Memorandum

TO: Luke Morrison, Ben Pilon – Barnson
FROM: Reinier Koster, Daniel Wood – WMAwater
DATE: 23 January 2024
SUBJECT: Stormwater Mitigation on 10-12 Burrundulla Avenue, Mudgee
PROJECT NUMBER: 123046

1. INTRODUCTION

10-12 Burrundulla Avenue in Mudgee is a plot of land that is currently cleared, having previously been a bowls club. A development is proposed for the site where 47 (town)houses are to be built. A requirement of development approved is that needs to be accessible from both Burrundulla Avenue to the east and George Street to the west. An indicative drawing of the proposed development is presented in Diagram 1.

A preliminary flood information assessment showed that, to connect the site to George Street, level variations through east of the site could potentially result in impacts on the adjacent properties since a flow path is crossing the site there. Therefore, WMAwater was engaged to do a flood impact assessment and to develop a package of suitable mitigation options that will mitigate any negative impacts to adjacent properties when connecting the new development to George Street.

Diagram 1. Indicative drawing showing the proposed development on the site at 10-12 Burrundulla Avenue.

2. METHODOLOGY BASE (UNDEVELOPED) CASE

To assess the flow through and towards the site, the regional hydraulic model that was developed by WMAwater in 2019 was utilised. The model was updated to represent the local situation in more detail. The model was run for a 1% AEP event. It was determined that the critical duration for the site was 90 minutes. Figure A01 in Appendix A shows the setup of the hydraulic model in detail and Diagram 2 shows a simplified representation of the baseline case.

The following improvements were made to the model:

- The extent of the regional model was reduced to include only the upstream area of the site and the area downstream of the site to Cudgegong River. There is no impact from regional flooding on the site.
- The spatial resolution was increased to 2 m with a higher resolution of 1 m for the site.
- A 1 m DEM for the site was derived from the provided drawings and included in the model;
- Survey data of drainage features (pipes, culverts, channels bottoms etc.) and fences on and around the site was implemented in the model. Note that the dimensions of the upstream and downstream end of culverts sometimes differed, in these instances the smallest dimensions were used in the hydraulic model since it is not possible to use non-uniform structures. Table 1 shows the selected dimensions for the two culverts at the inlet and outlet of the drain.
- Fences were implemented in the model as vertical features to which a blockage percentage is assigned. A general blockage percentage of 80% was assumed, allowing for some flow through the fences;
- Additional fences were added based on aerial imagery;
- Any additional existing drainage data was reviewed and improved based on aerial imagery;
- Representation of existing buildings in the area was reviewed and improved;
- The TUFLOW software was updated to the latest version (2023-03-AA).

Table 1: selected culvert dimensions for culverts upstream and downstream of the existing drain.

Name	Location	Size	
RCBC_1	George Street	2.80 x 0.60 m	Selected based on upstream dimensions
RCBC_2	Outlet drain	3.50 x 0.60 m	Selected based on downstream dimensions

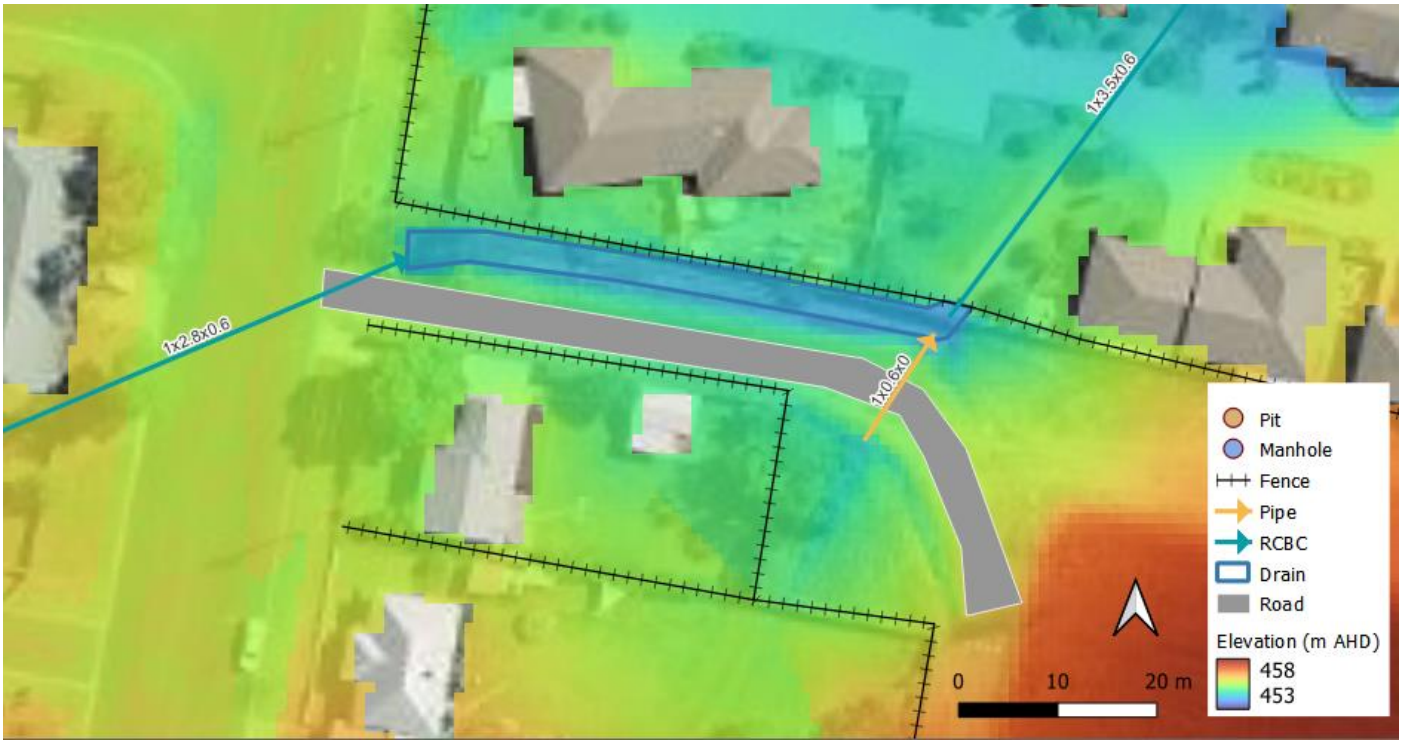

Diagram 2. Simplified representation of the undeveloped case showing the important culverts (line features), the drain (blue outline) and existing concrete (grey) on top of the digital elevation model.

3. BASE CASE - RESULTS

Figure A02 – A05 in Appendix A show the flooding on the site during a 1% AEP flood event. There is a significant flow path crossing the site from south to north at the entrance to George Street. Flood velocities across the site peak at a maximum of approximately 1.40 m/s in the drain, while overland flow velocities are relatively benign (i.e. 0.50 m/s) and flood depths are generally shallow, with peak flood depths of approximately 0.90 m in the drain and approximately 0.30 m outside the drain. The shallow flood depths combined with relatively low flood velocities result in low hazard categories, except for the drain which has a hazard category of H4.

The flow into the drain from the culvert that crosses George Street from the southwest is approximately 2.50 m^3/s, and the culvert at the southeast discharges approximately 0.30 m^3/s into the drain. Overland flow contributes to another 1.80 m^3/s. The culvert that acts as the outlet of the drain discharges a peak flow of approximately 3.70 m^3/s and overbank flow from the drain to the adjacent properties north of the site is approximately 0.80 m^3/s.

4. MITIGATION WORKS

To make the site accessible from George Street during a 1% AEP event, a flow of approximately 1.80 m^3/s (overland flow into the drain) needs to be collected on site, diverted and discharged through a system of pits and pipes.

Given that most of the overland flow comes from the south/southwest, it is proposed to close the drain, develop the road to the north of the site and capture the overland flow in a drain south of the new entrance road. The drain can then be connected to the existing or upgraded culverts. Diagram 3 shows a simplified representation of the developed case and Figure A06 shows the proposed flood mitigation works in more detail. The following mitigation works are proposed:

- Develop the road to the north side of the entrance and raise it to a level of approximately 455.80 m AHD with a slight crossfall sloping south to force the water into the drain to the south of the road. A width of approximately 7 m was assumed for the road allowing for traffic from both directions;
- Connect the culvert that crosses George Street with the culvert at the outlet of the drain with two manholes. In the hydraulic model, a size similar to the culvert at the outlet was assumed (i.e. 3.50 x 0.60 m). This is not a standard size, but something with at least a similar cross-sectional area should be selected during a detailed design phase. It is considered that this system will likely have to be cast in-situ given the dimensions.
- Incorporate a drain or a swale south of the road at a level of approximately 455.40 m AHD at George Street, sloped towards the east to a level of approximately 454.80 m AHD at the inlet of the existing culvert southeast of the existing drain.
- Develop a pit north and south of the entrance road near George Street at a level of 455.30 m AHD to capture the water that would otherwise flow towards the adjacent properties. These pits were connected to the manholes using rectangular box culverts (1.20x0.60 m or 1.80x0.60 m), however the final arrangement should be confirmed for construability in detailed design.
- Upgrade the culvert to the southeast of the existing drain to two rectangular box culverts (1.20x0.60 m) to drain the area.

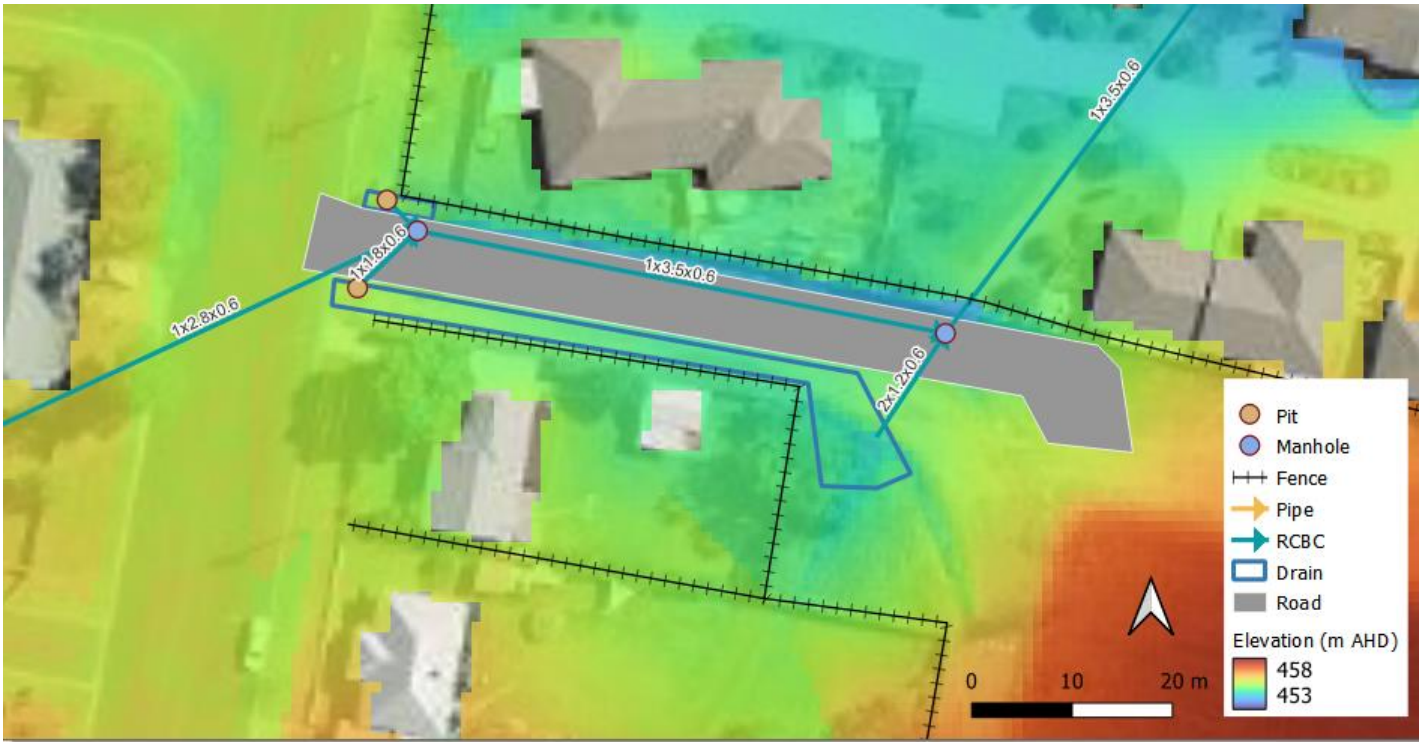

Diagram 3. Simplified representation of the developed case showing the important culverts (line features), the new drain (blue outline) and new road (grey) on top of the digital elevation model.

5. RESULTS - MITIGATION

Figure A07 – A10 in Appendix A show the flooding on the site during a 1% AEP flood event when the mitigation works are implemented. The entrance road from George Street is now flood free during a 1% AEP event. Flood velocities in the new drain peak at a maximum of approximately 1.10 m/s near in the inlet of the culvert but in general are relatively low (i.e. 0.50 - 1.00 m/s) and flood depths are generally shallow, with peak flood depths of approximately 0.50 m at the inlet of the culvert and approximately 0.25 m elsewhere in the new drain. The shallow flood depths combined with relatively low flood velocities result in low hazard categories, except for some local areas where the hazard category is H2 to H3.

The flow into the drain from the culvert that crosses George Street from the southwest is approximately 2.50 m^3/s, which is the same as the baseline situation. The two new pits next to the entrance road at George Street now discharge a combined peak flow of approximately 0.50 m^3/s and the upgraded box culverts to the southeast now discharge approximately 1.20 m^3/s into the manhole. The culvert at the outlet of the site discharges a peak flow of approximately 4.10 m^3/s. The overland flow downstream of the site is reduced to 0.50 m^3/s.

The afflux map (Figure A11) shows that the mitigation works reduce flooding on the site, the entrance road is now free from flooding. Negative impact on adjacent properties is negligible or even positive (reduction of flooding) due to a reduction in overland flow.

6. CONCLUSIONS

A potential development on 10-12 Burrundulla Avenue, Mudgee requires an entrance road that connects the site to George Street. However, the part of the site where the road should be developed is significantly inundated during a 1% AEP event caused by a flow path running through the site from south to north. Any works to this area of the site are therefore likely to cause negative impacts (afflux) to adjacent properties. Therefore, a flood impact assessment has been undertaken to assess future developments on flooding during a 1% AEP event.

The existing regional hydraulic model for Mudgee has been utilised and updated to represent the local situation of the site in more detail. The updated model was used to assess current flooding during a 1% AEP event in more detail and to develop a package of mitigation options for a scenario in which the entrance road

will be developed. The proposed mitigation options include a concept design of the road and upgrades to the existing drainage and storm water network. Further refinement of the concept design should be undertaken during a detailed design phase.

The flood impact assessment shows that it is possible to reduce / mitigate the flooding on the site without negatively impacting adjacent properties and even reducing flooding on properties located downstream (to the north) of the site. The entrance road will be dry during the 1% AEP event.

It should be highlighted that there is significant inundation on George Street during a 1% AEP event and therefore the new entrance road should not serve as an evacuation route. Burrundulla Avenue however is free from flooding which in case of emergency can be used to evacuate the site.

APPENIDIX A - FIGURES

List of Figures

FIGURE A01

10- 12 BURRUNDULLA AVENUE
MODEL SET UP AND LOCALITY

George Street

Burrundulla Avenue

N

Type
- Type C culvert
- Type R culvert
- Fences
- Drains
- Site Boundary
- Cadastre

1 m DEM
High : 459.5
Low : 454.4

meters
0 10 20 30 40 50

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FIGURE A02

1 % AEP BASELINE WATER LEVEL

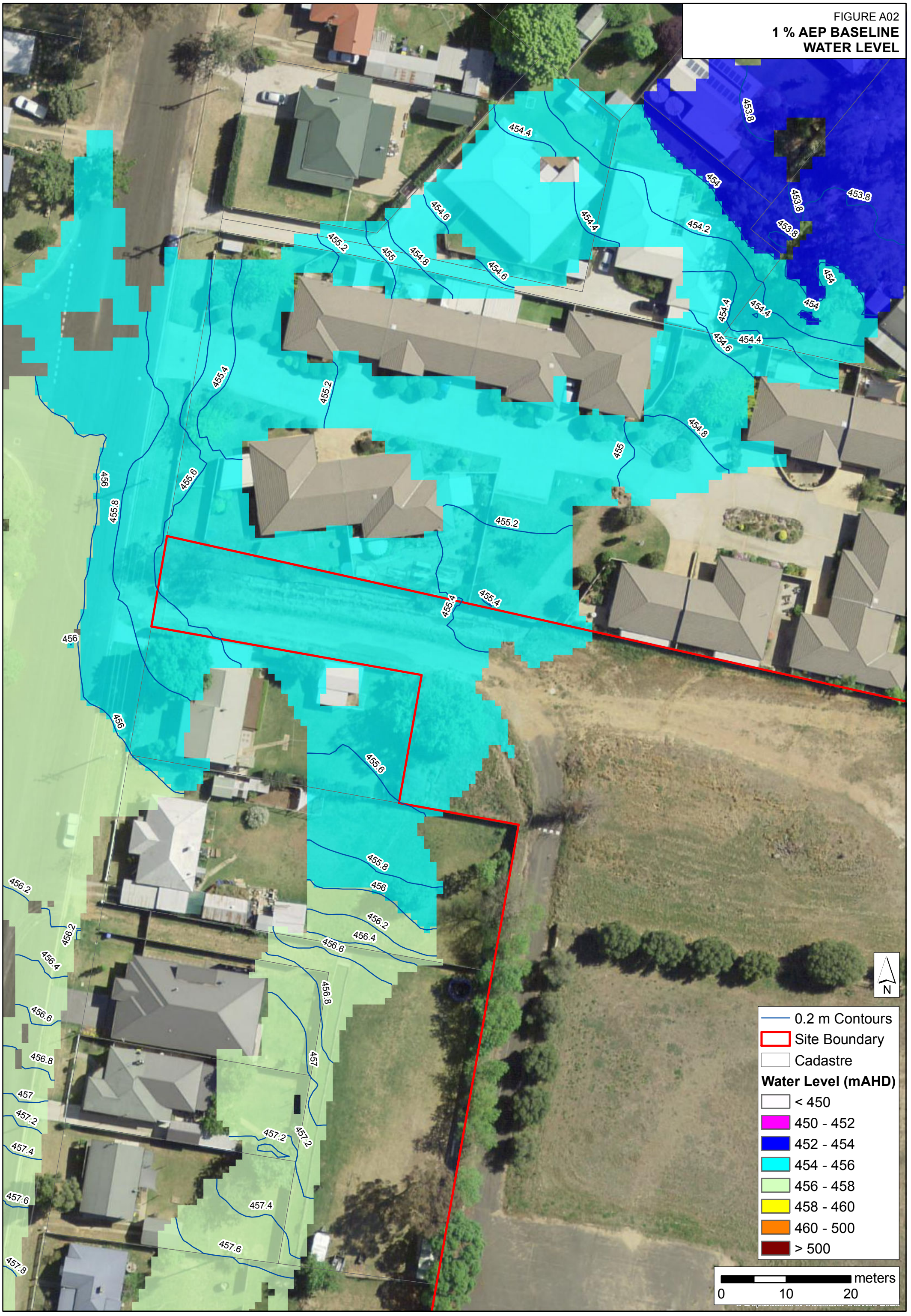

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FIGURE A03

1 % AEP BASELINE FLOOD DEPTH

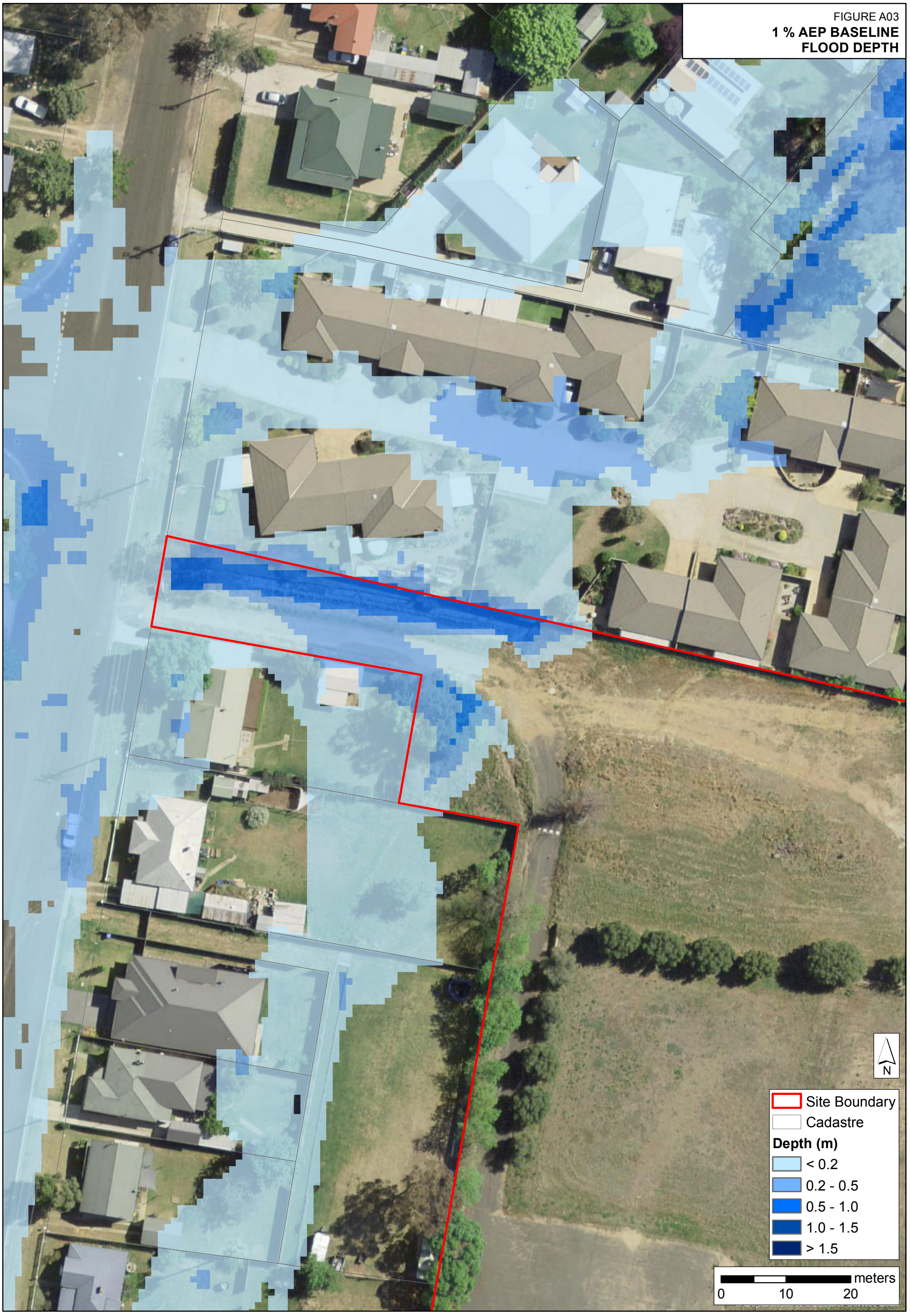

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FIGURE A04

1 % AEP BASELINE FLOOD VELOCITY

Site Boundary

Cadastre

Velocity (m/s)

< 0.5

0.5 - 1.0

1.0 - 1.5

1.5 - 2.0

2.0 - 3.0

> 3.0

N

0 10 20 meters

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FIGURE A05

1 % AEP BASELINE FLOOD HAZARD

N

Site Boundary

Cadastre

Hydraulic Hazard

H1

H2

H3

H4

H5

H6

meters

0 10 20

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FIGURE A06

BURUNDULLA AVENUE MITIGATION WORKS

455.8
455.3
455.3
455.8
455.3
455.3
1x1.2x 0.6
1x1.8x 0.6
455.8
455.3
455.75
455.4
1x 2.8x 0.6
1x 3.5x 0.6
2x 1.2x 0.6
455.8
455.8
455.3
455.1
454.8
455.75
455.75
455.75
454.8
454.8
454.8
3x 0.3x 0

Pits
Drain/ Swale elevation
New road elevation
Culverts
Fences
Drain/ Swale
New Road
Site Boundary
Cadastre

N

0 10 20 30 meters

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FIGURE A07

1 % AEP DESIGN WATER LEVEL

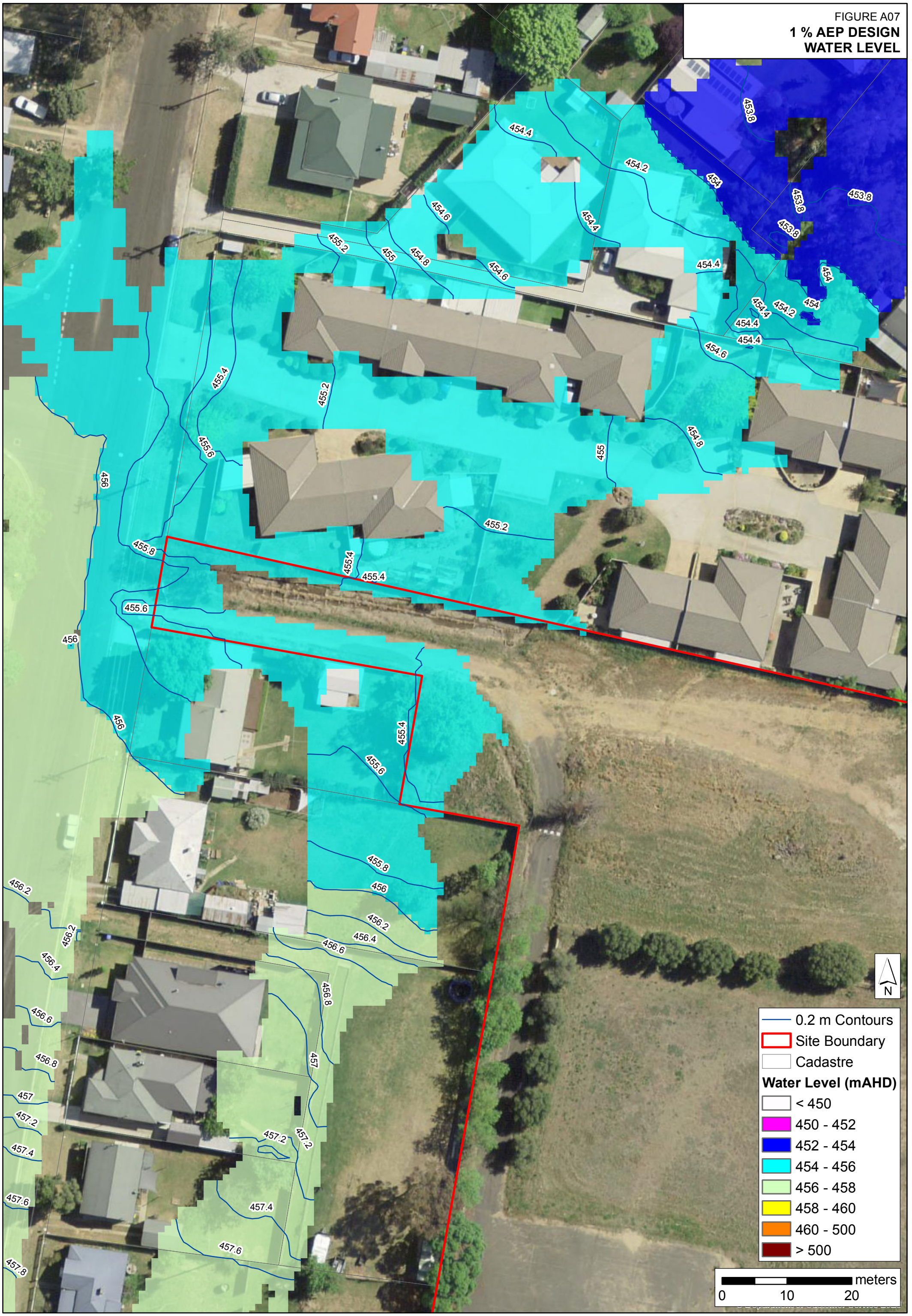

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FIGURE A08

1 % AEP DESIGN FLOOD DEPTH

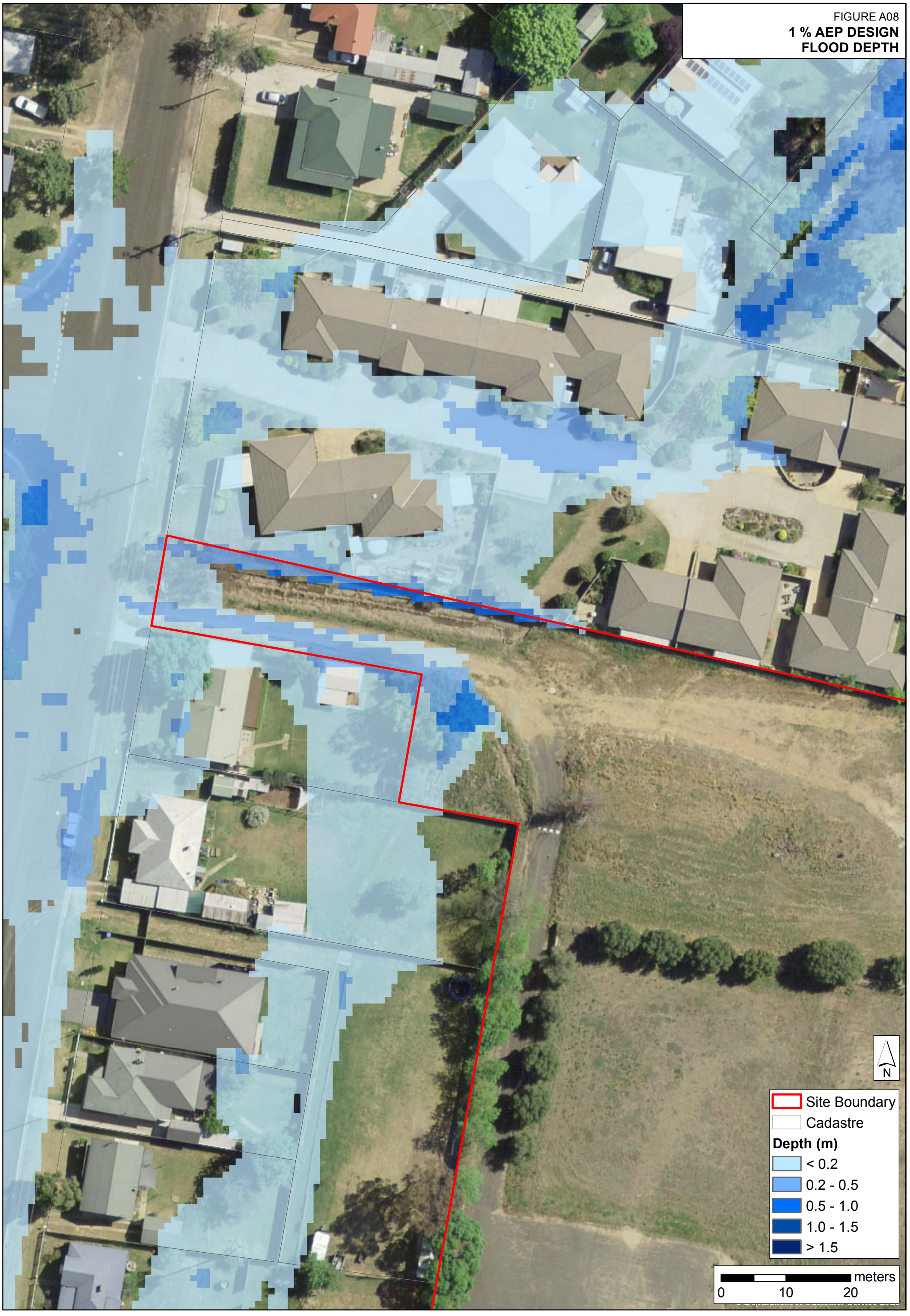

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FIGURE A09

1 % AEP DESIGN FLOOD VELOCITY

Site Boundary

Cadastre

Velocity (m/s)

< 0.5

0.5 - 1.0

1.0 - 1.5

1.5 - 2.0

2.0 - 3.0

> 3.0

N

0 10 20 meters

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FIGURE A10

1 % AEP DESIGN FLOOD HAZARD

N

Site Boundary

Cadastre

Hydraulic Hazard

H1

H2

H3

H4

H5

H6

meters

0 10 20

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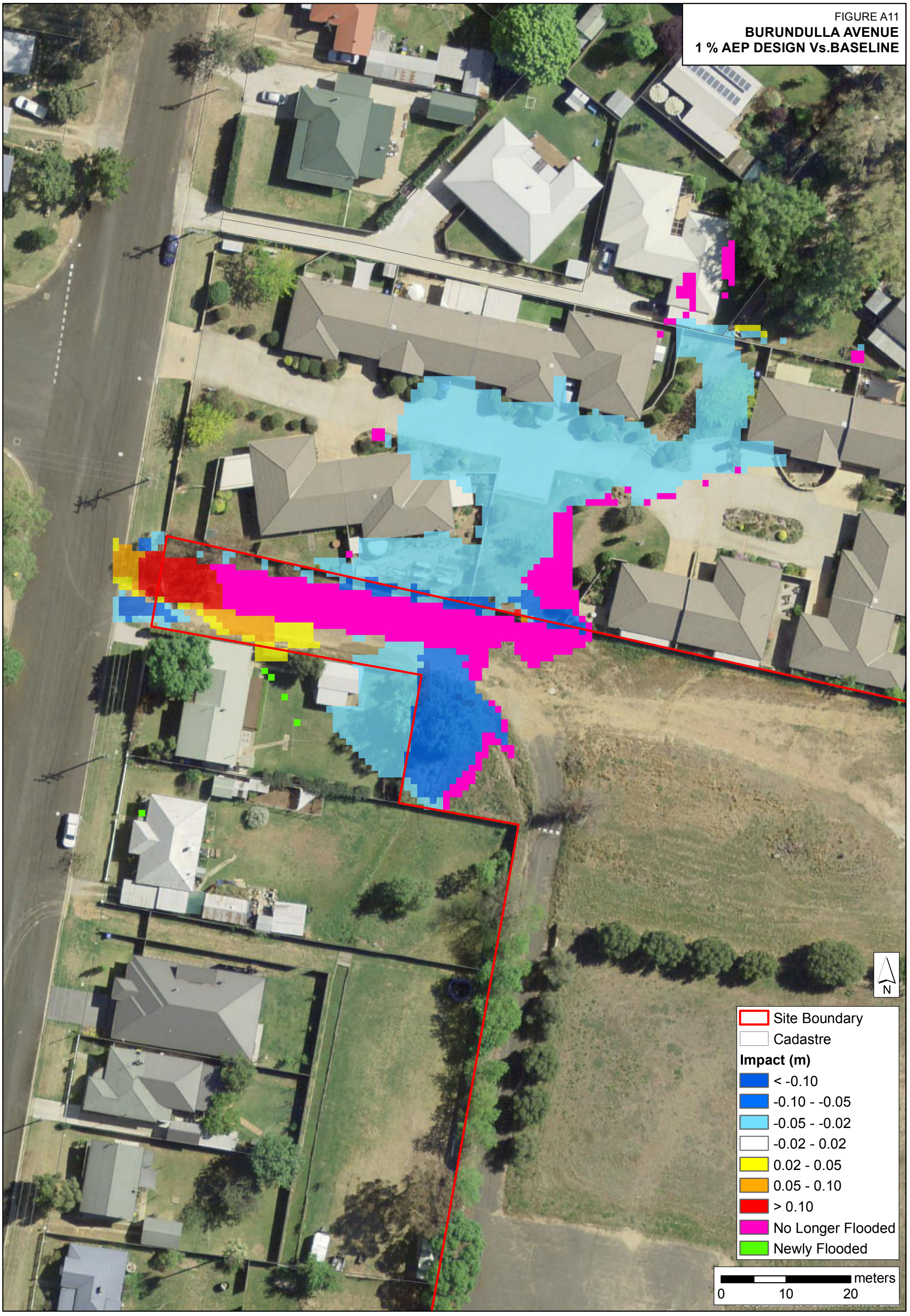
FIGURE A11

BURUNDULLA AVENUE
1 % AEP DESIGN Vs.BASELINE



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