flooding investigation to extract the flow and flood depths, water surface levels and extents, velocities (i.e DRAINS, TUFLOW or other). Details of adopted model parameters (eg. roughness values as a table, initial loss, continuing loss, blockage factors adopted, initial and continuing loss or any assumptions made)

f. If applicable plans and cross sections of the proposed roads, culverts, drainage infrastructure. The plans to include profile view, plan view, cross section view, all elevations, all invert and obvert levels and the like

g. A discussion on the basis of the geometric data (including plans and cross sections if applicable) used as input in the model

h. ALL modelling to include at least: MINIMUM REQUIRED Storm Events (AEPs): PMF, 1%, 5% and 20% (PRE & POST DEVELOPED)

i. A discussion on the existing flood behaviour in the vicinity of the property based on the modelling results including storm event figures as a minimum (plan and cross sections of flood extent and depths and water surface levels including velocity vectors as outlined below) for the existing scenario.

j. A discussion on the changes made to the structure of the pre-developed model in order that it reflect the pre and post-developed conditions based on modelling result including the required events figures (plan and cross sections of flood extent and depths and water surface levels including velocity vectors as outlined below) for the proposed scenario.

k. A discussion on post-developed flood behaviour in the vicinity the property based on the findings of the flood study.

l. A discussion on the impact, if any, the proposed development will have on flooding conditions in adjacent and downstream properties.

1. A discussion is also to be provided setting out what measures, if any, have been incorporated in the design to mitigate any adverse flooding conditions resulting from the development (e.g. flood mitigation measures)

m.

2. Figures to be provided:

- Pre development flood depths from 0.05m and greater for required storm events
- Pre development flood velocity magnitudes for the required storm events
- Pre development flood velocities vector arrows for 1% AEP and PMF events
- Post development flood depths from 0.05m and greater for 1% and PMF storm events.
- Post development flood velocities magnitude for required storm events
- Post development flood velocity vectors for 1% AEP and PMF events
- Peak water level difference map for 1% AEP and PMF events
- Peak velocity difference map for 1% AEP and PMF events
- 1% AEP and PMF event pre-development hazard map (H1 to H6 based on Handbook 7)
- Map of hydraulic categories of flood prone land: floodway, flood storage and flood fringe
- 1% AEP and PMF post development hazard map (H1 to H6 based on Handbook 7)
- Climate change map with additional graduations between 0.1 m and 0.5 m for 1% AEP
- Drainage network and peak flows in pipeline for 1% AEP event- no blockage

- Drainage network and peak flows in pipeline for 1% AEP event- 50% blockage
- Boundary conditions to be shown on the maps and explained in the report
- Pre and post development surface roughness areas and values as a table
- Soft copies of the files (shapefiles, autocad files, hydrological and hydraulic models) of all the above is to be provided to Council

Run off loss rates applied to the model are to be specified based on the respective land use defined per the different surface roughness areas.

3. The following information must be submitted to Council with the flood study:

a) A soft copy of all Hydrological (DRAINS, RAFTS, WBNM etc.) and Hydraulic (HECRAS, TUFLOW) models.

b) A scaled plan view showing:

- All parameters, and any assumptions;
- Roughness coefficients and the existing and future flood characteristics for the 100 year design storm;
- All catchments and sub-catchments areas contributing to flows in the vicinity of the development site;
- "DRAINS" sub-catchments and areas and nomenclature used to define the various piped reaches;
- Overland flow paths;
- Location and sections of all drainage lines showing pipe sizes and grades;
- Pit/gully surface levels as well as invert levels of inlet and outlet pipes;
- Proposed finished surface levels (all levels shall be relative to the Australian Height Datum); and
- Location of all "HEC-RAS" (or other model) cross sections on the aerial photography map.

<u>Sewer and Water</u>

- The submitted report does not provide sufficient information for the rezoning. It only consolidated the previous comments provided by W&S. No further detail strategy is provided which was suggested in the report.
- The developer will be required to provide detail W&S servicing strategy just for the subject application area. The strategy will need to include but not limited to the following:
    - The staging of the development
    - Estimated timeframe of each stage
    - Concept design of the subdivision plan

  The strategy will identify any sewer system capacity constraint and identify any required upgrades to accommodate the proposed rezoning.

- W&S in-house sewer modelling data can be made available to assist the preparation of the strategy upon request from the proponent.

<u>Traffic and Transport assessment</u>

Traffic and transport assessment has been reviewed and deemed to be acceptable to refer to Transport for NSW-RMS for comment prior to exhibition.

If you have any questions about the above please do not hesitate to contact me.

Regards
Lucy Larkins

Lucy Larkins
Senior Strategic Planner
Local Planning and Policy
Central Coast Council

P.O. Box 21 Gosford, NSW 2250
t: 4304 7571
e: Lucy.Larkins@centralcoast.nsw.gov.au


Please consider the environment before printing this email

Appendix D – Council Email 9th December 2021

Scott Brisbin

From: Rudy VanDrie <Rudy.VanDrie@centralcoast.nsw.gov.au>
Sent: Thursday, 9 December 2021 12:09 PM
To: Scott Brisbin; Lucy Larkins; Lucy Larkins; Scott Duncan; Peter Sheath; Ian Stewart; Mark Eastham EDH Group; Mark Dowdell
Cc: joel.shanahan1@gmail.com; Jonathan Terry
Subject: RE: 285-335 Pacific Highway, Lake Munmorah | Confirmation of Flood Assessment Requirements

Yes given the nature of this being a Planning Proposal, and your limited time frame, agreed in principle.

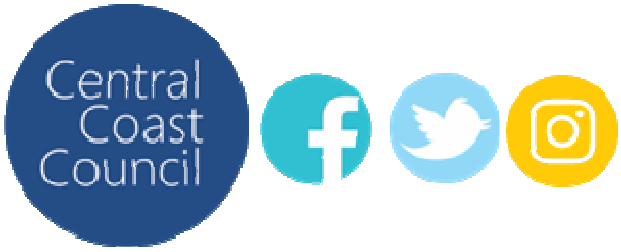
Note that the reporting of ARR 2016, requires identification of the Critical Duration, and Critical Pattern, for the 1% event.
It has been observed that ARR2016 is more sensitive to land use changes (% Impervious) and inclusion of Storage, in the identification of critical storms.

It has been observed for example that durations, and patterns may differ from Pre – to Post-Developed.

Please ensure reporting is clearly identifying any specific changes.

Regards Rudy Van Drie

Rudy VanDrie
Planning Engineer Hydrology
Floodplain Management
Central Coast Council
PO Box 21 Gosford, NSW 2259
t: 02 4304 7094
m: 0428 204 013
e: Rudy.VanDrie@centralcoast.nsw.gov.au



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From: Scott Brisbin <ScottB@brs.com.au>
Sent: Thursday, 9 December 2021 06:06
To: Lucy Larkins <Lucy.Larkins@centralcoast.nsw.gov.au>; Lucy Larkins <Lucy.Larkins@centralcoast.nsw.gov.au>; Scott Duncan <Scott.Duncan@centralcoast.nsw.gov.au>; Peter Sheath <Peter.Sheath@centralcoast.nsw.gov.au>; Rudy VanDrie <Rudy.VanDrie@centralcoast.nsw.gov.au>; Ian Stewart <Ian@brs.com.au>; Mark Eastham EDH Group <edh1@bigpond.com>; Mark Dowdell <Mark.Dowdell@centralcoast.nsw.gov.au>

Cc: joel.shanahan1@gmail.com; Jonathan Terry <jonathan@brs.com.au>
Subject: 285-335 Pacific Highway, Lake Munmorah | Confirmation of Flood Assessment Requirements

Rudy,

Thanks for your time yesterday to discuss flood assessment requirements to support the proposed rezoning application at 285-335 Pacific Highway, Lake Munmorah.

Included below are the flooding requirements as provided by Lucy via email on 1/9/2021. I have updated these requirements as discussed in yesterday's meeting.

We will work toward completing the flood modelling and reporting as soon as possible and submit to Council for review and approval.

Thanks,

Scott

Extract from Lucy Larkin's email dated 1/9/2021, updated per meeting held 8/12/2021.

Flooding

Unclear if ARR 1987 or ARR 2016 has been used ?
[ARR2016 to be used]

RECOMMENDATIONS:
In order for Council to be able to appropriately assess the modelling the following should be provided based on the NSW Floodplain Development Manual guidelines, Australian Rainfall & Run off 2016 or 1987 and Handbook 7 (and the accompanying guideline: Australian Disaster Resilience Guideline 7-3 Flood Hazard (AIDR 2017)):

1. A flood study report should be provided for the subject site incorporating the following:
    a. A brief description of the proposed development including site boundaries, proposed land uses, densities, population, infrastructure, development staging
    b. Description of study objectives and summary of findings
    a. A description of the features influencing the flooding patterns in the vicinity of the property and any site constraints
    b. Identification of the catchments draining into the lots and inclusion of diagrams of the existing and proposed catchments draining to the site, drainage lines and features and receiving environments (both within and downstream of the site)
    c. Recent ground survey (<1 year) carried out by a certified surveyor
    d. Hydrological assessment and hydraulic assessment (in 2D- 2 meter grids as a minimum) {Finer for developments} to extract the flow depths, extents, levels, velocities and the like
    e. A description of the modelling approach adopted in the flooding investigation to extract the flow and flood depths, water surface levels and extents, velocities (i.e DRAINS, TUFLOW or other). Details of adopted model parameters (eg. roughness values as a table, initial loss, continuing loss, blockage factors adopted, initial and continuing loss or any assumptions made)
    f. ~~If applicable plans and cross sections of the proposed roads, culverts, drainage infrastructure. The plans to include profile view, plan view, cross section view, all elevations, all invert and obvert levels and the like~~ [Not applicable at this stage, consider at DA]

g. A discussion on the basis of the geometric data (including plans and cross sections if applicable) used as input in the model

h. ALL modelling to include at least: MINIMUM REQUIRED Storm Events (AEPs): PMF, 1%, ~~5% and 20%~~ (PRE & POST DEVELOPED) [5% and 20% not required]

i. A discussion on the existing flood behaviour in the vicinity of the property based on the modelling results including storm event figures as a minimum (plan and cross sections of flood extent and depths and water surface levels including velocity vectors as outlined below) for the existing scenario.

j. A discussion on the changes made to the structure of the pre-developed model in order that it reflect the pre and post-developed conditions based on modelling result including the required events figures (plan and cross sections of flood extent and depths and water surface levels including velocity vectors as outlined below) for the proposed scenario.

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2. Figures to be provided:

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- 1% AEP and PMF post development hazard map (H1 to H6 based on Handbook 7)
- ~~Climate change map with additional graduations between 0.1 m and 0.5 m for 1% AEP~~
- ~~Drainage network and peak flows in pipeline for 1% AEP event- no blockage~~
- ~~Drainage network and peak flows in pipeline for 1% AEP event- 50% blockage~~
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- Soft copies of the files (shapefiles, autocad files, hydrological and hydraulic models) of all the above is to be provided to Council
- Run off loss rates applied to the model are to be specified based on the respective land use defined per the different surface roughness areas.

3. The following information must be submitted to Council with the flood study:

a) A soft copy of all Hydrological (DRAINS, RAFTS, WBNM etc.) and Hydraulic (HECRAS, TUFLOW) models.

b) A scaled plan view showing:

- All parameters, and any assumptions;
- Roughness coefficients and the existing and future flood characteristics for the 100 year design storm;
- All catchments and sub-catchments areas contributing to flows in the vicinity of the development site;

- ~~"DRAINS" sub-catchments and areas and nomenclature used to define the various piped reaches;~~ [Not applicable at this stage, consider at DA]
- ~~Overland flow paths;~~
- ~~Location and sections of all drainage lines showing pipe sizes and grades;~~
- ~~Pit/gully surface levels as well as invert levels of inlet and outlet pipes;~~
- ~~Proposed finished surface levels (all levels shall be relative to the Australian Height Datum); and~~
- ~~Location of all "HEC-RAS" (or other model) cross sections on the aerial photography map.~~ [Tuflow to be used for modelling]

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ENGINEERING | PLANNING | SURVEYING | CERTIFICATION

-----Original Appointment-----
From: Lucy Larkins <Lucy.Larkins@centralcoast.nsw.gov.au>
Sent: Tuesday, 30 November 2021 9:33 AM
To: Lucy Larkins; Scott Duncan; Peter Sheath; Rudy VanDrie; Ian Stewart; Mark Eastham EDH Group; Mark Dowdell
Cc: joel.shanahan1@gmail.com; Scott Brisbin; Jonathan Terry
Subject: Flood study requirements
When: Wednesday, 8 December 2021 10:00 AM-11:00 AM (UTC+10:00) Canberra, Melbourne, Sydney.
Where: Microsoft Teams Meeting

-----Original Appointment-----
From: Lucy Larkins <Lucy.Larkins@centralcoast.nsw.gov.au>
Sent: Tuesday, 30 November 2021 7:47 AM
To: Lucy Larkins; Scott Duncan; Peter Sheath; Rudy VanDrie; Ian Stewart; Mark Eastham EDH Group; Mark Dowdell

Subject: Flood study requirements
When: Wednesday, 8 December 2021 10:00 AM-11:00 AM (UTC+10:00) Canberra, Melbourne, Sydney.
Where: Microsoft Teams Meeting

Meeting to discuss flood study requirements for PP related to 285-335 Pacific Highway Lake Munmorah. Previous advise has been given about what needs to be included in the flood study for this precinct, consultants is wishing to clarify matters within this request.

@Ian Stewart can you please forward to any other parties who are attending.

Microsoft Teams meeting

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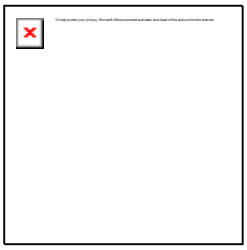
Click here to join the meeting



If you haven't used Teams meetings previously, please attempt to join the meeting 15 minutes prior to the scheduled commencement time. If you are experiencing difficulties in joining this meeting, please contact your IT Support team for assistance.

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