Woodville Road Corridor Planning Proposal

Customer	Cumberland City Council
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Document Control

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Amendment Record

The Amendment Record below records the history and issue status of this document.

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00	21 June 2023	Cumberland City Council	Draft Report
01	14 August 2023	Cumberland City Council	Final Report
02	08 September 2023	Cumberland City Council	Amended Final Report

Contents

1 Introduction

1.1 Background

Woodville Road Corridor (herein “the Study Area”) is a major roadway corridor located in the centre of the Cumberland Local Government Area (LGA). It forms a major cross-regional north-south connection between the Parramatta CBD and Bankstown.

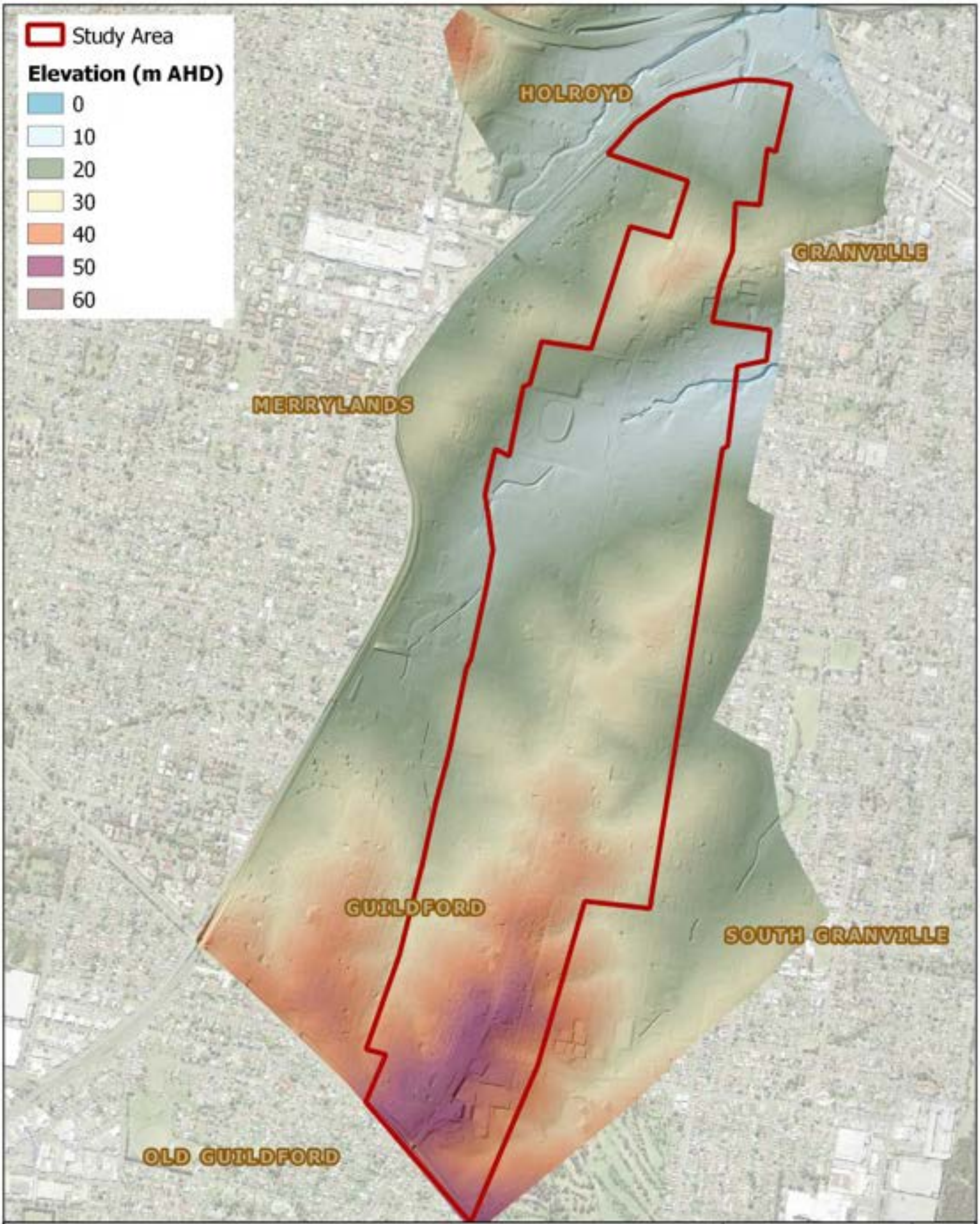
The Study Area extends 4 km from Parramatta Road in the north to the Prospect Reservoir Water Pipeline to the south and covers an area of 2.5 km^2. The Study Area is currently a mixed-use area predominated by low-density housing.

Cumberland City Council have identified 3 areas for urban renewal in the Study Area, including Woodville North Precinct, Merrylands East Precinct and Woodville South Precinct. Within these 3 areas, 29 separate planning proposal sites have been identified for future development to accommodate additional housing and jobs in the area. This forms part of the Cumberland Local Strategic Planning Statement (LSPS).

The Study Area is located within the Cumberland LGA and subject to the Cumberland Local Environment Plan (CLEP) 2021. Under the current CLEP, the Site has a broad range of designations, predominantly R2 Low Density Residential but also including medium-high density residential, industrial, public recreation and local centre areas. The Planning proposal will seek amendments to the CLEP and Cumberland Development Control Plan (CDCP).

1.2 Description of Existing Study Area Conditions

The Woodville Road Corridor lies within the Duck River catchment, an upper tributary of the Parramatta River. The Site is partially bisected by Duck Creek and by an unnamed tributary of Duck Creek draining from Guildford to Granville, and is adjacent to A’Becketts Creek. Elevations across the study area vary broadly, with peaks of 53.9 mAHD along the intersection of Woodville Road and Chiltern Road in Guildford, to low points of 5.1 mAHD along the Duck Creek watercourse adjacent to Illoura Reserve (see Figure 1.1). The Woodville Road corridor forms a significant portion of the catchment draining to the confluence of A’Becketts Creek and Duck Creek and is subject to overland flows draining into both channels.



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Site Locality and Topography

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1.3 Proposed Development Framework

A Planning Proposal is proposed to facilitate urban renewal along the Woodville Road Corridor across 3 targeted precincts (see Figure 1.2 and Figure 1.3):

- Woodville North Precinct – This area covers the northern portion of the Woodville Road Corridor, from Granville Park (south) to the intersection with the trainline (north). The precinct is dominated by low rise housing, although there is industrial land use at the northern end and some mixed-use multi-storey buildings at the intersection with Merrylands station.
- Merrylands East Precinct – This area covers the middle portion of the Woodville Road Corridor from Bursill Street (south) to Granville Park (north). Three-four storey mixed-use buildings and shop-top housing are scattered along the corridor in this section.
- Woodville South Precinct – This area covers the southern portion of the Woodville Road Corridor, from the Prospect Reservoir Pipeline to Bursill Street (north). This precinct is characterised by three-four storey residential flat buildings and mixed-used developments along both sides of the corridor and warehouse/industrial areas in the south.

The Planning Proposal proposes the following within each of the identified precincts (CM+, 2023):

- Woodville North Precinct
    - *“Introduce a new mixed use zone fronting Granville Park providing job opportunities close to living and amenity. The mixed use zone enjoys higher development potential than other land use zones.*
    - *Introduce four-storey streetwall height (podium) along Woodville Road and local streets, with up to six-storey buildings set back from the podium to create a human scale streetscape.*
    - *Transition the higher built form along Woodville Road down to the lower scale surrounds. This will also bolster housing choices.*
    - *Provide landscape setbacks along Woodville Road and local streets to create green links and mitigate acoustic and air quality issues.*
    - *Locate the future local open space at the triangular site along Union Street, meeting the need in the northern part of the precinct.”*
- Merrylands East Precinct
    - *“Create a village feeling precinct by introducing urban plaza, recreational facilities, ground floor activation and mix of uses in the precinct.*
    - *Echo Council's LSPS by introducing the highest development potential within Merrylands East Precinct on the development ready John Cootes site.*
    - *Introduce a new mixed use zone to the north of Lansdowne Street, providing job opportunities close to the emerging Local Centre.*
    - *Increase the precinct's permeability by introducing through site links and road access in John Cootes site.*

- *Introduce four-storey streetwall height (podium) along Woodville Road and local streets, with up to eight-storey buildings set. back from the podium to create a human scale streetscape*
- *Transition the higher built form along Woodville Road down to the lower scale surrounds.*
- *Provide landscape setbacks along Woodville Road and local streets to create green links and mitigate acoustic and air quality issues.*
- *Increase the size of the public open space within the John Cootes site to a minimum 3,000sqm.*
- *Utilise the land near Kenelda Avenue / Woodville Road intersection to create an adequate local open space."*

- Woodville South Precinct
  - *"Encourage site amalgamation between Woodville Road and Chamberlain Road to facilitate vehicular access from a local street rather than Woodville Road.*
  - *Introduce a new mixed use zone at Guildford Road / Woodville Road intersection, providing employment and living opportunities.*
  - *Introduce four-storey streetwall height (podium) along Woodville Road and local streets, with up to six-storey buildings set back from the podium to create a human scale streetscape.*
  - *Transition the higher built form along Woodville Road down to the lower scale surrounds.*
  - *Limit the building height along Chamberlain Road to four storeys reflecting adjacent low density to the west.*
  - *Provide landscape setbacks along Woodville Road and local streets to create green links and mitigate acoustic and air quality issues.*
  - *Provide new public open space close to the future mixed use area and transfer Rhodes Avenue to a new local open space."*

The preferred Medium Growth Masterplan is shown in Figure 1.3.

Figure 1.2 Proposed Development Masterplan (CM+,2023)

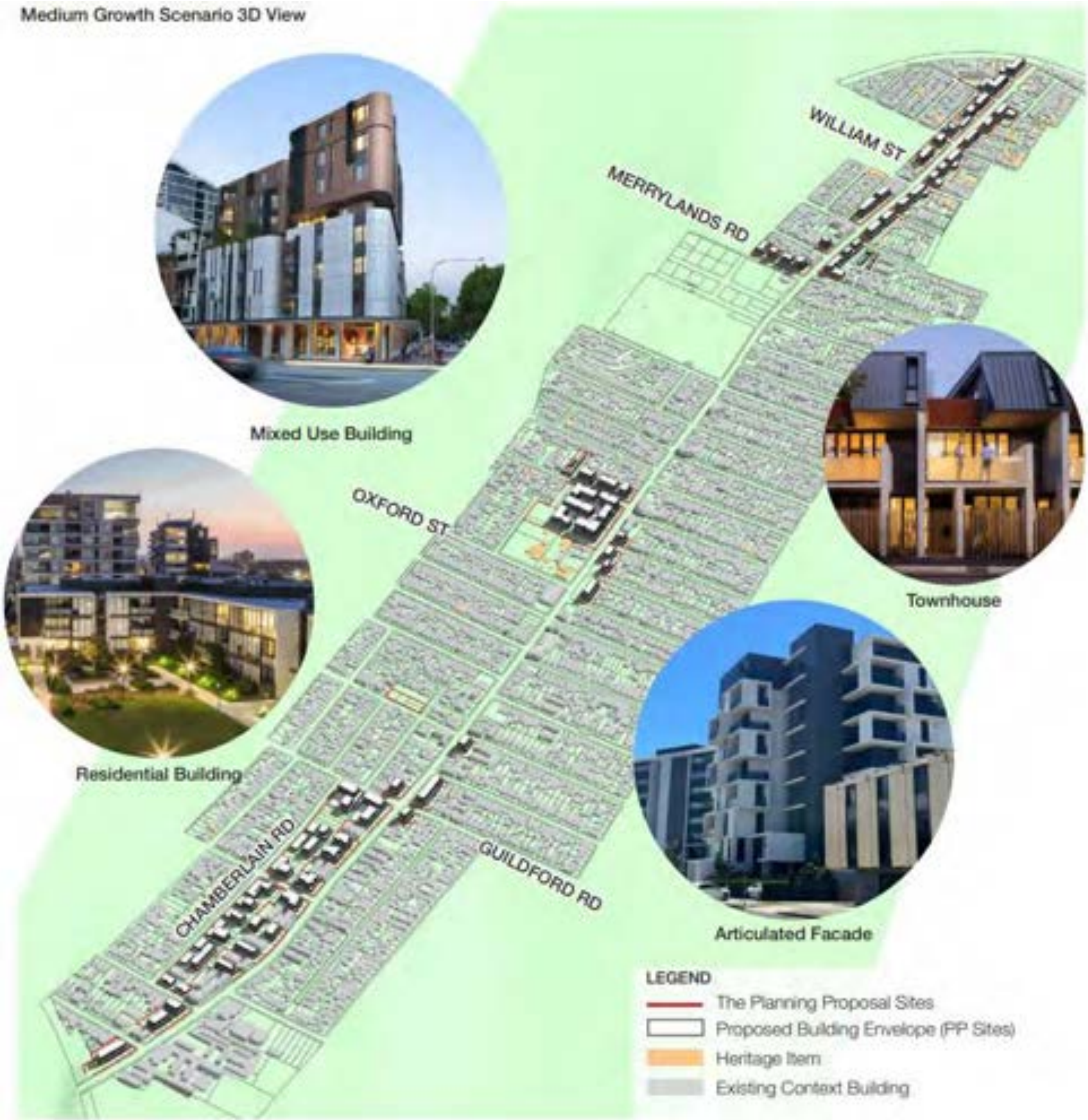


Figure 1.3 Proposed Development (3D View) (CM+,2023)

1.4 Purpose of this Report

The Study Area lies within the Duck River catchment. Mainstream flood behaviour within the Duck Creek channel is defined by the Duck River and Duck Creek Flood Study Review (Parramatta City Council, 2011). However, overland flow draining from the urban environment into the channels has not yet been defined.

In 2021, a Draft Woodville Road Corridor Planning Proposal was endorsed by Cumberland City Council and submitted to the NSW Department of Planning and Environment (DPE) for gateway determination. In 2022 DPE requested further technical studies to support the planning process. Accordingly, BMT Commercial Australia Pty Ltd ("BMT") was commissioned to undertake a Flood Impact and Risk Assessment (FIRA) for the proposed works to accompany the Planning Proposal (this report) which documents the methodology and findings of the assessment, including:

- definition of existing (baseline) design flood conditions;
- definition of post-development flood conditions;
- assessment of the potential impacts of the proposed development on existing flood behaviour; and
- preparation of a flood impact assessment report.

2 Flood Model Development

2.1 Available Flood Studies and Modelling

Details of previous reports (including flood studies) undertaken and their relevance in the context of the current study are presented in the following sections.

2.1.1 Duck River and Duck Creek Flood Study Review (2011)

Parramatta City Council commissioned WMAwater to define the existing flood behaviour in the Duck River catchment, to establish the basis for the Duck River Floodplain Risk Management Study and Plan. The key objective of the Duck River and Duck Creek Flood Study Review undertake design flood analysis for a range of design events and ensure consistency of modelling approach and modelling results with studies in neighbouring catchments. The study defines flood behaviour in the catchment for a range of standard design floods and thereby provides reliable estimates of planning flood levels within the LGA. Flood models developed as part of the study could also be used to assist future floodplain management studies to assess options for reducing existing flood damages or in providing guidance to regional planning.

As part of Duck River and Duck Creek Flood Study Review, XP-RAFTS hydrologic models developed for previous studies and covering the extent of the Duck River, Duck Creek and A'Becketts Creek catchments were used. Three separate TUFLOW hydraulic models – Duck River, Duck Creek and the confluence – were developed, with the results of each model combined to produce a single integrated set of results. The model adopted a grid cell size of 2m. The model was based on several sources of topographic data from 2001-2006.

Calibration of the model was not undertaken due to a limited amount of historical flood information and rainfall records as well as uncertainty regarding observed flood levels. An attempt was made to validate the model against historical events but the models were not able to closely reproduce historical flood behaviour. The model was verified against observed flood behaviour in the catchment.

Several design flood events were defined utilising Australian Rainfall and Runoff 1987 (AR&R 87) rainfall data and methods. The simulated design events included the 20%, 5%, 2% and 1% Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) events. Sensitivity tests were undertaken to identify the impacts on design flood levels due to changes in model parameters, such as structure blockage and the impacts of climate change.

2.2 Hydrologic Model Development

While the Study Area is partially bisected by the Duck Creek watercourse, the majority of the proposed works (including the entirety of the Woodville South Precinct) are located in areas elevated well above the mainstream flood extent. As the Study Area forms part of the catchment draining to the Duck Creek watercourse, an overland flow flood model has been developed to assess potential flood affectation of all 3 precinct areas. A summary of the modelling approach adopted is outlined below.

The hydrologic model simulates the rainfall-runoff process on the catchment. The amount of rainfall-runoff from the catchment is dependent on:

- The catchment slope, area, vegetation, urbanisation and other characteristics.
- Variations in the distribution, intensity and amount of rainfall; and
- The antecedent moisture conditions (dryness/wetness) of the catchment.

The existing XP-RAFTS model of the Duck Creek catchment was utilised as an input to the Duck River and Duck Creek Flood Study (herein the Council Flood Study). Within the Council Flood Study, inflows were placed at the lowest channel point in each sub-catchment to simulate overland flows draining into the channel and then discharging downstream. A similar process was adopted for the A'Becketts Creek catchment.

As part of this study, the Duck Creek and A'Becketts Creek XP-RAFTs models were reviewed. The review found that both models were representative of current conditions (reflecting that no major land use changes had been observed since they were completed in 2012) and no changes were required for this assessment. As part of the review process, it was noted that the sub-catchment delineation within both models was reasonably discretised for an urban study. Therefore, it was decided to expand the Duck Creek hydrological model to include the A'Becketts Creek catchments, but to retain the model in its existing condition to serve as the hydrologic input into the Woodville Road Corridor Flood Assessment.

To account for the potential complexity of overland flow across varying urban topography, flows from each subcatchment were further discretised and applied equally to all inlet pits across each sub-catchment (see Section 2.3.5). This approach allowed for the dissemination of flow across each the Study Area, but promoted the concentration of flows within sub-surface drainage assets (initially) and then along road corridors (once the drainage capacity is exceeded) representing realistic overland flow behaviour in rare and extreme events. The approach has been adopted in a number of similar studies and is considered appropriate for the purposes of this assessment.

The adopted parameters utilised within the XP-RAFTS models developed for the Council Flood Study have been utilised within this study. The outflows from the XP-RAFTS model were used as hydrological inflows to the TUFLOW Hydraulic model developed for this assessment.

2.3 Hydraulic Model Development

An integrated 1D/2D TUFLOW model was created to model the dynamic interactions between the Duck Creek waterway and the urban environment, complex overland flow paths, converging and diverging of flows through structures, and the interaction between surface and sub-surface flow (i.e. stormwater drainage system). This has involved schematisation of the study area based on the following key model features:

- Open watercourse channels and overland flow areas represented in the 2D domain;
- Bridge crossings and culvert structures represented as 1D elements;
- Stormwater drainage network represented as 1D elements, dynamically linked to the 2D domain;
- Hydrologic inflows derived using XP-RAFTS model applied at stormwater inlet pits;

The development of the hydraulic model and adopted parameters are discussed in the following sections.

2.3.1 Model Extent and Grid Size

The hydraulic model for the Woodville Road Corridor Planning Proposal Flood Assessment (herein "the BMT Flood Assessment") was developed using TUFLOW (version 2020-10-AF). The TUFLOW Heavily Parallelised Compute (HPC) solver was utilised for the study to improve modelling run times.

The area modelled within the TUFLOW 2D domain represents a total area of approximately 6.4 km^2. The model domain was defined by determining the portions of the Duck Creek and A'Becketts Creek catchments that formed part of the Study Area. This included the areas from Woodville Golf Course in the south, the railway line in the west, Boundary Street in the north and Blaxcell Street in the east.

The TUFLOW software uses a grid to define the spatial variation in topography and hydrologic/hydraulic properties (e.g. Manning's 'n' roughness, rainfall losses) across the study area. Accordingly, the choice of grid size can have a significant impact on the performance of the model. In general, a smaller grid size will provide a more detailed and reliable representation of flood behaviour relative to a larger grid size. However, a smaller grid size will take longer to perform all of the necessary hydraulic computations. Therefore, it is typically necessary to select a grid size that makes an appropriate compromise between the level of detail provided by the model and the associated computational time required.

A grid size of 1 metre was adopted for the hydraulic model and is considered to provide a reasonable compromise between reliability and simulation time.

2.3.2 Topography

A high-resolution Digital Elevation Model (DEM) was derived for the study area from 2019 LiDAR survey data supplied by Cumberland City Council. The ground surface elevation for the TUFLOW model grid points are sampled directly from the DEM.

A TUFLOW 2D domain model resolution of 1 m was adopted for the study area. It should be noted that TUFLOW samples elevation points at the cell centres, mid-sides and corners, so a 1 m cell size results in DEM elevations being sampled every 0.5 m. This resolution provides the necessary detail required for accurate representation of catchment topography.

The Duck Creek watercourse is a concrete lined channel which runs from Railway Terrace to Illoura Reserve within the model boundary. Aerial inspection and measurement of the channel using GIS software indicates that it is 5 m wide at the base. The Duck Creek channel has been reinforced as a 5 m wide channel within the hydraulic model, with elevations based off the 2019 LiDAR. Elevations are shown in Figure 1.1

2.3.3 Hydraulic Roughness

Utilising available land use information, the development of the TUFLOW model requires the definition of different hydraulic roughness (Manning's 'n') zones that assign surface materials for each grid cell in the model for simulating the variation in flow resistance afforded by different land-use surfaces within the model extent (e.g. trees, grass, roads, etc). Council's land-use planning data and aerial photography have been used as the basis for defining the different hydraulic roughness zones within the model.

The land-use map used to assign the different hydraulic roughness zones across the model is shown in Figure 2.1 and the adopted Manning's 'n' values are listed in Table 2.1.

Table 2.1 Adopted Manning's 'n' Values

Land Use Type	Manning's 'n' Value
Roads	0.025
Concrete Channel	0.015
General Open Space	0.04
Medium Density Urban Lots	0.08
High Density Urban Lots	0.1
Industrial	0.2

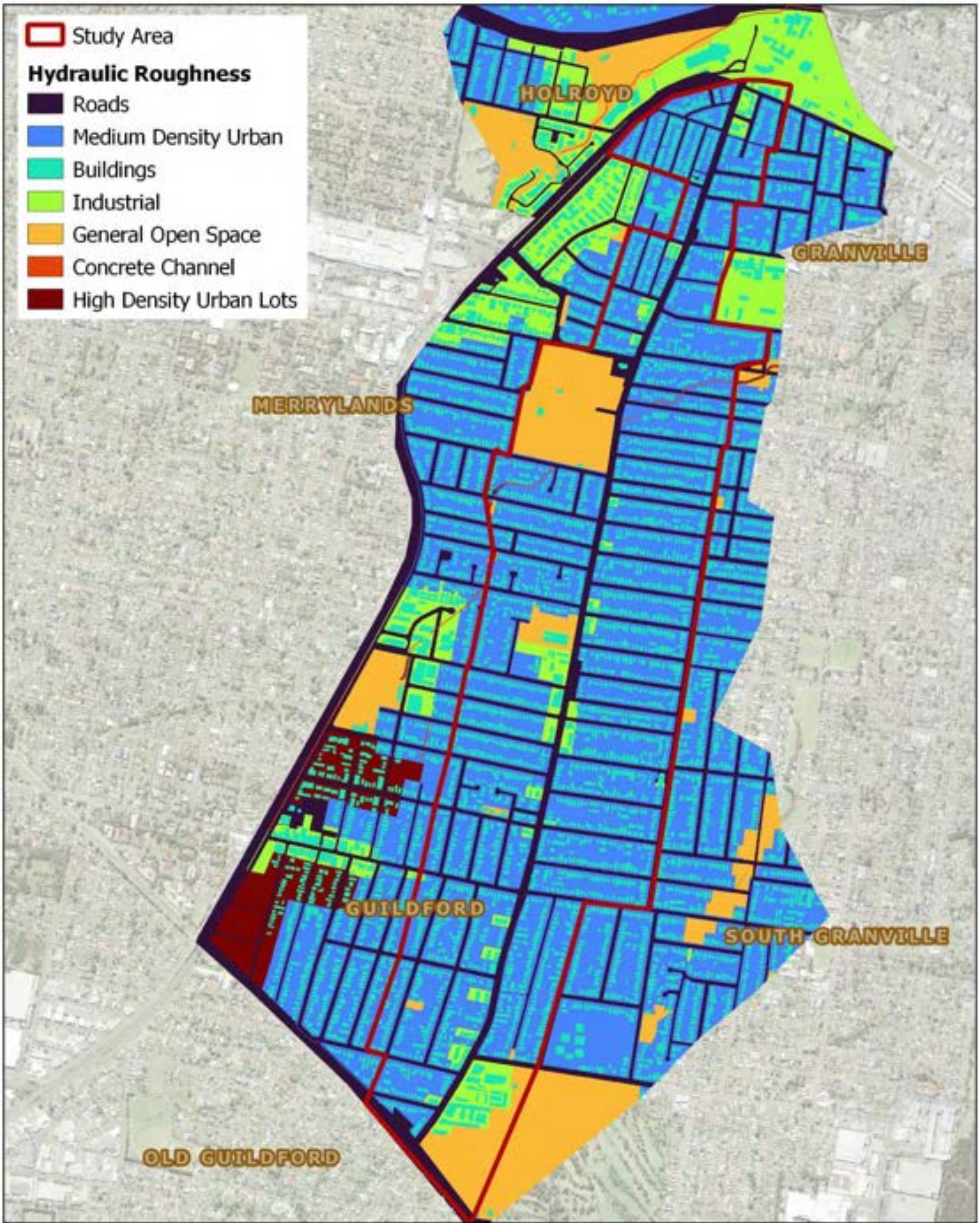
Land Use Type	Manning's 'n' Value
Buildings	0.3

Representation of Buildings and Localised Obstructions

Building GIS layers were obtained from Bing Maps (2020) and are shown in Figure 2.1. The presence of buildings and garages/sheds may impede and divert flood flows in the catchment. Buildings further reduce the available overland flood storage available due to building materials such as internal and external walls and the concrete slab the building may be constructed upon. The representation of buildings is therefore particularly important in areas conveying significant volumes of flow or experiencing significant ponding depth.

There are various ways to approach the modelling of buildings. In this study, buildings are represented in the TUFLOW model as a high Manning's 'n' value which considers the energy dissipation of water flowing through and around the building. This approach also includes the potential storage effects of the building being inundated (and will therefore show water within building footprints).

Smaller localised obstructions within or bordering private property, such as urban fences (for example Colorbond or wood paling fences), were not explicitly represented within the hydraulic model. Rather, these obstructions have been incorporated into the adopted Manning's 'n' roughness value for urban development land use across the study area (i.e. residential and commercial lots), due to their propensity to fail during large flood events.



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Hydraulic Roughness (Manning's 'n') Zones

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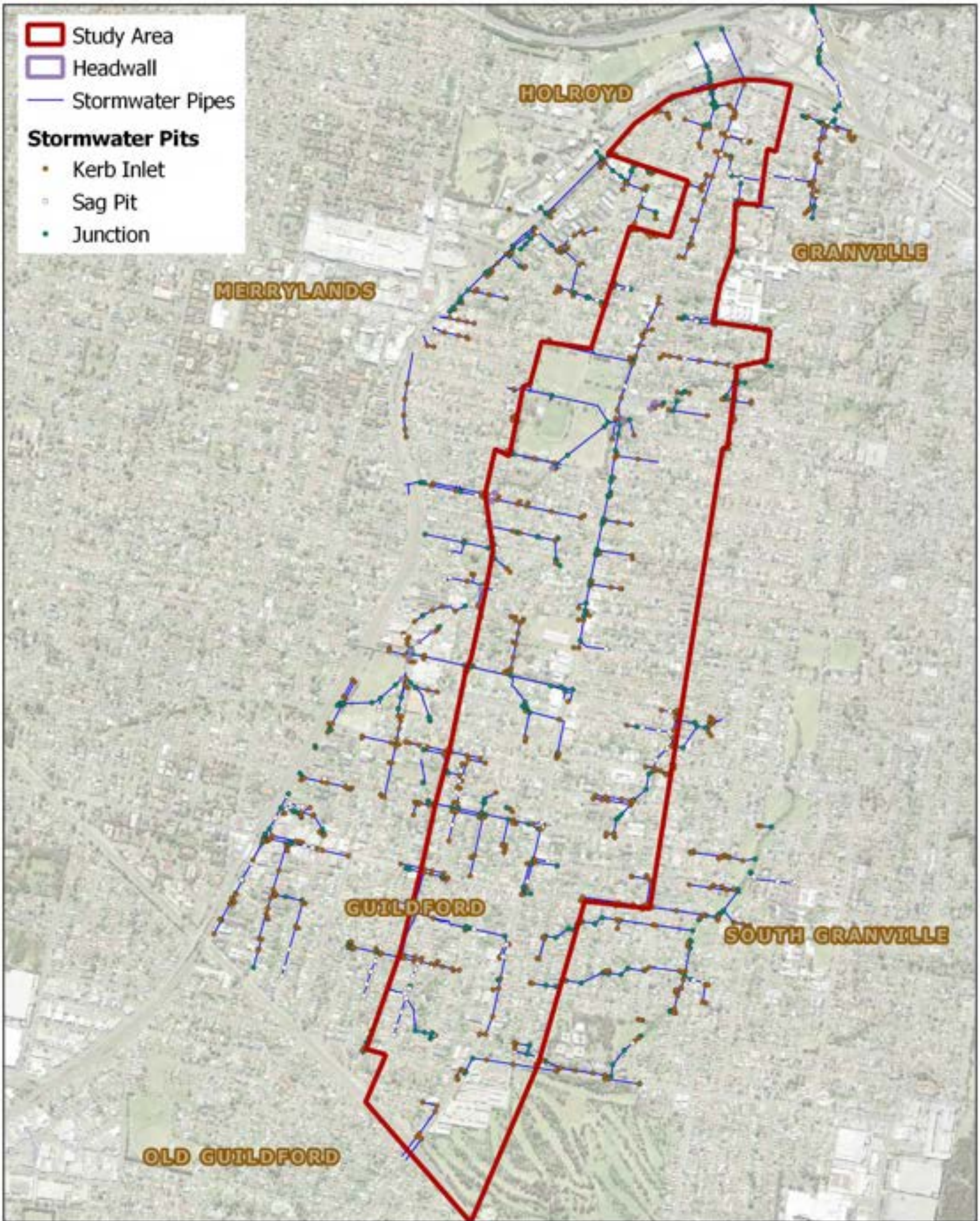

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Modelled Stormwater Network

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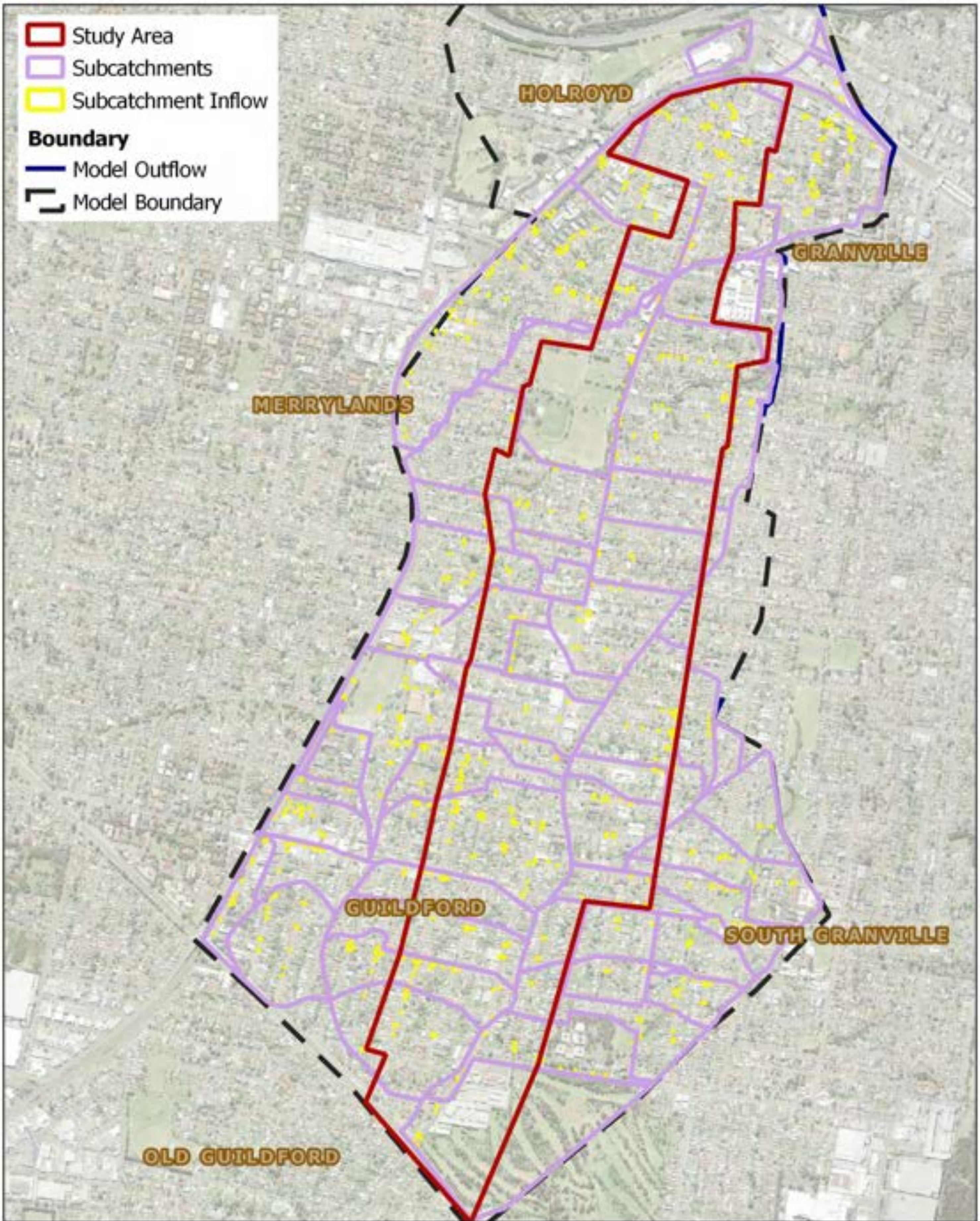
2.3.5 Model Boundary Conditions

The specification of suitable boundary conditions that account for design flows into the system and tailwater conditions at the outlet of the system is a critical component of flood simulations. Model boundary locations are shown in Figure 2.3. The boundary conditions used in the TUFLOW model include:

- Local inflow conditions: Local catchment runoff hydrographs derived by the XP-RAFTS model are applied directly to the hydraulic model as inflow hydrographs. The local catchment runoff is divided and applied equally to every inlet stormwater pit (i.e. kerb or sag) within each sub-catchment (see Section 2.2). For sub-catchment areas containing no stormwater drainage network, the catchment runoff is applied directly to the 2D domain at the outlet of the catchment.

- Downstream boundary conditions: The study area is primarily affected by local overland flows and flooding from Duck Creek. A 'Stage-Discharge' or 'HQ' boundary has been applied along the eastern boundary areas of the Site to represent flow continuing along Duck Creek and prevent flows ponding against the model boundary.

Figure 2.3 shows the distribution of sub-catchment inflows in this study as well as the location of the downstream model boundary.



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TUFLOW Model Configuration

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2.4 Flood Model Verification

As part of a verification exercise, the outputs from the BMT Flood Assessment model have been compared against the results of the Council Flood Study. It is noted that the Council Flood Study and the BMT Flood Assessment have differences in the hydraulic software package used (TUFLOW Classic vs TUFLOW HPC), model extent, underlying DEM, hydrologic approach, and of most relevance are assessing different flood mechanisms across the catchment (mainstream flooding of Duck Creek vs overland flow flooding in the Woodville Corridor). Table 2.2 summarises the main differences between the two studies. However, given the Duck Creek XP-RAFTS model has been utilised as the hydrologic input in both cases, a verification has been undertaken against the results of the Council Flood Study to ensure that the model developed for this assessment is fit for purpose.

Table 2.2 Main Differences Between Council's and BMT's Models

Component	BMT Flood Assessment	Council Flood Study
Hydraulic software package	TUFLOW HPC	TUFLOW Classic
Model Resolution	1 m	2 m
Underlying DEM	2019	LiDAR gathered between 2001-2006
Hydrologic Extent	Duck Creek XP-RAFTS model expanded to incorporate A'Becketts Creek	Duck Creek and A'Becketts Creek XP-RAFTS model
Duck Creek Channel	Modelled in 2D	Modelled in 1D
Stormwater Network	Included in Model	Not Included in Model

Figure 2.4 shows 1% AEP predicted peak flood level differences between the BMT Flood Assessment model and the Council Flood Study model. As can be seen in the figure, there are significant differences in the peak flood levels predicted by the two models.

The BMT model peak flood levels were found to be predominantly higher than the results of the Council Flood Study model, with differences of 500 mm+ in the Duck Creek channel although broadly within +/-100 mm of the Council Flood Study outside of the Channel itself. The largest peak flood differences are observed downstream of Woodville Road with peak flood level differences in excess of +1.5 m in some locations.

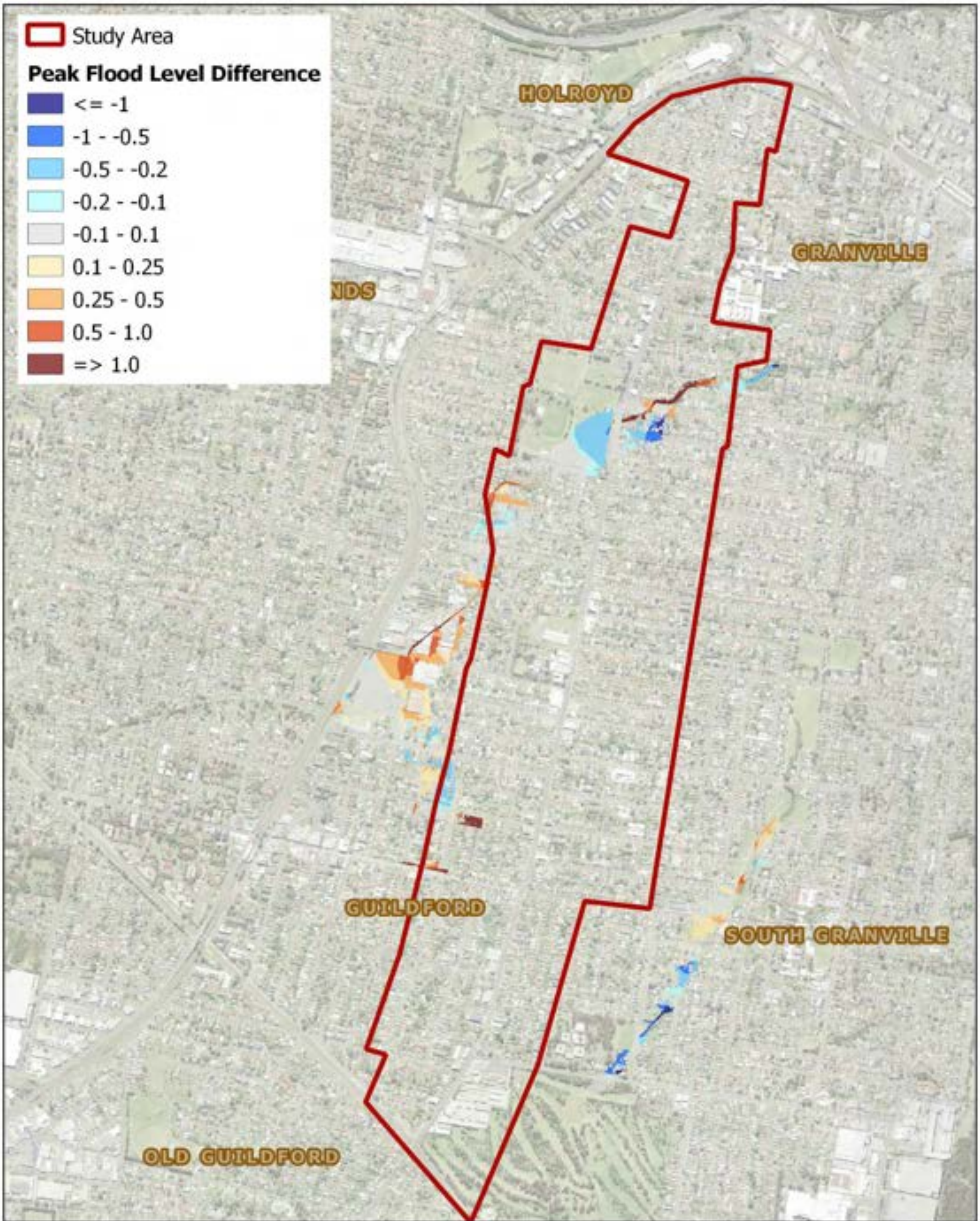
It is considered that the peak flood level differences are attributable to several factors including the differences in the hydraulic software package, the DEM used, the approach to hydrologic flow input and the approach to modelling the Duck Creek channel itself. Differences in the approach to modelling the Duck Creek channel itself can be further broken down to:

- Differences in the modelling approach – The Council Flood Study adopted a 1D modelling approach with cross-sections obtained from the MIKE11 hydraulic models established in the previous Duck Creek Flood Study. This assessment has adopted a 2D modelling approach, with elevation based off 2019 LiDAR and a fixed width enforced along the channel length.
- Differences in channel assumptions – in the Council Flood Study, Duck Creek was modelled with the assumption that properties immediately adjacent to the main drainage channels would not be part of the effective flow path due to the presence of fences and buildings. The BMT Flood Assessment has modelled fences and obstructions within the Manning's 'n' roughness

layers but otherwise does not prevent the discharge of water from or to the channel via residential areas.

- Losses at structures – The results of the 1% AEP design event in the Council Flood Study indicate a head loss of approximately 2 m at the Woodville Road Crossing. In the BMT Flood Assessment, the head loss at the same location is 0.4 m, resulting in a 1.5 m difference downstream. Modelling of the structure significantly varies across the 2 models. Within the BMT Flood Assessment, the crossing is modelled as a dual box culvert arrangement utilising the stormwater network information supplied by Council. Within the Council Flood Study, the crossing is modelled as an irregular 2D channel. An inspection of the crossing (undertaken during this assessment) indicates that it is a complex hydraulic arrangement – which may include both box culverts and an underlying irregular channel – but this would need to be confirmed via survey and ground truthing as part of a catchment-wide study and is beyond the scope of this assessment.

Differences between the models are to be expected given the variations in software packages, underlying DEM and the overall modelling approach. It is also noted that the Council Flood Study was not calibrated, but rather verified against historic observations of flooding behaviour within the catchment and that the differences between the two models occur in areas outside of the Precincts. As the BMT Flood Assessment reasonably matches the Council Flood Study in a number of locations and is representative of flooding behaviour within the catchment, it can be considered to be fit for purpose to define the pre-development and post-development flood behaviour along the Woodville Road Corridor and to assess the impact of the development.



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Woodville Road Flood Assessment vs Duck Creek Flood Study - 1% AEP Flood Level Difference

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3 Existing Flood Behaviour

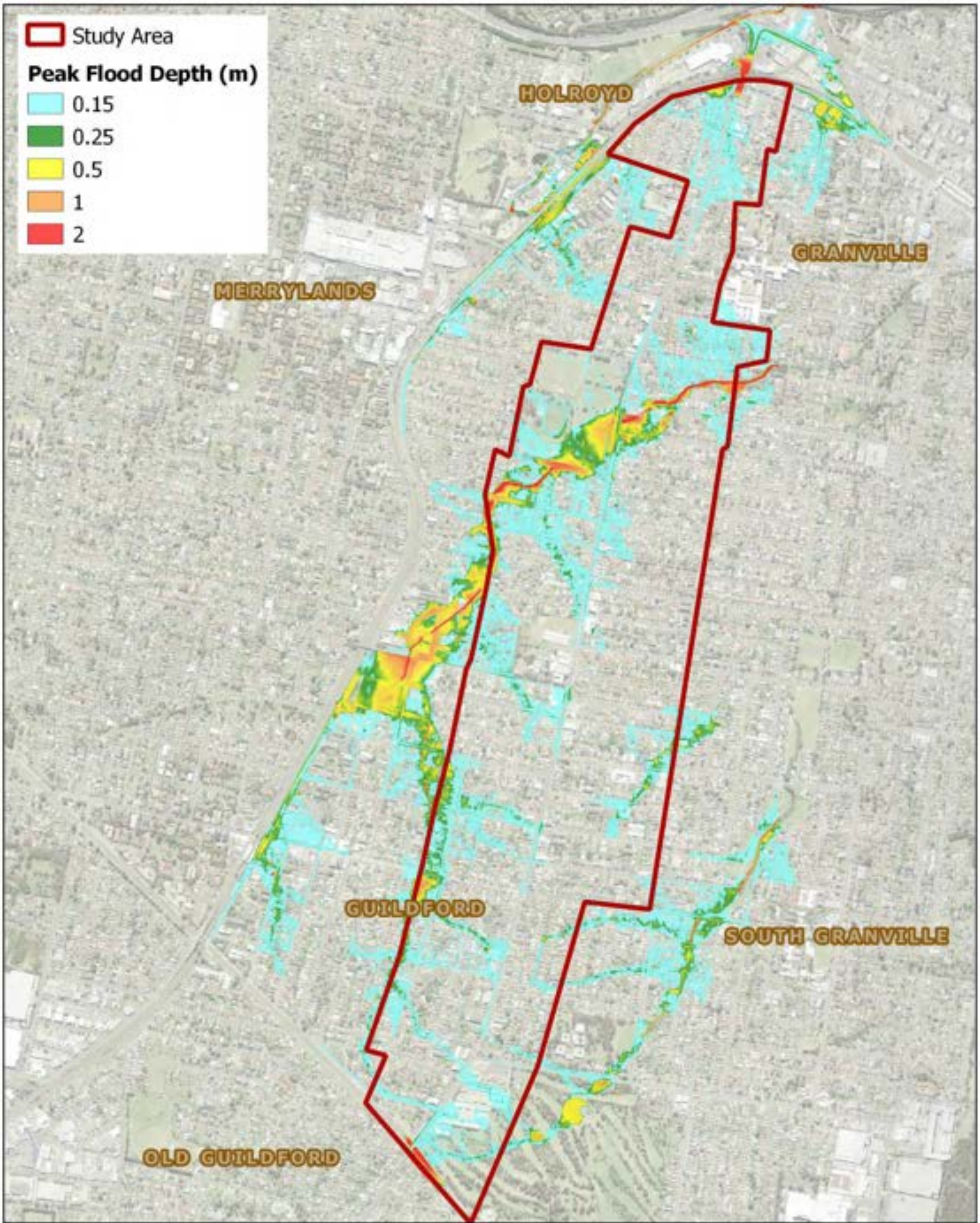
3.1 Existing Flood Conditions

The Existing Scenario TUFLOW model was used to stimulate the 5%, 1%, 0.5% and 0.2% Annual Exceedance Probability (AEP) design events and the Probable Maximum Flood (PMF) event and define the on-site flood conditions discussed in this section. This defined the pre-development (baseline) flood conditions against which flood impacts of the proposed developments will be assessed. The predicted peak flood level, depth, velocity, and hazard are included in Annex A of this report, and are discussed below.

The Study Area is located along an elevated area above both A'Becketts Creek (to the north), Duck Creek (in the centre) and Duck River (to the south). Floodwaters draining to all 3 watercourses originate in the upper urbanised portions of the catchment (which includes the Woodville Road corridor), generally flowing along urbanised paths. Along the Woodville Road corridor, stormwater affectation is generally widespread, with greater concentrations of flow along areas of lower elevations which form part of major trunk lines and/or discharge into all 3 watercourses. Within the Study Area these include the areas:

- Between Rhodes Avenue and Guildford Road;
- North of Mountford Avenue;
- Between Landsdowne Street and Bertha Street;
- Between Hewlett Street and Spring Garden Street;
- Between Wallace Street and the Railway Line; and
- Along Woodville Road beneath the Railway Line.

Figure 3.1 shows 1% AEP flood depths across the entire Study Area. Table 3.1 and Table 3.2 present flood levels and depths at several locations in each of the 3 precincts (noted in Figure 3.2 to Figure 3.4 along with the peak 1% AEP Flood Depths).



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1% AEP Peak Flood Depths

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Figure 3.2 Woodville South Precinct POI and Existing 1% AEP Flood Depths

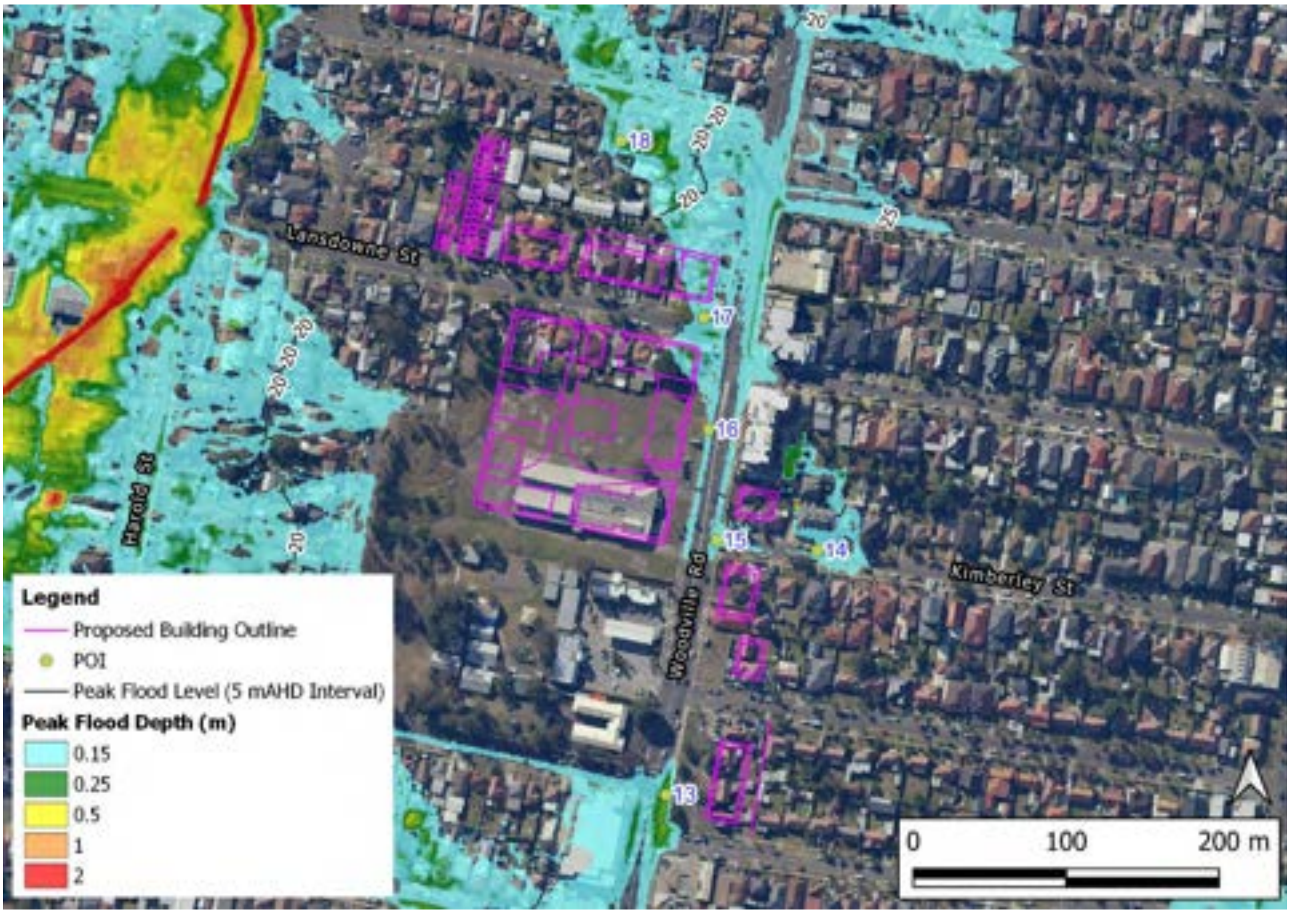


Figure 3.3 Merrylands East Precinct POI and Existing 1% AEP Flood Depths

Figure 3.4 Woodville North Precinct POI and Existing 1% AEP Flood Depths

Table 3.1 Peak Flood Level (m AHD) - Existing Conditions

ID	5% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
1	51.6	51.6	51.6	51.6	51.7
2	48.3	48.3	48.3	48.4	48.4
3	49.7	49.7	49.7	49.7	49.7
4	44.9	44.9	44.9	44.9	44.9
5	49.4	49.4	49.4	49.4	49.4
6	48.6	48.6	48.6	48.6	48.6
7	43.4	43.4	43.4	43.4	43.4
8	40.3	40.3	40.3	40.3	40.3
9	35.5	35.5	35.6	35.6	35.7
10	37.4	37.4	37.4	37.4	37.4
11	34.9	34.9	34.9	34.9	35
12	28.9	29	29	29	29.1
13	27.3	27.4	27.4	27.4	27.4
14	26.4	26.4	26.4	26.4	26.4
15	26.2	26.2	26.2	26.2	26.2
16	23.7	23.7	23.7	23.7	23.7
17	22.3	22.3	22.3	22.3	22.4
18	19	19	19	19	19.4
19	17.3	17.3	17.3	17.3	17.3

ID	5% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
20	23.2	23.3	23.3	23.3	23.3
21	30	30	30	30	30.1
22	24.5	24.5	24.5	24.5	24.6
23	22.5	22.5	22.5	22.5	22.5
24	18.3	18.3	18.3	18.3	18.3
25	16	16	16	16.1	16.1
26	12.6	12.7	12.7	12.7	12.8

Table 3.2 Peak Flood Depth (m) - Existing Conditions

ID	5% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
1	0.08	0.09	0.1	0.11	0.15
2	0.08	0.09	0.09	0.1	0.13
3	0.03	0.04	0.05	0.05	0.07
4	0.03	0.03	0.03	0.04	0.05
5	0.07	0.08	0.08	0.09	0.11
6	0.08	0.09	0.1	0.1	0.14
7	0.03	0.04	0.04	0.04	0.06
8	0.01	0.01	0.01	0.01	0.02
9	0.26	0.32	0.34	0.36	0.49
10	0.02	0.02	0.02	0.02	0.03
11	0.11	0.13	0.14	0.15	0.19
12	0.14	0.16	0.18	0.19	0.26
13	0.29	0.31	0.31	0.31	0.35
14	0.01	0.01	0.01	0.01	0.02
15	0.03	0.04	0.04	0.04	0.05
16	0.07	0.08	0.09	0.09	0.12
17	0.14	0.16	0.17	0.19	0.26
18	0.07	0.09	0.1	0.11	0.55
19	0.07	0.07	0.08	0.08	0.12

ID	5% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
20	0.02	0.03	0.03	0.04	0.06
21	0.04	0.05	0.05	0.06	0.1
22	0.06	0.07	0.07	0.08	0.13
23	0.01	0.02	0.02	0.02	0.04
24	0.04	0.05	0.05	0.06	0.1
25	0.03	0.04	0.04	0.05	0.11
26	0.05	0.06	0.07	0.08	0.22

4 Post-Development Flood Behaviour

4.1 Model Updates

The proposed development shown in Figure 1.2 comprises the following works:

- Demolition of existing buildings; and
- Construction of new buildings.

These proposed works have been incorporated into the Post Development Scenario TUFLOW model. Post-development flood condition mapping is included as Annex B.

4.2 Potential Flood Impacts

Flood level and velocity impact mapping for all design events is included in Annex C. A description of flood impacts for the 1% AEP event is included below.

4.2.1 Peak Flood Level Impacts

The peak 1% AEP flood level impact map shown in Figure 4.1 indicates that the proposed development will re-distribute floodwater on individual building sites/lots but will otherwise cause minimal changes to overall flood behaviour within the catchment. Peak flood level increases are primarily located adjacent the proposed new buildings – as they act as partial obstructions to local and overland flow draining towards the Duck Creek watercourse – but within the lot boundaries and therefore do not increase off-site affectation.

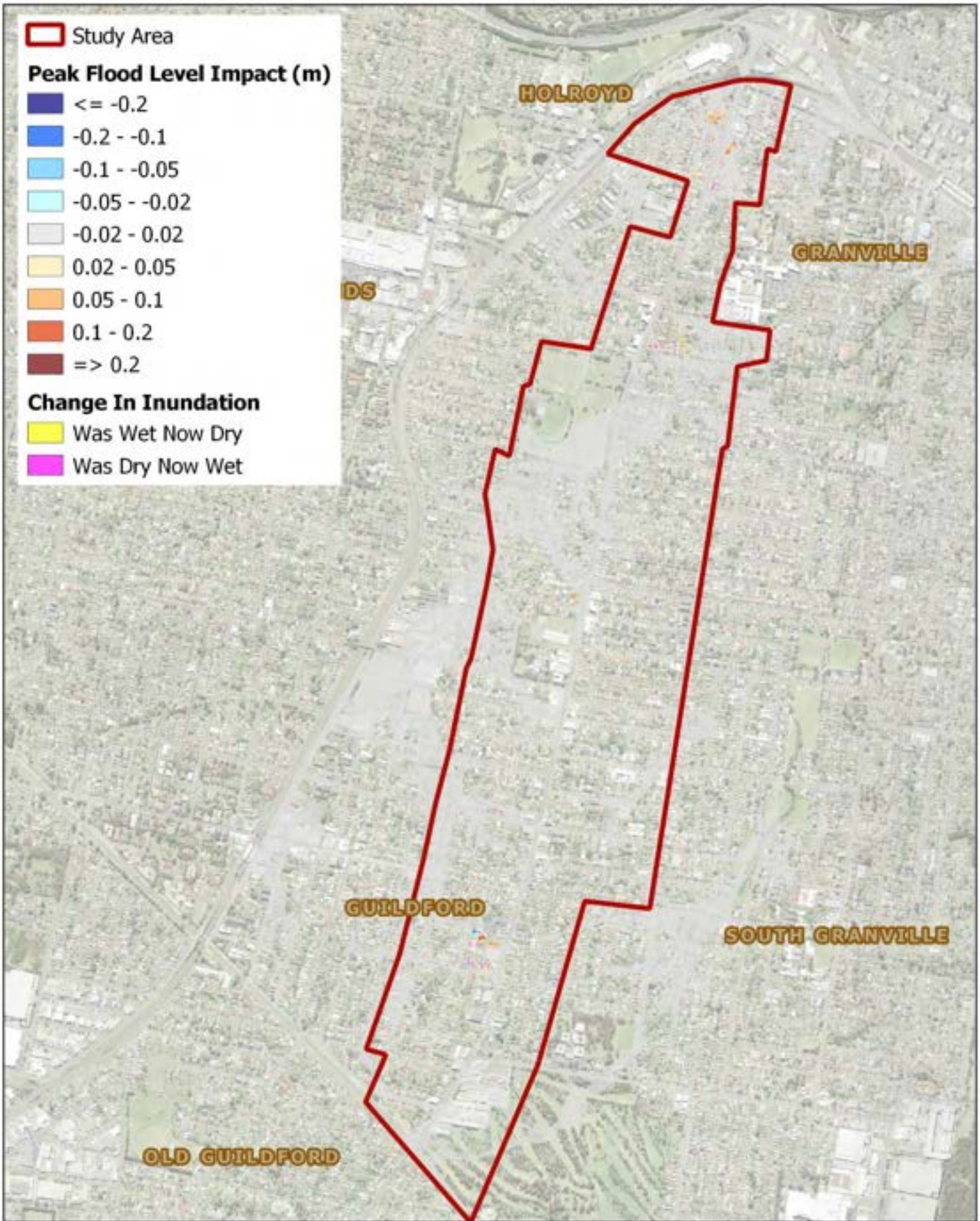
There are a few locations where peak level increases and changes to inundation extents will increase affectation to neighbouring properties/off-site. It is noted that these increases are localised, proximate to the boundary and minor in scale. Peak flood level increases to roadways or on other land owned by the Council could be considered acceptable for this development given the potential benefits to the community that the proposed works will have within the Study Area and the LGA. However, a mitigation scenario has been modelled (see Section 4.4) in order to provide a potential design modification that would prevent all off-site flood level increases in the 1% AEP event should this be required.

4.2.2 Peak Flow Velocity Impacts

The flow velocity impact mapping shown in Figure 4.2 indicates that the proposed development will result in negligible changes to peak flows in the 1% AEP event.

4.2.3 Climate Change

Modelling of the 0.5% AEP and 0.2% AEP flood events has been undertaken as part of this assessment as a proxy for potential increases to rainfall intensity associated with climate change. As outlined in Table 3.1, due to the location of the three precinct areas in higher elevations within the catchment only minor increases to peak flood conditions would be expected to occur as a result of potential increase to rainfall intensity.



Title:

Peak 1% AEP Flood Level Impact

Drawing: 4.1

Rev: A

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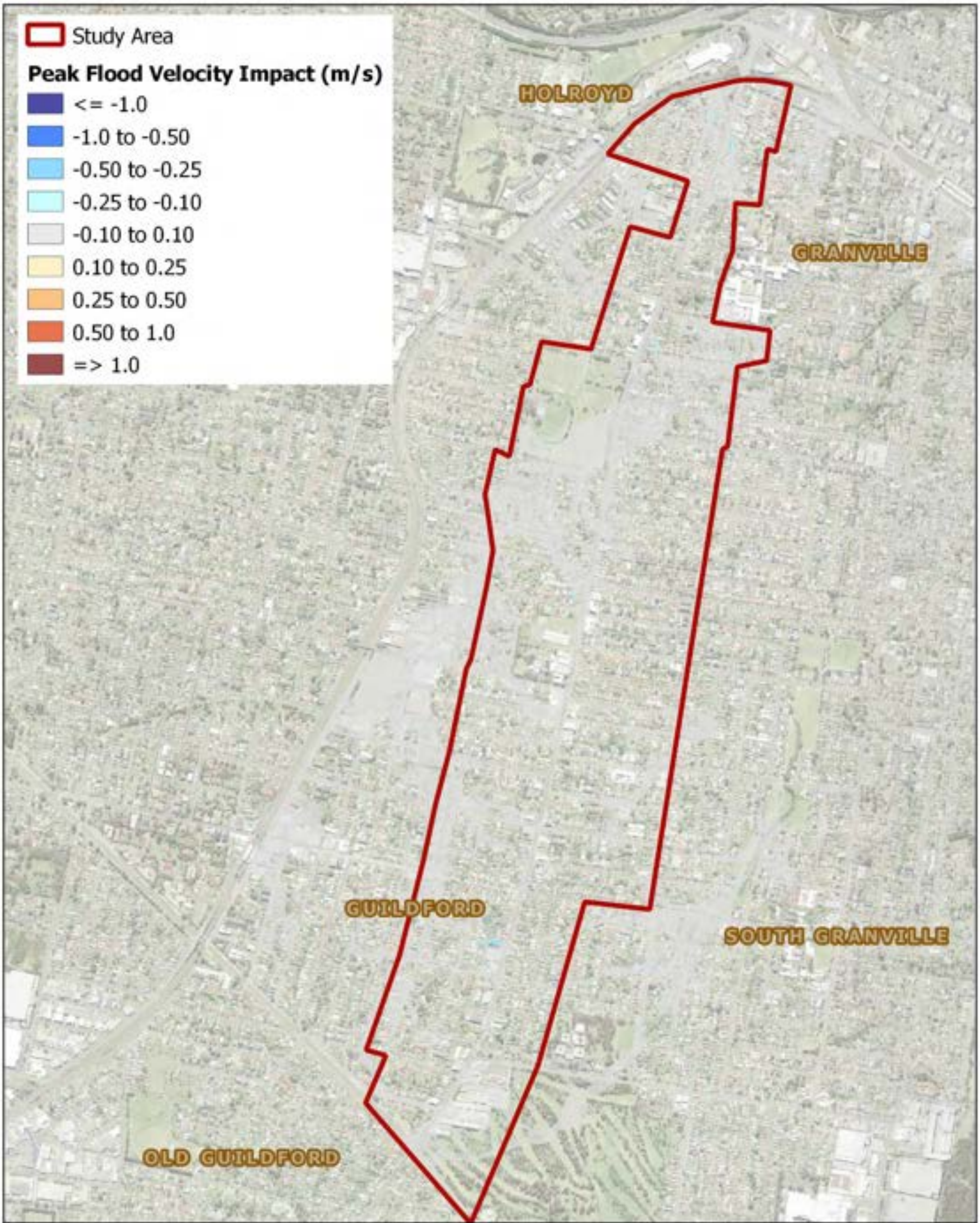

Title:

Peak 1% AEP Flood Velocity Impact

Drawing: **4.2**

Rev: **A**

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4.3 Flood Hazard

The Best Practice Flood Risk Management approach to flood hazard mapping (AIDR, 2017) classifies the floodplain into the six distinct hazard classification (H1 to H6) shown in Figure 4.3. These hazard classifications are based on adopted thresholds of flood depth, velocity and depth-velocity product that identify when flood conditions are likely to present a risk to people, vehicles and buildings. A description of each hazard threshold is provided in Table 4.1.

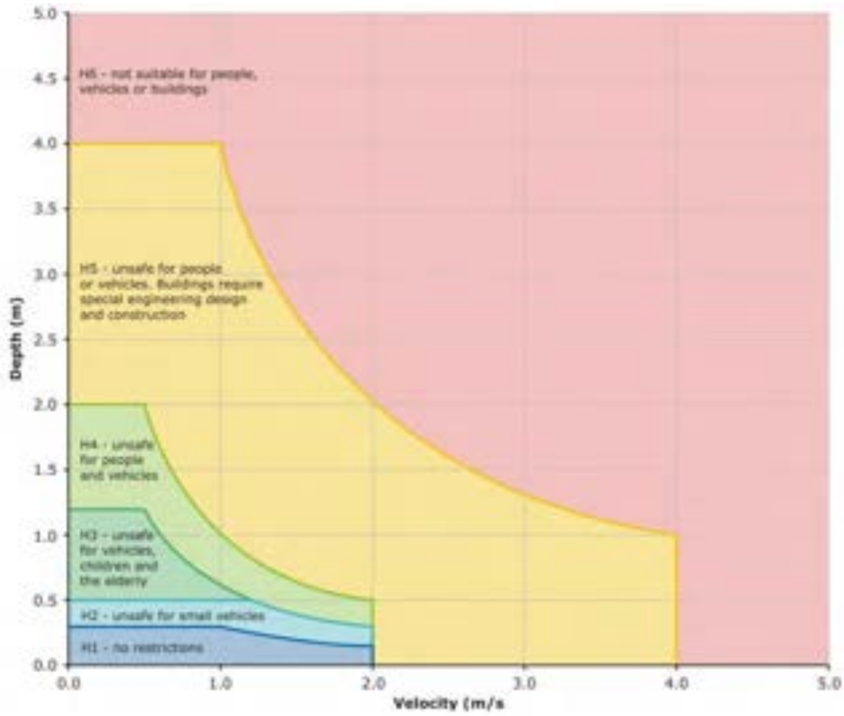


Figure 4.3 Flood Hazard Curves (2017)

Table 4.1 Flood Hazard Classification Thresholds (ADR, 2017)

Hazard Classification	Description
H1	Relatively benign flow conditions. No vulnerability constraints.
H2	Unsafe for small vehicles.
H3	Unsafe for all vehicles, children and the elderly.
H4	Unsafe for all people and vehicles.
H5	Unsafe for all people and vehicles. Buildings require engineering design and construction.
H6	Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure.

As shown in Figure 4.4, the modelling results indicate a 1% AEP flood hazard classification of H1 to H2 at the proposed building layers under post-development conditions, although higher hazards are observed along roadways and properties adjacent. A summary of hazards for each precinct is included below.

4.3.2 Woodville South Precinct

The properties that form part of the Woodville South Precinct are predominantly flood-free but will be affected primarily by H1 hazard flooding, with minor affectation of H2 to properties to the north of Rhodes Avenue. Along the southern sections of the Woodville Road roadway, peak hazards of up to H5 are observed in local sag points but the properties in these areas will be flood free for the same event.

4.3.3 Merrylands East Precinct

The properties that form part of the Merrylands East Precinct are predominantly flood-free but will be affected by minor H1 hazard flooding.

4.3.4 Woodville North Precinct

The properties that form part of the Woodville North Precinct will be affected primarily by H1 hazard flooding. The property adjacent to the trainline will be bordered by H2-H3 hazard flooding (considered unsafe for children, vehicles and the elderly).

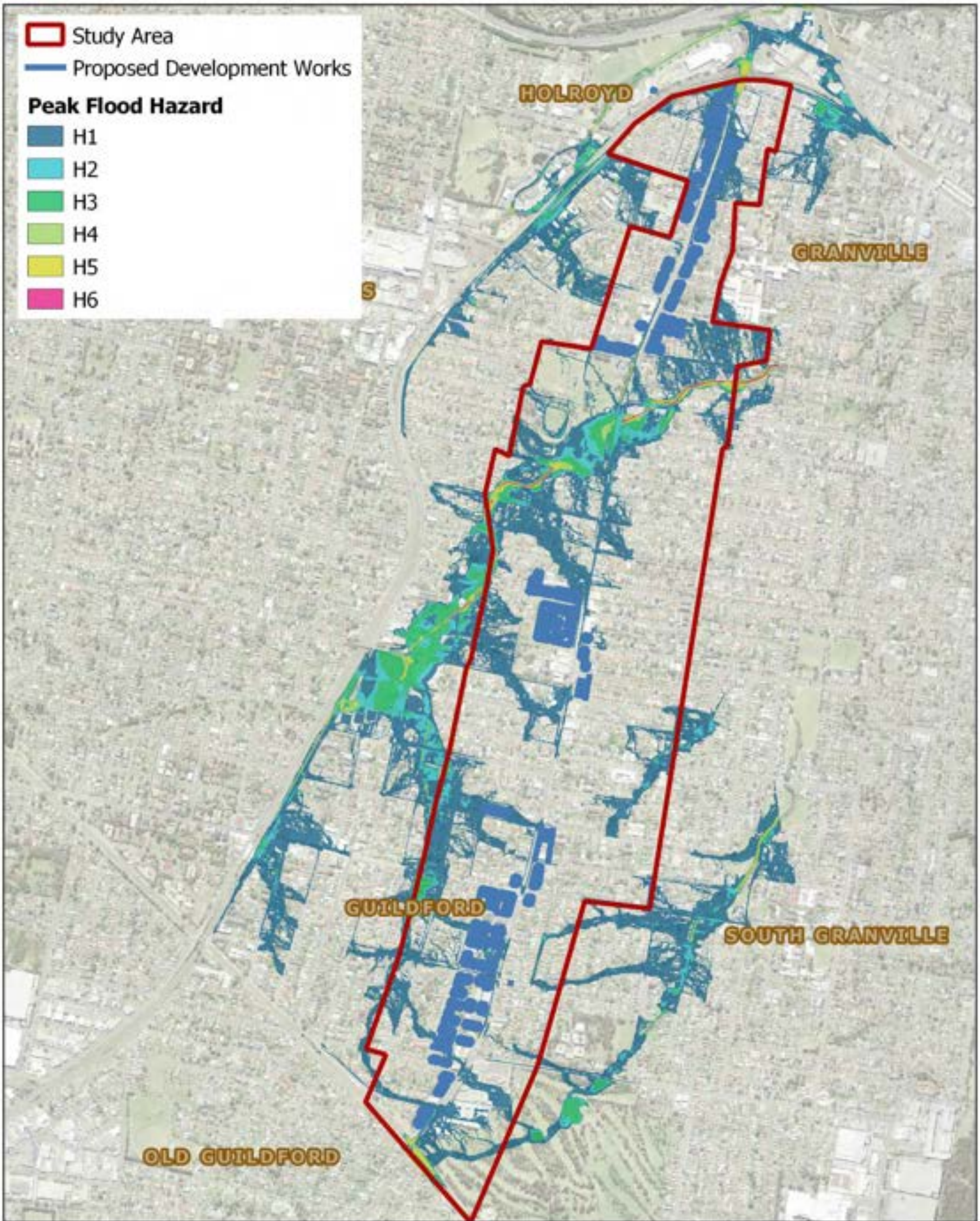
4.3.5 PMF Hazard

During the PMF event (refer Figure 4.5), hazard classifications of:

- H1-H3 are predicted in the Woodville South Precinct;
- H1-H2 are predicted in the Merrylands East Precinct; and
- H1-H3 are predicted in the Woodville North Precinct.

High Hazard flooding will be present along other sections of the Woodville Road Corridor, particularly at the Duck Creek Crossing with H5 hazards present in the PMF.

It is noted that the proposed development is not predicted to increase the existing peak 1% AEP flood hazard classification. This is because the magnitude of the changes in peak 1% AEP flood level and/or peak 1% AEP flow velocity are not sufficient to result in an increased flood hazard categorisation.



Title:

Post-Development 1% AEP Peak Flood Hazard

Drawing: 4.4

Rev: A

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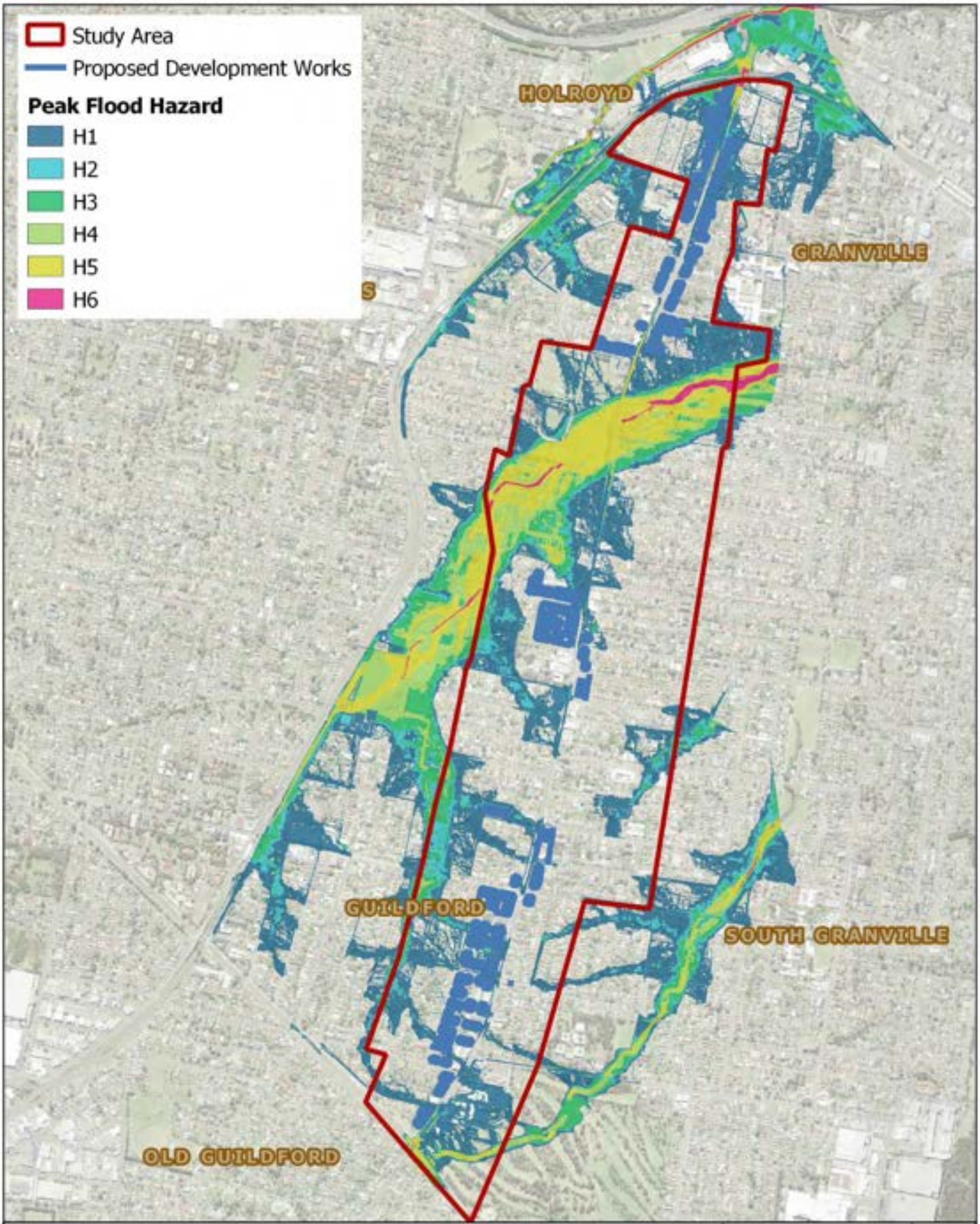

Title:

Post-Development PMF Peak Flood Hazard

Drawing: 4.5

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4.4 Flood Impact Mitigation

As outlined in Section 4.2, the proposed Woodville Road Corridor Planning Framework development will cause off-site impacts in a number of locations including:

- Properties along Woodville Road adjacent to Chamberland Road and Rhodes Avenue (see Figure 4.6);
- Easement areas on Grasmere Street (see Figure 4.7);
- Properties along Woodville Road near the corner with Lansdowne Street (see Figure 4.8); and
- Properties on Elizabeth Street near the intersection with Woodville Road (see Figure 4.9).

These impacts are minor and localised in nature but may require mitigation as part of the detailed design to ensure compliance as part of the planning proposal submission.

A preliminary mitigation scenario has been investigated as part of this assessment to remove the peak flood level increases to neighbouring properties. For the mitigation scenario, building polygons were resized in order to reduce the impedance of buildings on major flow-paths, and the model was then re-run for the 1% AEP event. The peak 1% AEP flood level impact for the mitigation scenario is shown in Figure 4.6 to Figure 4.9. The figures indicate that the reduced building extents are effective in mitigating peak flood level increases off-site.

It is noted that the mitigation scenario modelled is a preliminary option only, aimed at demonstrating that reduction in off-site peak flood level impacts can be achieved in the detailed design phase. Mitigation of flood impacts associated with the development (if required) could be achieved on an individual lot basis via several different options, or a combination of options including but not limited to:

- Increases to local stormwater drainage.
- Local terrain changes and the construction of local overland flowpaths.
- A reduction/alteration in building footprints (as demonstrated in this report).

Given the shallow overland flows present in the catchment, reduction/alterations of building footprints would only be required at ground level.

Figure 4.6 Peak Flood Level Impact – Mitigation Option

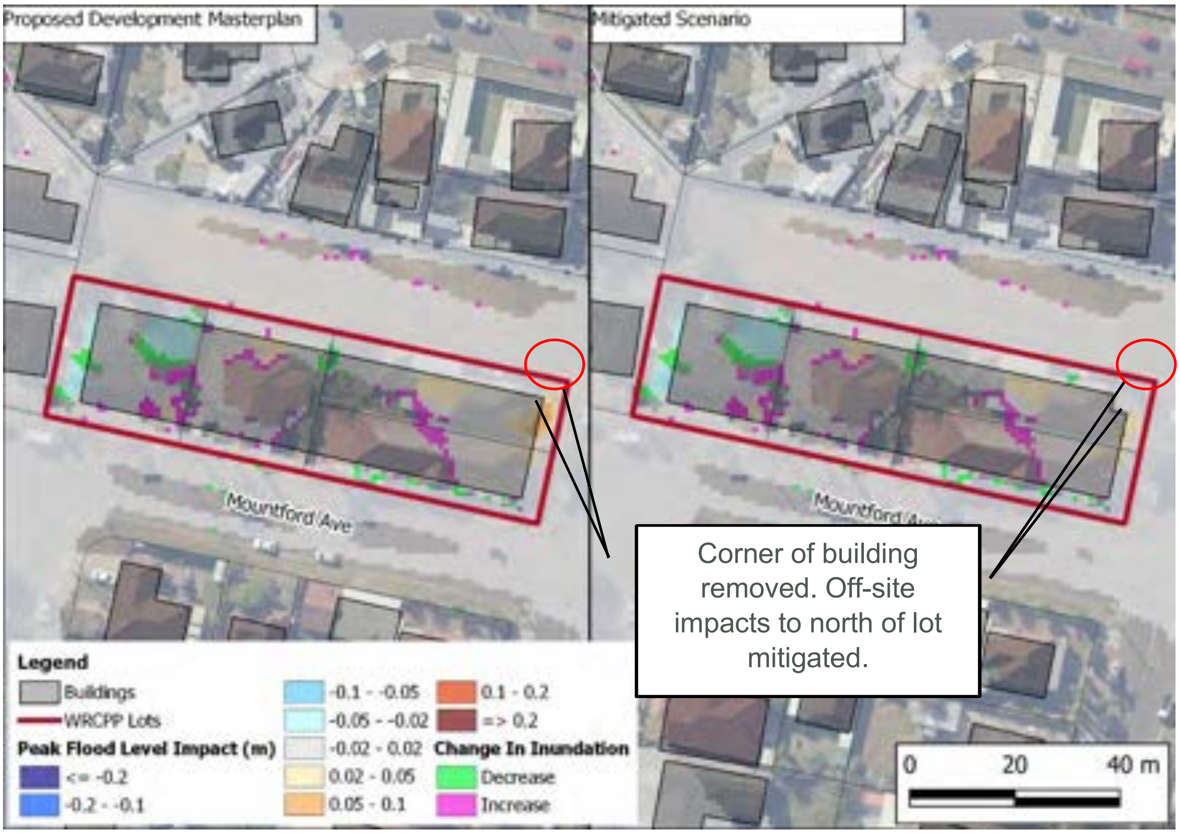

Figure 4.7 Peak Flood Level Impact – Mitigation Option

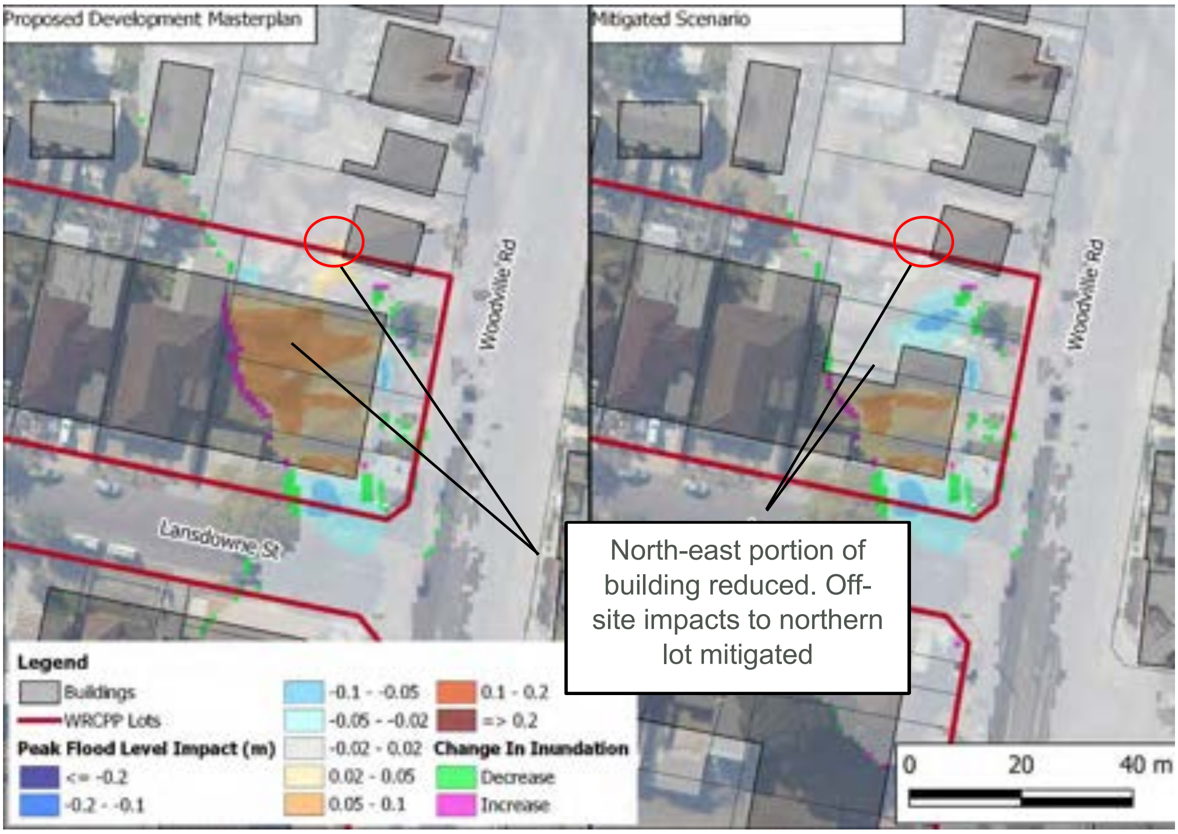

Figure 4.8 Peak Flood Level Impact – Mitigation Option

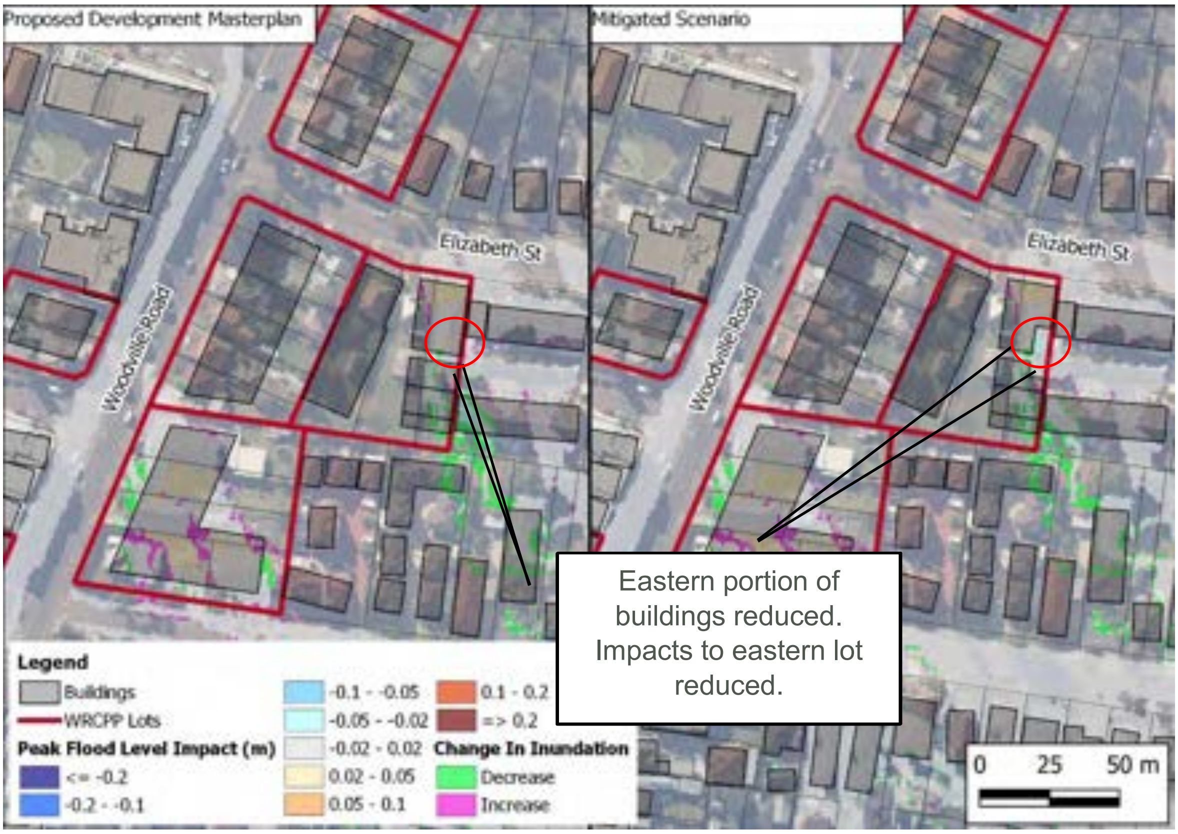

Figure 4.9 Peak Flood Level Impact – Mitigation Option

4.5 Flood Emergency Response Considerations

Physical protection of all proposed new buildings within the Study Area to exclude floodwaters for all events up to the PMF is unlikely to be practical, achievable and/or cost effective in every case. For floods larger than the level of protection that is achieved by design, an emergency management plan may be used to assist in mitigation of the residual flood risk to people during extreme floods. A key objective of such a plan is to facilitate evacuation of building occupants to safe locations if there is a risk of floodwater inundation. Enclosed ground floor spaces are prone to higher risk as once the flood protection level is breached the space may fill rapidly, reducing the available evacuation time.

While it is preferable to evacuate off-site if possible, available warning and evacuation time as well as other factors may preclude this option. Due to the rate of rise associated with overland flow flooding, areas on, adjacent to and along the vehicular egress routes for all 3 precinct development areas will be inundated with high hazard floodwaters during extreme events with insufficient warning time to enable safe evacuation. As such, the most practical method of controlling the risk is to provide evacuation to refuge points on-site that are above the level of the PMF and which can be reached quickly and without reliance on automated measures.

The finished floor levels for all proposed development buildings will need to be set at the relevant flood planning level (see Table 5.5). Based on the peak flood levels/depths outlined in Table 3.1 all internal floors will be elevated above the floodplain if ground levels are set at the flood planning levels nominated in Section 5.2. However, high depth and high hazard floodwaters will be present in surrounding areas during flood events. Therefore, a shelter-in-place arrangement is the most suitable evacuation strategy for the Study Area.

In the event of a flood emergency, where occupants are located in buildings, and the ground floor levels for these buildings is above the PMF, it is recommended that they remain inside until floodwaters recede. People located outside or in any future underground carpark areas shall swiftly make their way to higher levels. The total shelter-in-place period would be less than a few hours in a PMF event.

During future design it is recommended that a Flood Emergency Management Plan (FEMP) be prepared on a Precinct Level to formalise flood evacuation planning and strategy with respect to flood intelligence, the flood behaviour presented in this report and relevant procedures. The SES recommends that all flood prone properties prepare their own emergency management plans as SES resources are scarce during emergencies and it is often the case that they cannot service all affected parties in case of flood, particularly given mobilisation time. The FEMP shall be used as a guide for building wardens and other responsible parties nominated in the evacuation strategy. The aim of the FEMP is to inform the future operators of the building of the appropriate response measures required in the event of an extreme flood.

It will be necessary to confirm the number of people expected to occupy each building to establish that there is adequate space available within the allocated flood refuge areas and identify if additional refuge areas need to be allocated. Consideration of the likely site occupants and their awareness of the potential flood risk will also need to be undertaken as a final flood emergency consideration.

5 Development Controls

5.1 General Flood Planning Requirements

Flood planning requirements for development with the Cumberland City Council LGA are set out in the following documents:

- Cumberland Development Control Plan (DCP) (2021), Part G – Miscellaneous Development Controls, Part G4 – Stormwater and Drainage
  - Section 2.5 Technical details of stormwater and drainage systems, Overland flow paths
  - Section 2.6 Flood Risk Management
- Cumberland Local Environmental Plan (LEP) (2021), Section 5.21 Flood Planning
- Cumberland Flood Risk Management Policy (2021)

Flood related development consent conditions relevant to the Site have been extracted from these policies for this assessment and are shown in Table 5.1 to Table 5.5.

Table 5.1 Cumberland Development Control Plan (2021), Overland flow paths controls

	Cumberland City Council Requirement	BMT comment
C1.	*Designated overland flow paths are to be provided within the development in case of pipe blockage or major storm events to direct runoff to receiving body without impacting the development or other properties.*	The proposed development will involve the construction of some new building footprints along minor overland flowpaths. Under existing conditions overland flow progresses via existing gaps between buildings. Under proposed post-development conditions this behaviour will be maintained with minor redirection of flow in some locations (see Figure 4.1 and Annex C).
C2.	*Provision shall be made to ensure runoff up to the 100 year ARI (minor system including overflows from roof gutters), is safely conveyed within formal or informal overland flow paths to the receiving body.*	This assessment is a catchment-wide overland flow flood study. Under both existing and post-development flood conditions overland flow will be conveyed along roadways and local depressions into the Duck Creek watercourse.
C3.	*Where it is not practicable to provide paths for overland flows, the piped drainage system shall be sized to accept runoff up to the 100 year ARI with the blockage factor.*	Not applicable.
C4.	*Development shall not cause flooding of adjoining properties*	The proposed development works will cause flood level increases at several isolated locations (see Section 4.2). Mitigation of these impacts via a reduction in building

	Cumberland City Council Requirement	BMT comment
		extents has been demonstrated in this report (see Section 4.4), but it is noted that mitigation may be possible via alternate options. Flood impact mitigation should be further considered during the concept design stage.
C5.	*Runoff currently entering the site from upstream properties shall not be obstructed from flowing onto the site and shall not be redirected so as to increase the quantity or concentration of surface runoff entering adjoining properties.*	The proposed development may result in an increase in impervious area in some locations. On-Site Detention may be required on a lot by lot basis to mitigate potential associated impacts. This requirement should be considered as part of the concept design stage.
C6.	*Where a site includes either an existing or proposed overland flow path, register a restriction on use of land and a positive covenant on the title of the subject property. The covenant should require that the overland flow path on the site:* • *not be altered; and* • *be maintained in good working order.* *Note: In this instance, "overland flow path" includes all structures, pipes, drains, walls, kerbs, pits, grates, fencing and all surfaces graded to convey and/or allow stormwater flows to pass through the site.*	This requirement should be considered during the concept design stage.
C7.	*Where the overland flow rates are high, the requirements outlined in Council's Flood Risk management Policy on flood risk management will need to be satisfied.*	See below.

Table 5.2 Cumberland Development Control Plan (2021), Flood risk management

	Cumberland City Council Requirement	BMT comment
General		
C1.	*The proposed development does not result in any increased risk to human life and does not increase the potential flood affectation on other development or properties*	The proposed development does not result in any increased risk to human life. The proposed development works will cause flood level increases to at several isolated locations (see Section 4.2). Mitigation of these impacts via a reduction in building extents has been demonstrated in this report (see Section 4.4), but it is noted that mitigation may be

	Cumberland City Council Requirement	BMT comment
		possible via alternate options. Flood impact mitigation should be further considered during the concept design stage.
C2.	*The additional economic and social costs which may arise from damage to property from flooding is no greater than that which can reasonably be managed by the property owner and general community*	The proposed development works will be affected by low-hazard flooding for all events up to and including the PMF event.
C3.	*The proposal should only be permitted where effective warning time and reliable access is available for the evacuation of an area potentially affected by floods. Evacuation should be consistent with any relevant disaster plans (DISPLAN) or flood plan where in existence.*	As noted in Section 4.3, the proposed development will be affected by low depth floodwaters for all events up to and including the PMF. Given short flood warning times, a shelter-in-place strategy is flood emergency management strategy. The PMF is lower than the FPL for all locations (see Table 5.5).
C4.	*A 15m setback from the mean high water mark applies to properties fronting Duck River to the east and 10m to Haslams Creek.*	The proposed development is not located along Duck River or Haslams Creek.
C5.	*The proposal does not adversely impact upon the recreational, ecological, aesthetic or utilitarian use of the waterway corridors, and where possible, should provide for their enhancement, in accordance with ecologically sustainable development principles.*	The proposed development does not adversely impact upon the waterway (see Section 4.2).
C6.	*The proposal shall not have a significant detrimental impact on:* • *water quality;* • *native bushland vegetation;* • *riparian vegetation;* • *estuaries, wetlands, lakes or other water bodies;* • *aquatic and terrestrial ecosystems;* • *indigenous flora and fauna; or* • *fluvial geomorphology.*	This requirement should be considered during the concept design stage by an ecological engineer.
C7.	*The filling of flood prone land, where acceptable and permitted by this Part, must involve the extraction of the practical maximum quantity of fill material from that part of the site adjoining the waterway.*	This requirement will need to be addressed at the final design stage.
C8.	*The proposed development shall comply with Council's Flood Risk Management Policy.*	See comments in Table 5.4
C9.	*Site specific flood studies shall comply with Council's standard requirements.*	This assessment is a catchment-wide flood study. It has been undertaken as per the requirements outlined in

	Cumberland City Council Requirement	BMT comment
		Table 5.1 to Table 5.5 where appropriate.
Fencing		
C1.	*Fencing within the floodplain shall be constructed in a manner that does not affect the flow of floods.*	This requirement will be addressed at the concept design stage.
C2.	*Fencing within a high flood risk precinct (FRP) shall not be permissible except for security/permeable/safety fences of a type approved by Council.*	This requirement will be addressed at the concept design stage.
C3.	*Council shall require a development application for all new solid (non-porous) and continuous fences in the high and medium risk FRPs, unless otherwise stated by exempt and complying development provisions.*	This requirement will be addressed at the concept design stage.

Table 5.3 Cumberland Local Environmental Plan 2021 – Flood Planning

	Cumberland City Council Requirement	BMT comment
(2)	*Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development –* *(a) is compatible with the flood function and behaviour on the land, and* *(b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of the other development or properties, and* *(c) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.*	a) The Site is affected by low velocity floodwaters for all events up to and including the PMF and can be considered a flood fringe area. b) The proposed development works will cause flood level increases to at several isolated locations (see Section 4.2). Mitigation of these impacts via a reduction in building extents has been demonstrated in this report (see Section 4.4), but it is noted that mitigation may be possible via alternate options. Flood impact mitigation should be further considered during the concept design stage. c) The development will not adversely affect the watercourse.
(3)	*In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters –* *(a) the impact of the development on projected changes to flood behaviour as a result of climate change,* *(b) the intended design and scale of building result from the development,*	a) As per Table 3.2 and Section 4.2.3, peak flood depths adjacent to the proposed development are not expected to be significantly impacted as a result of climate change. b) The proposed development works will be

Cumberland City Council Requirement	BMT comment
(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood, *(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.*	located within areas of existing development. c) The proposed development works will be located in areas affected by low hazard floodwaters for all events up to and including the PMF. See Section 4.3.5. d) The proposed development will be primarily effected by low hazard/minor flow flooding for all events up to the PMF. The development will not be impacted by Coastal Erosion.

Table 5.4 Cumberland Flood Risk Management Policy

	Cumberland City Council Requirement	BMT comment
(1)	*Development applications lodged in accordance with the Environmental Planning and Assessment Act 1979 on land affected by potential flood are to be assessed in accordance with the controls in the Cumberland LEP 2021 and Cumberland DCP 2021, as well as the requirements of this policy, as applicable.*	See Table 5.1 to Table 5.3
(2)	*When assessing flood risk, both mainstream and overland flooding are to be considered.*	The proposed development works are affected by overland flow flooding. This assessment includes consideration of mainstream flooding from Duck Creek.
(3)	*Blockage needs to be included when analysing overland flow paths, pipes, etc. This analysis should be carried out on the basis that all bridges, culverts, pipes, etc. are at least 50% blocked.*	A blockage factor of 50% has been applied to all drainage assets.
(4)	*A number of major land use categories have been identified for the purpose of floodplain management control. Table 1 (in the Appendix) shows these major categories together with the specific uses under each category (as defined by Cumberland LEP 2021), and the relevant requirements for each category.*	See Table 5.5.
(5)	*Where flood compatible materials are required, refer to Table 2 in the Appendix.*	This requirement will need to be addressed at the concept design stage.

	Cumberland City Council Requirement	BMT comment
(6)	*Development is to comply with the controls applicable to the proposed land use category and FRPs within which the site is located:* • *Haslams Creek floodplain as specified in Table 3 in the Appendix;* • *Duck River floodplain; and* • *Cooks River floodplain.* *Maps for these catchment areas can be found in the appendix*	The development is classified as a Medium Flood Risk Precinct. See Table 5.5.

Table 5.5 Duck River Floodplain Development Requirements

Planning Consideration	Requirements	BMT Comment
Residential		
Floor Level	• Floor levels of open car parking areas to be equal to or greater than the 20-year ARI plus freeboard. Enclosed car parking must be protected from the 100-year ARI flood • Habitable floor levels to be equal to or greater than the 100-year ARI plus freeboard • Below ground swimming pools should be free from inundation from storms up to the 5-year ARI	• To be addressed as part of the concept design stage • See Section 5.2 • To be addressed as part of the concept design stage
Building Components	• All structures to have flood compatible building components below or at the 100-year ARI flood level	• To be addressed as part of the concept design stage
Structural Soundness	• Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100-year flood.	• To be addressed as part of the concept design stage
Flood Affectation	• The impact of the development on flooding elsewhere to be considered	• Undertaken as part of this assessment.
Evacuation	• Reliable access for pedestrian or vehicles is required from the	• Shelter-in-place recommended as a preliminary flood

Planning Consideration	Requirements	BMT Comment
	dwelling, commencing at a minimum flood level equal to the lowest habitable floor level to an area of refuge above the PMF level, either on-site or off-site. • Applicant to demonstrate the development is to be consistent with any relevant DISPLAN or flood evacuation strategy.	emergency management strategy. See Section 4.5 for further detail. • SES Cumberland LGA Flood Emergency Sub Plan requires the use of Land Use Planning and Floodplain Risk Management as a prevention/mitigation strategy (undertaken as part of this project and the wider Woodville Road Corridor Planning Proposal assessment).
Management and Design	• Site Emergency Response Flood plan required (except for single-dwelling houses) where floor levels are below the design floor level. • Applicant to demonstrate that area is available to store goods above the 100-year flood plus 0.5 m (freeboard) • No external storage of materials below design floor level which may cause pollution or be potentially hazardous during any flood.	• Shelter-in-place recommended as a preliminary flood emergency management strategy. See Section 4.5 for further detail. • To be addressed as part of the concept design stage • To be addressed as part of the concept design stage
Commercial and Industrial		
Floor Level	• Floor levels of open car parking areas to be equal to or greater than the 20-year ARI plus freeboard. Enclosed car parking must be protected from the 100-year ARI flood • Habitable floor levels to be equal to or greater than the 100-year ARI plus freeboard	• To be addressed as part of the concept design stage • See Section 5.2
Building Components	• All structures to have flood compatible building components below or at	• To be addressed as part of the concept design stage

Planning Consideration	Requirements	BMT Comment
	the 100-year ARI flood level	
Structural Soundness	• Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100-year flood.	• To be addressed as part of the concept design stage
Flood Affectation	• The impact of the development on flooding elsewhere to be considered	• Undertaken as part of this assessment.
Evacuation	• Reliable access for pedestrian or vehicles is required from the dwelling, commencing at a minimum flood level equal to the lowest habitable floor level to an area of refuge above the PMF level, either on-site or off-site. • Applicant to demonstrate the development is to be consistent with any relevant DISPLAN or flood evacuation strategy.	• Shelter-in-place recommended as a preliminary flood emergency management strategy. See Section 4.5 for further detail. • SES Cumberland LGA Flood Emergency Sub Plan requires the use of Land Use Planning and Floodplain Risk Management as a prevention/mitigation strategy (undertaken as part of this project and the wider Woodville Road Corridor Planning Proposal assessment).
Management and Design	• Site Emergency Response Flood plan required (except for single-dwelling houses) where floor levels are below the design floor level. • Applicant to demonstrate that area is available to store goods above the 100-year flood plus 0.5 m (freeboard) • No external storage of materials below design floor level which may cause pollution or be potentially hazardous during any flood.	• Shelter-in-place recommended as a preliminary flood emergency management strategy. See Section 4.5 for further detail. • To be addressed as part of the concept design stage • To be addressed as part of the concept design stage

5.2 Flood Planning Levels

Cumberland City Council sets flood related development controls in the Cumberland Flood Risk Management Policy. The policy identifies that habitable floor levels for residential, commercial and industrial developments must be set at or above the 1% AEP flood level plus freeboard.

Final finished floor levels for the developments proposed as part of each of the 3 precincts will need to be confirmed at the concept design stage.

5.3 Compliance With Ministerial Direction

Section 9.1(2) of the Environmental Planning and Assessment Act 1979 Focus Area 4.1 applies to all relevant planning authorities that are responsible for flood prone land when prepare a planning proposal that creates, removes or alters a zone or a provision that affects flood prone land. Ministerial Directions 4.1.3 and 4.1.4 are outlined in Table 5.6 below along with relevant commentary:

Table 5.6 Ministerial Direction 4.1 Flooding

Ministerial Direction	BMT Comment
4.1.3 a planning proposal must not contain provisions that apply to the flood planning area which: a permit development in floodway areas b permit development that will result in significant flood impacts to other properties c permit development for the purposes of residential accommodation in high hazard areas d permit a significant increase in the development and/or dwelling density of that land. e permit development for the purpose of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate. f permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require development consent g are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities h permit hazardous industries or hazardous storage establishments where hazardous	a) The development will not be located in a floodway. b) Minor isolated flood level increases are expected as a result of the development works (see Section 4.2). Mitigation of these impacts via a reduction in building extents has been demonstrated in this report (see Section 4.4), but it is noted that mitigation may be possible via alternate options. Flood impact mitigation should be further considered during the concept design stage. c) The development will not be located in high hazard areas. d) Increases to dwelling density will largely fall outside of flood prone land. This requirement will need to be addressed as part of the concept design stage. e) Shelter-in-place has been identified as an appropriate preliminary emergency management strategy (see Section 4.5) for the overall Study Area. Site-specific flood emergency response requirements will need to be addressed as part of the concept design stage. f) N/A to this development. g) The proposed development works are not likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities.

Ministerial Direction	BMT Comment
materials cannot be effectively contained during the occurrence of a flood event.	h) To be confirmed as part of the concept design stage.
4.1.4 A Planning proposal must not contain provisions that apply to areas between the flooding planning area and probable maximum flood to which Special Flood Considerations apply which: a permit development in floodway areas b permit development that will result in significant flood impacts to other properties c permit a significant increase in the dwelling density of that land d permit the development of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate e are likely to affect the safe occupation of and efficient evacuation of the lot f are likely to result in a significantly increased requirement for government spending on emergency management services, and flood mitigation and emergency response measures, which can include but not limited to road infrastructure, flood mitigation infrastructure and utilities.	a) The development will not be located in a floodway. b) Minor isolated flood level increases are expected as a result of the development works (see Section 4.2). Mitigation of these impacts via a reduction in building extents has been demonstrated in this report (see Section 4.4), but it is noted that mitigation may be possible via alternate options. Flood impact mitigation should be further considered during the concept design stage. c) Increases to dwelling density will largely fall outside of flood prone land. This requirement will need to be addressed as part of the concept design stage. d) To be confirmed as part of the concept design stage. e) Shelter-in-place has been identified as an appropriate preliminary emergency management strategy (see Section 4.5). f) The proposed development works are not likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities.

5.4 Compliance With Flood Prone Land Policy

The NSW Flood Prone Land Policy is included as Annex D. The primary statement is provided below:

"The primary objective of the NSW Flood Prone Land Policy (this policy) is to reduce the impact of flooding and flood liability on communities and individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible. In doing so, community resilience to flooding is improved."

The proposed Woodville Road Corridor Planning Proposal will be located in areas that are primarily flood-free or affected by low hazard flooding. Setting of finished-floor levels at the 1% AEP flood level plus freeboard in these areas will place developments above the PMF level. It is considered that the development location and these controls will reduce the impact of flooding and flood liability to the properties, limit the potential for flood losses and prevent the sterilisation of land with only minor flood affectation.

5.5 Compliance with Floodplain Development Manual and Flood Risk Management Manual

The Flood Risk Management Manual sets out 10 principles for Flood Risk Management as per the below.

- *Principle 1 Establish sustainable governance arrangements*
- *Principle 2 Think and plan strategically*
- *Principle 3 Be consultative*
- *Principle 4 Make flood information available*
- *Principle 5 Understand flood behaviour and constraints*
- *Principle 6 Understand flood risk and how it may change*
- *Principle 7 Consider variability and uncertainty*
- *Principle 8 Maintain natural flood functions*
- *Principle 9 Manage flood risk effectively*
- *Principle 10 Continually improve the management of flood risk*

The undertaking of a detailed flood assessment for the proposed Woodville Planning Corridor contributes towards achieving Principles 1-7.

In regard to Principle 8, the proposed development areas are predominantly affected by low-hazard shallow overland flows. The natural flood function affecting the proposed development area is broadly low-hazard flood fringe. This behaviour will be maintained under post-development conditions.

In regard to Principles 9 and 10, the following extracts reflect the most relevant objectives of the Woodville Road Corridor Planning Framework:

- *Limit increases in flood risk related to new and modified development.*
  - *Decisions to place new development in the floodplain generally increases flood risk. This may be due to the risks to the new development and its users. It may also relate to the impacts the development may have on flood behaviour or flood and EM risks to the existing community.*
  - *Consistent with the policy a merit-based approach is recommended in developing and implementing strategic planning through local strategic planning statements (LSPSs) and planning instruments such as local environmental plans (LEPs) and development control plans (DCPs). This involves considering the risks outlined above to limit the potential for increases in flood losses and risks in areas proposed for new development.*
  - *The opportunity to effectively consider flood risk in modifying or rebuilding development should be considered in LEPs and DCPs. This may reduce or limit increases in flood and EM risks relative to the risk to the existing development and its users.*
- *Establish or improve EM arrangements and planning for floods to assist in managing the continuing risk that remains after FRM and land-use planning measures are implemented. This can further limit but generally cannot eliminate the residual flood risk faced by the community.*

The proposed Woodville Road Corridor Planning Proposal will be located in areas affected by low-hazard, shallow overland flooding. Setting of finished-floor levels at the 1% AEP flood level plus freeboard in these areas will place developments above the PMF level. As outlined in Table 3.2, only minor scaling of flood affectation is expected to occur with event rarity. Therefore, effective management of current and future flood risk along the proposed development can be achieved by existing flood planning controls (see Section 5.1) and consideration of Emergency Management Planning (see Section 4.5).

As the Flood Risk Management Manual is intended to replace the Floodplain Development, it is considered that this assessment also addresses the requirements of the Floodplain Development Manual.

6 Conclusions and Recommendations

A Planning Proposal is proposed to facilitate urban renewal along the Woodville Road Corridor across 3 targeted precincts. The Woodville Road Corridor lies in the upper portion of the Duck Creek catchment and is affected by overland flow flooding draining to the Duck Creek and A'Becketts Creek watercourses. Flood models developed as part of this flood assessment, inclusive of hydrologic input from the Duck River and Duck Creek Flood Study Review indicate that the Study Areas has variable flood depths, with peak depths in excess of 0.3 m in low lying areas in the 1% AEP event, but is broadly affected by shallow, low hazard flooding for all events up to and including the PMF.

Post-development flood modelling indicates that the proposed works have the potential to cause minor off-site flood impacts in isolated areas. Mitigation of these impacts via a reduction in building extents has been demonstrated in this report, but it is noted that mitigation may be possible via alternate options which should be further considered during future design stages. Modelling also indicates that the proposed precinct areas will not be heavily impacted by the potential effects of climate change. Shelter-in-place has been identified as an appropriate preliminary flood emergency response strategy, although it is recommended this is investigated further as part of the concept design stage.

This report has demonstrated that the proposed precinct locations are compatible with the flooding controls in the Cumberland Development Control Plan 2021, Cumberland Local Environmental Plan 2021, Cumberland Flood Risk Management Policy 2021, Section 9.1(2) of the Environmental Planning and Assessment Act 1979 Focus Area 4.1 flooding, the Flood Prone Land Policy and the NSW Floodplain Risk Management Manual. These requirements are addressed as part of Section 5 of this report.

7 References

CM+ (2023). *Woodville Road Corridor Planning Framework Urban Design Report - Stages 1+2 Report,* Prepared for Cumberland City Council

Cumberland City Council (2021). *Cumberland Development Control Plan*

Cumberland City Council (2021). *Cumberland Local Environment Plan*

Cumberland City Council (2021). *Cumberland Flood Risk Management Policy*

Department of Planning and Environment (2022). *Flood Risk Management Manual,* NSW Government

NSW Government (2022). *Environment Planning and Assessment Act 1979 No 203, Section 9.1 (2), Focus Area 4.1 Flooding*

WMAwater (2011). *Duck River and Duck Creek Flood Study Review*, Prepared for Parramatta City Council

Annex A Existing Flood Condition Mapping

Annex B Post-Development Flood Conditions Mapping

Annex C Flood Impact Mapping

Annex D Flood Prone Lane Policy

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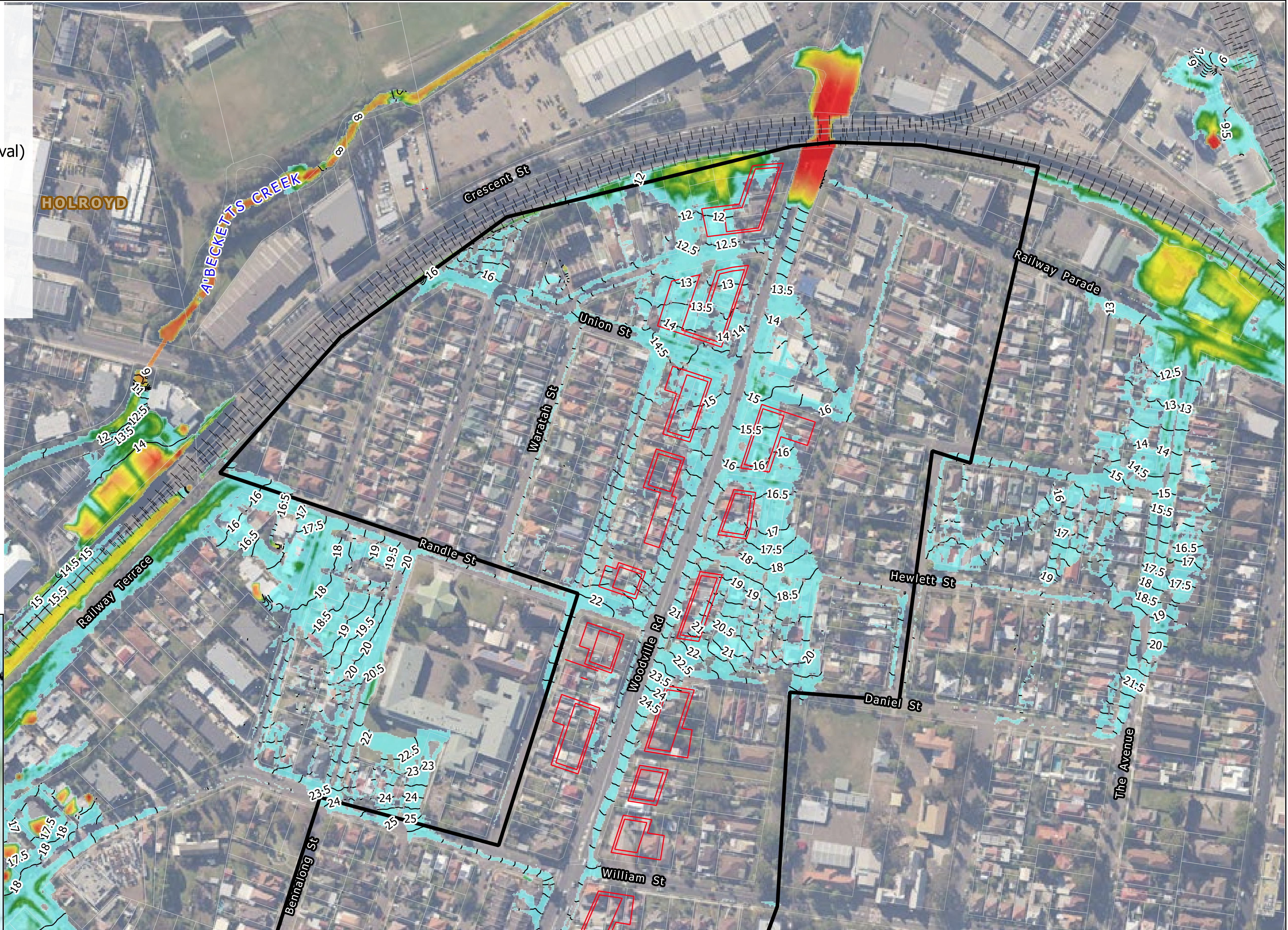
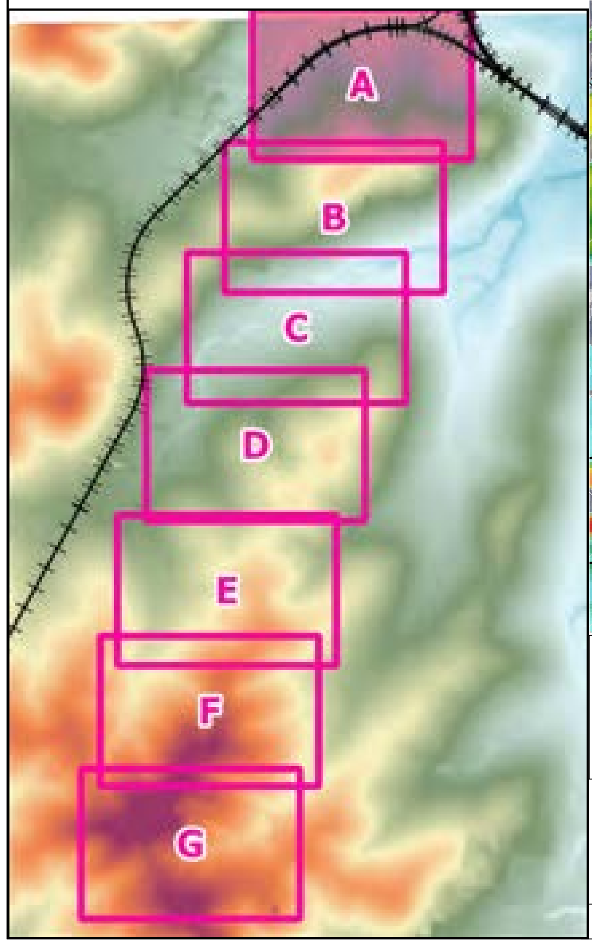
LEGEND

- Study Area
- Proposed Building Outline
- Railway
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15
- 0.25
- 0.5
- 1
- 2





Title: **Peak Flood Levels and Depths - Existing Conditions - 20% AEP Event - View A**

Figure: **A-01.A**

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LEGEND

- Study Area
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Peak Flood Depth (m)

- 0.15
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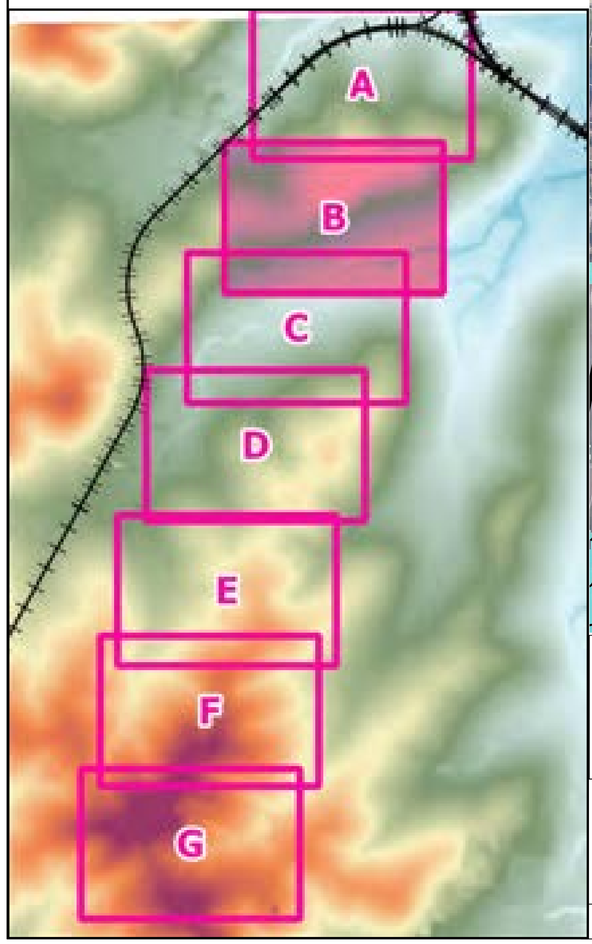

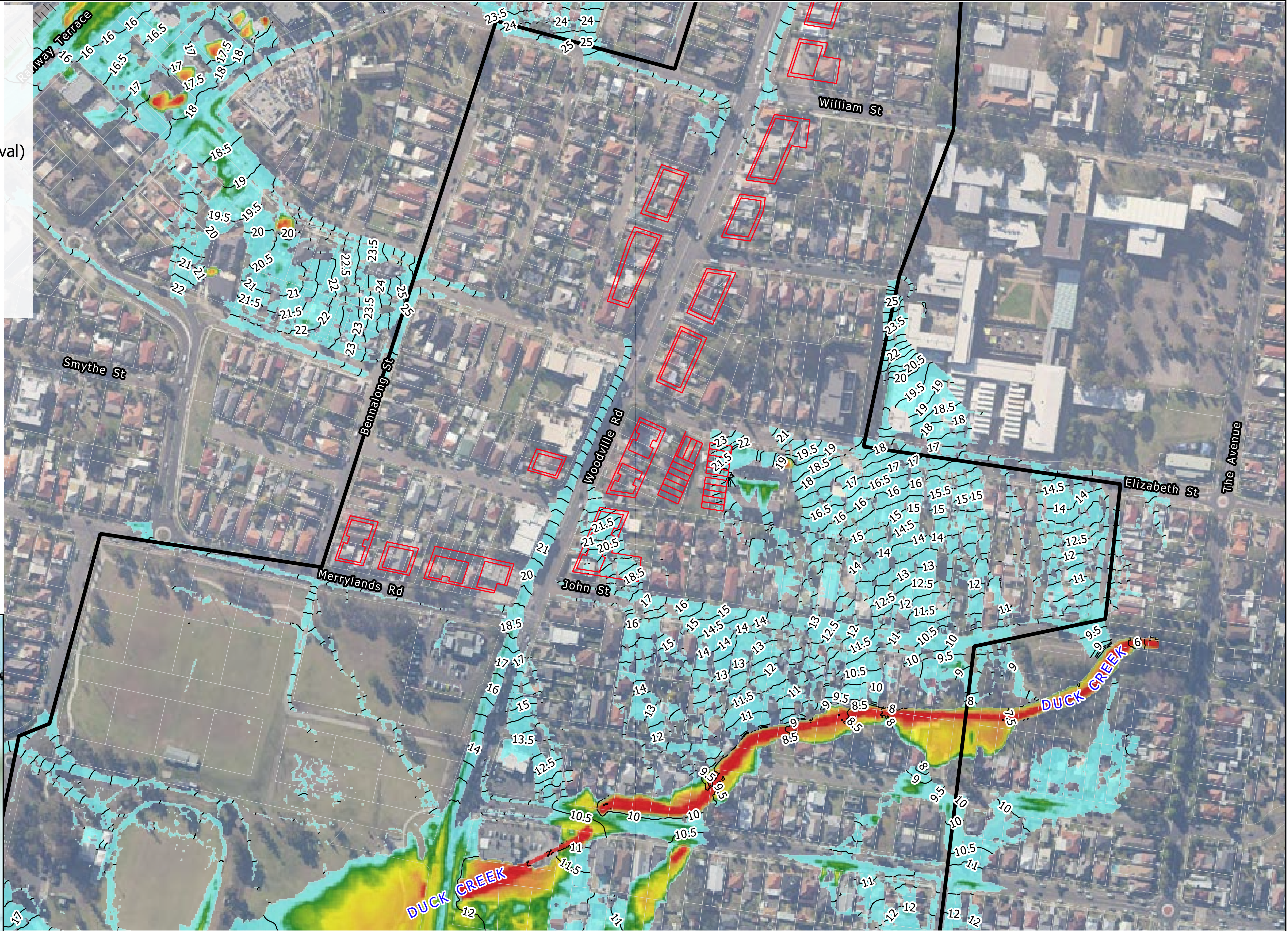

Title: **Peak Flood Levels and Depths - Existing Conditions - 20% AEP Event - View B**

Figure: A-01.B

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LEGEND

- Study Area
- Lot
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Peak Flood Depth (m)

- 0.15
- 0.25
- 0.5
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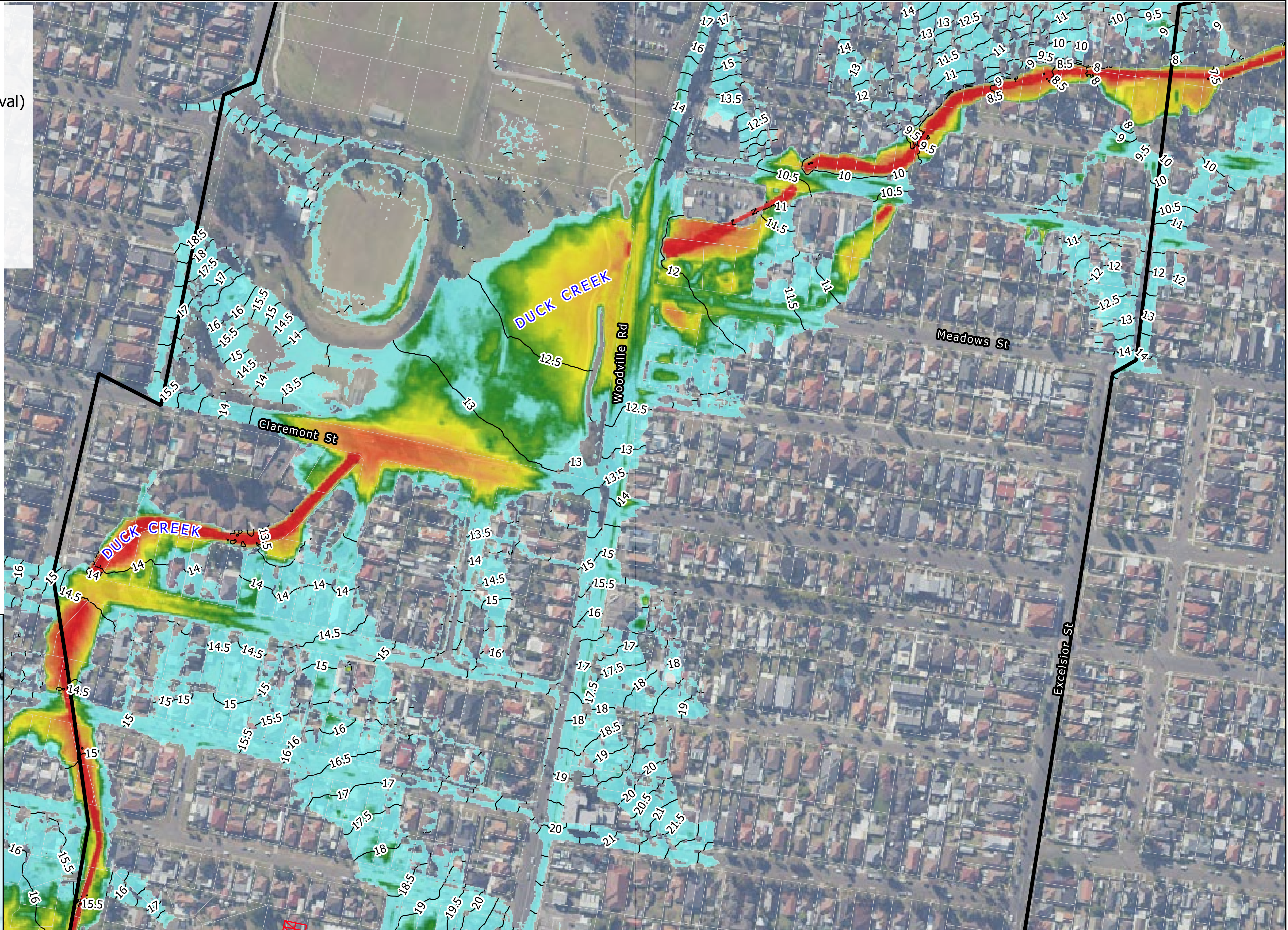

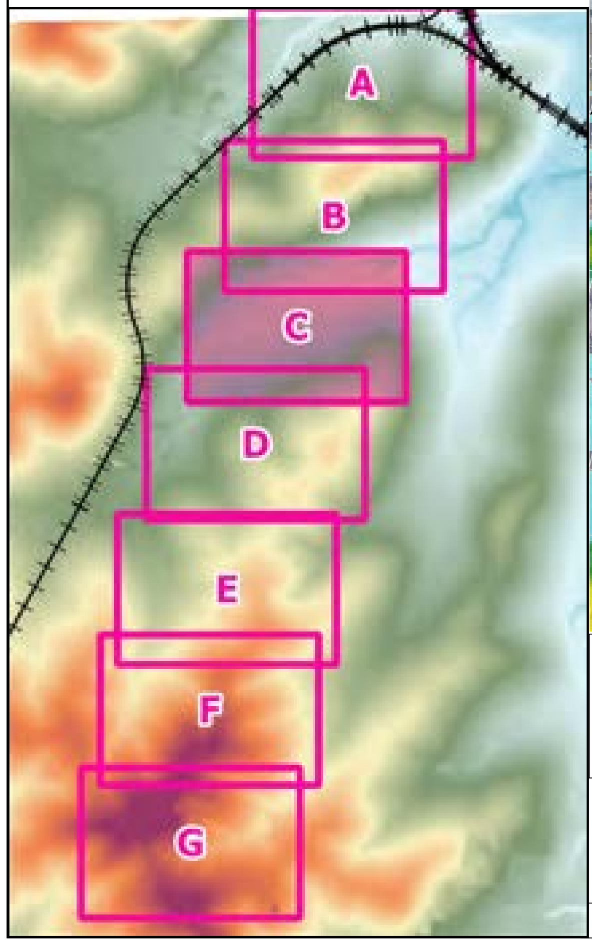

Title: **Peak Flood Levels and Depths - Existing Conditions - 20% AEP Event - View C**

Figure: A-01.C

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LEGEND

- Study Area
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- Lot
- Peak Flood Level (0.5 mAHD Interval)

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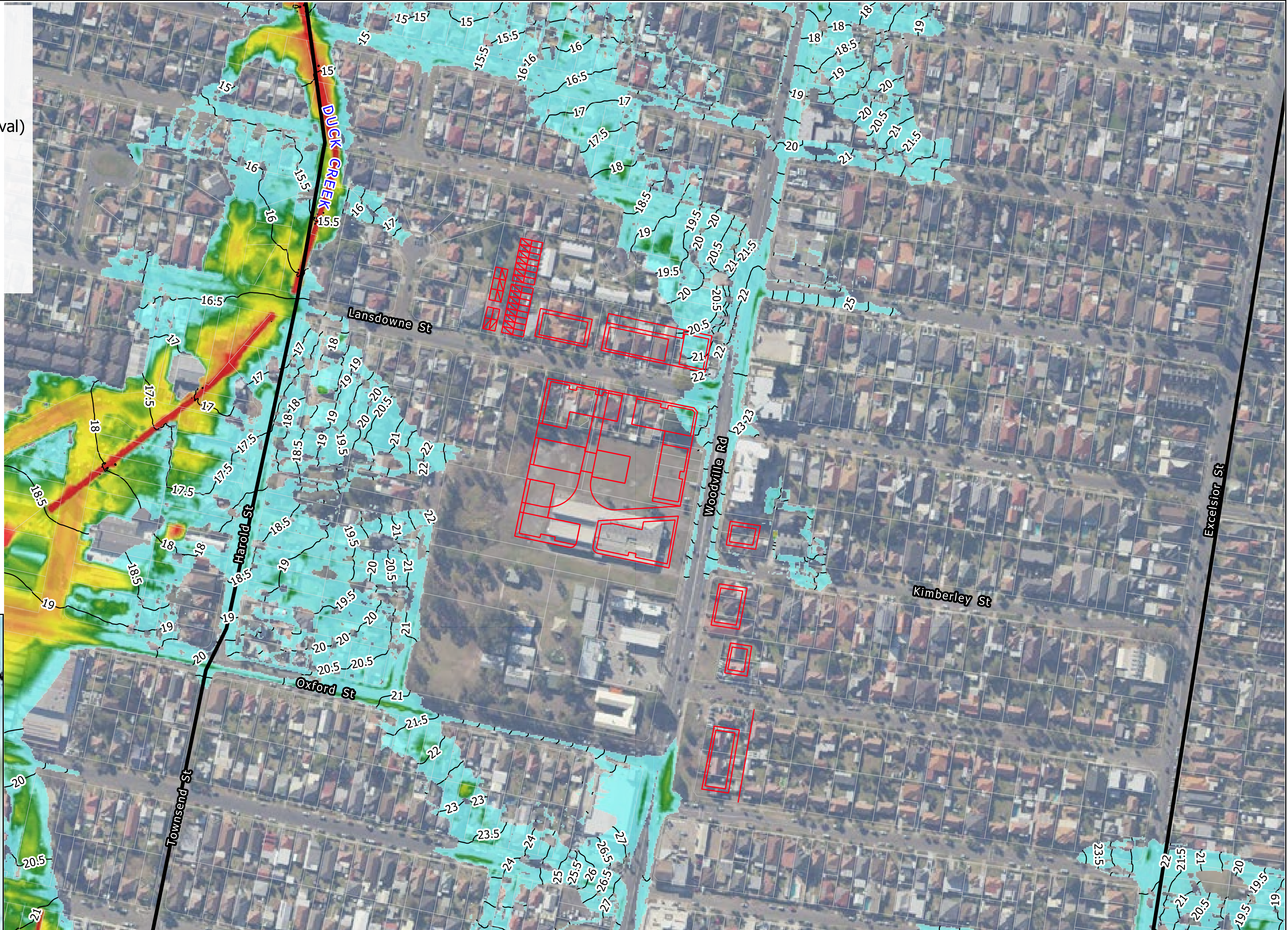
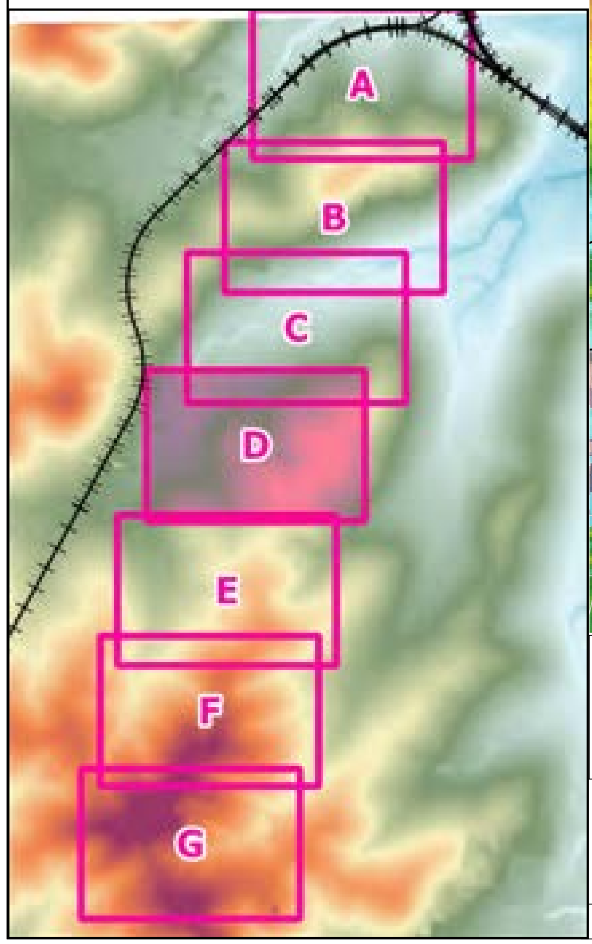
- 0.15
- 0.25
- 0.5
- 1
- 2





Title: **Peak Flood Levels and Depths - Existing Conditions - 20% AEP Event - View D**

Figure: **A-01.D**

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LEGEND

- Study Area
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- Lot
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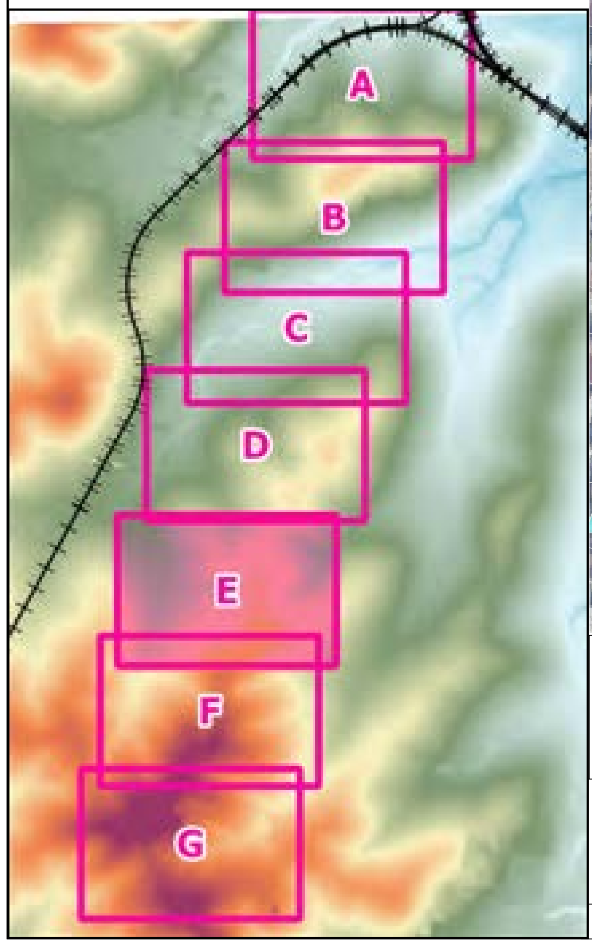
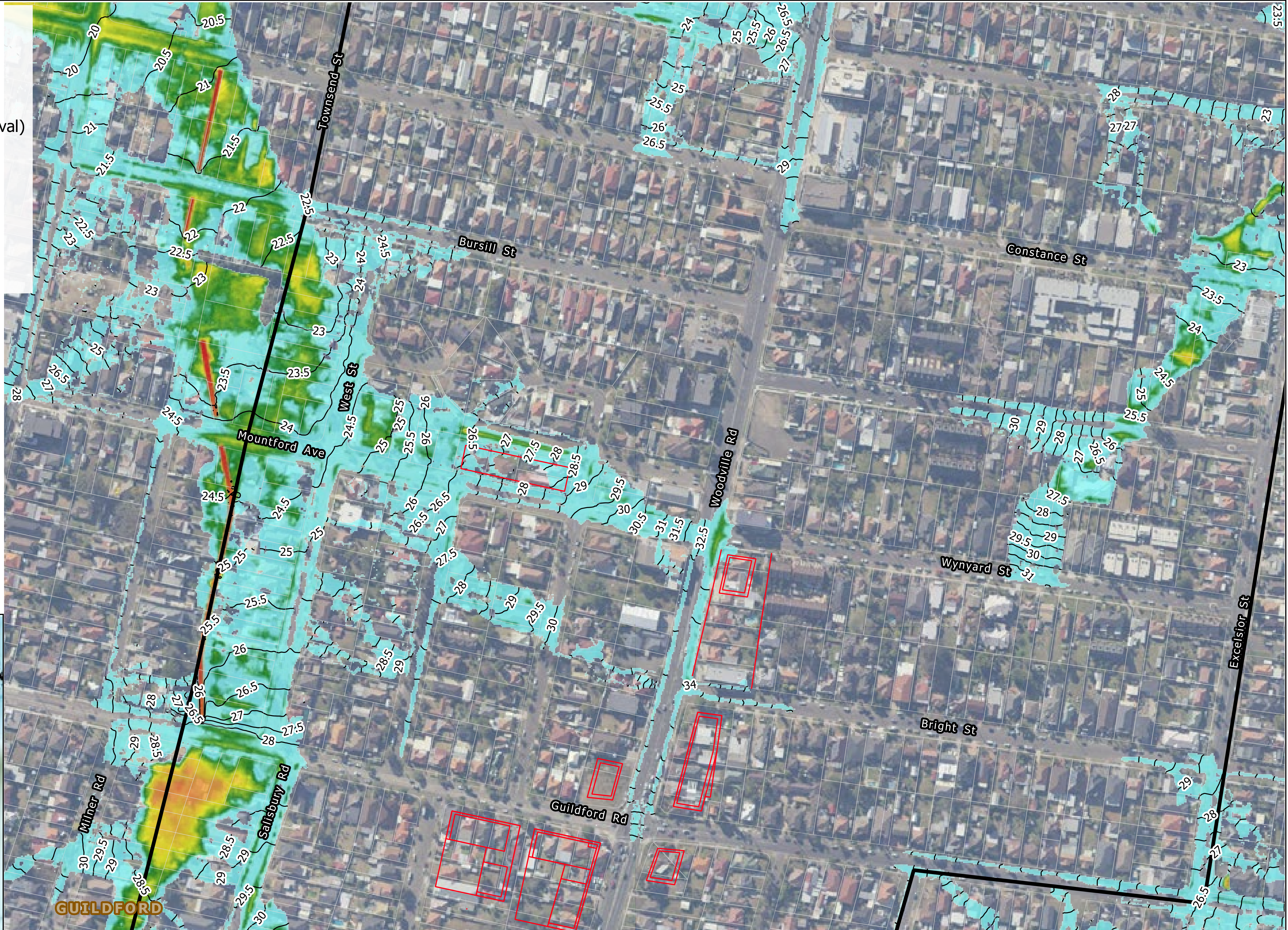
Peak Flood Depth (m)

- 0.15
- 0.25
- 0.5
- 1
- 2





Title: **Peak Flood Levels and Depths - Existing Conditions - 20% AEP Event - View E**

Figure: A-01.E

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LEGEND

Study Area

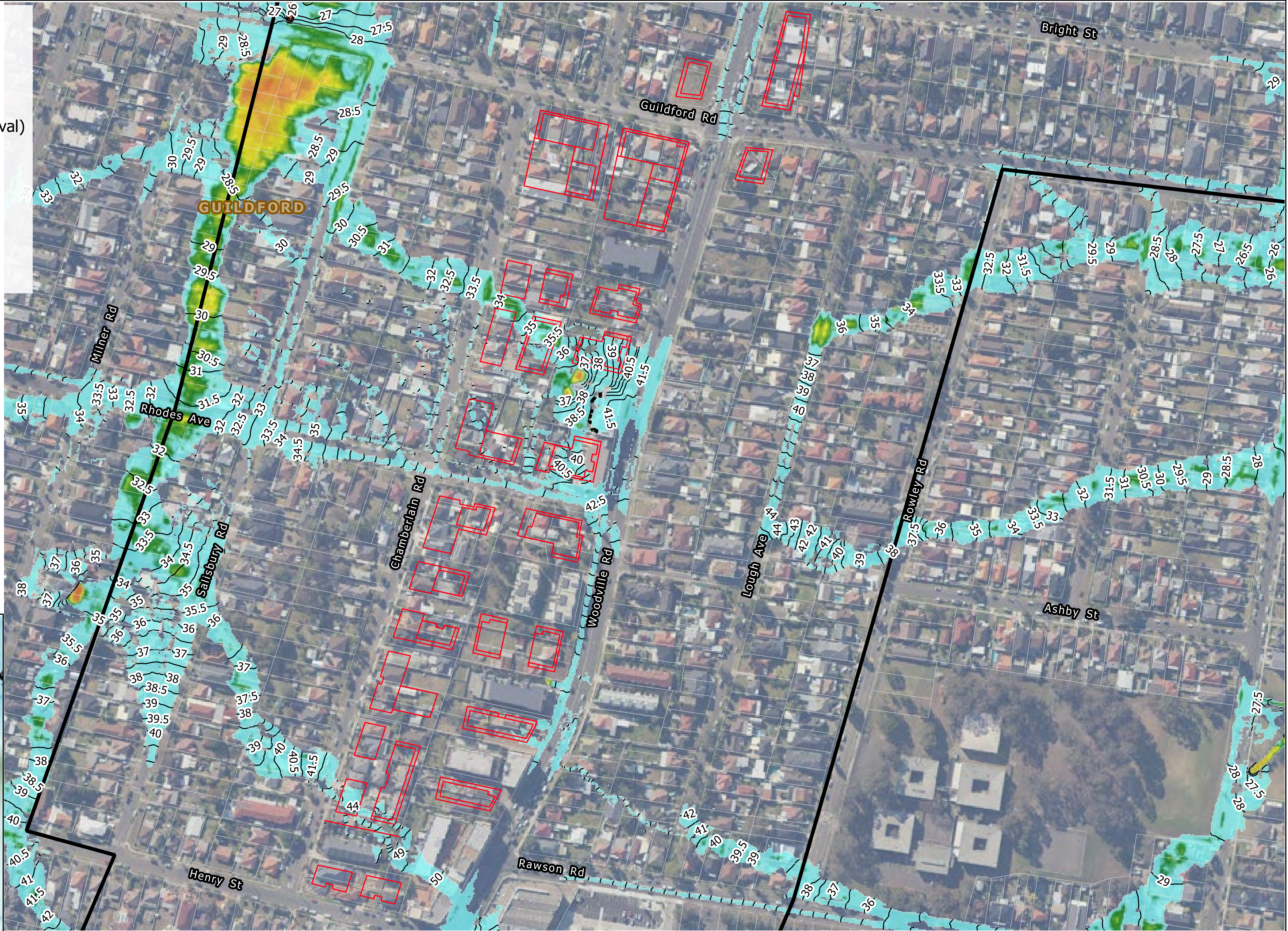
Proposed Building Outline

Lot

Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15
- 0.25
- 0.5
- 1
- 2



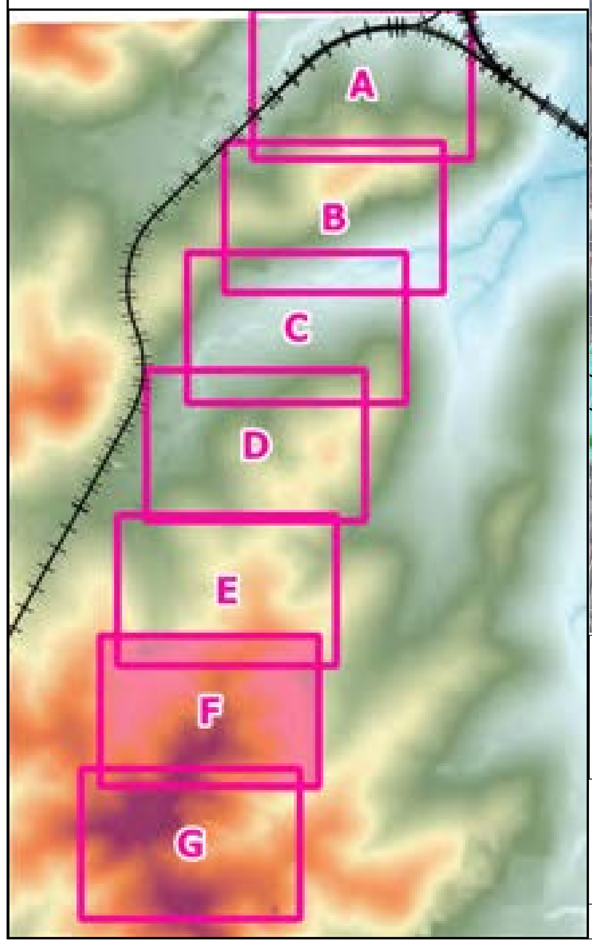


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Figure: **A-01.F**

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LEGEND

- Study Area
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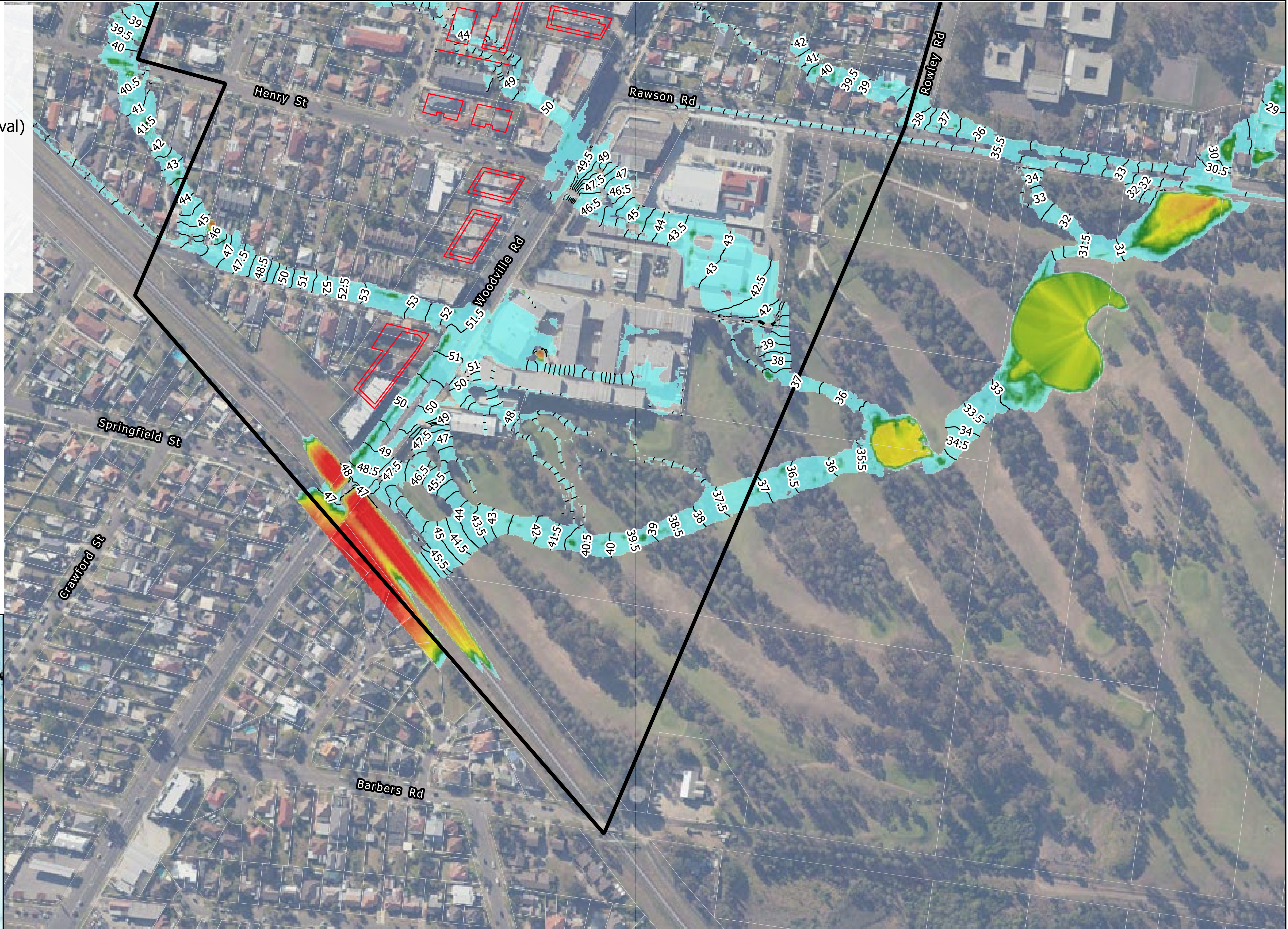
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15
- 0.25
- 0.5
- 1
- 2



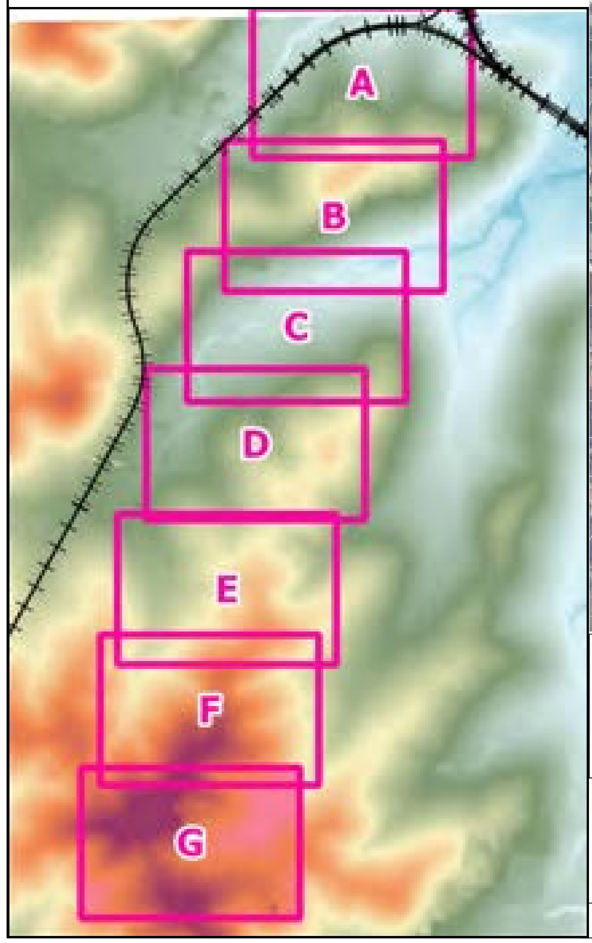


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Figure: A-01.G

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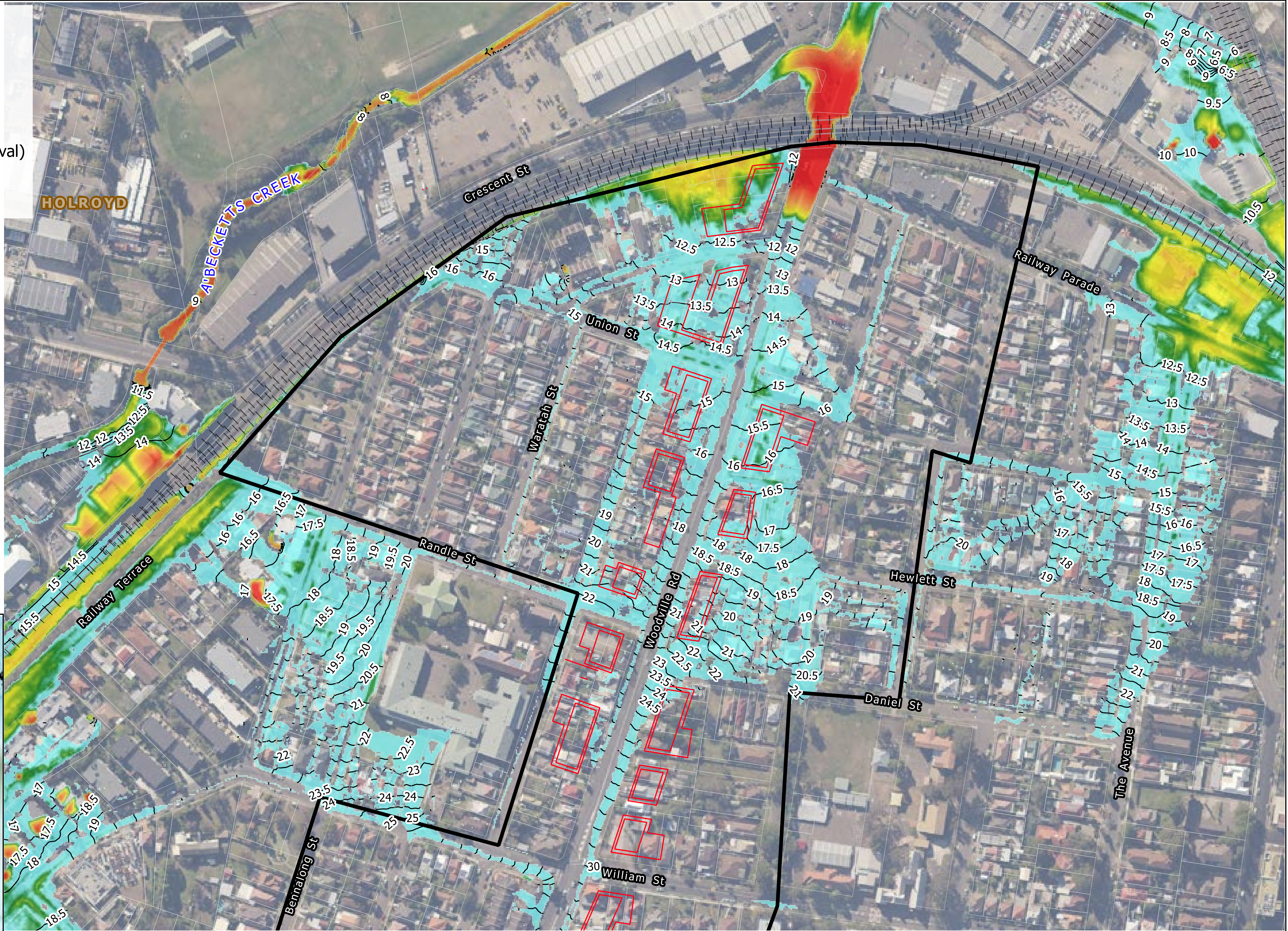
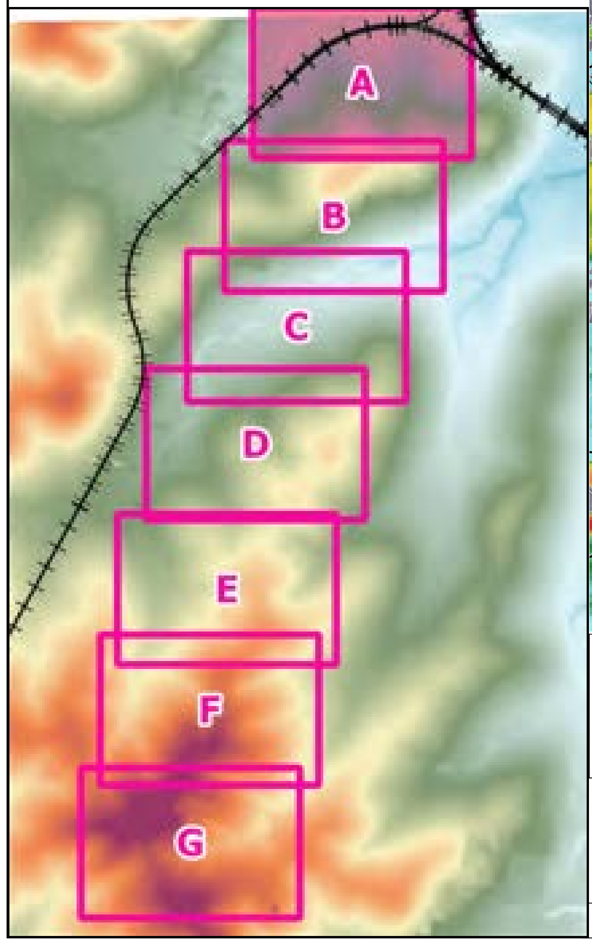
LEGEND

- Study Area
- Proposed Building Outline
- Railway
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 1% AEP Event - View A**

Figure: **A-02.A**

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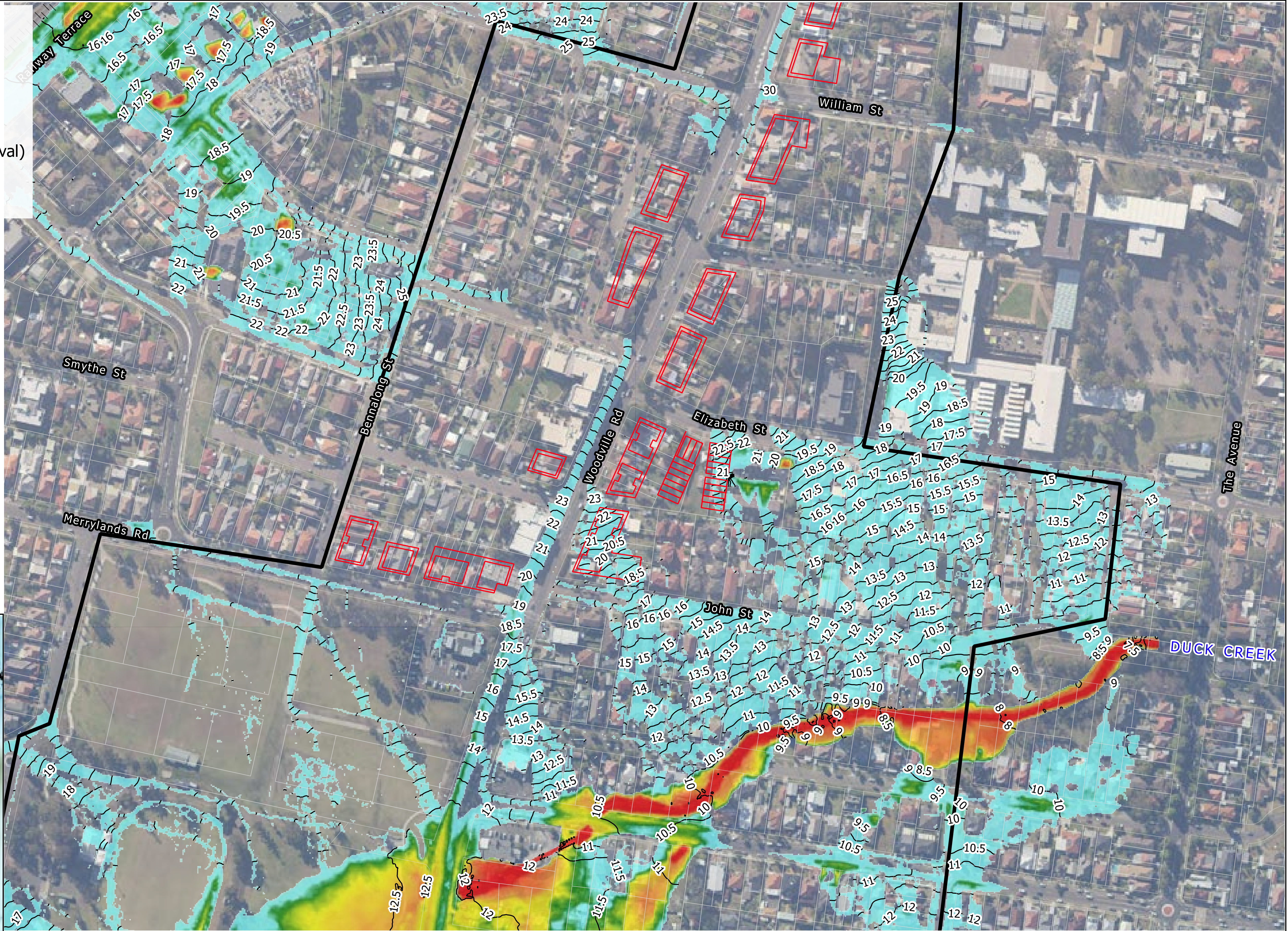
LEGEND

- Study Area
- Proposed Building Outline
- Railway
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15



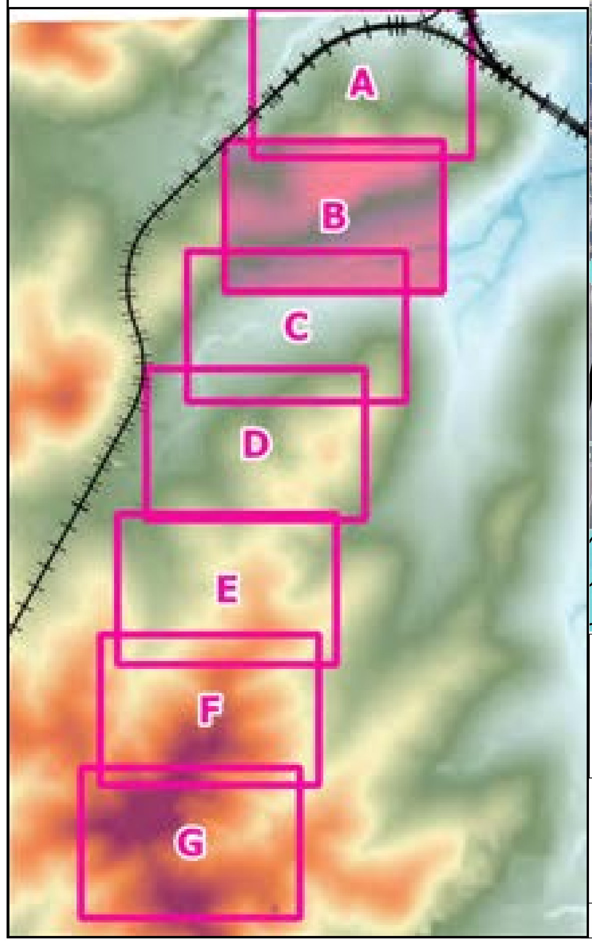


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Figure: A-02.B

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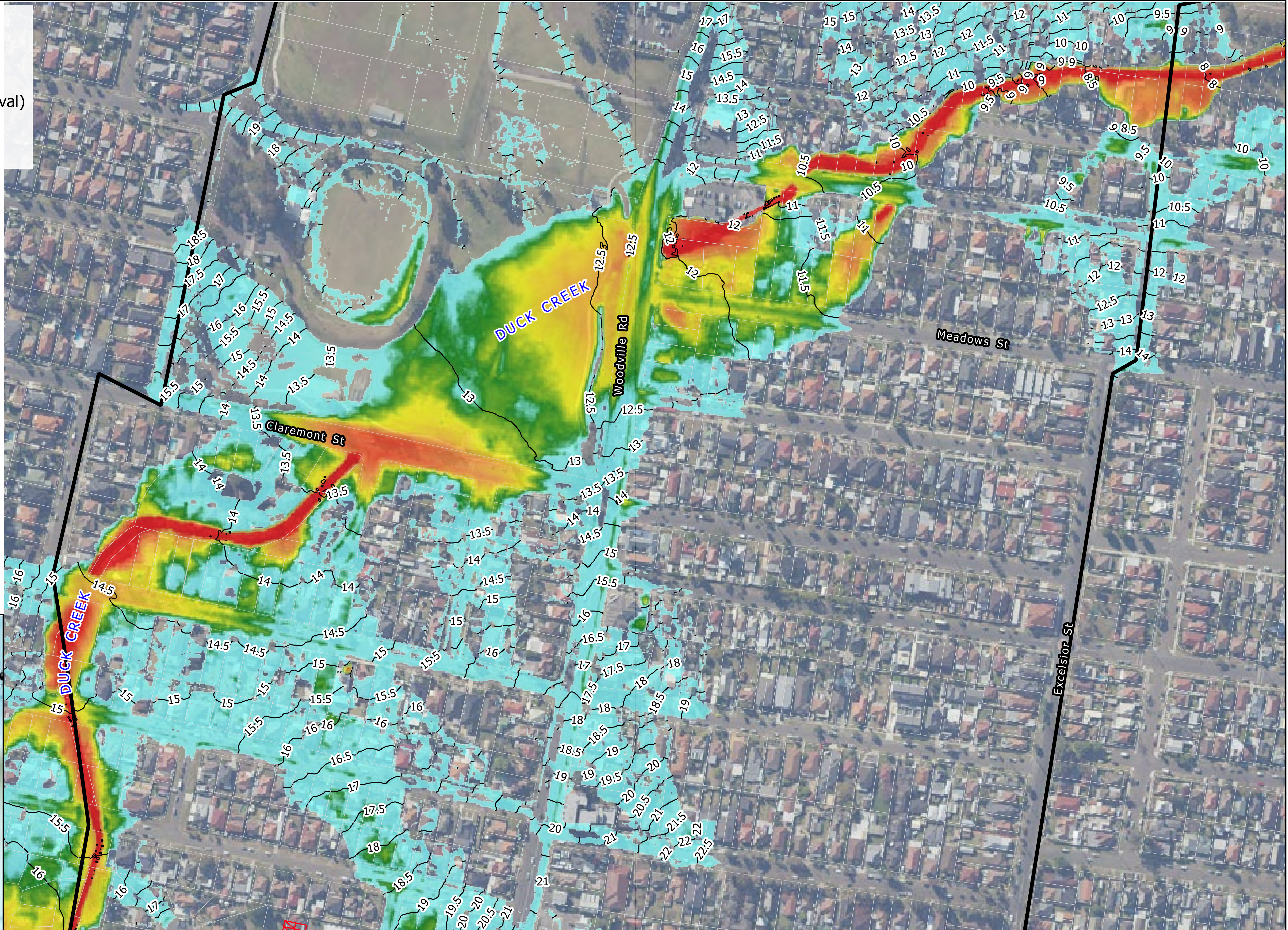
LEGEND

- Study Area
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15



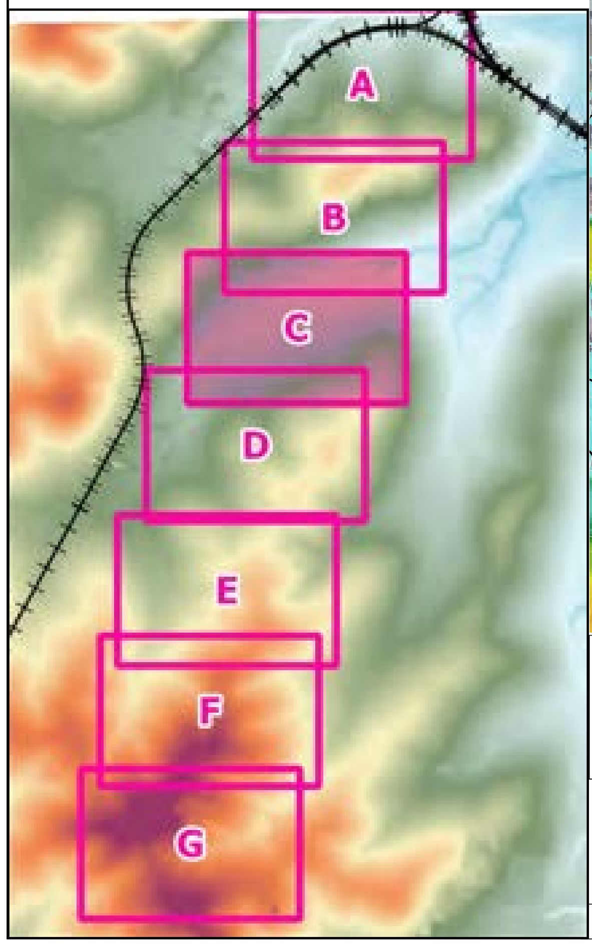


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Figure: **A-02.C**

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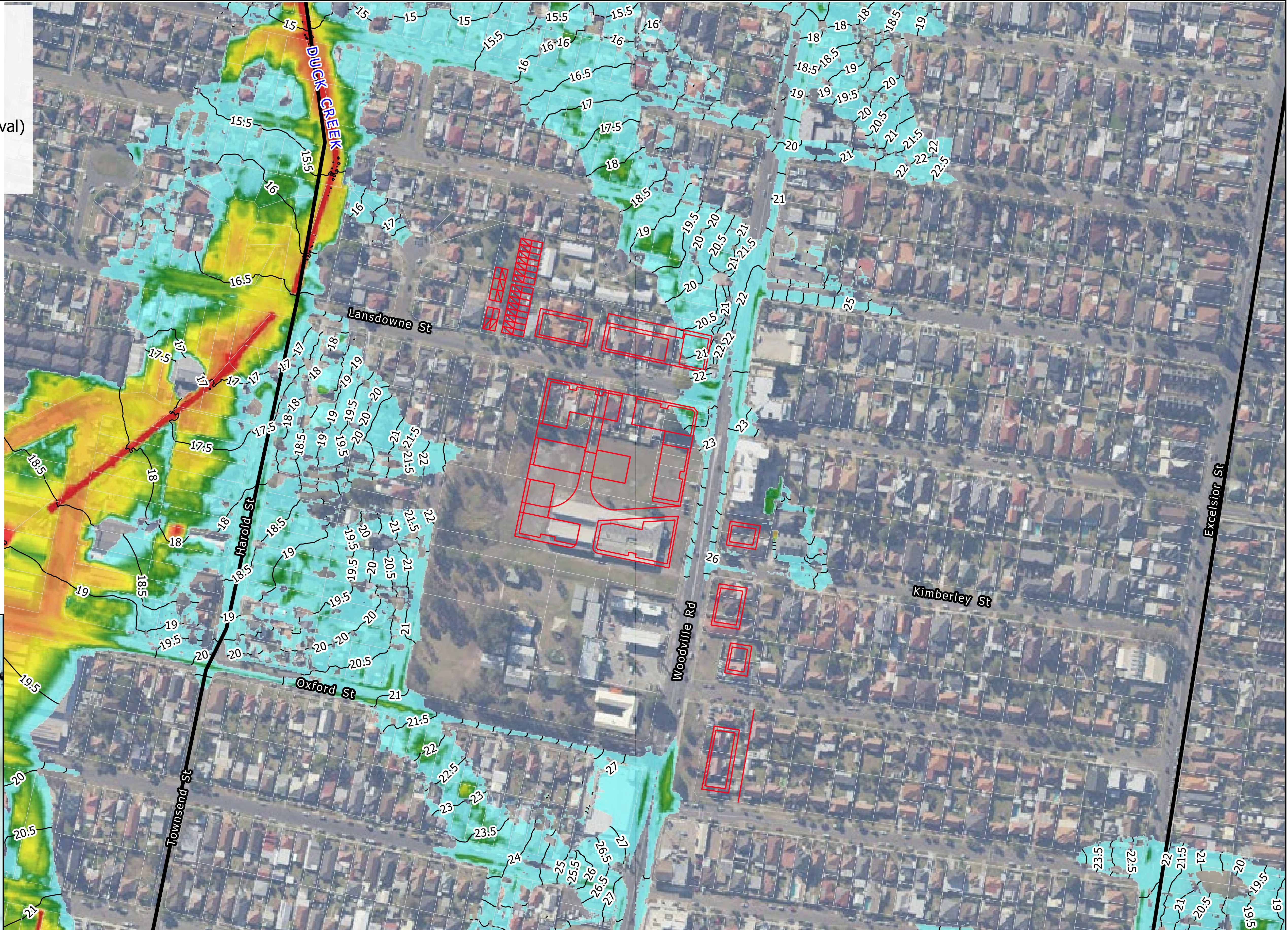
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15



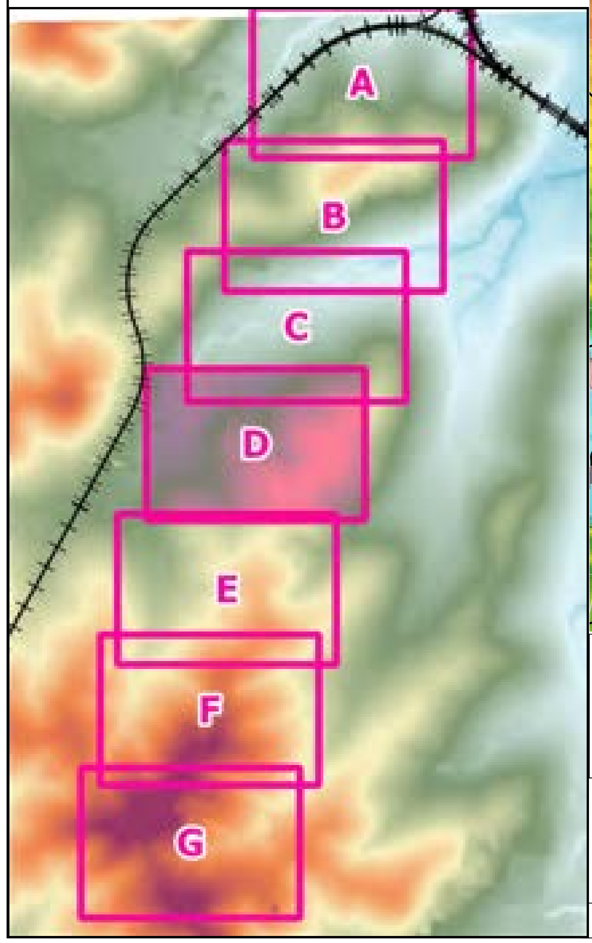


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Figure: A-02.D

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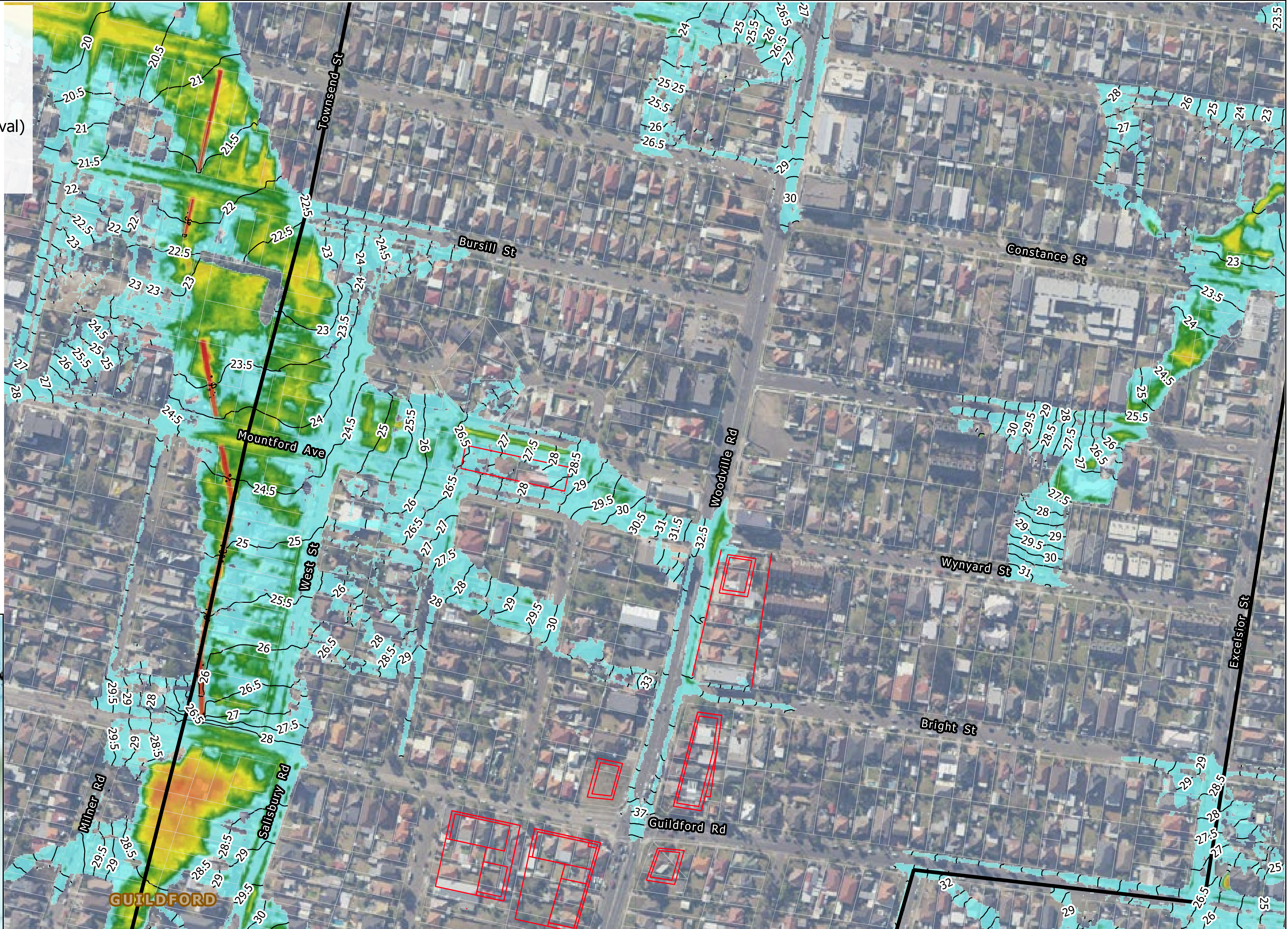
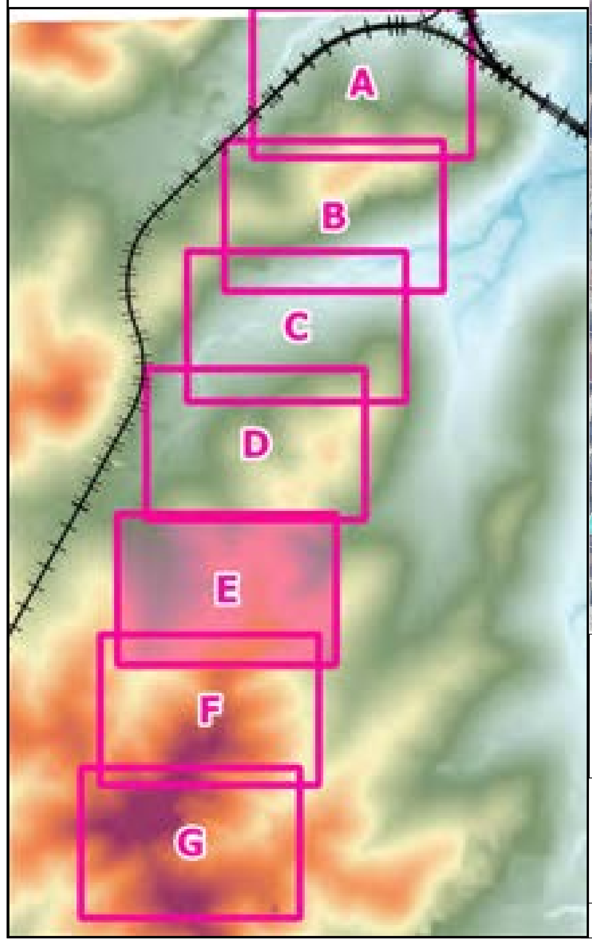
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 1% AEP Event - View E**

Figure: A-02.E

Rev: -

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BMT

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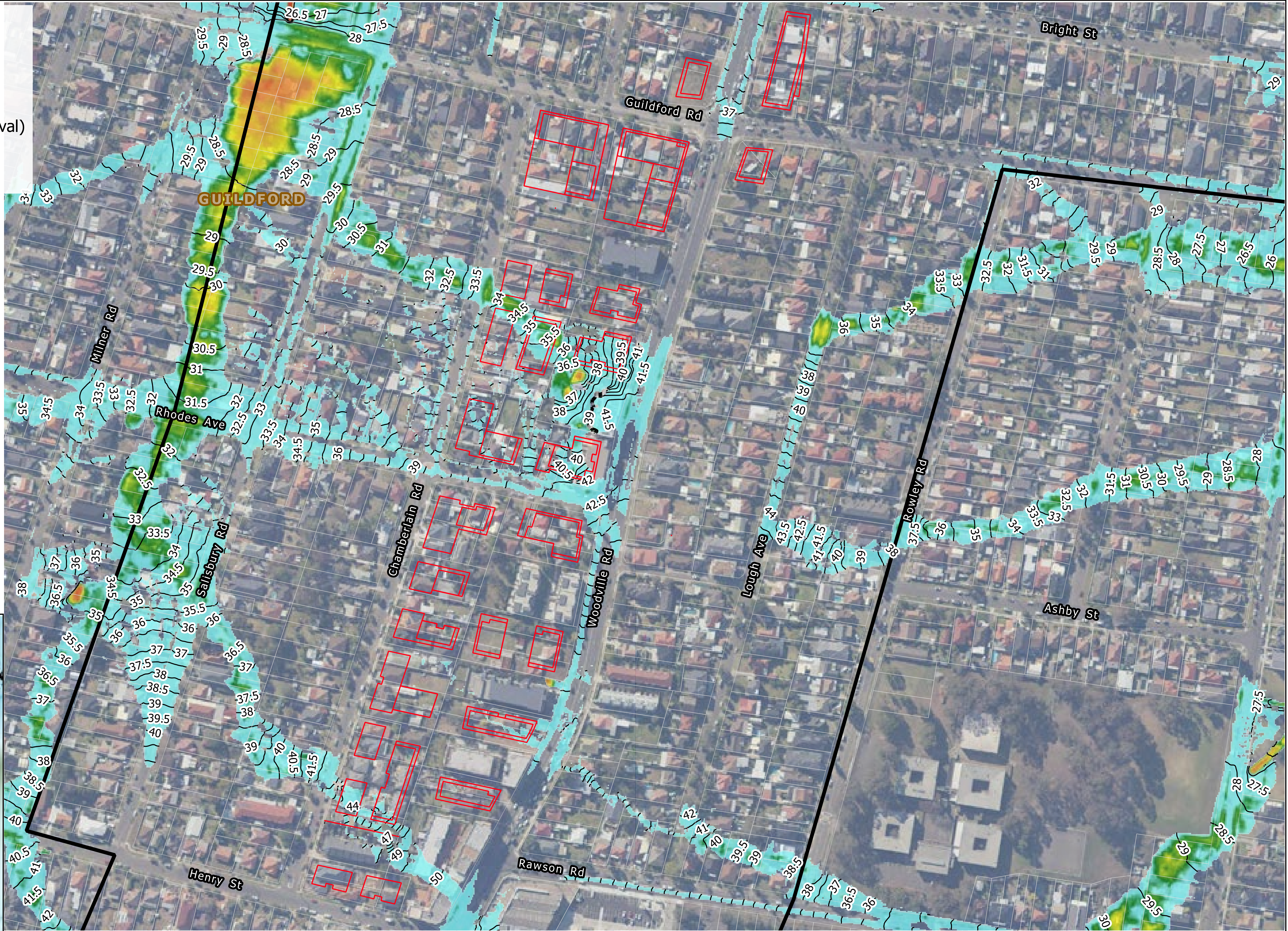
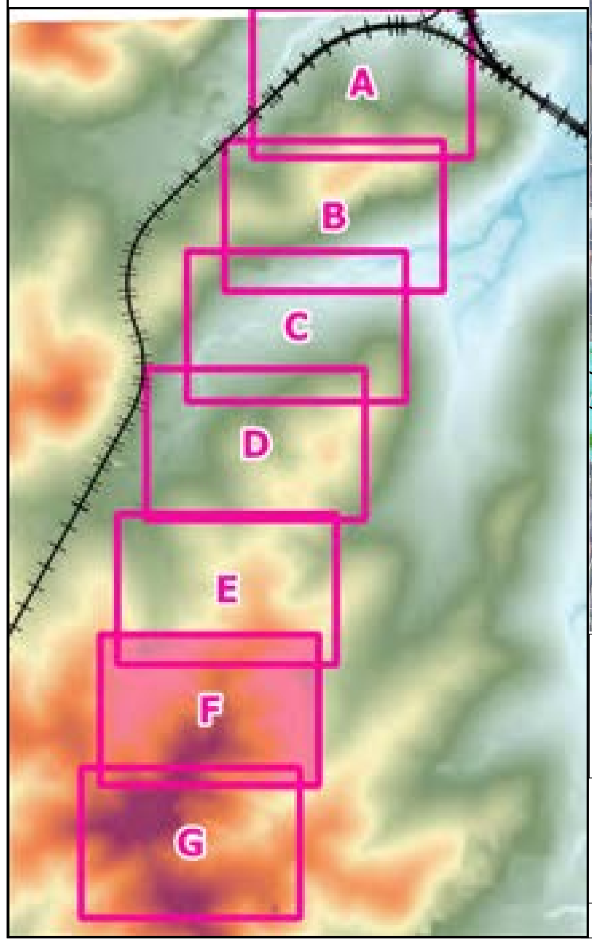
LEGEND

Study Area
Proposed Building Outline
Lot
Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 1% AEP Event - View F**

Figure: **A-02.F**

Rev: **-**

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N

0 100 200 300 m

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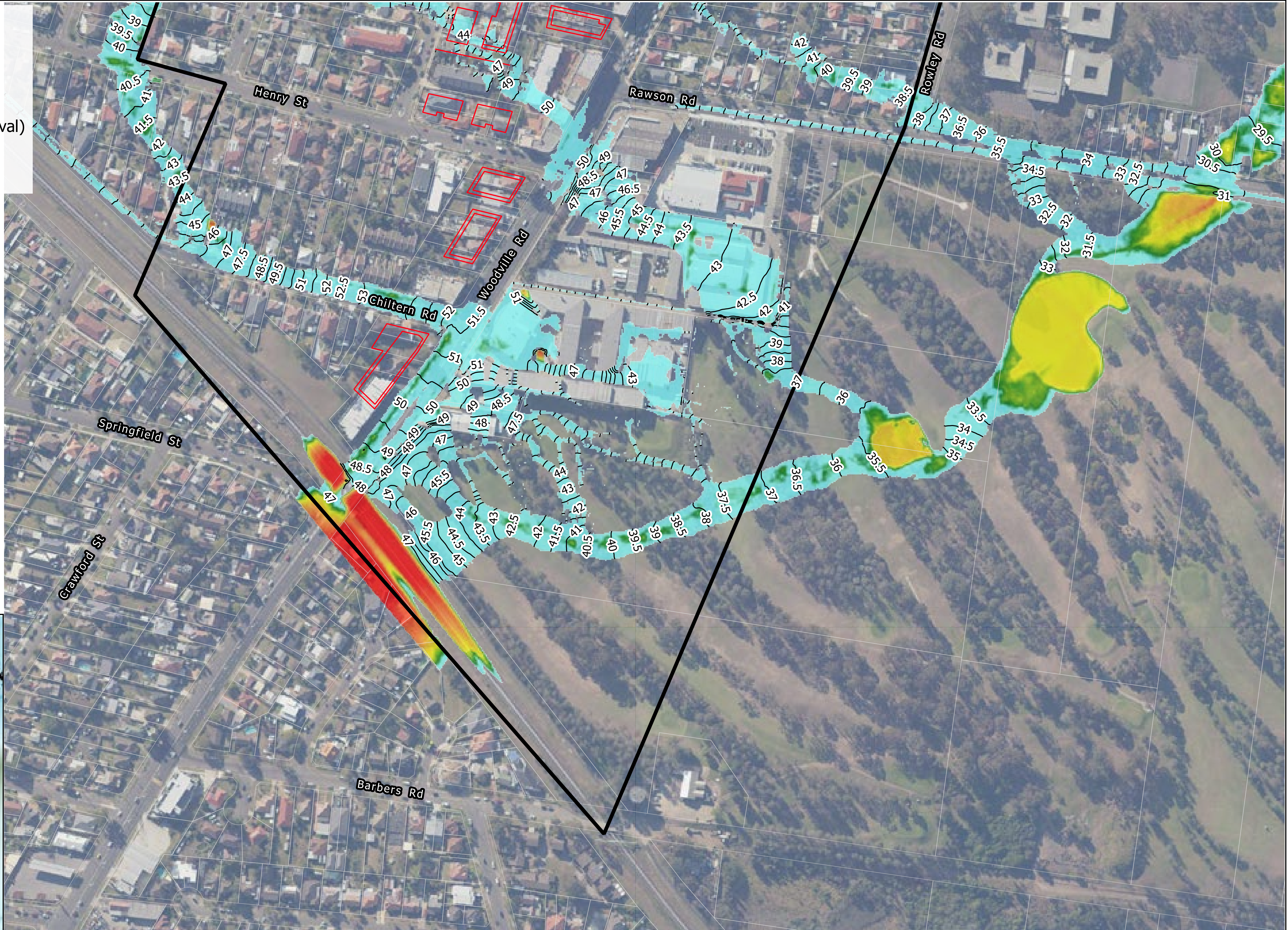
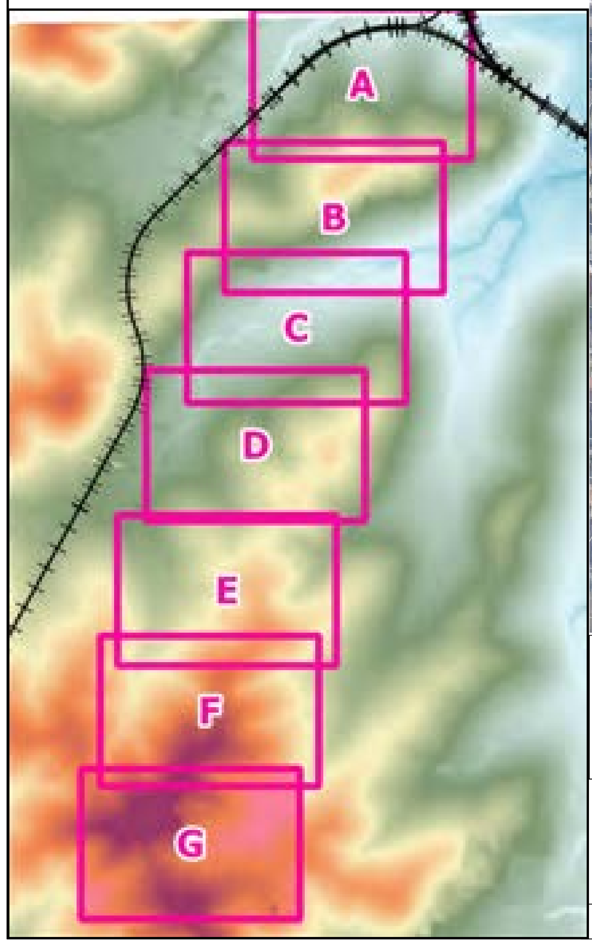
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 1% AEP Event - View G**

Figure: **A-02.G**

Rev: **-**

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N

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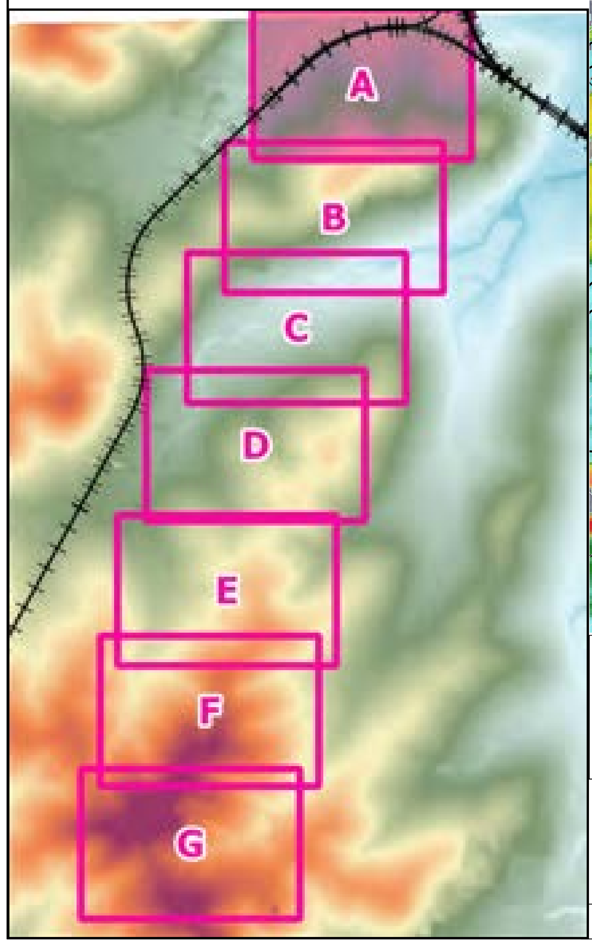
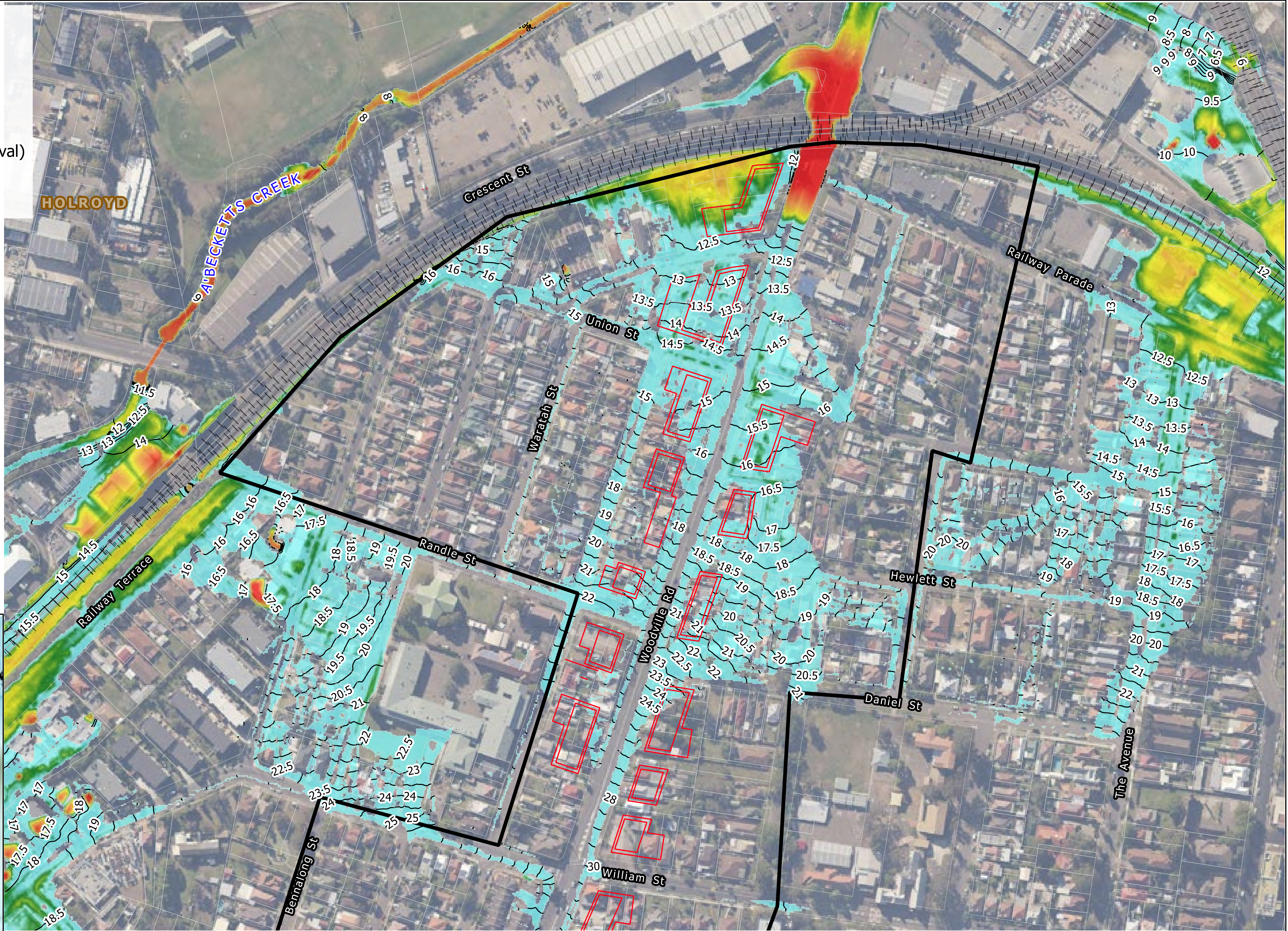
LEGEND

- Study Area
- Proposed Building Outline
- Railway
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.5% AEP Event - View A**

Figure: **A-03.A**

Rev: **-**

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BMT

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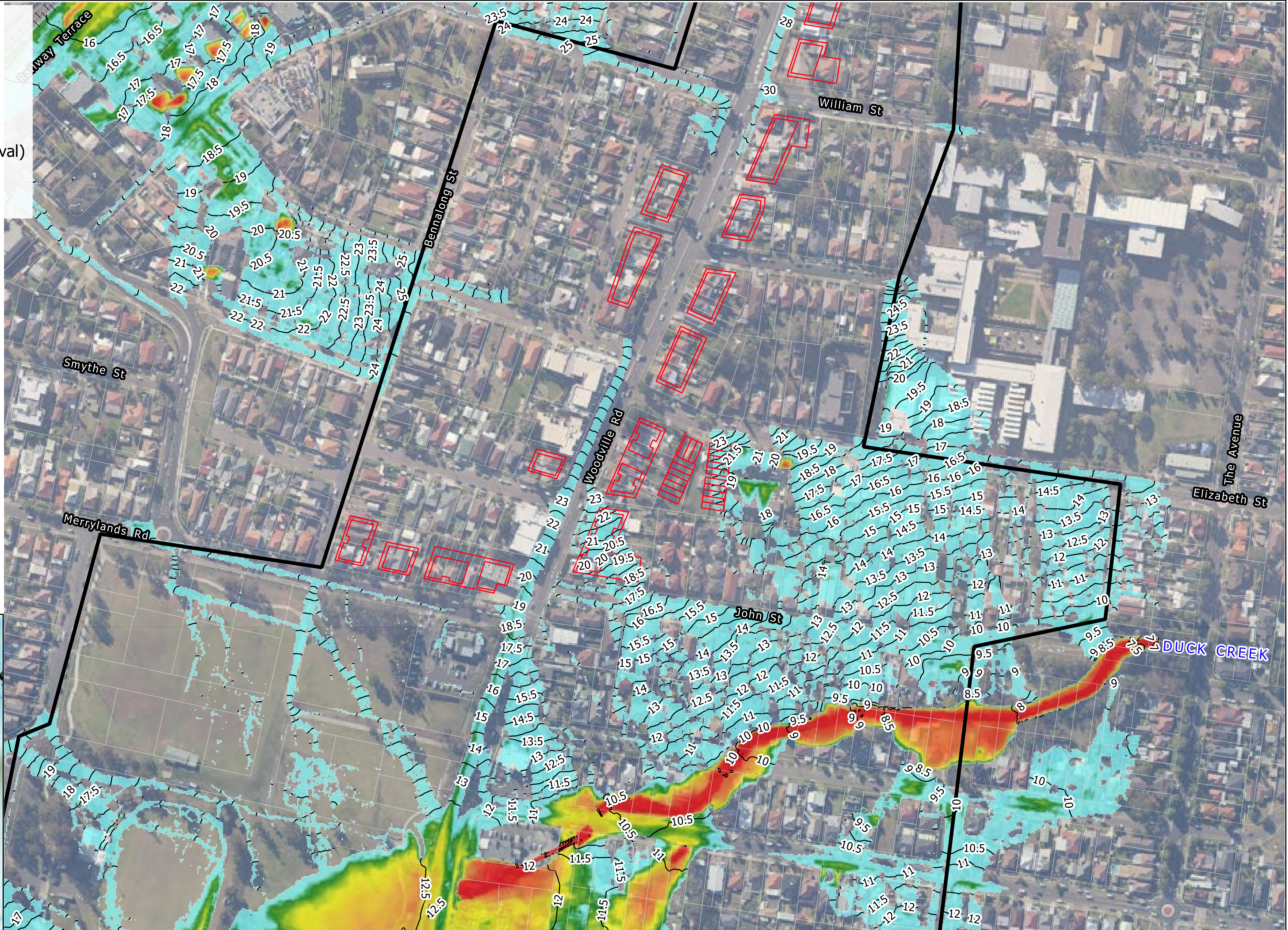
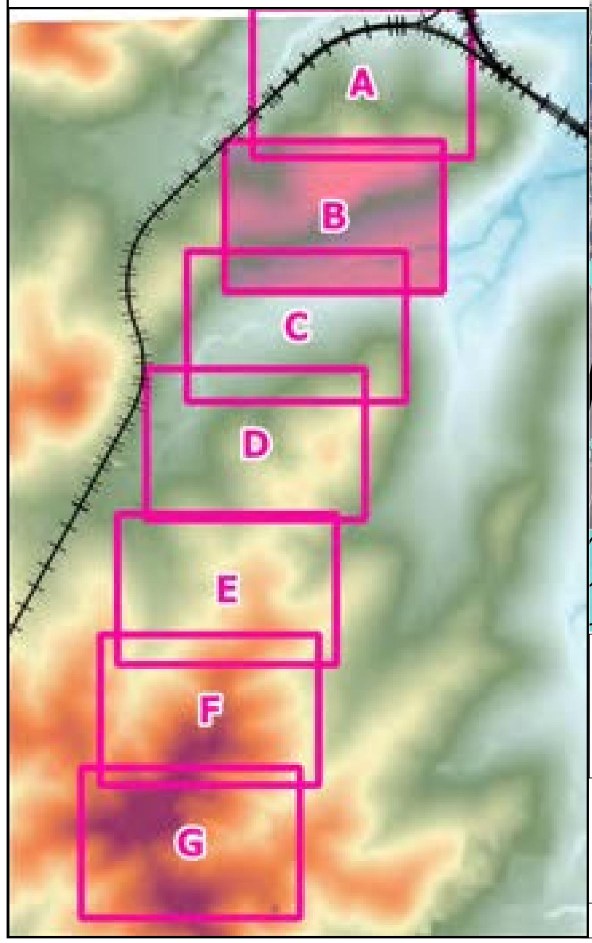
LEGEND

- Study Area
- Proposed Building Outline
- Railway
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.5% AEP Event - View B**

Figure: A-03.B

Rev: -

N

0 100 200 300 m

BMT

Filepath: S:\WATER\PROJECTS\A12533_WoodvilleRoadCorridorPlanningProposal\GIS\Figures\02_Result_Figure\Existing\EXIS.qgz

LEGEND

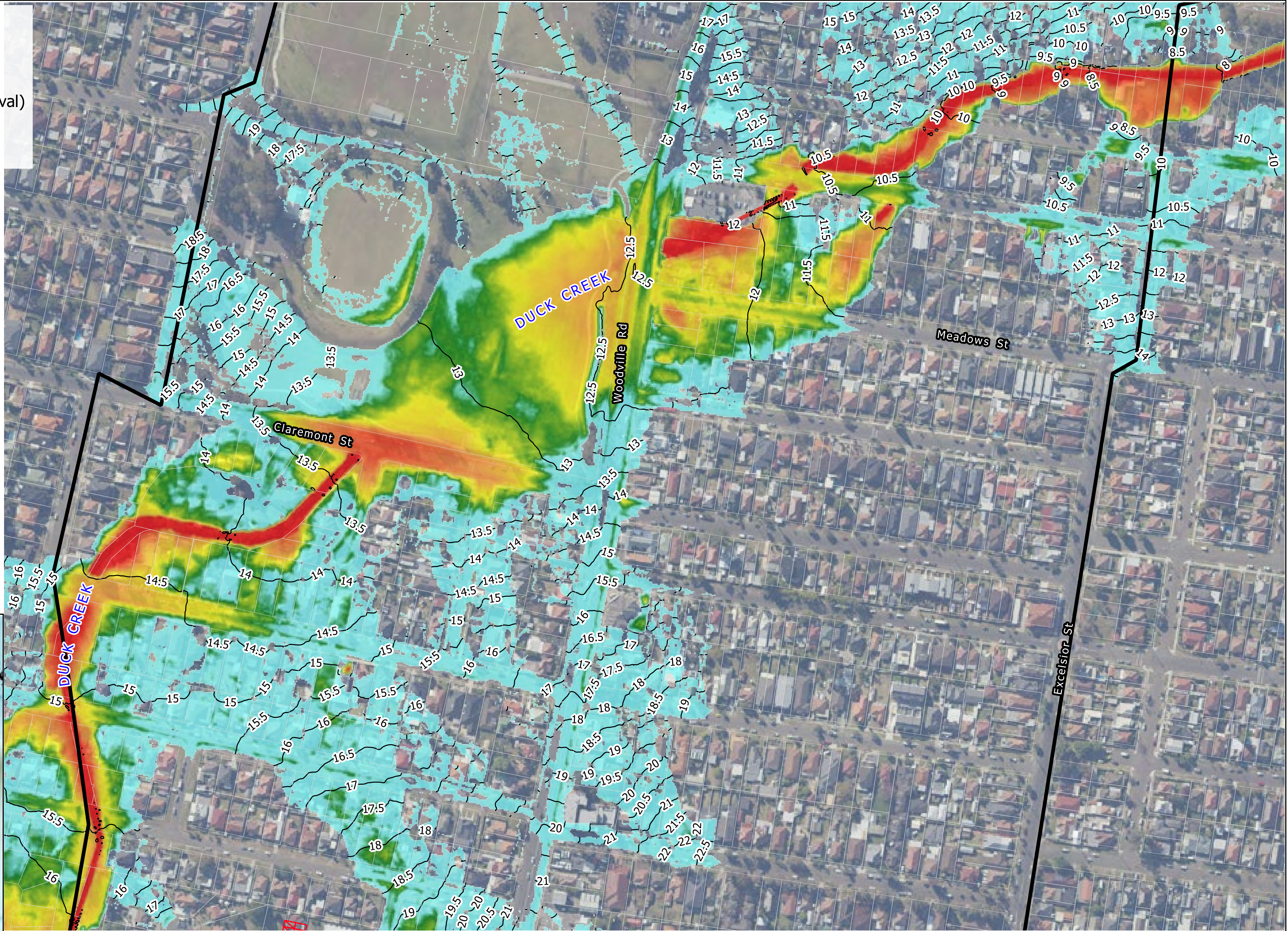
Study Area

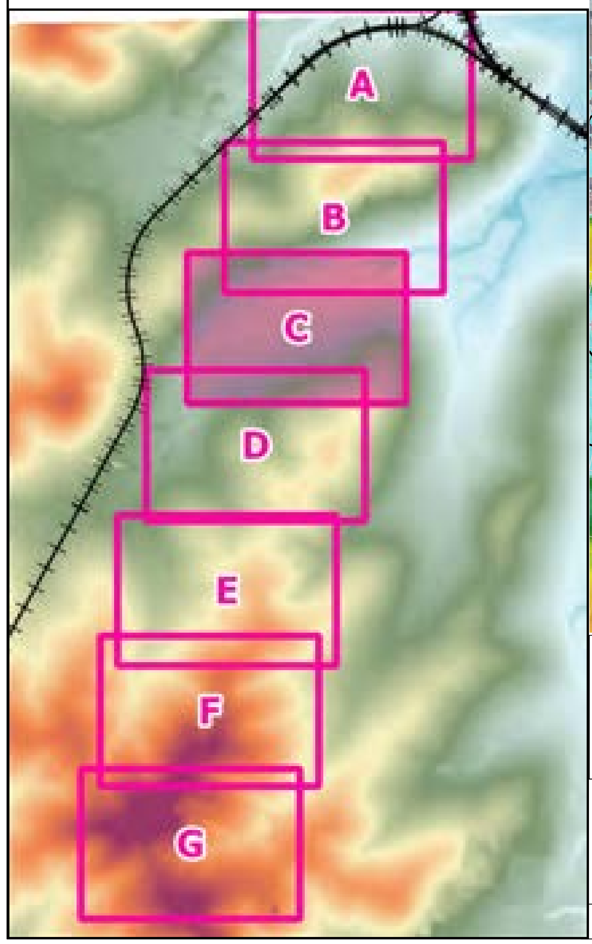
Lot

Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.5% AEP Event - View C**

Figure: **A-03.C**

Rev: **-**

N

0 100 200 300 m

BMT

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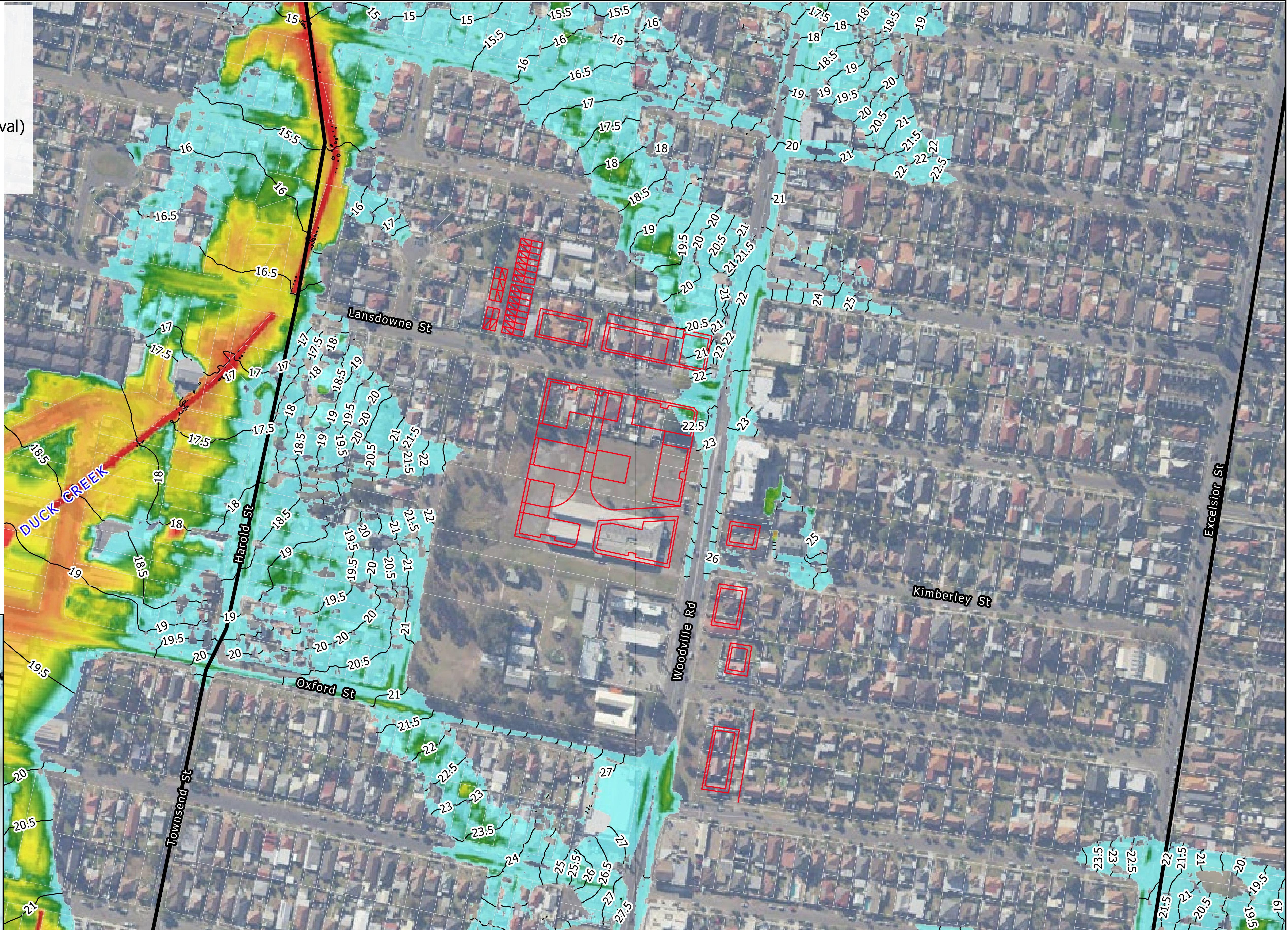
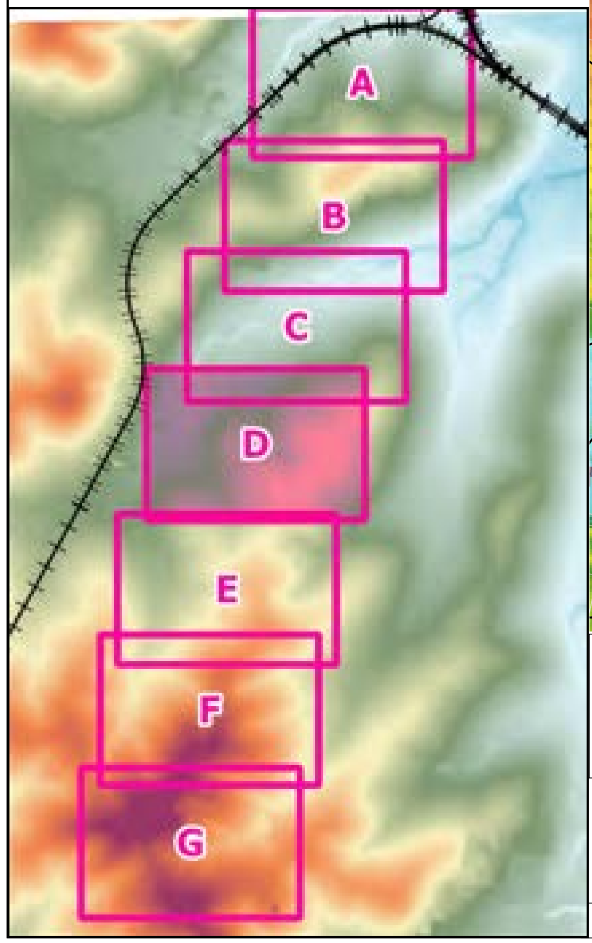
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.5% AEP Event - View D**

Figure: **A-03.D**

Rev: **-**

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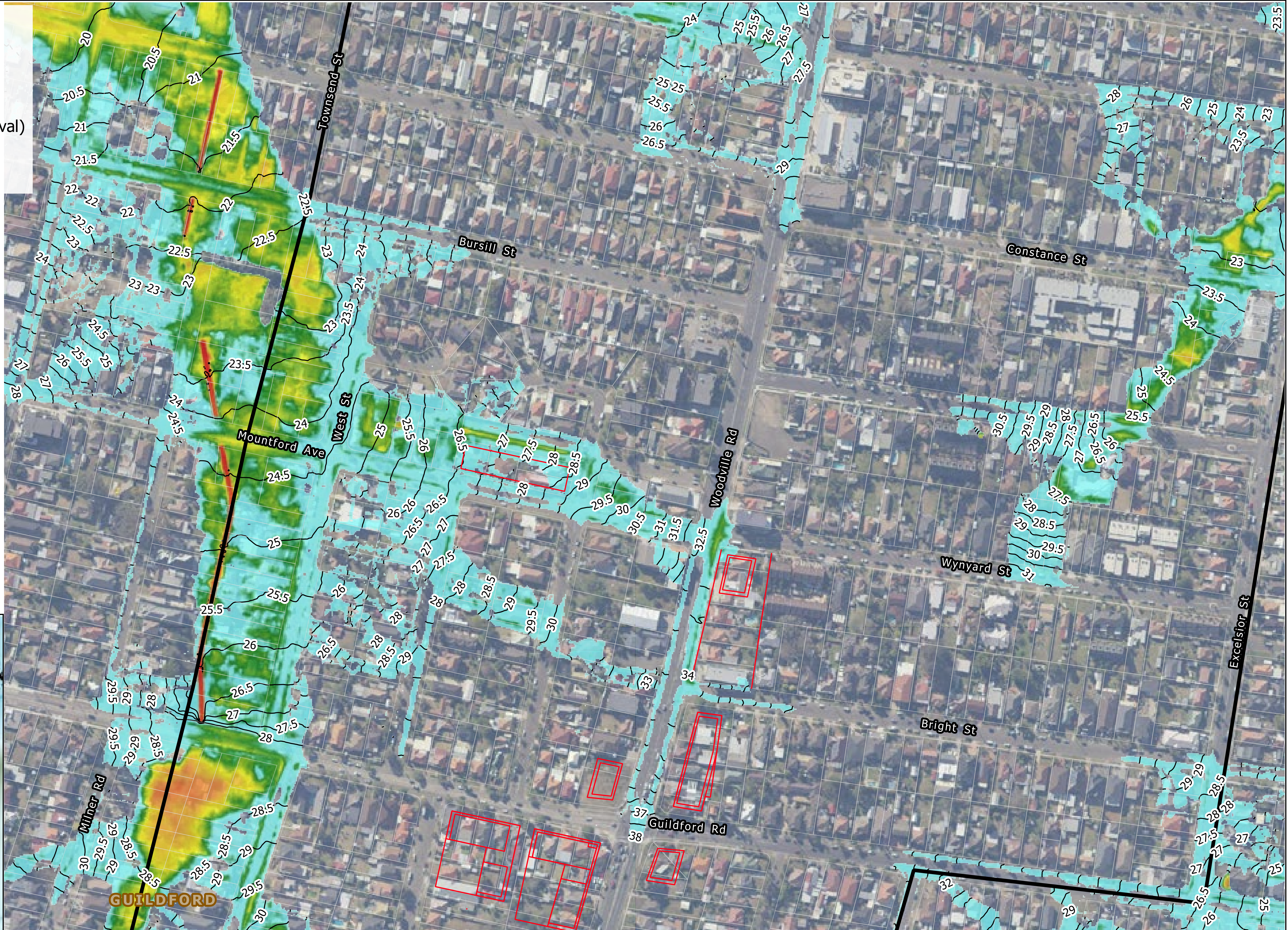
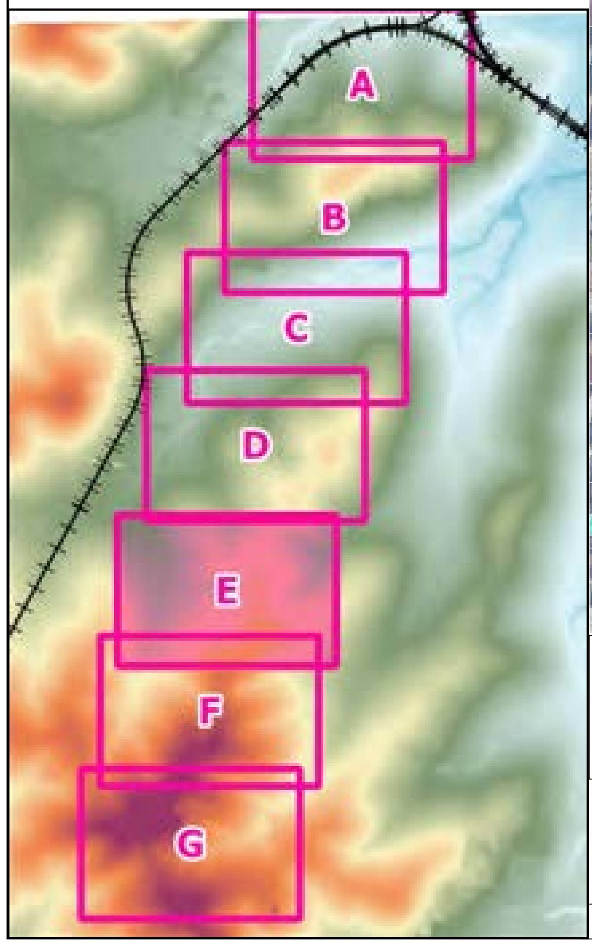
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.5% AEP Event - View E**

Figure: A-03.E

Rev: -

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0 100 200 300 m

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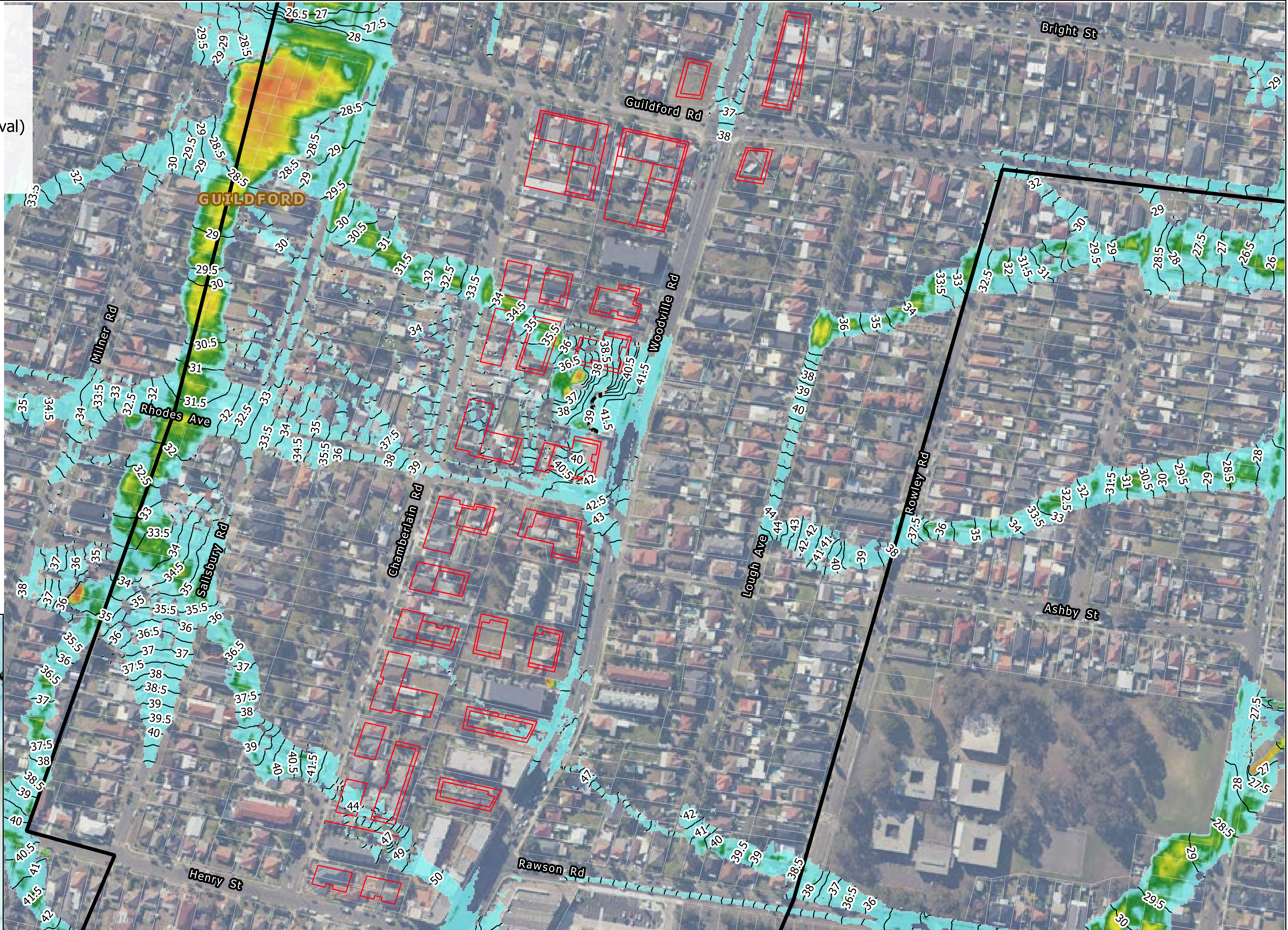
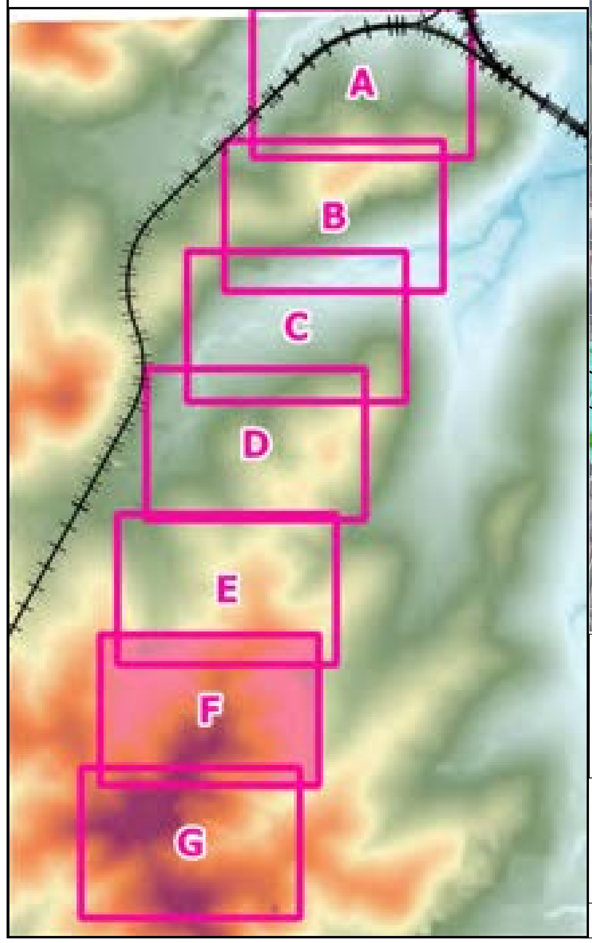
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.5% AEP Event - View F**

Figure: A-03.F

Rev: -

N

0 100 200 300 m

BMT

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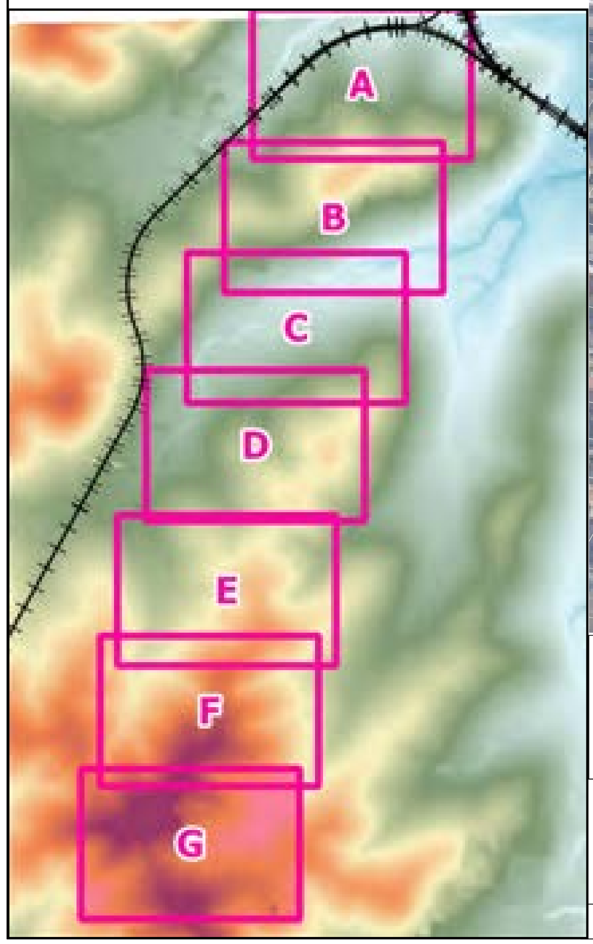
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15



Title: **Peak Flood Levels and Depths - Existing Conditions - 0.5% AEP Event - View G**

Figure: **A-03.G**

Rev: **-**

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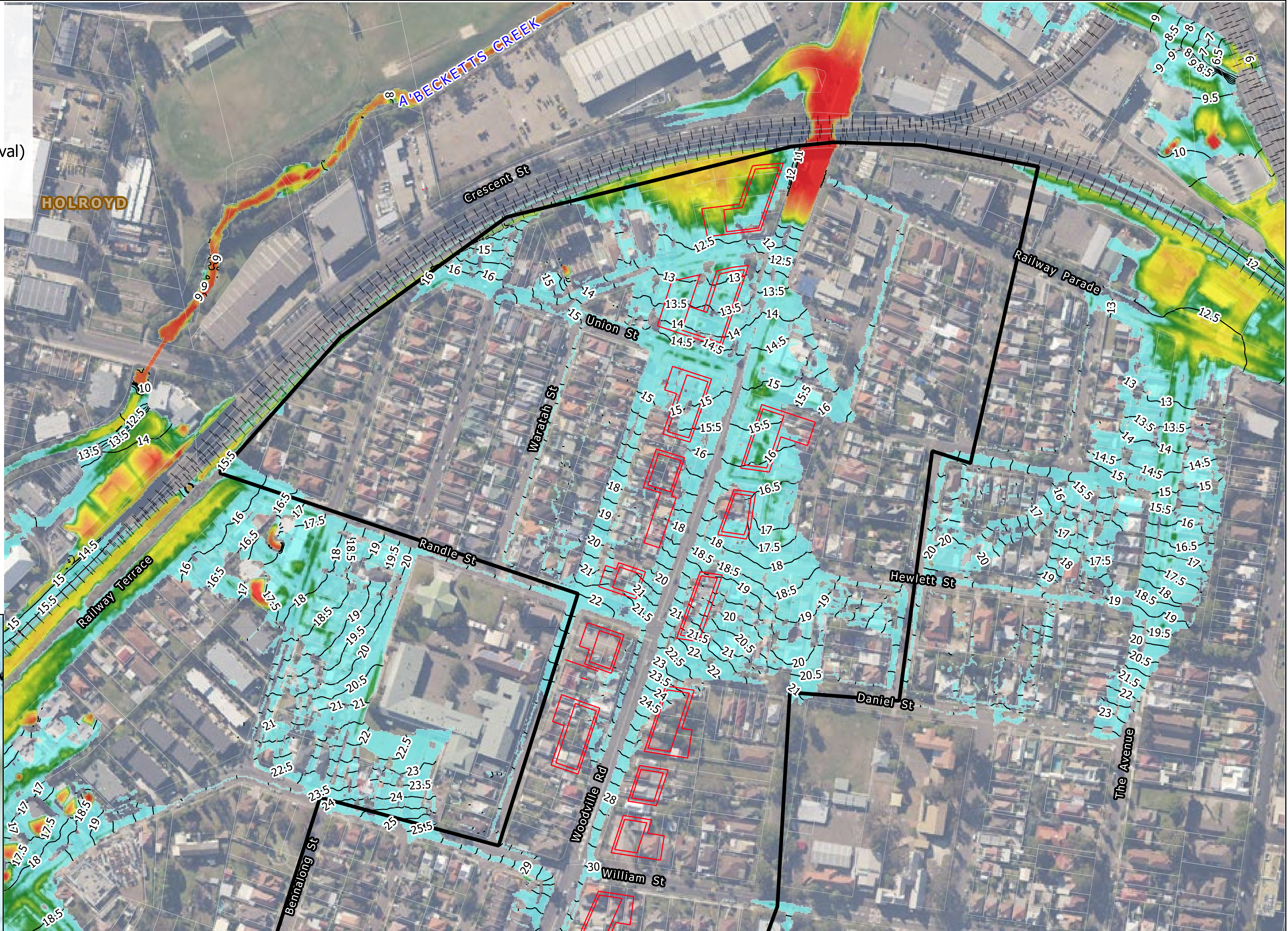
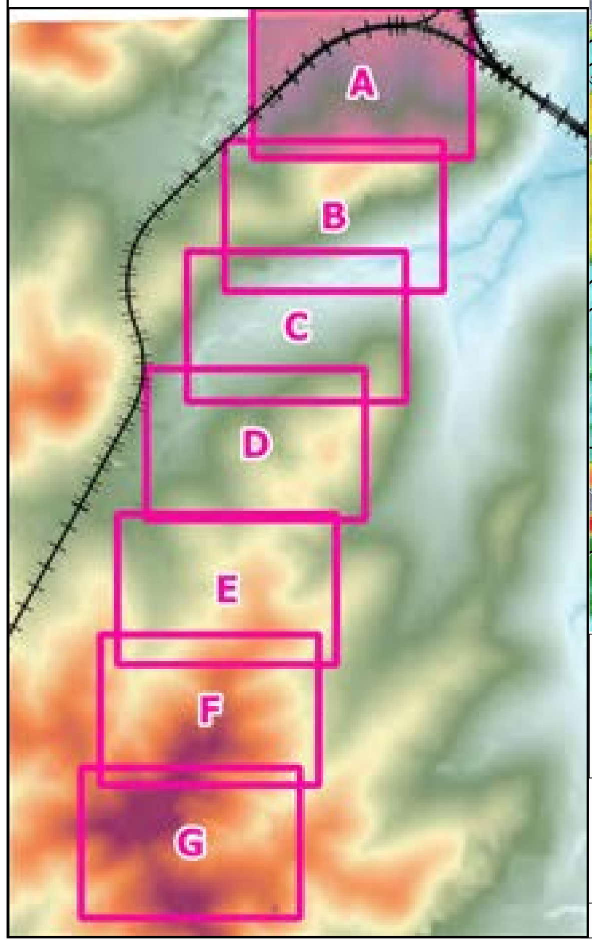
LEGEND

- Study Area
- Proposed Building Outline
- Railway
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.2% AEP Event - View A**

Figure: **A-04.A**

Rev: **-**

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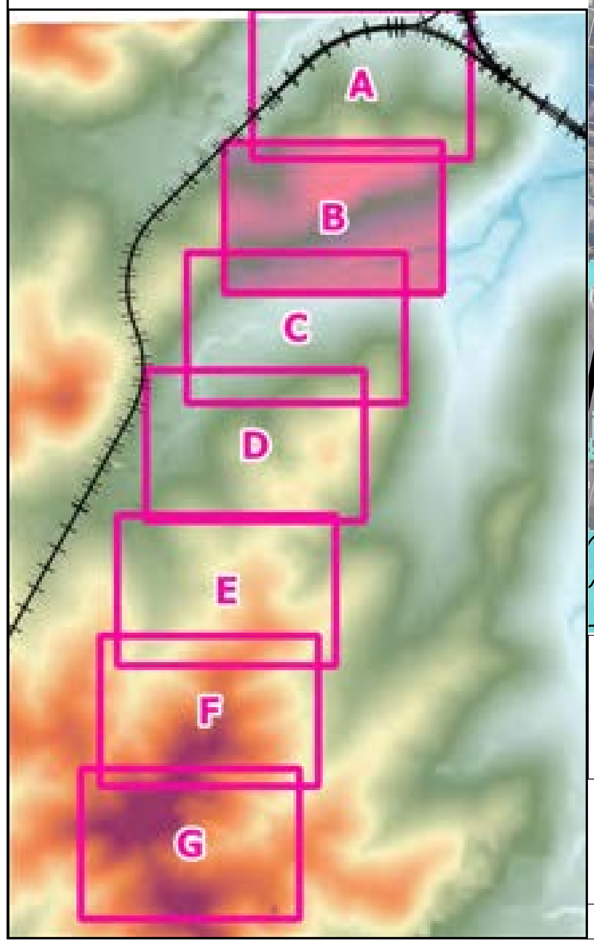
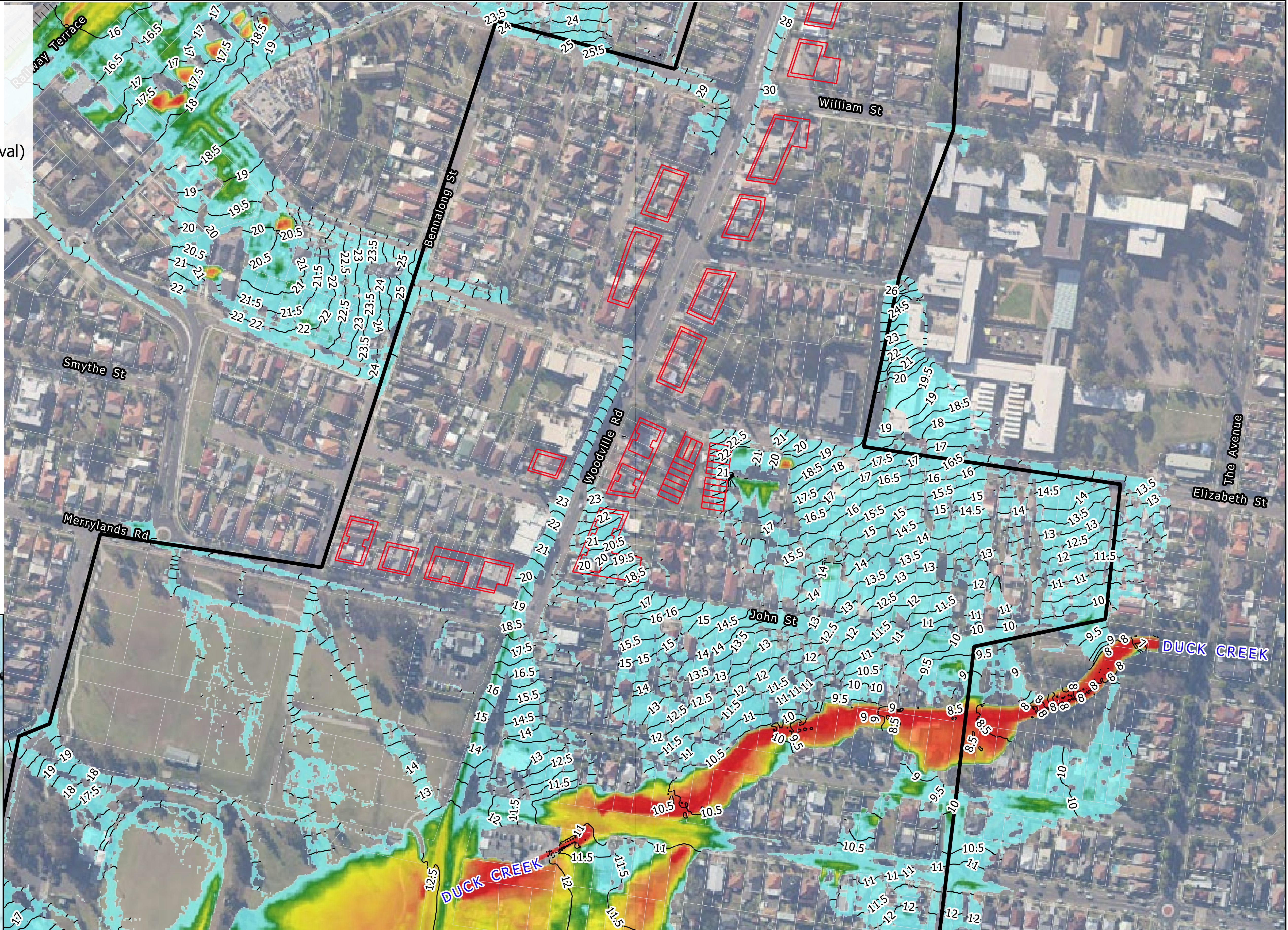
LEGEND

- Study Area
- Proposed Building Outline
- Railway
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.2% AEP Event - View B**

Figure: **A-04.B**

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LEGEND

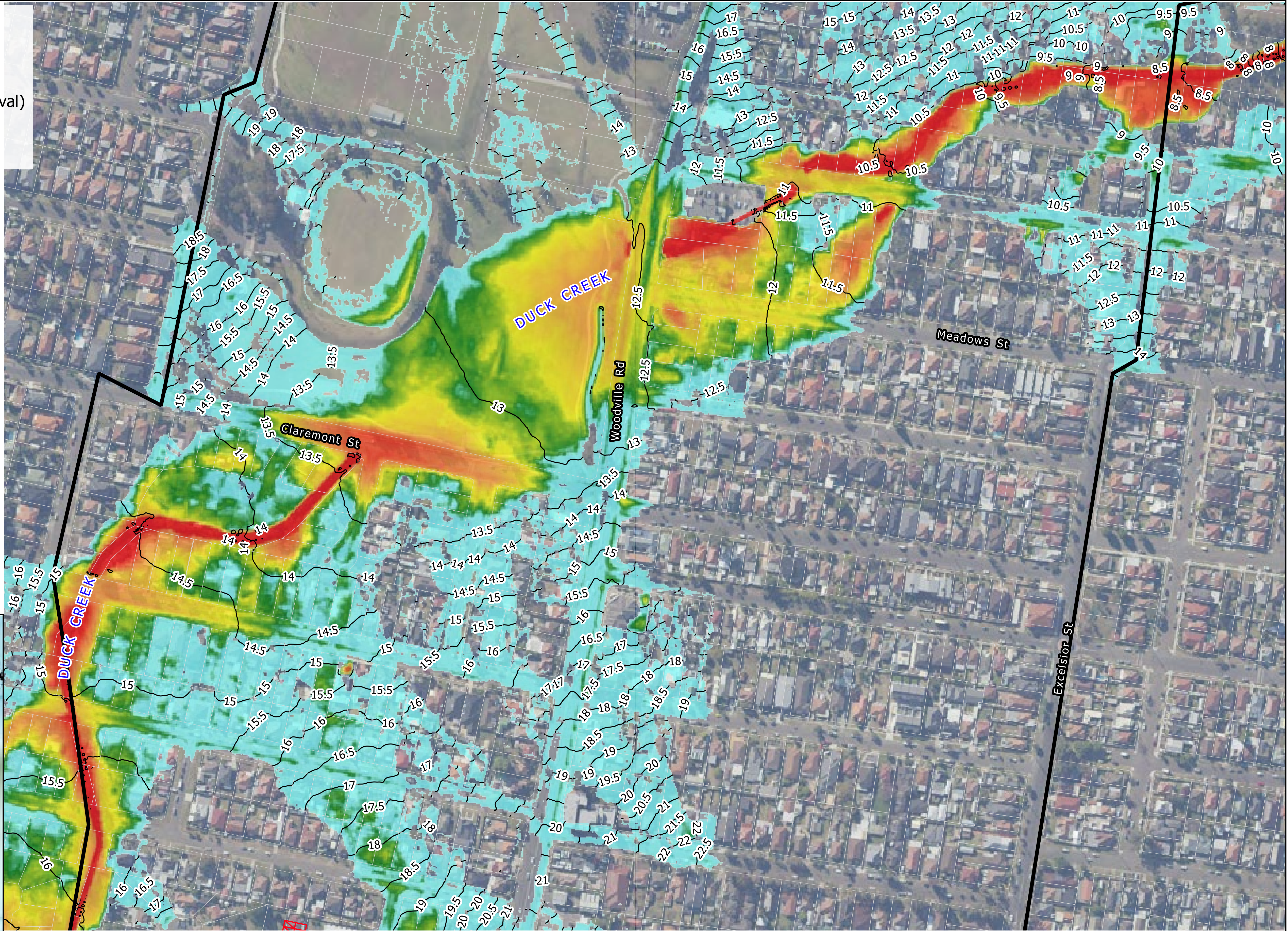
Study Area

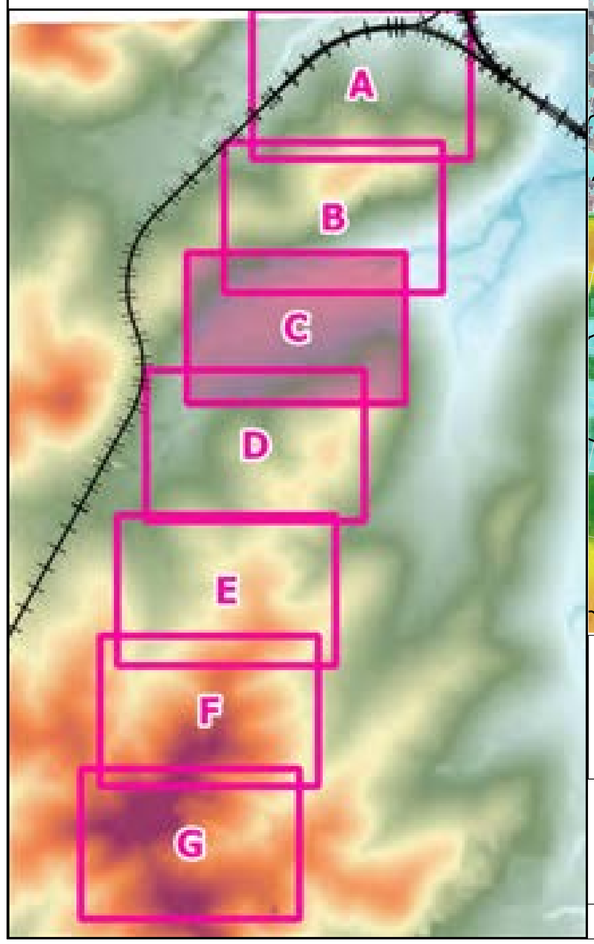
Lot

Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.2% AEP Event - View C**

Figure: A-04.C

Rev: -

N

0 100 200 300 m

BMT

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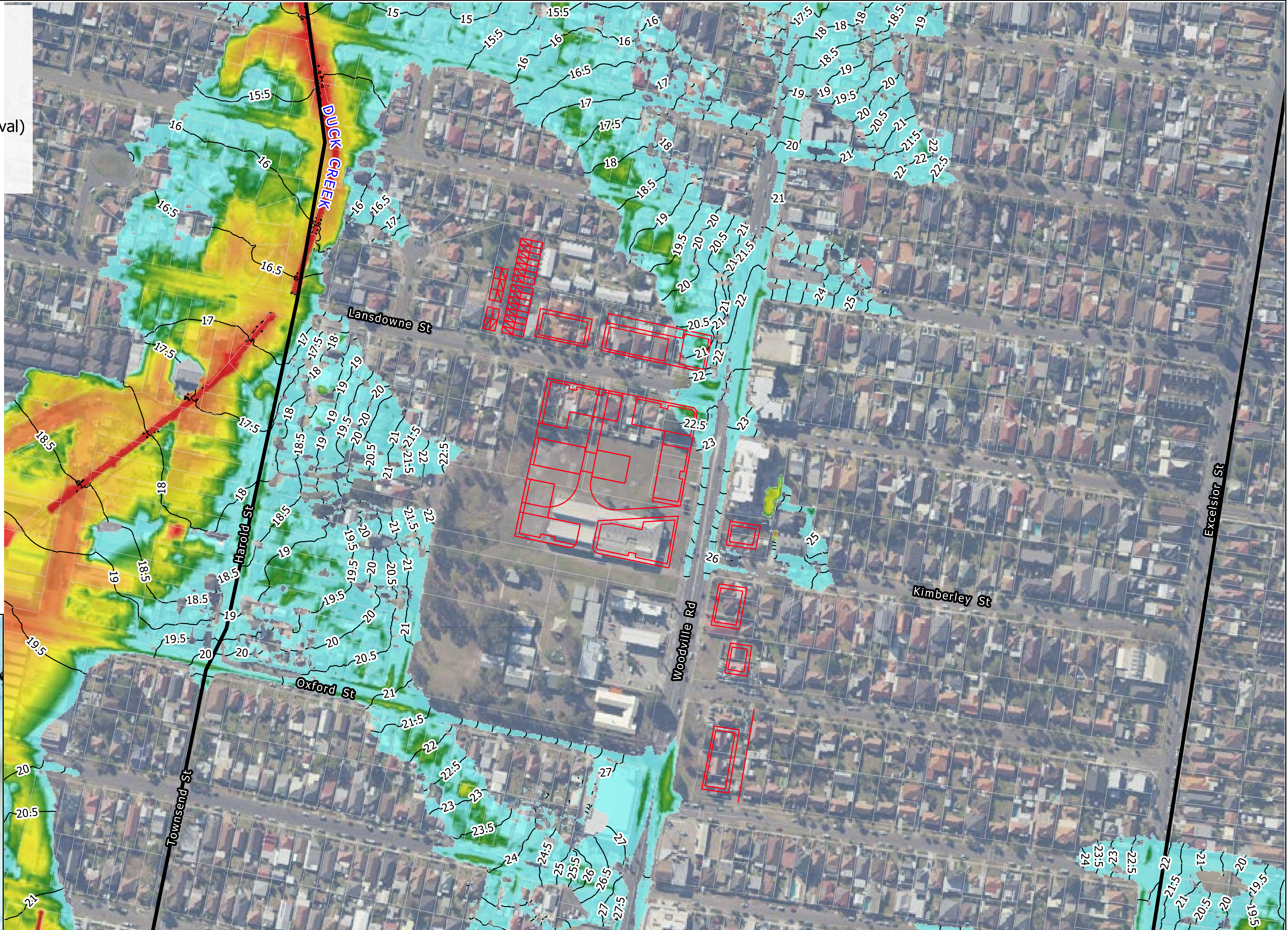
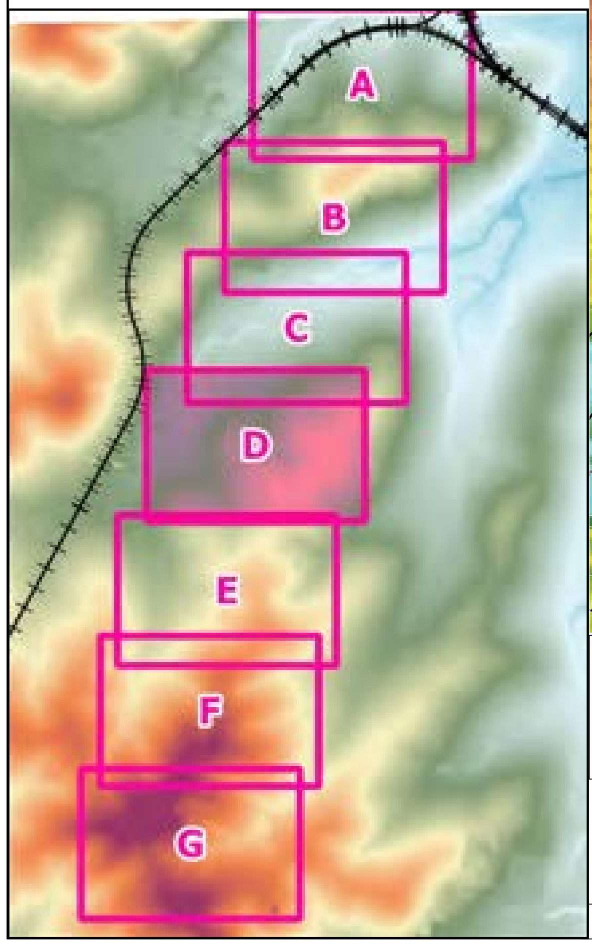
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.2% AEP Event - View D**

Figure: A-04.D

Rev: -

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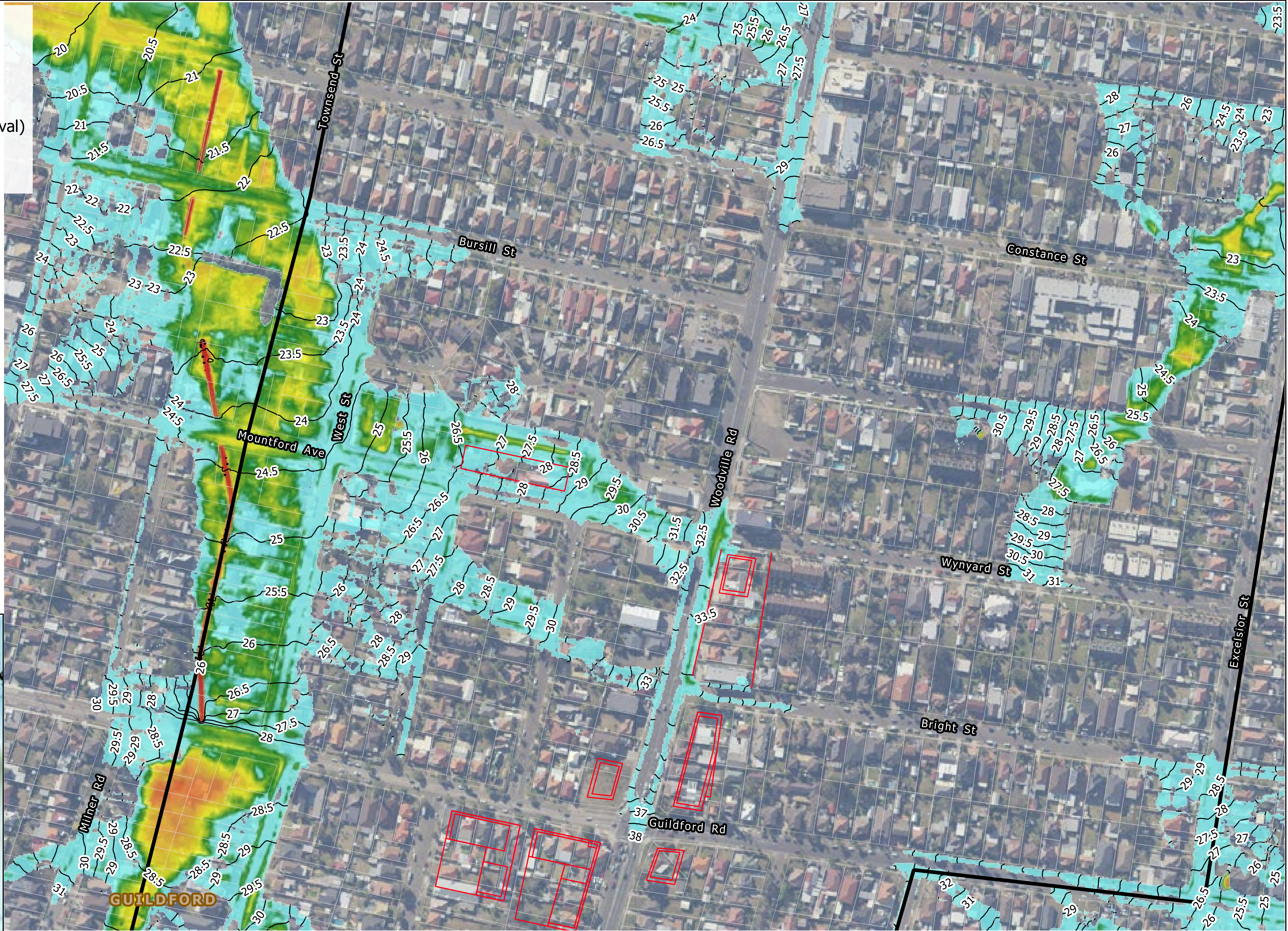
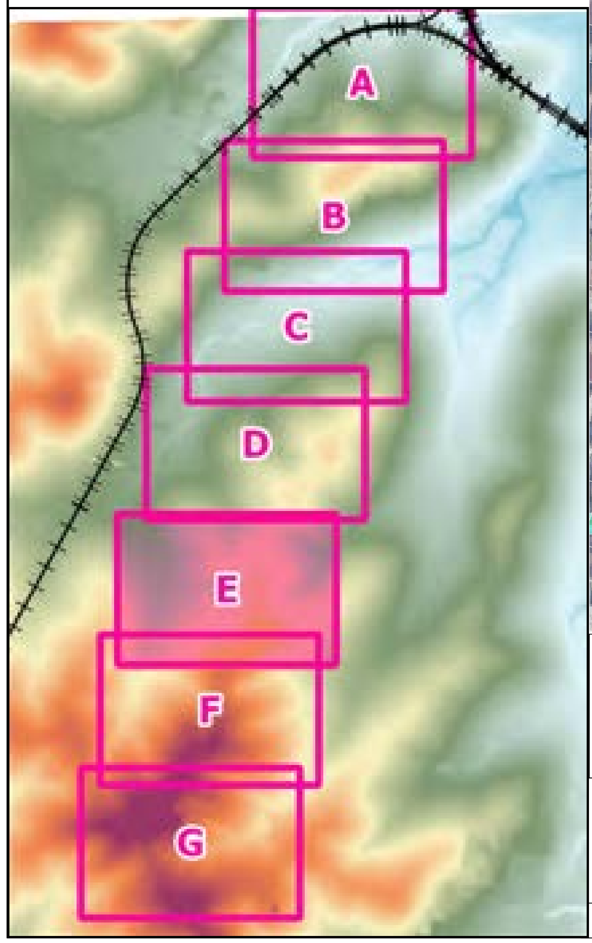
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.2% AEP Event - View E**

Figure: A-04.E

Rev: -

N

0 100 200 300 m

BMT

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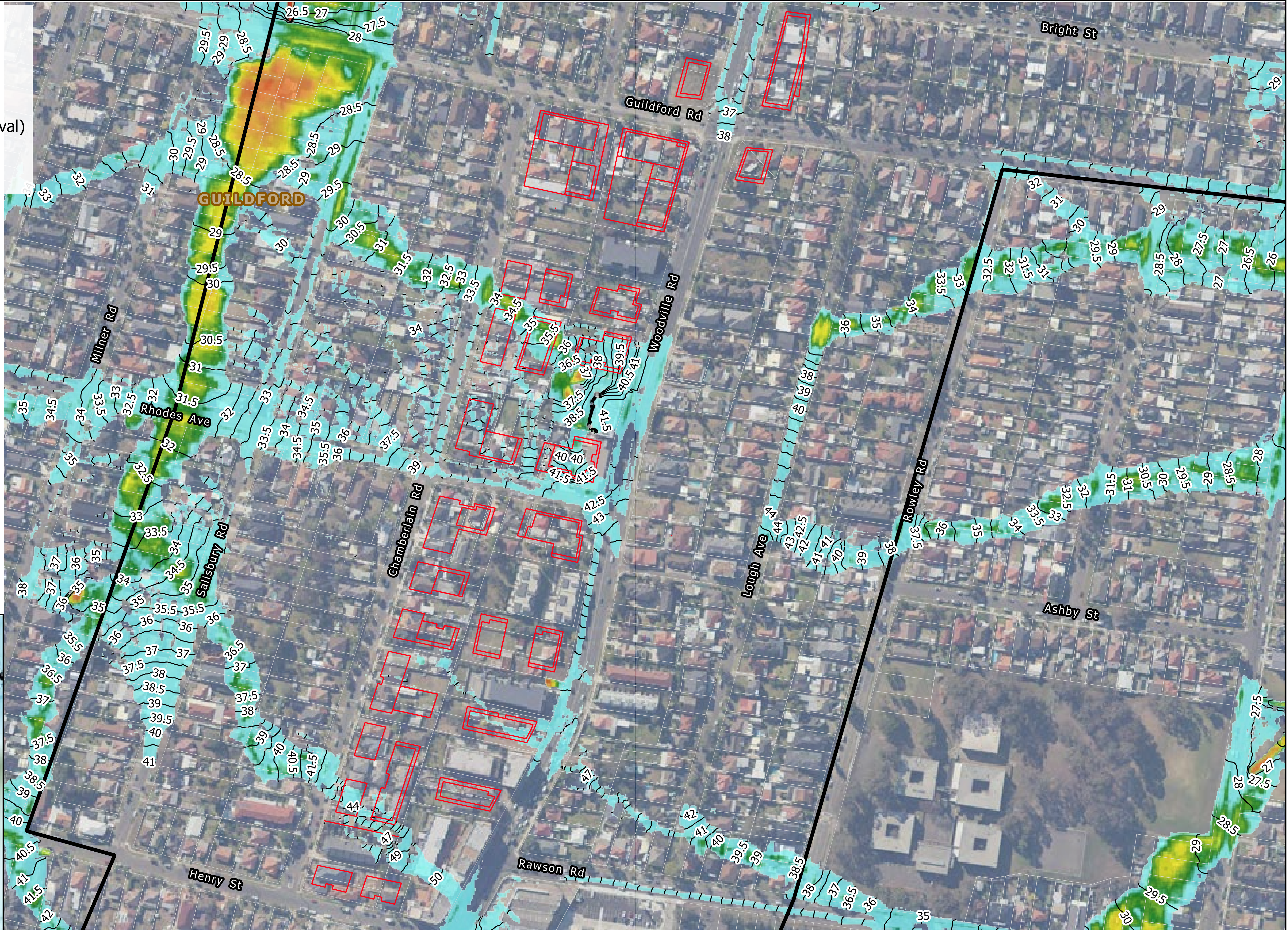
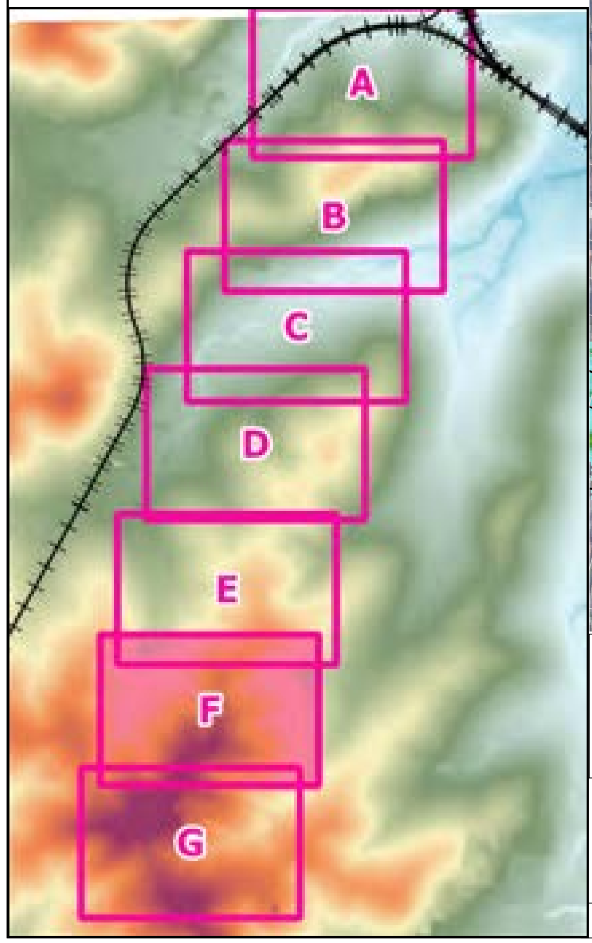
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15





Title: **Peak Flood Levels and Depths - Existing Conditions - 0.2% AEP Event - View F**

Figure: A-04.F

Rev: -

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0 100 200 300 m

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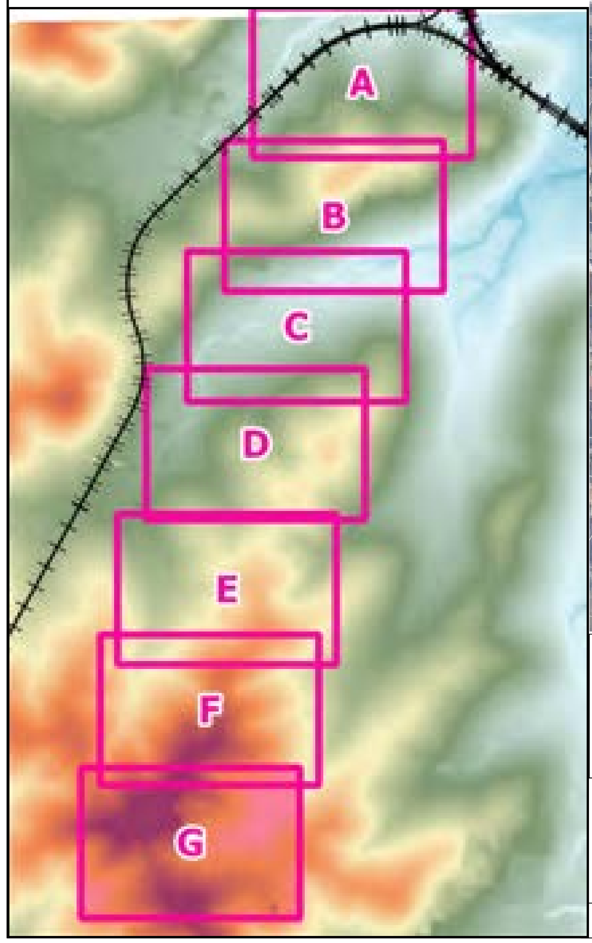
LEGEND

- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- 0.15



Title: **Peak Flood Levels and Depths - Existing Conditions - 0.2% AEP Event - View G**

Figure: A-04.G

Rev: -

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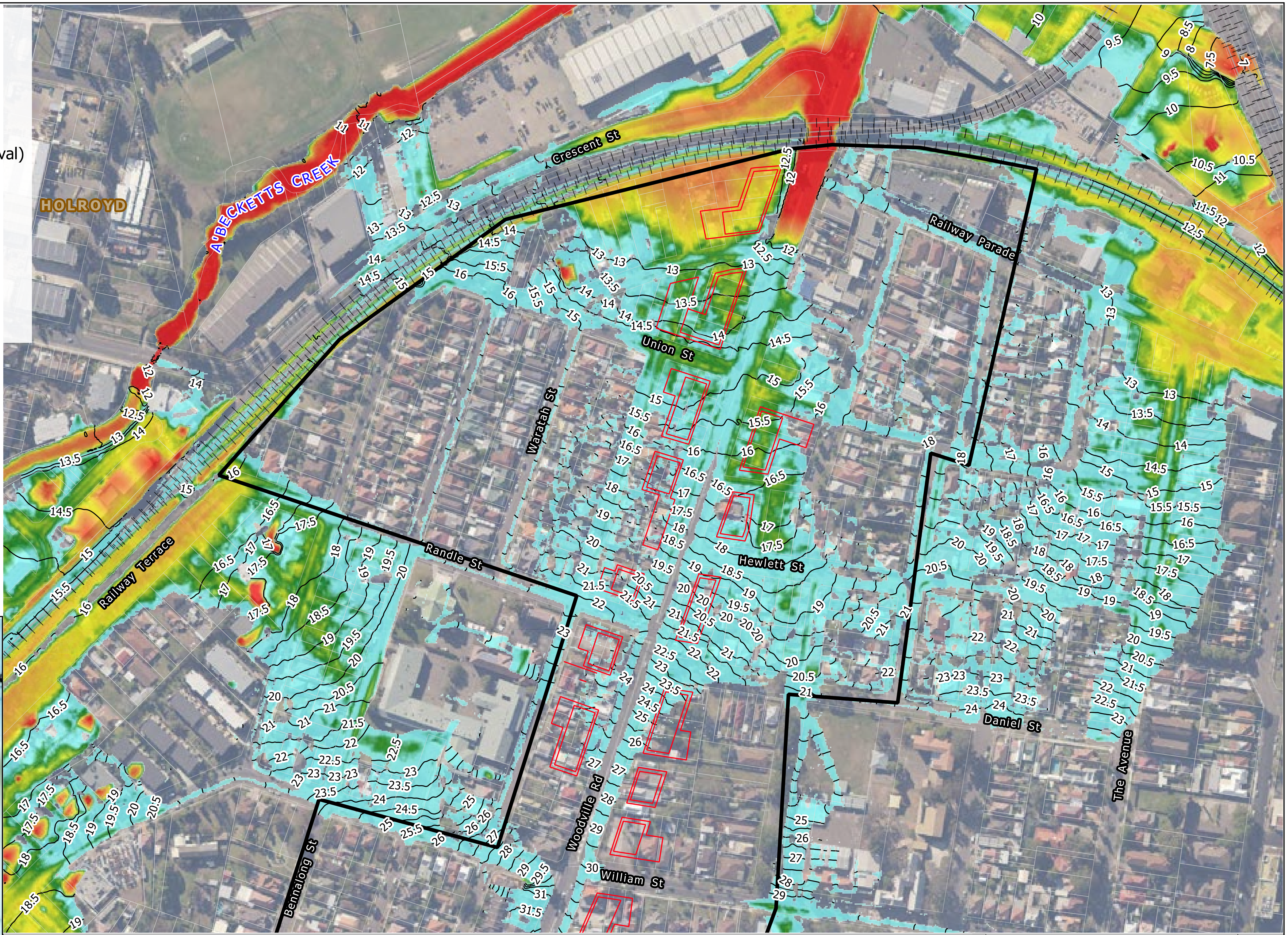

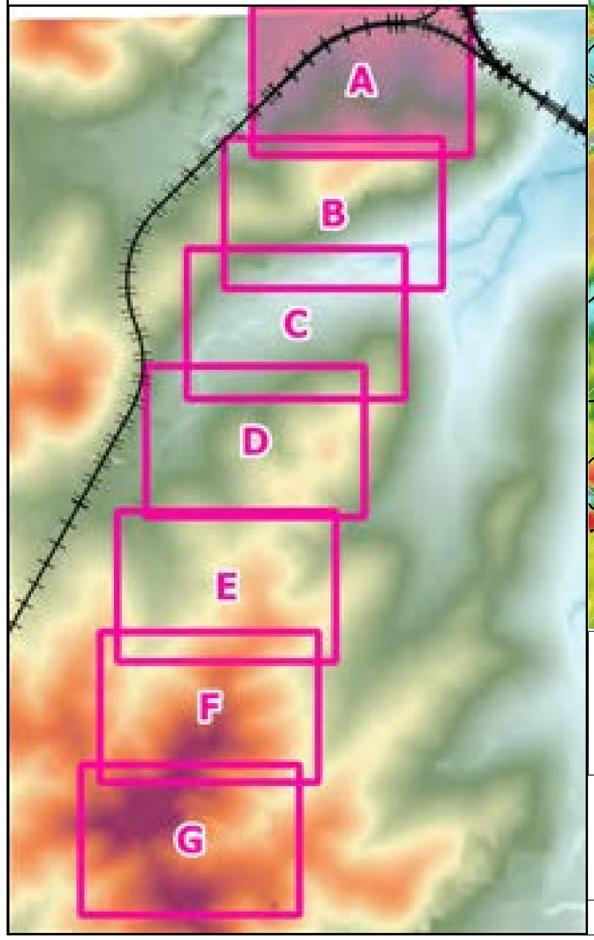

Title: **Peak Flood Levels and Depths - Existing Conditions - PMF Event - View A**

Figure: **A-05.A**

Rev: **-**

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N

0 100 200 300 m

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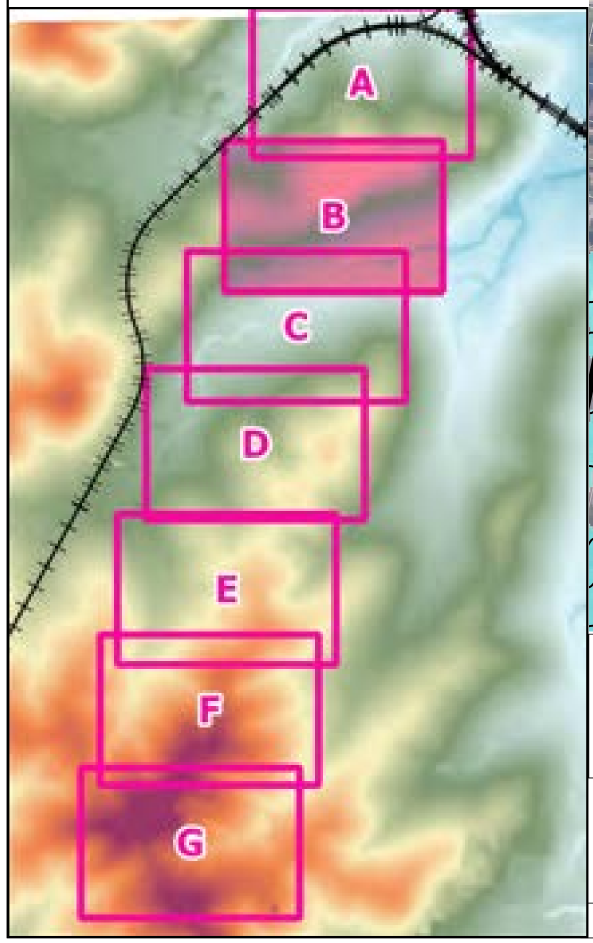
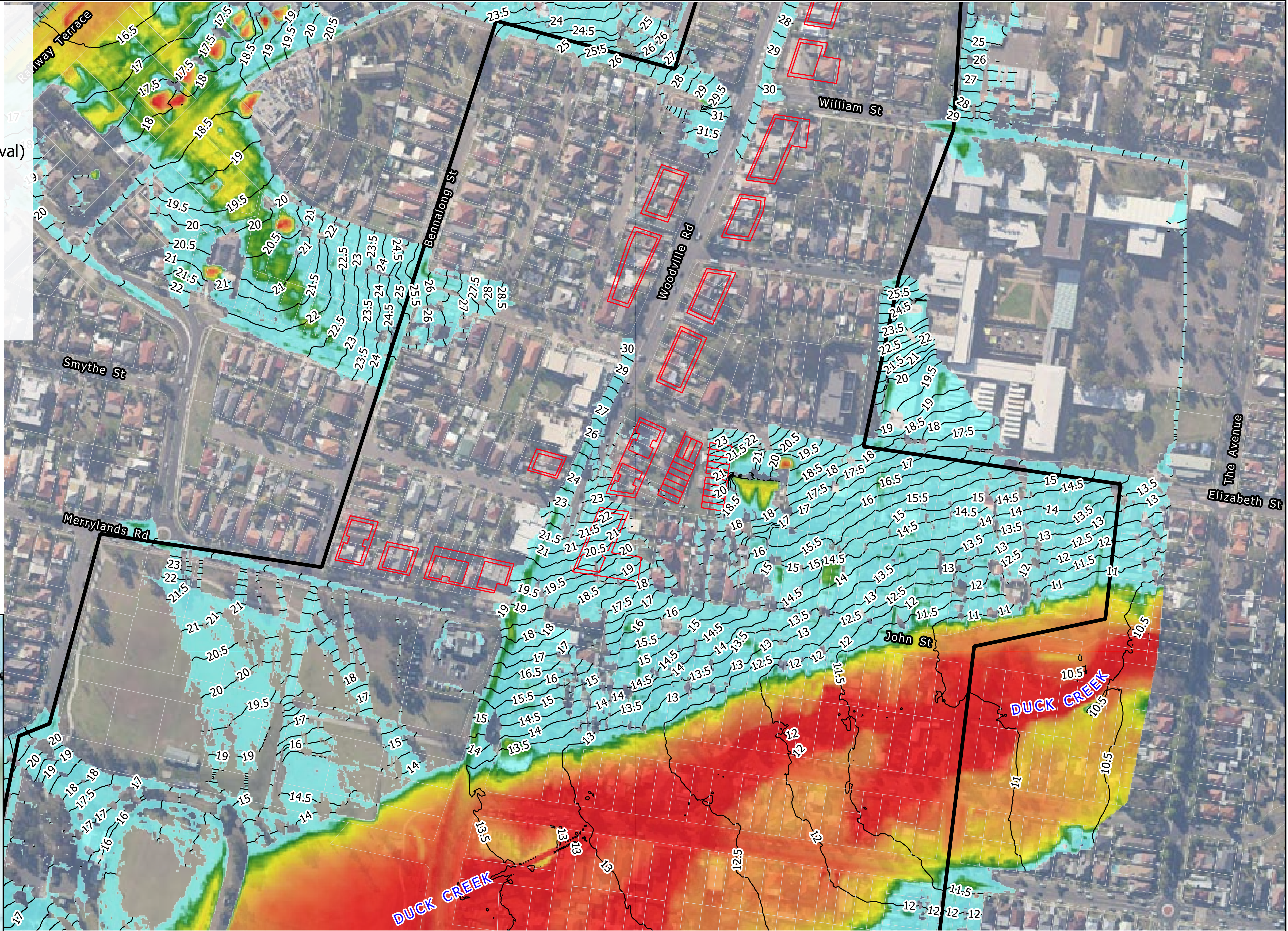
LEGEND

- Study Area
- Proposed Building Outline
- Railway
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

- Band 1
- 0.15
- 0.25
- 0.5
- 1
- 2





Title: **Peak Flood Levels and Depths - Existing Conditions - PMF Event - View B**

Figure: **A-05.B**

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0 100 200 300 m

BMT

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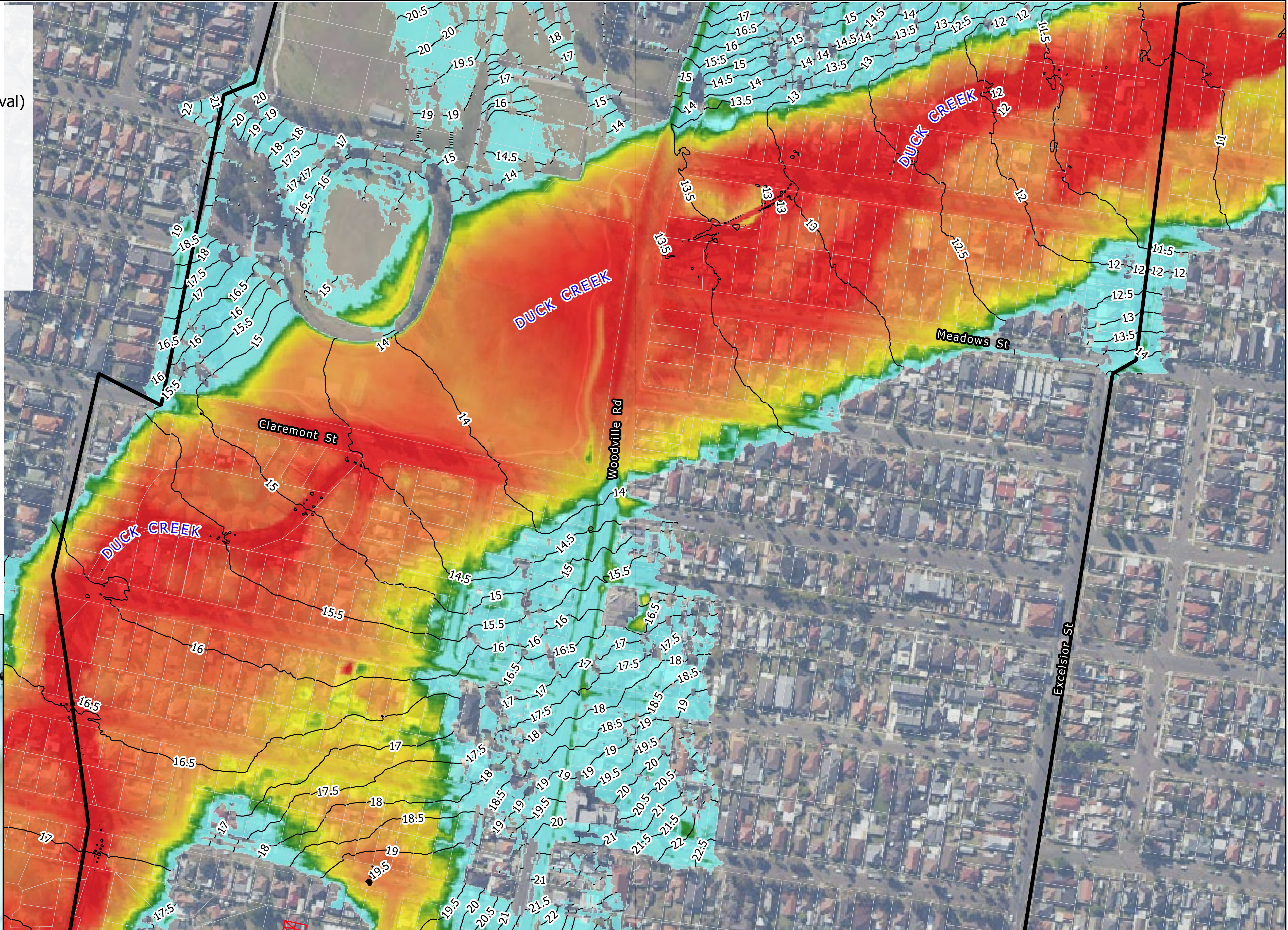
LEGEND

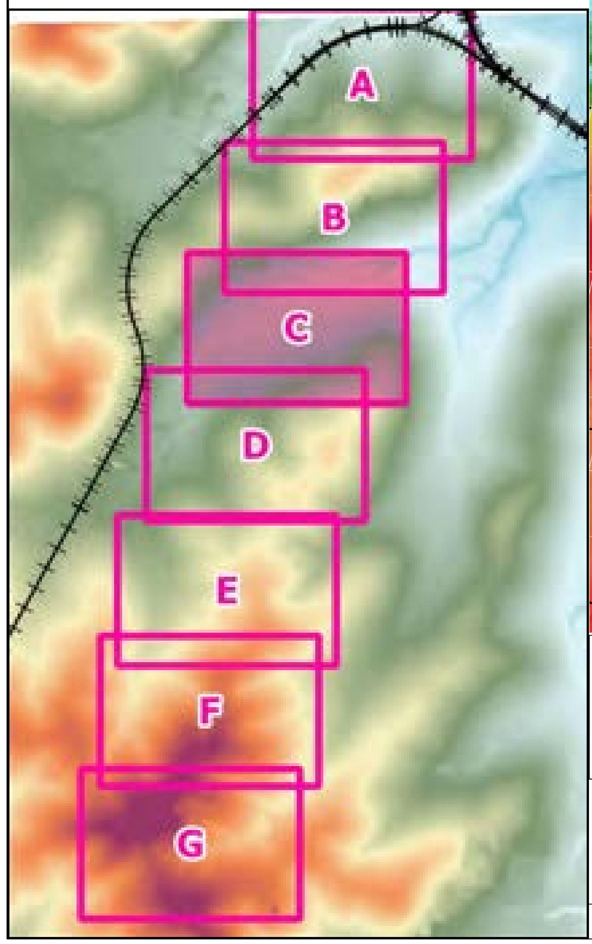
- Study Area
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

Band 1

- 0.15
- 0.25
- 0.5
- 1
- 2





Title: **Peak Flood Levels and Depths - Existing Conditions - PMF Event - View C**

Figure: **A-05.C**

Rev: **-**

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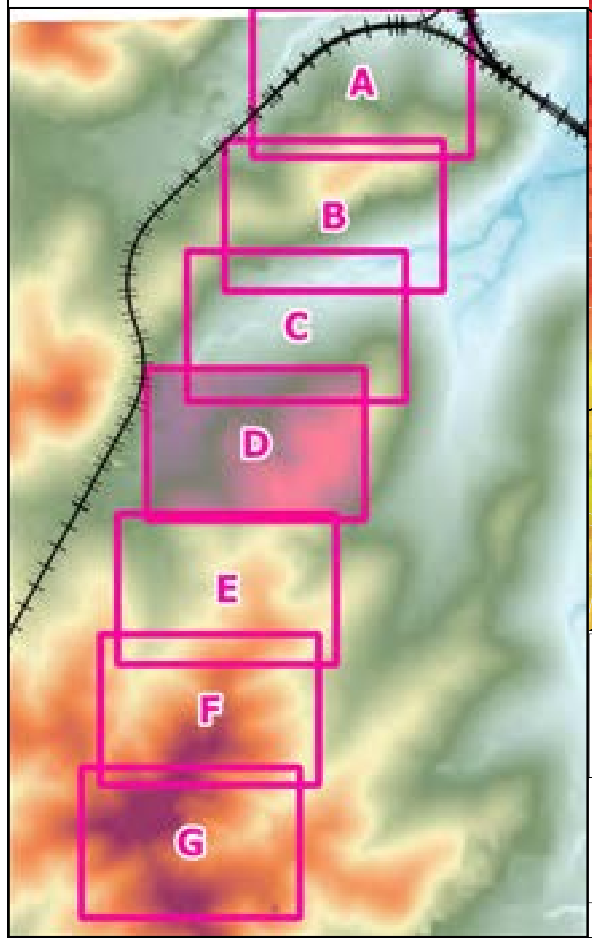
LEGEND

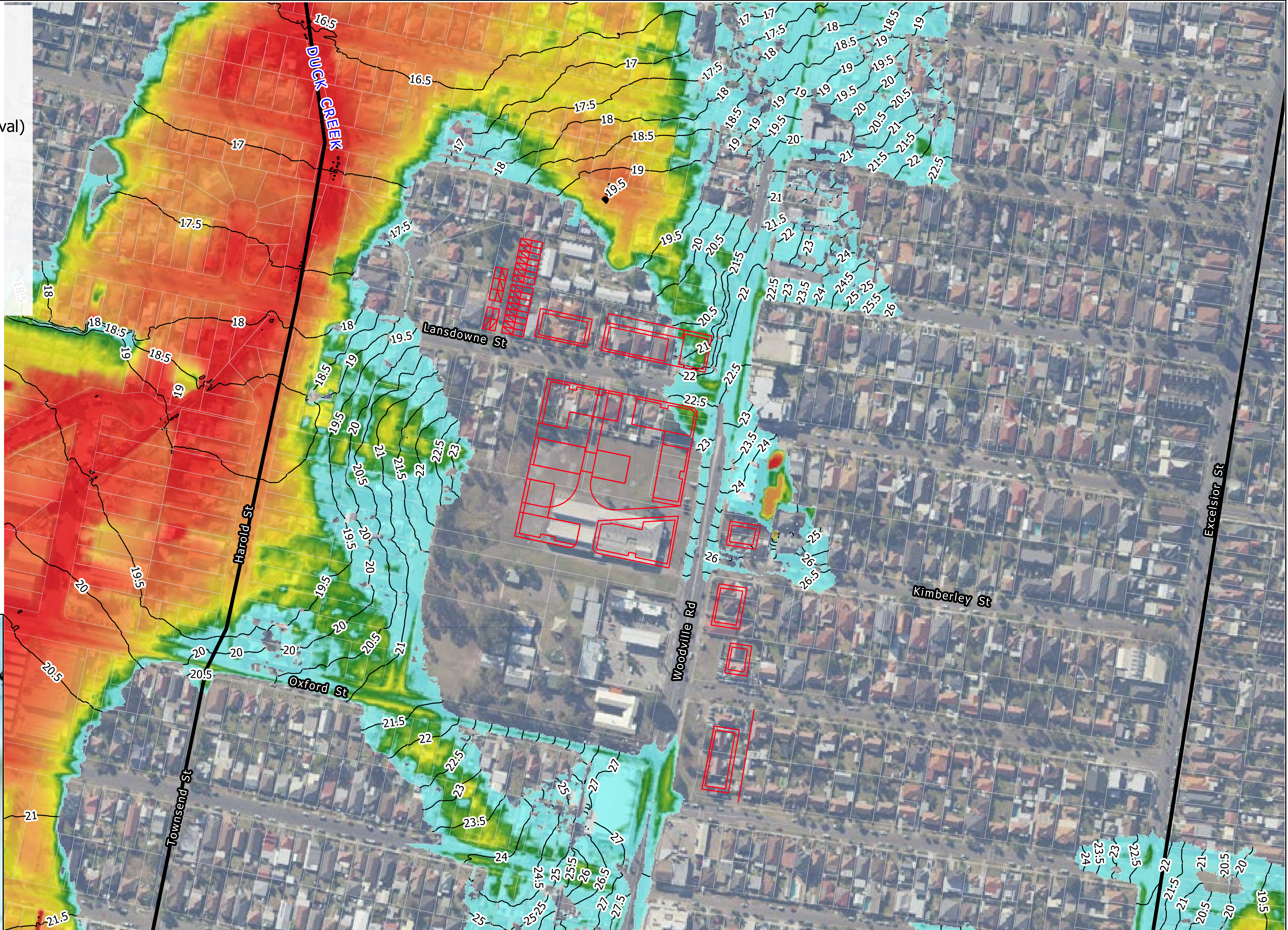
- Study Area
- Proposed Building Outline
- Lot
- Peak Flood Level (0.5 mAHD Interval)

Peak Flood Depth (m)

Band 1

- 0.15
- 0.25
- 0.5
- 1
- 2





Title: **Peak Flood Levels and Depths - Existing Conditions - PMF Event - View D**

Figure: **A-05.D**

Rev: **-**

N

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BMT

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