Karimbla Construction Services (NSW) Pty Ltd
Level 1, 528 Kent Street
Sydney NSW 2000

Ref: 120066

9 October 2020

**Attention: Hannah Gilvear**

**Re: 128 Bunnerong Road and 120 Banks Avenue Eastgardens –**
**Site Flood Assessment for Concept Development Assessment**

## Table of Contents

# 1. INTRODUCTION

## 1.1. Overview

WMAwater have undertaken a site-specific flood assessment for the planned redevelopment of the above site (comprising Lot 24 DP1242288 and Lot 100 DP 1250842, shown on Diagram 1). The site comprises the northern component of a larger precinct previously known as the BATA site (British American Tobacco Association site), which is being developed as per a 2015 Masterplan.

Diagram 1: Site Location

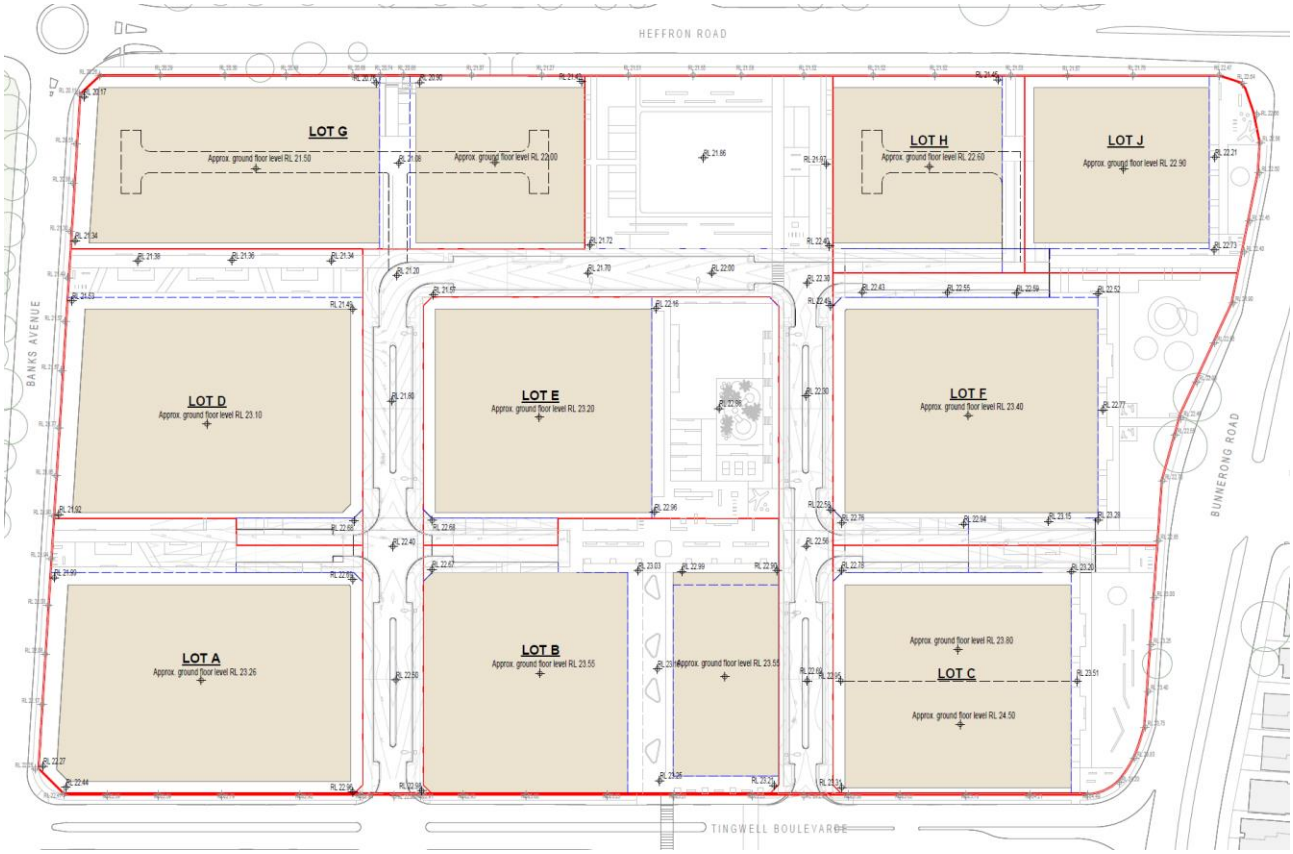

Residential development of the southern part of the BATA precinct has already been approved and constructed. This flood assessment is in relation to a Concept Development Application (DA) of the BATA North area, being prepared by Meriton (Karimbla Construction Services) for the site.

This assessment included flood impact modelling of the proposed road layout and conceptual overland flow routes, and a preliminary review of indicative ground floor levels for the proposed buildings, to determine whether the proposed building envelopes and elevations can meet the relevant flood-related development controls from the Botany Development Control Plan (DCP).

## 1.2. Background

The site has been identified as flood prone by Bayside Council (Council). As part of the Concept DA, Council indicated it is necessary to demonstrate that the prospective development is compatible with the flood hazard and flood-related development controls under Council's planning framework. The prospective development would involve demolition of existing structures and construction of a new road network within the site with associated stormwater drainage, to allow future development of various residential development lots through subsequent development applications Indicative ground floor elevations in each lot are also proposed as part of the DA (see Diagram 2).

Diagram 2: Indicative lot layout and levels




Flood information at this site is available from the Springvale Drain and Floodvale Drain (SDFD) Flood Study (Reference 1) and Floodplain Risk Management Study and Plan (Reference 2) previously completed by Council.

Using the existing flood model developed for the Flood Study, WMAwater have undertaken an impact assessment of the effects of the proposed development on flood behaviour in and around the site, as well as a preliminary assessment of the indicative proposed ground floor levels. An assessment of flood emergency response management requirements was also undertaken.

## 1.3. Available Data

The following documents were relied upon for this assessment:

- Springvale Drain and Floodvale Drain Flood Study, prepared by BMT WBM on behalf of City of Botany Bay, January 2014 (Reference 1);
- Springvale Drain and Floodvale Drain Floodplain Risk Management Study, prepared by WMAwater on behalf of City of Botany Bay, December 2019 (Reference 2);
- Botany Bay Development Control Plan 2013, Part 3G: Stormwater Management (Reference 3);
- Botany Bay Development Control Plan 2013, Stormwater Management Technical Guidelines (Reference 3);
- Flood Advice Letter for 128 Bunnerong Road and 120 Banks Avenue Eastgarden (Bayside Council, August 2020);
- 130-150 Bunnerong Road Pagewood – Civil Development Application Report, at&l, Rev 04 July 2014;
- 128 & 130-150 Bunnerong Road Pagewood – Pagewood Part II DA Report, at&l, Rev 03 August 2019;
- 130-150 Bunnerong Road Pagewood – Civil Work Road Package Stage 2 Drawings, at&l, Rev A dated 2 October 2019;
- BATA North 128 Bunnerong Road Pagewood – Stage 1 DA Architectural Drawings, SJB architects, Rev 13 dated 2 September 2020; and
- BATA North 128 Bunnerong Road Pagewood – Ground Levels Drawing DA106, SJB architects, Rev 13 dated 14 September 2020.

The SDFD flood model developed for the flood study was reviewed and updated in order to assess the proposed development. Details of the modelling undertaken can be found in Section 2.

# 2. EXISTING FLOOD BEHAVIOUR

## 2.1. Existing Flood Modelling

The flood model developed for the SDFD Flood Study (Reference 1) and refined for the FRMS (Reference 2) was used for this investigation. The flood model was developed in TUFLOW and covers the entire catchment to Botany Bay, including the subject site, which is located in the upper part of the catchment. The model utilises a 3 m x 3 m grid to simulate flood behaviour across the catchment using flows from a DRAINS hydrologic model. The topographic data within the model is primarily derived from LiDAR aerial survey data captured in 2007 and 2008, with additional detail from detail survey in various places.

## 2.2. Catchment Description and Flood Behaviour

The site lies in upper-most area of the SDFD catchment. Bunnerong Road forms the catchment divide with the Bunnerong Drain catchment to the east. The only area of catchment that contributes runoff from upstream of the site is the Eastgardens shopping centre and BATA Stage 1 areas to the

south. The flow behaviour within the site is therefore predominantly driven by the form of the topography and the road network of the development.

Stormwater drainage from the site discharges into a Sydney Water trunk drain. Sydney Water's requirements for discharging to this system were addressed in Reference 4.

When runoff exceeds the capacity of the piped stormwater network, either within the site or in the receiving Sydney Water system downstream, overland flow will occur. The site grades generally downwards from south-east to north-west, and under existing site conditions, overland flow is discharged towards the low point at the intersection of Heffron Road and Banks Avenue at the north-west corner of the site.

The stormwater system within the site is designed for a nominal capacity of the 5% AEP design storm (Reference 4). This means that in more intense storms such as the 1% AEP design event, provision for overland flow along the road network or other open areas will be required. This overland flow will need to be managed such that flood risk within the site is appropriate in the context of the proposed development, and also to ensure that downstream flood impacts are not exacerbated.

## 2.3. Updated Flood Modelling of Current Conditions

The existing flood model was reviewed, and it was determined that it did not include the BATA south development, bounded by Tingwell Boulevard, Banks Avenue, Westfield Drive and Bunnerong Road. This development was constructed after the catchment-wide modelling for References 1 and 2 was completed. The stormwater and overland flow design for the BATA North and South precincts are linked, so it was necessary to update the modelling to include the previously approved works.

WMAwater made the following updates to the existing conditions flood model within the BATA precinct (locations indicated on Figure 2):

1. More recent LiDAR data from the NSW Spatial Services Department, collected in 2018, was used as the base topographic information (within the yellow boundary on Figure 2)
2. AT&L provided design levels in the form of a TIN file for the BATA South (Stage 1) area (indicated by the red extent on Figure 2),
1. The building footprints for the BATA South development were blocked out from the model grid,
2. The existing Sydney Water trunk drain within the site was added to the model, based on detailed survey,
3. The BATA South (Stage 1) stormwater network was added to the model, based on design plans from AT&L,
4. On-site Detention (OSD) capacity was added to the model for the BATA South buildings (volumes as indicated on Figure 2).

It was assumed for the purposes of this assessment that the OSD storages would fill up in the early parts of the storm event, and release water slowly after runoff from the rest of the site had peaked. Therefore the OSD storages were implemented as a simple initial loss on the design rainfall. The modelled initial loss in millimetres corresponding to the OSD volume for each lot is given in Table 1.

Table 1: OSD volumes and assumed equivalent losses for flood modelling – BATA South

| Catchment area to OSD ($m^2$) | OSD volume ($m^3$) | Assumed Rainfall Initial Loss (mm) |
|---|---|---|
| **11,458** | 326 | 28 |
| **8,196** | 256 | 32 |
| **6,070** | 207 | 34 |
| **21,320** | 465 | 22 |

## 2.4. Flood Modelling of Proposed Conditions

Similar adjustments to the model were implemented to reflect the proposed conditions:

- A digital elevation model of the proposed road network was imported directly from CAD files provided by AT&L (file 4).
- The stormwater network was schematised from the AT&L design drawings (Reference 4).
- The proposed development sub-lots were represented in the model as solid obstructions to flow, assuming that they are generally developed in a way that excludes overland flow.
- OSD volumes were modelled as initial losses to the design rainfalls, as per Table 2.

Table 2: OSD volumes and assumed equivalent losses for flood modelling – BATA North

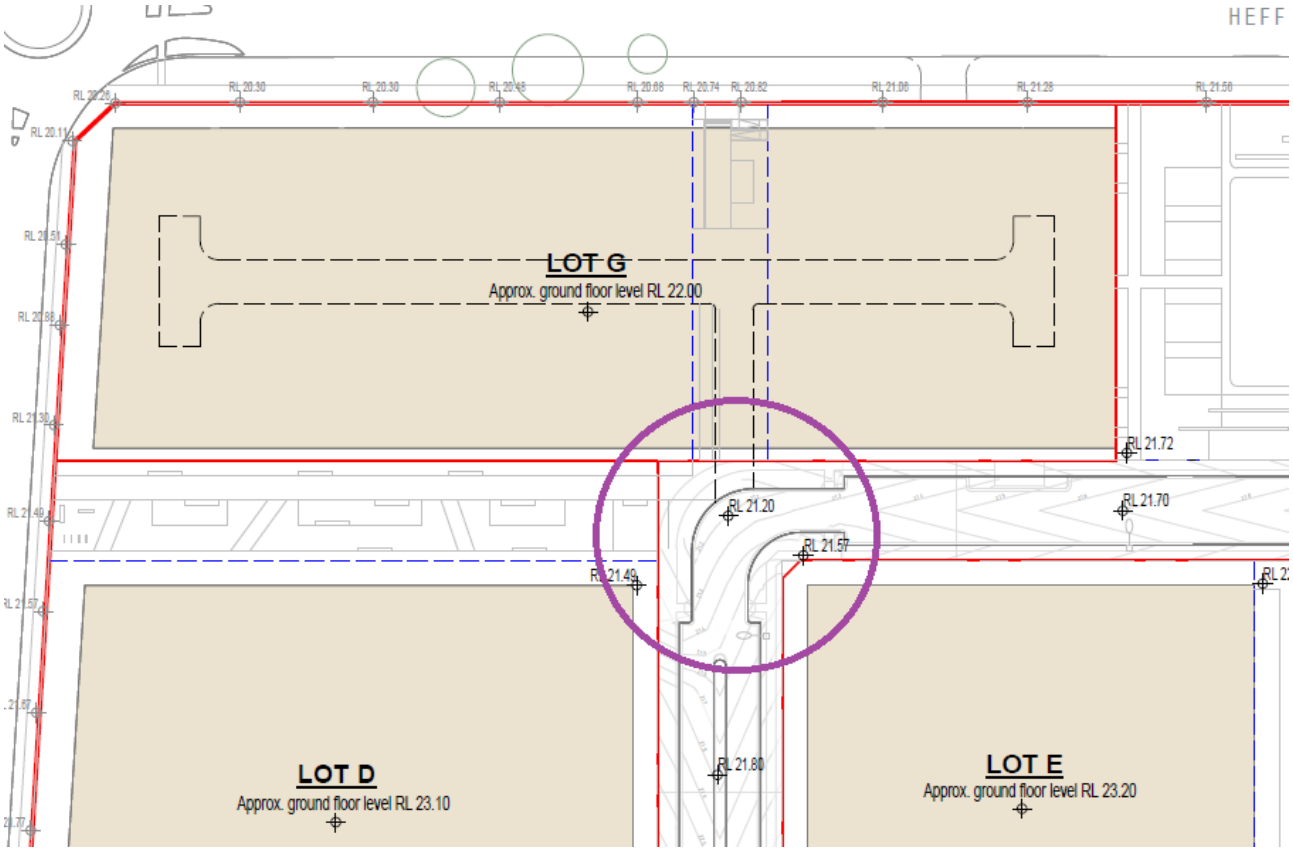
| Catchment area to OSD ($m^2$) | OSD volume ($m^3$) | Assumed Rainfall Initial Loss (mm) |
|---|---|---|
| **31,177** | 1,495 | 48 |
| **7,773** | 450 | 58 |
| **8,854** | 260 | 29.3 |
| **8,896** | 405 | 46 |
| **8,815** | 560 | 64 |

The layout of the post-development scenario is shown on Figure 3.

The revised existing condition scenario and the post-development scenario were each run for the 1% Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) design events. The critical duration for the site and surrounding area was assessed to be the 2 hour storm for the 1% AEP and the 30 minute storm for the PMF.

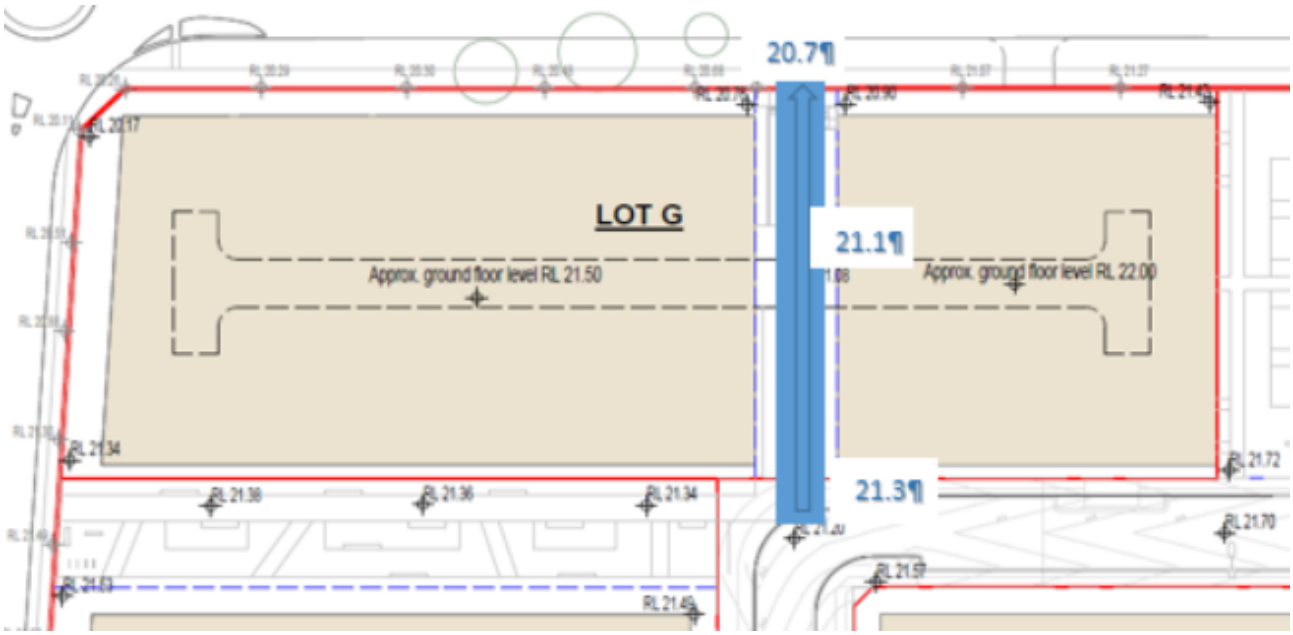
Initial modelling of the proposed road and lot layout indicated that in the 1% AEP and PMF events, overland flow would collect in the north-western corner of the internal road network, adjacent to Lot G unless an overland flow path was provided to allow water to drain from this location towards Banks Avenue and/or Heffron Road (see Diagram 3).

Diagram 3: Trapped sag point near Lot G without relief overland flow path




The concept layout allows for an internal access driveway to the townhouses within Lot G, but the detailed design including grading has not yet been specified (presumably to be undertaken later as part of a Detailed DA for Lot G). Based on liaison with Meriton and AT&L, WMAwater included an indicative overland flow path along the Lot G driveway and access ramp to Heffron Road with levels as indicated in Diagram 4.

Diagram 4: Assumed concept grading of overland flow relief path through Lot G



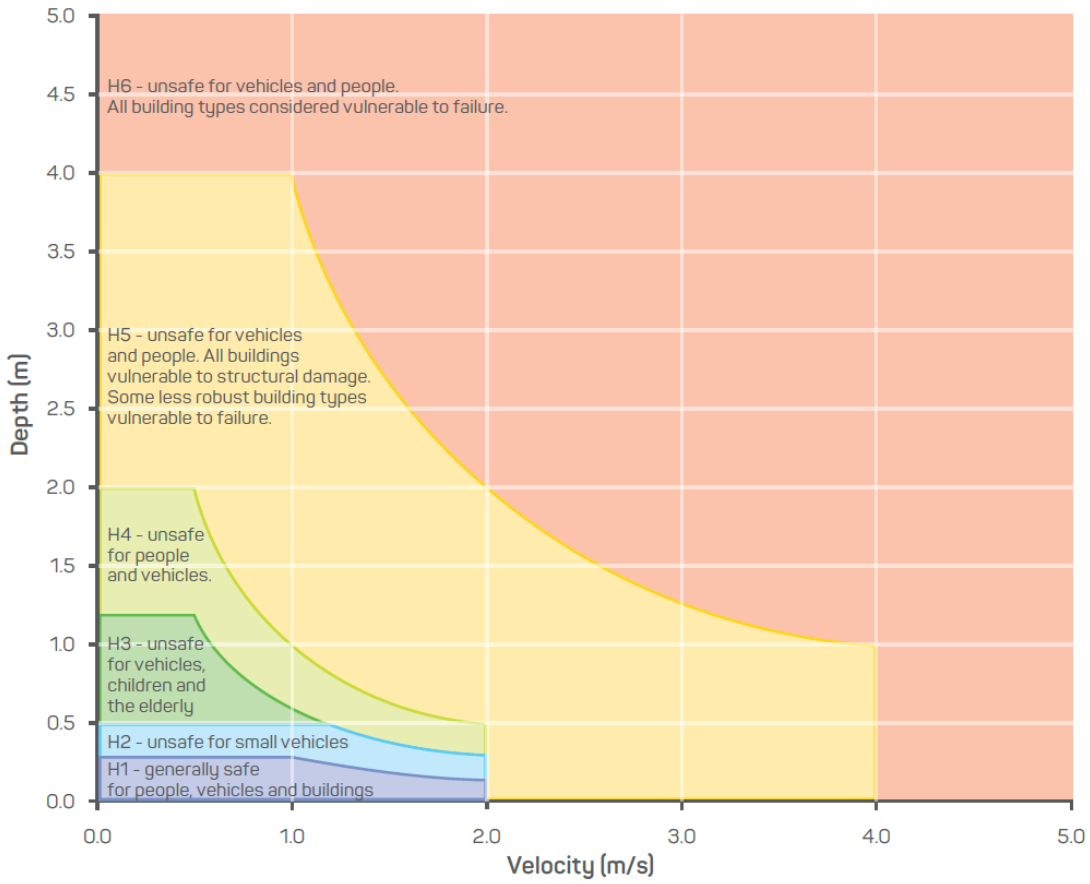
The mapping for proposed conditions in this report assumes that the concept overland flow path through Lot G is in place. The subsequent discussion and assessment of compliance with planning controls in Section 4 also assumes this flow path is in place. It will be necessary to ensure that an overland flow path is included in the subsequent development of Lot G, and that the flow behaviour and floor level requirements in Lot G are re-assessed at the Detailed DA stage.

## 2.5. Flood Modelling of Proposed Conditions

Mapping of the TUFLOW results (depth, height, velocity and hazard) for the proposed development is provided on Figure 4 to Figure 9.

The peak flood hazard across the site was determined using the hazard curves presented in the Australian Disaster Resilience Handbook 7: Managing the Floodplain (Reference 5). The curves present flood hazards as a function of the depth and velocity of floodwaters, as shown in Diagram 5.

Diagram 5: Flood hazard vulnerability curves (from Reference 5)




Under the proposed conditions, flooding at the site will be generally localised to the two sag points in the road network:

1. Between Lots E and F, and
2. At the corner near the Lot G driveway access.

In the 1% AEP event, peak flood depths will be up to 0.4 m in the road between Lots E and F, and up to 0.3m adjacent to Lot G, assuming the driveway is graded as per Diagram 4 to allow overland

flow to exit this low point. If the relief path from the low point near Lot G is not provided, initial modelling indicated flood depths at this location would exceed 1 m in the 1% AEP event.

The peak velocities in the 1% AEP event are generally low, with maximum values of approximately 1 m/s occurring along the concept driveway flow path through Lot G. The combination of depths and velocities produce a hazard classification of H1 for the majority of the site, apart from small areas of H2 within the sag points. These velocities and hazard are appropriate for the type of development being proposed, and typical of urban residential road networks in the 1% AEP event.

The change in flood behaviour between current and proposed conditions is discussed in Section 4.2.

# 3. FLOOD RELATED PLANNING CONTROLS

## 3.1. Overview

Although Botany Bay City Council and Rockdale Council have merged to form Bayside Council, the Botany Bay Development Control Plan (DCP) 2013 (Reference 3) still governs the control of development within Eastgardens. The DCP relies on the Stormwater Management Technical Guidelines (part of the DCP) to prescribe requirements related to flooding. Since the site has been identified as flood prone by Bayside Council, flood planning controls apply to the site. A summary of these controls is presented in Sections 3.2 to 3.4 of this report. Since this is a Concept DA and some components of the development have not been designed yet, some of the requirements cannot be conclusively assessed, and compliance will need to be confirmed for subsequent detailed DAs.

## 3.2. Finished Floor Levels

Minimum floor levels apply to sites that are flood prone (Section 8 of the Stormwater Management Technical Guidelines). Habitable floors are to be 500 mm above the 1% AEP flood level and non-habitable floors are to be 300 mm above the 1% AEP flood level. In areas where there is no overland flow affectation for the new lots, the requirement for habitable floors is lower (300 mm above the top of the kerb). For below ground basements and carparks, the crest levels of ramps and steps at entry points are to be 300 mm above the 1% AEP flood level (where known), or 300 mm above the top of kerb adjacent to the layback.

## 3.3. Flood Impact

Any development, as a result of raising floor levels or site levels, must not create or exacerbate flooding on any other private or public properties, including public roads and open space (Section 8 of the Stormwater Management Technical Guidelines).

## 3.4. Flood Study

A flood study / overland flow path assessment shall be carried out by the developer and submitted to Council as part of the Development Application (DA) documentation when the site is located at / adjacent to the sag point of the catchment, which is the case for the site (Section 11 of the Stormwater Management Technical Guidelines). The flood study is required to demonstrate:

- The proposed development does not cause an increase in flood level outside the site,
- The proposed development meets floor level requirements,
- Flood storage within the site is maintained,
- Adequate mitigation measures have been proposed for any impacts, and
- Flood evacuation in the PMF event has been considered

Assessment of compliance with each of these requirements is provided in subsequent sections.

# 4. FLOOD ASSESSMENT

## 4.1. Minimum Floor Levels

The Building Code of Australia (Reference 6, Part A1, pg. 26) defines a 'habitable room' in a residential context as follows:

> **Habitable room** means a room used for normal domestic activities, and—
>
> (a) includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom; but
>
> (b) excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes-drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.

The NSW Floodplain Development Manual 2005 (Reference 7), extends this definition to an industrial or commercial situation, defining a 'habitable room' as (pg. 22):

> in an industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.

This assessment has assumed that the majority of the ground floor for each building will comprise 'habitable' spaces. This means that minimum ground floor levels are to be 500 mm above the 1% AEP flood level where there overland flow flooding in the adjacent street, or 300 mm above the top of the kerb where there is no overland flow affectation, according to the Botany DCP (Reference 3).

It is unclear at this stage whether basement car parks are proposed for each of the sub-lots. The crest levels at the basement entries, including ventilation and fire exit stairwells, would need to reach a minimum level of 300 mm above the 1% AEP level according to the DCP. This is slightly lower than the ground floor level requirement for each building, and it is expected that this could be readily managed at the detailed design stage.

The flood levels vary for each lot, due to the varying levels along the new road network which conveys overland flow through the site. Under the proposed road layout, some of the lots will not be adjacent to any significant overland flow paths or flooding of sag points. For these lots, where the 1% AEP flow is less than 0.15 m depth in the adjacent road, and there is a gradient to drain the lots, the only minimum floor requirement in the DCP is to be 0.3 m above adjacent ground levels (i.e. top of kerb. The eastern lots adjacent to Bunnerong Road are along the crest of the catchment divide, and it may be reasonable to have less than 0.3 m above surrounding ground at the eastern corners of these buildings.

Table 3 provides the minimum floor levels for all lots based on 0.3 m freeboard above adjacent ground levels. The indicative proposed levels for each of the proposed lots comply with requirements, apart from the southern edge of Lot G (townhouses).

Table 3: Minimum Floor Level Requirements Based on Adjacent Ground Levels

| Sub-Lot | Highest Kerb Level (mAHD) | Minimum Habitable Floor Level with 0.3m freeboard (mAHD) | Indicative Proposed Ground Floor Level (mAHD) | Complies? |
|---|---|---|---|---|
| **Lot A** | 22.96 | 23.26 | 23.26 | Yes |
| **Lot B** | 23.25 | 23.25 | 23.55 | Yes |
| **Lot C (north)** | 23.5 | 23.8 | 23.80 | Yes |
| **Lot C (south)** | 24.2 | 24.5 | 24.5 | Yes |
| **Lot D** | 22.7 | 22.0 | 23.1 | Yes |
| **Lot E** | 22.9 | 23.2 | 23.2 | Yes |
| **Lot F** | 23.1* | 23.4 | 23.4 | Yes |
| **Lot G** | 21.4 | 21.7 | 21.5 | No |
| **Lot H** | 22.2 | 22.5 | 22.6 | Yes |
| **Lot J** | 22.6* | 22.9 | 22.9 | Yes |

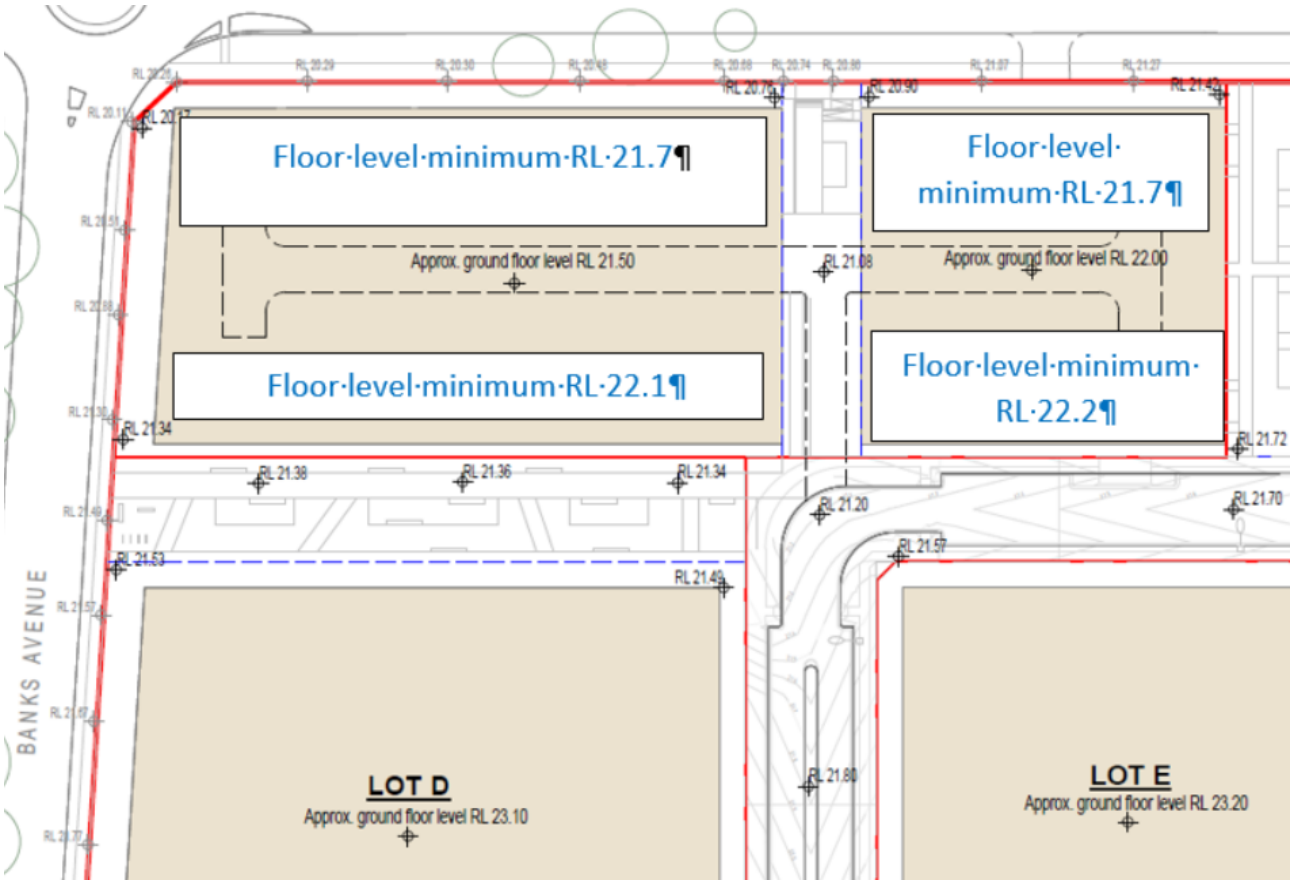
The relevant flood levels and minimum floor level requirements for lots adjacent to a sag point or significant overland flow in the road are specified in Table 4. A freeboard of 0.5 m is applicable to these locations.

Table 4: Minimum Floor Level Requirements Based on Overland Flood Levels

| Sub-Lot | Peak Flood Level (mAHD) | Minimum Habitable Floor Level with freeboard (mAHD) | Indicative Proposed Ground Floor Level (mAHD) | Complies? |
|---|---|---|---|---|
| **Lot D** | 21.6 | 22.1 | 23.10 | Yes |
| **Lot E** | 22.4 | 22.9 | 23.20 | Yes |
| **Lot F** | 22.4 | 22.9 | 23.40 | Yes |
| **Lot G (west)** | 21.2 to 21.6 (varies) | 21.7 to 22.1 (varies) | 21.50 | Partial |
| **Lot G (east)** | 21.2 to 21.7 (varies) | 21.7 to 22.2 (varies) | 22.0 | Partial |

The proposed indicative floor levels from Diagram 2 comply with the requirements, apart from certain areas within Lot G adjacent to the driveway flow path or sag point. The proposed development in Lot G comprises townhouses, so it will likely be feasible to apply varying floor levels to each townhouse to comply with the requirements. Diagram 6 indicates the required changes within Lot G to comply with the minimum floor level requirements. It is likely these changes can be readily implemented into the proposal, as the required increases in floor level are generally less than 0.5 m.

Diagram 6: Required minimum floor levels in Lot G for compliance




## 4.2. Flood Impact

The modelled change in 1% AEP peak flood level, comparing the proposed condition to the current conditions, is mapped on Figure 10.

The results indicate a significant reduction in downstream flood affectation resulting from the proposal. The primary reason for this reduction is the relatively large OSD volume proposed within each lot. This significantly reduces the peak runoff flow rates to downstream areas for the short-duration storm events that producing flooding in this area.

Under existing conditions, overland flow is discharged from the site in the vicinity of the Banks Avenue and Heffron Road intersection. This behaviour would be maintained by the proposed works (assuming the flow path along the driveway in Lot G is implemented to allow flow to discharge to Heffron Road, as per Diagram 4).

The assessment therefore indicates that there would be no adverse impacts on existing flood behaviour due to the proposed development with assumed Lot G flow path (and there would be a significant improvement to some flood prone areas downstream).

# 5. EMERGENCY MANAGEMENT AND EVACUATION CONSIDERATIONS

There is a requirement under the DCP that "*Flood Evacuation Plan in PMF storm events shall be submitted for assessment.*"

Flooding will generally occur quite rapidly in response to very heavy rain. Generally, the most effective way to mitigate flood risk to human life in this environment is to ensure that buildings are built to withstand flood forces to enable people to remain indoors during the intense storm events, and to discourage people from attempting to drive through floodwaters. This is best achieved by effective design of the building to ensure it remains flood free without requiring active measures such as the deployment of barriers or flood gates, so that people can remain on site until flooding has subsided. Since flooding around the site will be of short duration, the risks arising from isolation during flooding are relatively low.

Discussion is provided below about emergency management and evacuation considerations for the site.

## 5.1. Existing Flood Warnings and Response

### 5.1.1. Bureau of Meteorology flood warning

The Bureau of Meteorology issues quantitative flood warnings for specified forecast locations including expected flood class (major, moderate, minor) and timing of flooding. The Bureau does not cover quantitative flash-flood warnings, defined as rain-to-flood times of less than six hours. The area around the site is subject to flash-flooding and, as such, The Bureau does not issue quantitative warnings for this catchment.

### 5.1.2. Bureau of Meteorology severe weather warnings

The Bureau of Meteorology issues severe weather warnings whenever severe weather is occurring in an area or expected to develop or move into an area. This includes very heavy rain that may lead to flash flooding. The warnings describe the area under threat and the expected hazards. Warnings are issued with varying lead-times, depending on the weather situation, and can be from one hour to 24 hours or more. The Bureau also issues severe thunderstorm warnings that include thunderstorms producing heavy rainfall which may cause flash flooding.

### 5.1.3. SES warnings and response

The SES is the legislated Combat Agency for floods and is responsible for the control of flood operations. This includes the coordination of other agencies and organisations for flood management tasks. The SES Local Controller is responsible for dealing with floods as detailed in the State Flood Plan.

Given the flash flood nature of the catchment and the lack of warning time for flooding, the SES is unlikely to mobilise volunteers in the vicinity of the site in anticipation of flooding. The SES will generally only respond to specific calls for assistance in flash flood areas.

## 5.2. Assessment of Emergency Management Requirements for the Site

The flood risk at the site is predominantly due to overland flow along roadways when rainfall exceeds the capacity of the local stormwater network. This overland flow will be low hazard (H1/H2) in the 1% AEP event, with some areas of moderate hazard (H3) and high hazard (H5) in the PMF event. The areas of H5 in the PMF are confined to the concept overland flow path through Lot G, where each townhouse would have alternate access to lower hazard areas at the other end of the building if required.

It will not be possible in real time during a flood to understand what the peak of the flood will be for this site. This is because:

- the time between the rainfall occurring and flooding occurring is short - generally less than an hour, and possibly as short as 15 minutes for local flash flooding in the road reserves.
- the location of the most intense rainfall bursts for flood-producing storms in small catchments such as this cannot be predicted accurately ahead of time; and
- as a result of the above, there are no formal flood warning systems in place for the catchment.

There will likely be very little warning of flooding, apart from very heavy local rainfall. General warnings about severe storms will be available for the Sydney Metropolitan region provided by the Bureau of Meteorology (BoM) but these will not provide specific information for this site. The operators of the site will not have statutory authority to detain people on-site in the event of flooding. However, by designing the buildings in such a way that they remain safe during flash flooding, people will be encouraged to remain inside until the flood risk in the streets subsides.

The design of the proposed buildings is such that there will not be hazardous levels of flooding inside the buildings, even in a PMF event.

It is not necessary for the site to implement an active flood monitoring or warning system. The proposed development is designed in a way that it is protected to the required flood levels, and there is no requirement for an active emergency response management plan, flood monitoring/warning, or an evacuation plan for the site.

For the purposes of businesses and occupants of the site to assess their own flood risk and occupational health and safety requirements, this document should be made available to businesses and residents in the development.

## 6. SUMMARY AND CONCLUSIONS

WMAwater assessed the Concept DA at the subject site, according to best practice guidance from Australian Rainfall and Runoff (Reference 9) and the NSW Floodplain Development Manual (Reference 7) with regards to the following flood related planning controls:

- Minimum floor level requirements,
- Changes to flood behaviour beyond the site boundary, and
- Flood emergency management.

Since this is a Concept DA and some components of the development have not been designed yet, some of the requirements cannot be conclusively assessed, and compliance will need to be confirmed for subsequent detailed DAs.

This assessment found that the concept proposal can meet the flood-related planning requirements, provided the following refinements are implemented:

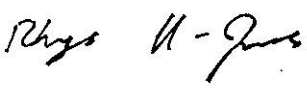
1. Provision of an overland flow path to relieve flooding from the sag point in the internal road near the Lot G driveway, as per the indicative grading and width indicated on Diagram 4.
2. Raising of some floor levels for townhouses within Lot G, as indicated Diagram 6 (final requirements to be confirmed subject to finalisation of the driveway overland flow path grading.

The details of the flow path and specific finished floor levels will need to be re-assessed at the detailed design stage to ensure compliance. However the proposed concept provides sufficient flexibility to demonstrate the requirements can reasonably be met.

It is not necessary for the site to implement an active flood monitoring or warning system. The proposed development is designed in a way that there is no requirement for an active emergency response management plan, flood monitoring/warning, or an evacuation plan for the site.

Sincerely,

**WMAwater**



**Rhys Hardwick Jones**

Senior Associate

**References:**

1. BMT WBM
**Springvale Drain and Floodvale Drain Flood Study**
City of Botany Bay Council, January 2014.

2. WMAwater
**Springvale Drain and Floodvale Drain Floodplain Risk Management Study and Plan**
Bayside Council, December 2019.

3. Bayside Council
**Botany Bay Development Control Plan 2013**
Part 3G: Stormwater Management
Stormwater Management Technical Guidelines

4. at&l
**128 & 130-150 Bunnerong Road Pagewood – Pagewood Part II DA Report Rev 03**
August2019

5. Australian Institute for Disaster Resilience
**Guideline 7-3 Flood Hazard**
**Supporting document for Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia**
Australian Government, 2017

6. Australian Building Codes Board
**National Construction Code 2016**
Volume 1, Amendment 1: Building Code of Australia Class 2 to Class 9 Buildings
March 2018

7. NSW Government
**Floodplain Development Manual**
NSW Government, April 2005

8. Bayside Council
**Local Environmental Plan 2013**

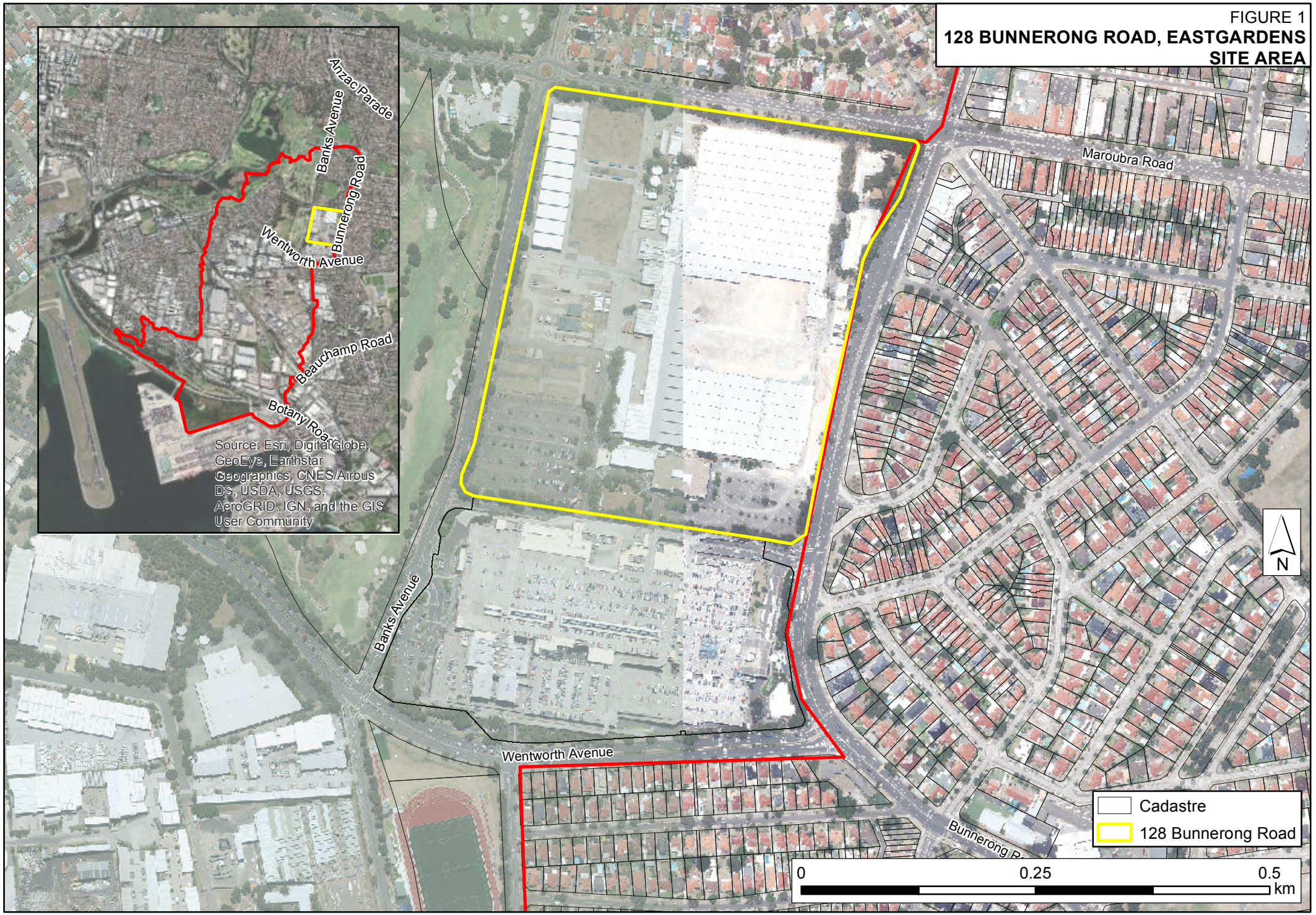
9. Pilgrim DH (Editor in Chief)
**Australian Rainfall and Runoff – A Guide to Flood Estimation**
Institution of Engineers, Australia, 1987

**Figures:**

FIGURE 1

**128 BUNNERONG ROAD, EASTGARDENS**

**SITE AREA**

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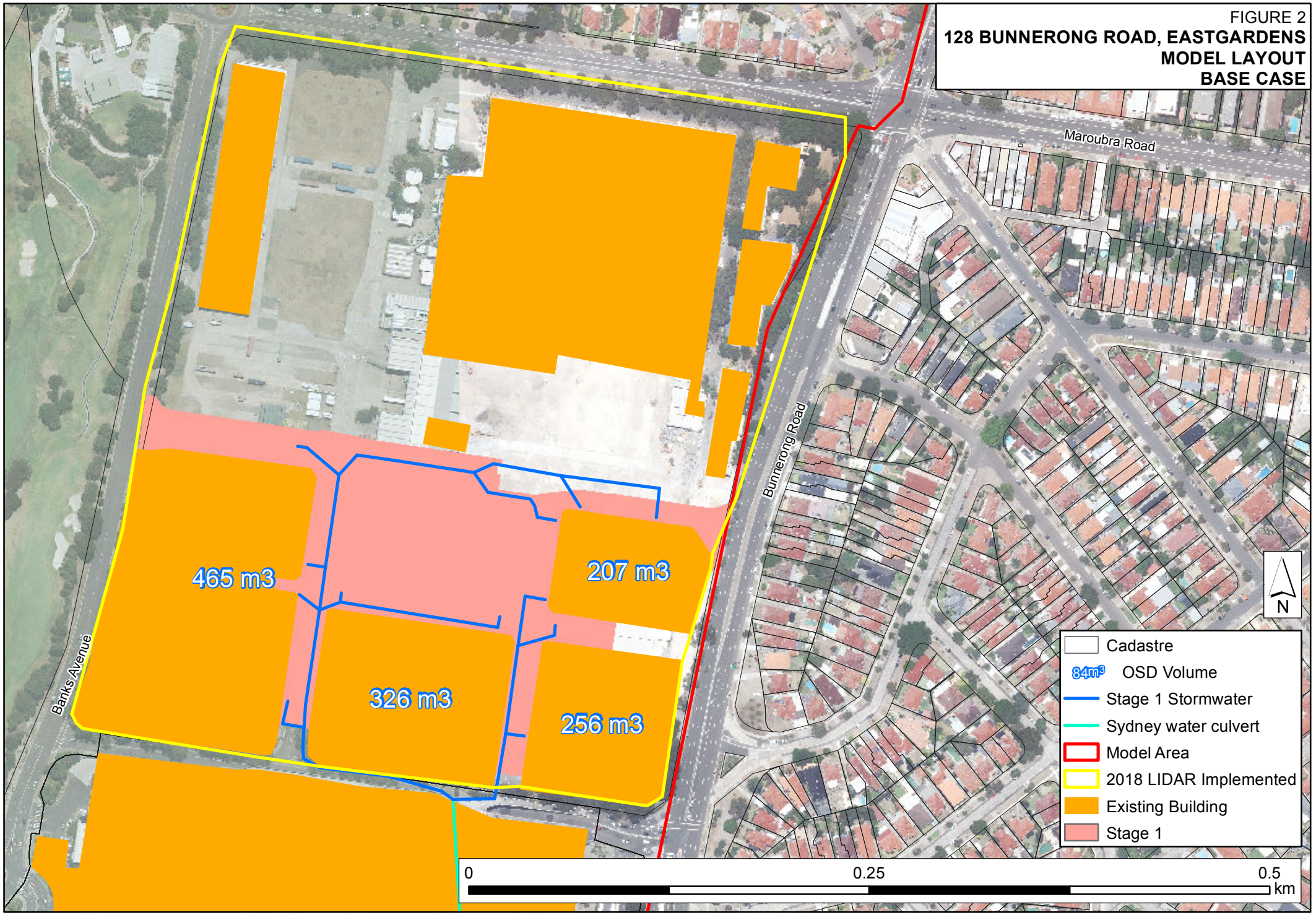
FIGURE 2
128 BUNNERONG ROAD, EASTGARDENS
MODEL LAYOUT
BASE CASE
Maroubra Road
Bunnerong Road
Banks Avenue
465 m3
207 m3
326 m3
256 m3
N
Cadastre
84m3 OSD Volume
Stage 1 Stormwater
Sydney water culvert
Model Area
2018 LIDAR Implemented
Existing Building
Stage 1
0
0.25
0.5
km
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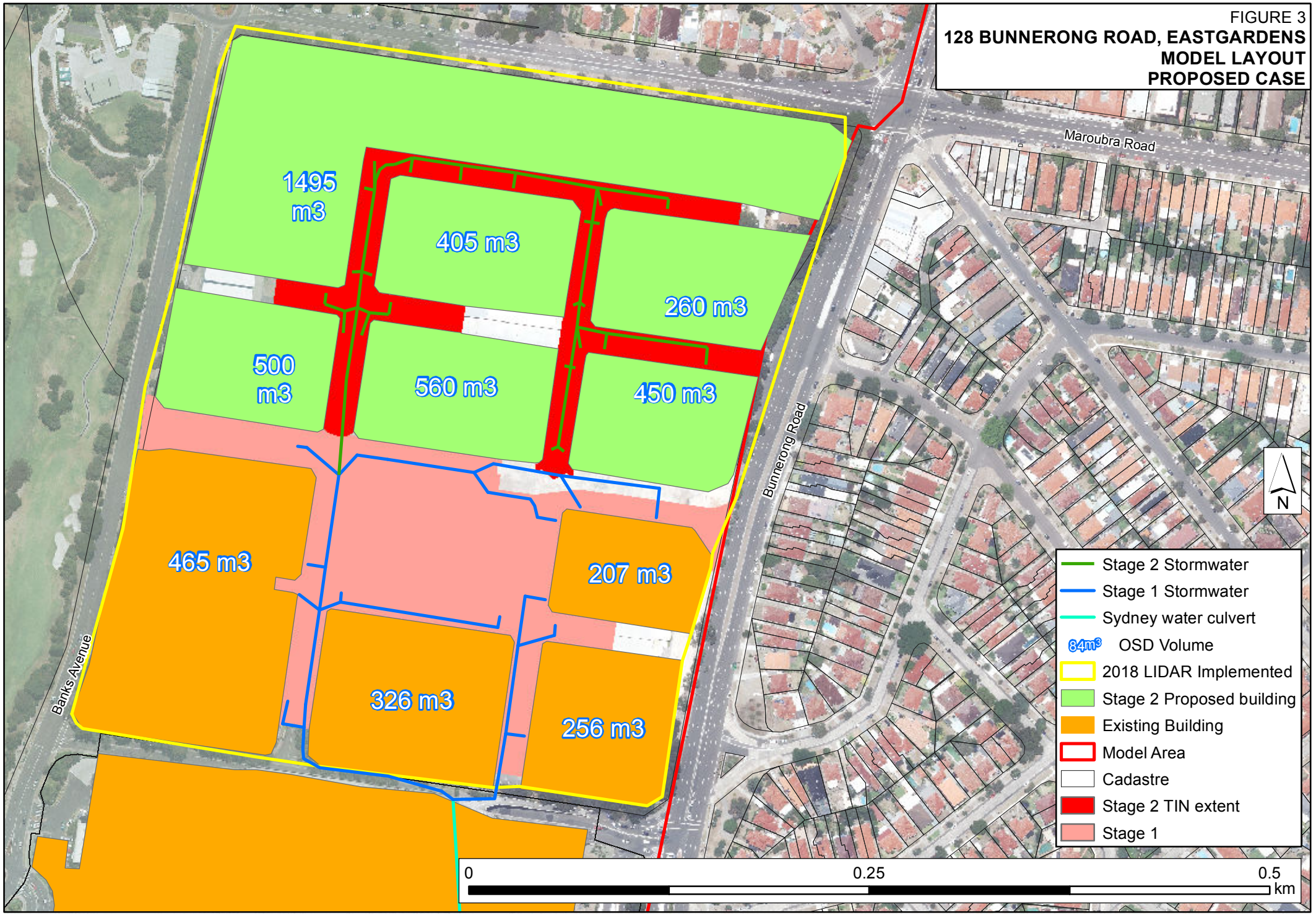


FIGURE 3
128 BUNNERONG ROAD, EASTGARDENS
MODEL LAYOUT
PROPOSED CASE
1495 m3
405 m3
260 m3
500 m3
560 m3
450 m3
465 m3
207 m3
326 m3
256 m3
Maroubra Road
Bunnerong Road
Banks Avenue
N
Stage 2 Stormwater
Stage 1 Stormwater
Sydney water culvert
84m3 OSD Volume
2018 LIDAR Implemented
Stage 2 Proposed building
Existing Building
Model Area
Cadastre
Stage 2 TIN extent
Stage 1
0
0.25
0.5
km
J:\Jobs\120066\ArcGIS\Arcmap\Report_200904\Figure03_Model_Layout_Proposed.mxd

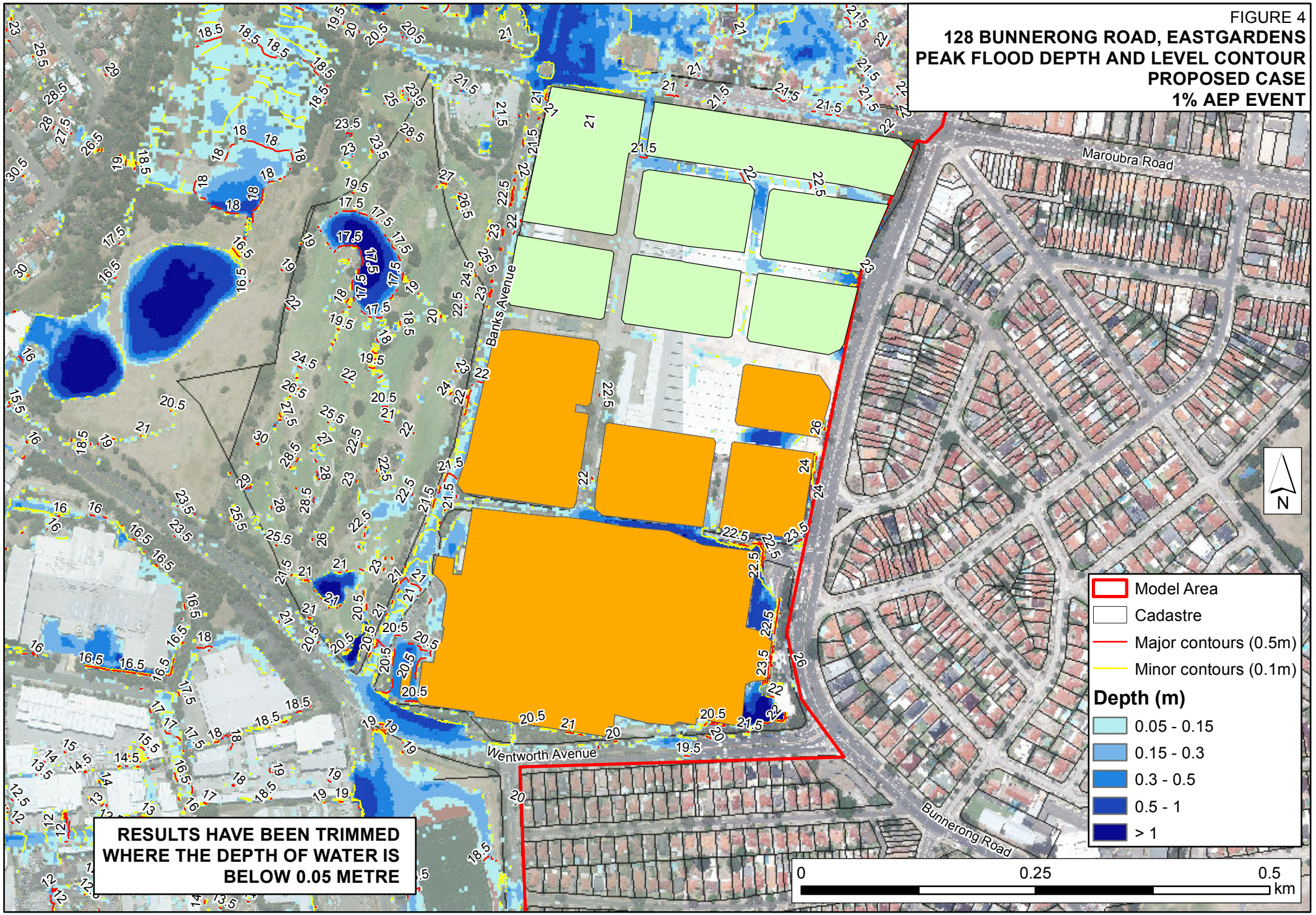


FIGURE 4
128 BUNNERONG ROAD, EASTGARDENS
PEAK FLOOD DEPTH AND LEVEL CONTOUR
PROPOSED CASE
1% AEP EVENT
Maroubra Road
Banks Avenue
Wentworth Avenue
Bunnerong Road
N
Model Area
Cadastre
Major contours (0.5m)
Minor contours (0.1m)
Depth (m)
0.05 - 0.15
0.15 - 0.3
0.3 - 0.5
0.5 - 1
> 1
0
0.25
0.5
km
RESULTS HAVE BEEN TRIMMED
WHERE THE DEPTH OF WATER IS
BELOW 0.05 METRE
J:\Jobs\120066\ArcGIS\Arcmap\Report_201009\Figure04_100Y_Proposed_Peak_Flood_Depth.mxd

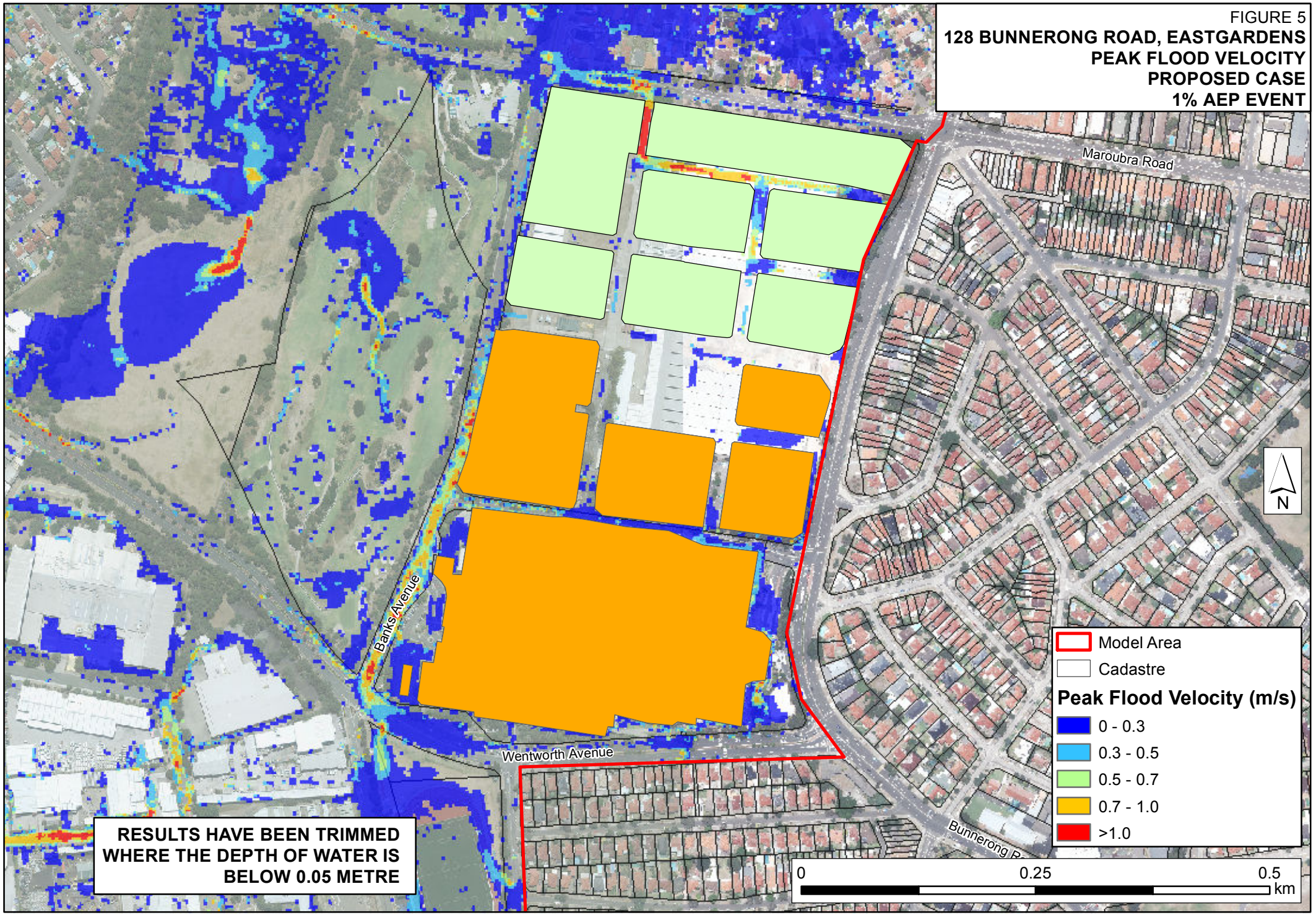
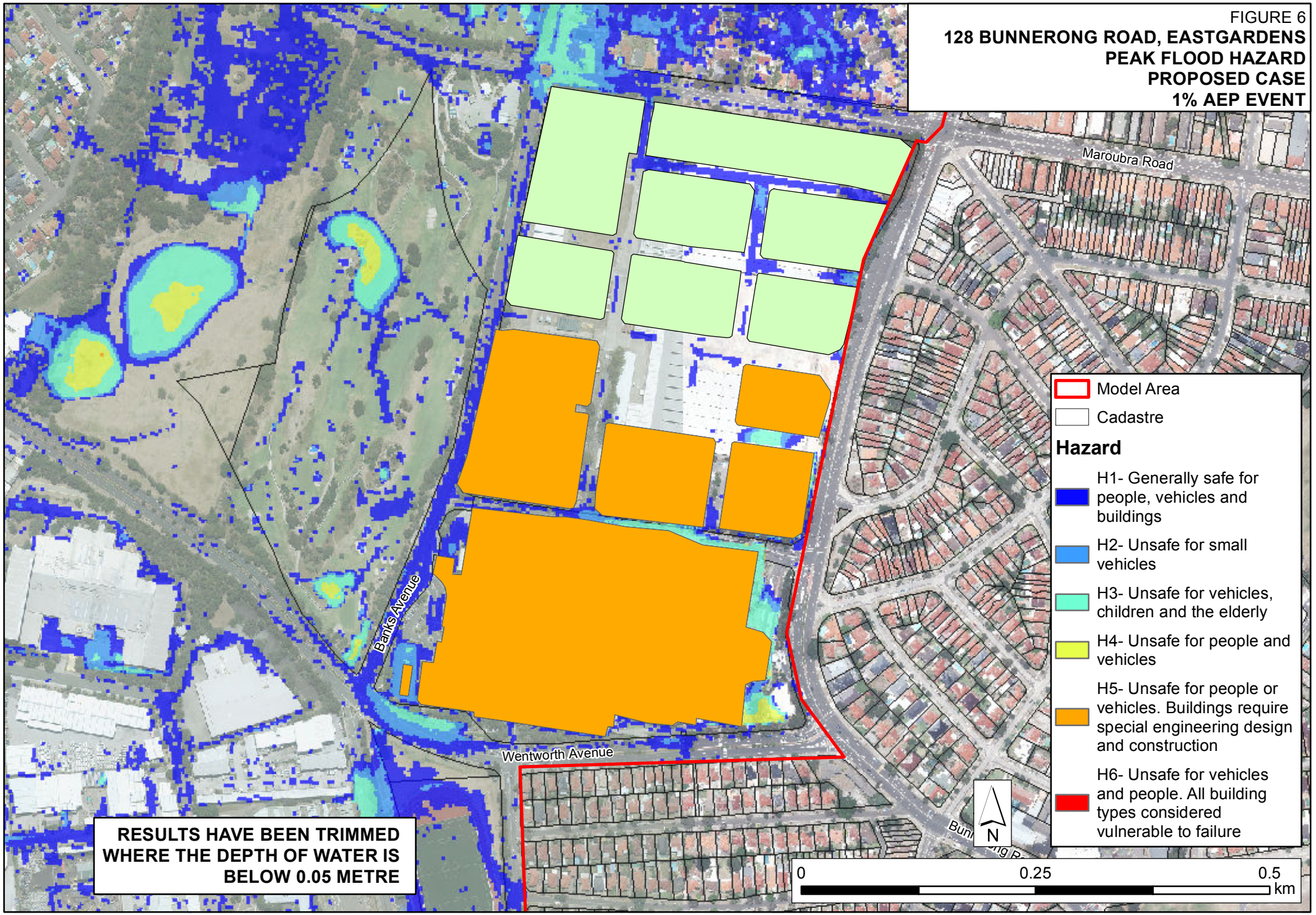


FIGURE 5
128 BUNNERONG ROAD, EASTGARDENS
PEAK FLOOD VELOCITY
PROPOSED CASE
1% AEP EVENT
Maroubra Road
Banks Avenue
Wentworth Avenue
Bunnerong R
N
Model Area
Cadastre
Peak Flood Velocity (m/s)
0 - 0.3
0.3 - 0.5
0.5 - 0.7
0.7 - 1.0
>1.0
0
0.25
0.5
km
RESULTS HAVE BEEN TRIMMED
WHERE THE DEPTH OF WATER IS
BELOW 0.05 METRE
J:\Jobs\120066\ArcGIS\Arcmap\Report_201009\Figure05_100Y_Proposed_Peak_Flood_Velocity.mxd

FIGURE 6

# 128 BUNNERONG ROAD, EASTGARDENS
# PEAK FLOOD HAZARD
# PROPOSED CASE
# 1% AEP EVENT

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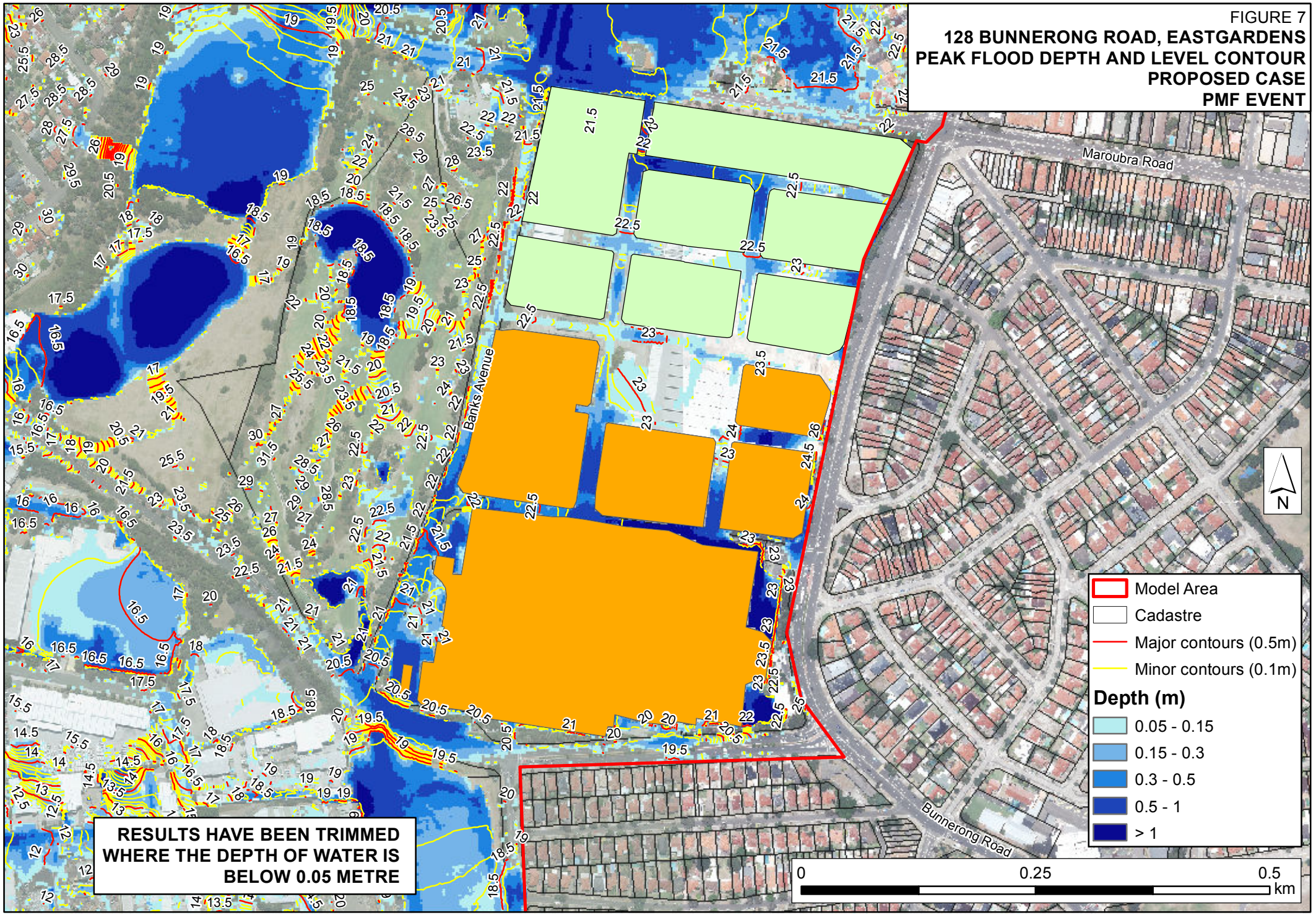
FIGURE 7
128 BUNNERONG ROAD, EASTGARDENS
PEAK FLOOD DEPTH AND LEVEL CONTOUR
PROPOSED CASE
PMF EVENT
Maroubra Road
Banks Avenue
Bunnerong Road
N
Model Area
Cadastre
Major contours (0.5m)
Minor contours (0.1m)
Depth (m)
0.05 - 0.15
0.15 - 0.3
0.3 - 0.5
0.5 - 1
> 1
0
0.25
0.5
km
RESULTS HAVE BEEN TRIMMED
WHERE THE DEPTH OF WATER IS
BELOW 0.05 METRE
J:\Jobs\120066\ArcGIS\Arcmap\Report_201009\Figure07_PMF_Proposed_Peak_Flood_Depth.mxd

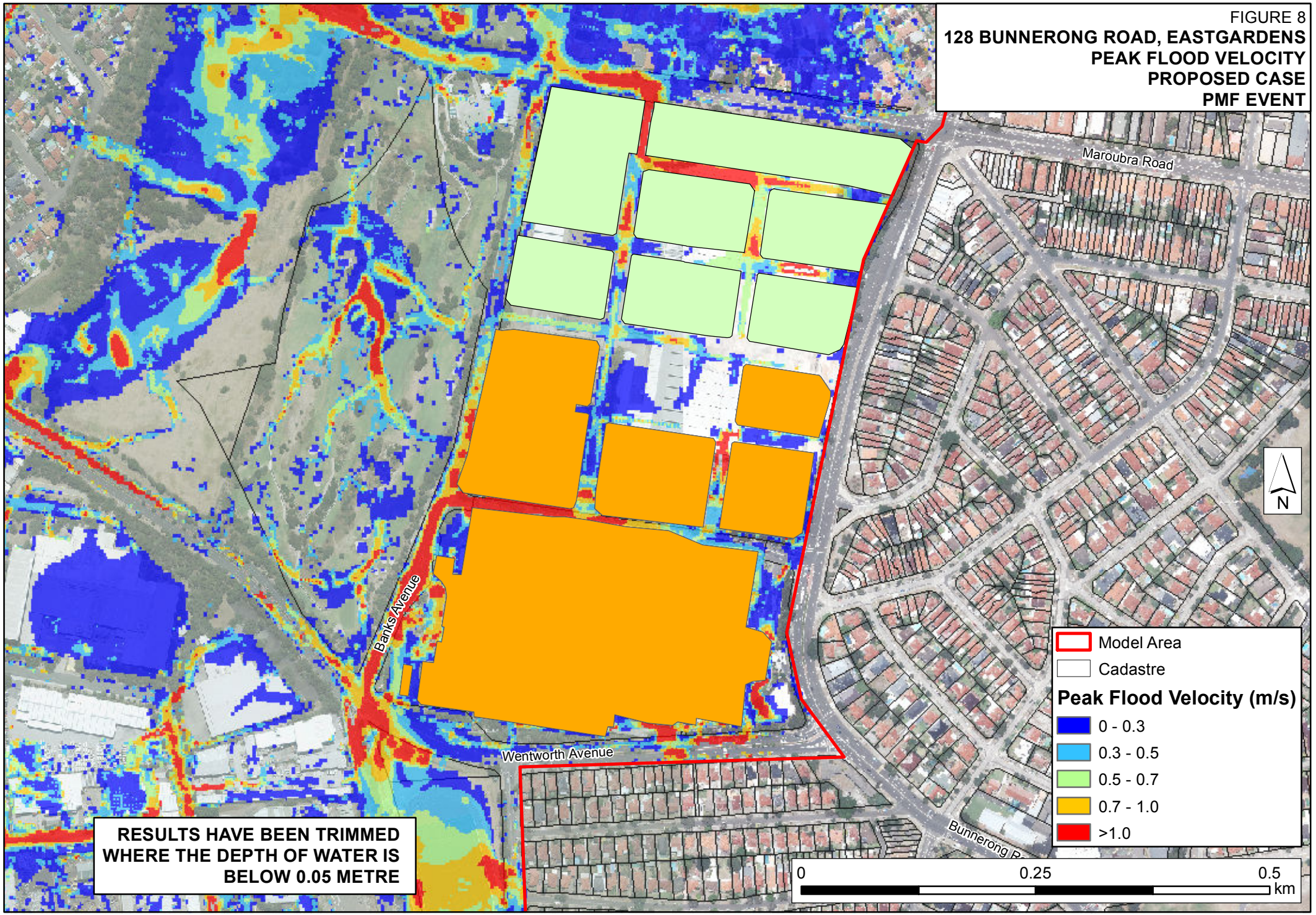
FIGURE 8
128 BUNNERONG ROAD, EASTGARDENS
PEAK FLOOD VELOCITY
PROPOSED CASE
PMF EVENT
Maroubra Road
Banks Avenue
Wentworth Avenue
Bunnerong R
N
Model Area
Cadastre
Peak Flood Velocity (m/s)
0 - 0.3
0.3 - 0.5
0.5 - 0.7
0.7 - 1.0
>1.0
0
0.25
0.5
km
RESULTS HAVE BEEN TRIMMED
WHERE THE DEPTH OF WATER IS
BELOW 0.05 METRE
J:\Jobs\120066\ArcGIS\Arcmap\Report_201009\Figure08_PMF_Proposed_Peak_Flood_Velocity.mxd

FIGURE 9

**128 BUNNERONG ROAD, EASTGARDENS**
**PEAK FLOOD HAZARD**
**PROPOSED CASE**
**PMF EVENT**

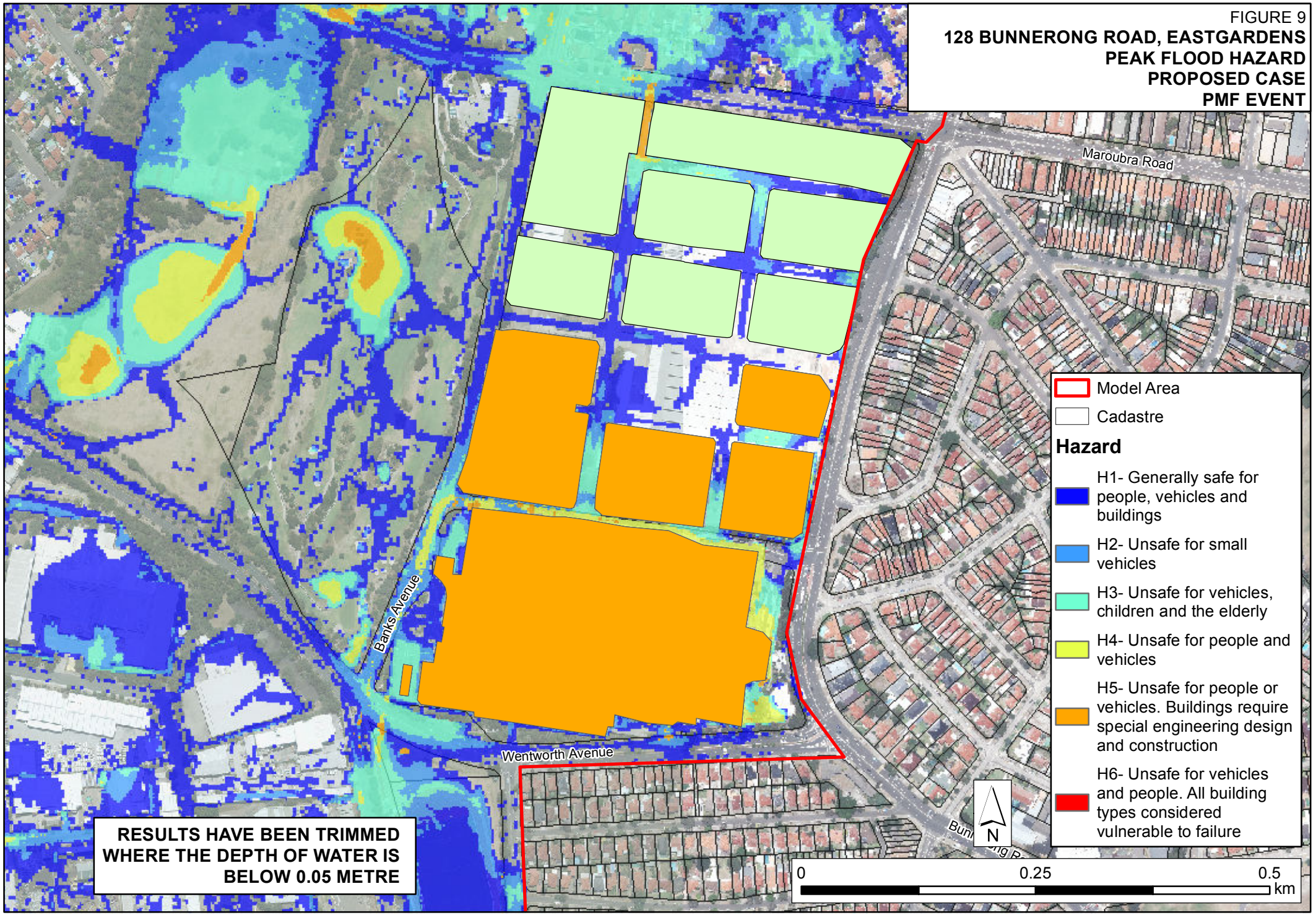


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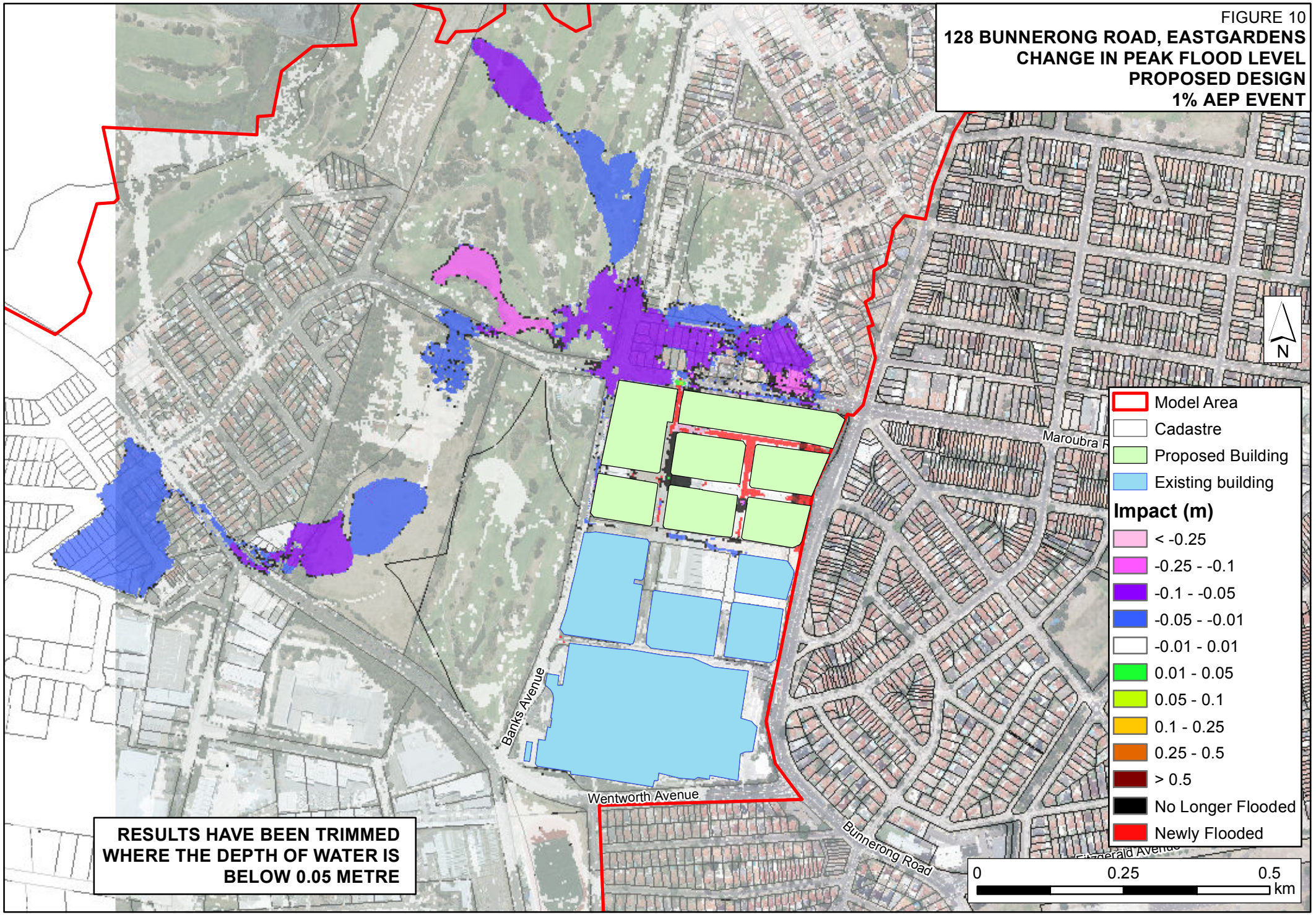
FIGURE 10

**128 BUNNERONG ROAD, EASTGARDENS**
**CHANGE IN PEAK FLOOD LEVEL**
**PROPOSED DESIGN**
**1% AEP EVENT**




**RESULTS HAVE BEEN TRIMMED WHERE THE DEPTH OF WATER IS BELOW 0.05 METRE**

J:\Jobs\120066\ArcGIS\Arcmap\Report_201009\Figure10_100Y_Impact_Design01_Driveway01.mxd