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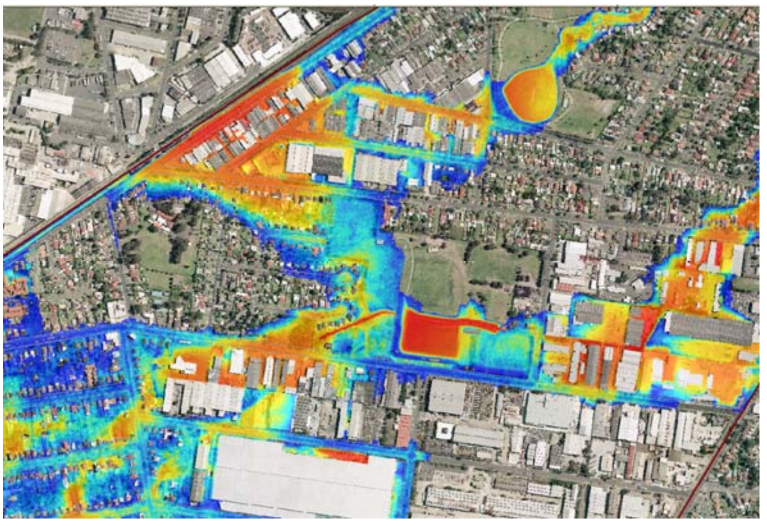
Old Guildford Overland Flood Study



FINAL REPORT

- August 2010

In association with

FAIRFIELD CONSULTING SERVICES
A Division of Fairfield City Council

Old Guildford Overland Flood Study

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Executive Summary

The local government area of Fairfield City is crossed by several major creeks, all of which are prone to mainstream flooding. In addition, parts of Fairfield City are at risk of overland flooding from stormwater that runs off from urbanised catchments to the creeks. Both types of flooding present a significant risk to life and property.

In order to address and mitigate this flood risk, Fairfield City Council is following the NSW Government's Flood Prone Land Policy and accompanying 2005 *Floodplain Development Manual*. The manual outlines a floodplain risk management process, leading to the preparation and implementation of a floodplain risk management plan. Plans are to be prepared for both mainstream and local overland flooding.

A preliminary assessment of the risk of flooding from overland flows within the urban areas of Fairfield was undertaken in 2003-2004 as part of the *Fairfield City Overland Flood Study*. This study prioritised the 18 urban subcatchments for more detailed investigation. The Old Guildford sub-catchment, centred on Fairfield East, was ranked as the second highest priority.

In 2007, Sinclair Knight Merz, in association with Fairfield Consulting Services, was engaged to undertake a detailed flood study of the Old Guildford subcatchment. The key objectives of the study were to describe the nature and extent of overland flooding within the subcatchment and to prepare flood risk precinct maps for several events including the probable maximum flood (PMF). This study would then provide the basis for preparing a floodplain risk management study and plan that would identify and recommend a range of measures to reduce the risk of overland flooding.

The methodology for undertaking the study was drawn from the *Canley Corridor Overland Flood Study*, completed in 2009. Modelling of the major trunk drainage network, as well as selected flooding 'trouble spots', was found to be the most efficient method of producing reliable results.

The 385 ha Old Guildford overland flow catchment is located to the west of Prospect Creek and is centred around Burns Creek. The catchment also extends beyong the Fairfield LGA into the Holroyd and Bankstown LGA's and encompasses parts of the suburbs of Old Guildford, Yennora, Villawood and Fairfield East. The catchment is highly urbanised and comprises residential, industrial and commercial development.

The catchment generally drains in a south-westerly direction via a network of stormwater pipes and open channels before outfalling into Burns Creek. Barrass Drain and Stimsons Creek are the only two other named tributaries of Burns Creek in this area. There are two detention basins in the catchment, one in Knight Park adjacent to Fairfield Street, the other in Springfield Park, adjacent to The Promenade. Because of urban and industrial development in the catchment, parts of the stormwater network were not designed to cater for the progressive increase in impervious area. Flooding problems along the main overland flow paths within the catchment are exacerbated by stormwater pipes built under private property and by development extending to the top of bank of open channels.

The adopted modelling approach used XP-STORM to simulate the urban sub-catchment hydrology, as well as the hydraulics of the stormwater pit and pipe network. Further, the approach using XP-STORM allowed modelling of the stormwater drainage system in conjunction with the overland flow in the two dimensional floodplain, with a dynamic link between the two components. The dynamic link between the one dimensional pipe network and two dimensional floodplain, provides the best representation of flood behaviour.

A one dimensional hydrologic and hydraulic model was initially established using topographic survey, spatial data and rainfall data. Relatively standard values for network and hydrologic parameters were assigned. A total of 202 pits and 199 pipes were represented in the model.

The floodplain in the XP-STORM was defined as a two dimensional domain based on a 2.5m topographic grid. Open channels were represented in the model but fencelines were excluded. Buildings were treated as solid objects within the floodplain in which floodwaters could not flow through. A downstream boundary condition was assigned based on the stage hydrographs developed in the draft Burns Creek Flood Study.

The XP-STORM model was constructed such that overland flows may enter the next downstream pit if there is sufficient inlet capacity. Flows in excess of the inlet capacity, or flows that surcharge from the pipe network, form overland flow which are routed through the two dimensional domain. Although the model could not be calibrated because of a lack of historical data, model results were compared and found to agree relatively well with the findings from previous drainage investigations and Council's database of known flooding trouble spots.

Sensitivity analyses revealed that the XP-STORM model was not sensitive to changes in Manning's n roughness values and tailwater conditions. Increasing blockage factors of pits increased flood depths n the industrial properties between Fairfield Street and Orchardleigh Street and increased rainfall intensity increased flood depths in the detention basins at Knight Park and Springfield Park and in isolated areas off Lisbon Street and Seville Street.

The model was run for the 20, 100, 200, 500, 2000, 10,000 year average recurrence interval (ARI) events and the PMF, for a range of storm durations from 30 minutes to three hours. The peak water level and velocity for each storm duration, at each 2D grid point, were extracted and used to form a 'peak of peaks' grid that was subsequently used a basis for the flood mapping. Areas of nuisance or localised flooding less than 150 mm in depth were manually removed from the flood mapping.

Flood model results and the flood mapping for the 100 year ARI event indicate that:

- There are a two main flowpaths in the upper catchment within the Fairfield LGA. The first flowpath carries stormwater from north of the Springfield Park Detention basin, along The Promenade and underneath the Liverpool to Granville Railway line into the Holroyd LGA.

This returns to the Fairfield LGA via Stimsons Creek. The second flowpath is located on Barrass Drain and disperses across the flatter terrain at Fairfield Street.

- Overland flooding is generally deepest alongside the railway embankment adjacent to Yennora Station due to a culvert providing obstruction, with depths exceeding 1.6m. Typical depths of flooding at properties in the mid and upper parts of the catchment are less than 0.3m. A number of properties downstream of Lisbon Street are affected by overland flood depths between 0.4m and 0.6m.
- The depth of flooding in road corridors is typically less than 0.3m. Some roads experience flooding greater than 0.5m deep, and include Woodville Road, Fairfield Street and Orchardleigh Street. Sections of certain roads experience flooding greater than 1m deep, and include Railway Street, Larra Street, Montrose Avenue, Spring Street, Tangerine Street, Mandarin Street, Malta Street and Hanson Street.
- Overland flow velocities within properties in the 100 year ARI event are typically less than 0.5m/s, although there are some isolated areas with flow velocities up to and exceeding 1m/s. Flow velocities exceed 2m/s in some streets, in addition to the car park at Bunnings Warehouse in Villawood.

Flood risk precinct maps were prepared based on modelling of the 100 year ARI (medium risk) and PMF (low risk) events and using the flood risk precinct categories outlined in the Fairfield City-Wide Development Control Plan. The flood risk precinct mapping has identified:

- Approximately 1300 properties are within the floodplain outline defined by the PMF event.
- Areas of high flood risk occur in the two detention basins in Springfield and Knight Parks, adjacent to the culvert passing under the railway line at Yennora, and in two locations between The Promenade and Fairfield Street.
- In the upper section of the catchment, the medium flood risk precinct extends along the two main trunk drainage lines in an east to west direction towards the two detention basins. There is also an area at medium flood risk between Orchardleigh Street and Burns Creek in the western part of the catchment, within the Villawood CBD and along Normanby Street.
- The low flood risk precinct follows the outline of the medium flood risk precinct closely in the upper catchment. The low flood risk precinct starts to widen south of The Promenade as well as south of Fairfield Street.

The flood risk precinct maps also incorporate mainstream flooding along Burns Creek as well as the overland flooding from stormwater runoff within the Old Guildford catchment.

It is considered that the study has ultimately provided a good foundation from which to prepare the Old Guildford Floodplain Risk Management Study and Plan, as the next step in the floodplain risk management process.

1. Introduction

1.1. Background

The Local Government Area (LGA) of Fairfield City covers an area of around 102.5 km^2 and is located on a number of floodplains. These floodplains comprise the low-lying land next to the Georges River and the city's eight major creeks. These creeks span over 80km in length and flow into both the Georges River and Hawkesbury-Nepean catchments. Being within a floodplain means that many suburbs in the LGA are prone to flooding.

In addition to the city's creeks, there are a number of watercourses and tributaries throughout the LGA that have been piped over the years, especially in the period between post-World War II and the 1970s, as part of the increasing urbanisation. Most of these piped flow paths are in urban areas. This gives rise to the potential for damage to properties and hazard to residents due to flooding.

Flooding in Fairfield LGA can occur in two different ways. These are mainstream flooding and local overland flooding. Mainstream flooding is the inundation of normally dry land due to flood waters overflowing the natural or artificial banks of a stream, river, estuary, lake or dam. Conversely, local overland flooding is the inundation caused by local runoff during heavy storms, usually from stormwater pits and pipes which have exceeded their capacities, rather than overbank discharge. Overland flows eventually end up in the local creek system.

Both types of flooding can cause significant damage. For example, major mainstream flooding occurred along lower Prospect Creek and Cabramatta Creek in August 1986 and April-May 1988. The 1986 flood caused an estimated total damage of $4.8 million. A smaller flood in January 2001 caused damage to the upper reach of Prospect Creek.

In addition, there are different scales of local flooding. At the lower end of the scale, minor flooding may result from a number of sources including blockage of drainage pits and pipes. At the upper end of the scale, major flooding can occur due to water flowing along natural floodways or across land due to the runoff exceeding the capacity of the trunk drainage system.

To mitigate the risk of flooding the NSW Government has adopted the Flood Prone Land Policy, as outlined in the 2005 NSW Floodplain Development Manual (FDM). The FDM describes the process by which Councils can undertake flood studies and prepare floodplain risk management studies and plans.

In accordance with the floodplain risk management process, Council has prepared a number of flood studies for both mainstream and overland flooding, as well as floodplain risk management plans for the Georges River, Cabramatta Creek and Prospect Creek. Eventually, flood studies and floodplain risk management plans will be prepared for all the city's sub-catchments for both mainstream and overland flooding. The plans detail a range of flood modification, property modification and emergency response measures that can be used to reduce flood risk. This may include voluntary house raising, vegetation management of the creeks, the construction of detention basins and floodways and implementation of development controls. Development controls are outlined in Council's City Wide Development Control Plan (DCP).

In the past, FCC concentrated primarily on studying mainstream flooding from the city's creeks as this was considered to be the main source of flood risk in the LGA. However, flooding from major overland flow paths and the resulting flood risk was not well understood. FCC has therefore embarked upon a program of undertaking overland flood studies in order to identify these major overland flow paths and to address the requirements of the FDM.

Identifying properties at risk of overland flooding within the entire LGA is a major undertaking. Instead of undertaking detailed assessment for the entire LGA in one step, FCC decided to undertake overland flood studies in a number of stages. In 2003-2004, Sinclair Knight Merz (SKM) was engaged by FCC to undertake the *Fairfield City Overland Flood Study* (SKM, 2004). This was a preliminary assessment of the flood risk from overland flows within the urban areas of the Fairfield LGA. The study divided the LGA into 18 catchments and ranked each catchment in terms of the potential severity of overland flooding.

The *Fairfield City Overland Flood Study* identified the Old Guildford catchment as the highest ranked out of the 18 sub-catchments in Fairfield LGA, in terms of the number of properties at high risk from flooding. Other high-priority sub-catchments identified included Fairfield (2nd), Smithfield (3rd) and the Canley Heights (4th) catchments.

The *Canley Corridor Overland Flood Study* (SKM, 2009), which primarily covered the Canley Heights catchment, was undertaken as the first of a series of detailed overland flood studies by FCC, as there was a large amount of stormwater asset data readily available for use in the study, and because there was a significant amount of urban renewal occurring in the study area which warranted a detailed understanding of the nature of overland flooding in the catchment. The *Canley Corridor Overland Flood Study* was undertaken as a pilot study to evaluate a number of alternative flood modelling and mapping methodologies, based on different assumptions made about the capacity of the stormwater drainage system. The *Canley Corridor Overland Flood Study* defined the flood behaviour and identified the major overland flow paths within the Canley Corridor catchment, identified properties at risk of overland flooding for the preparation of flood risk precinct maps.

It was concluded from the *Canley Corridor Overland Flood Study* that the Smithfield, Old Guildford and Fairfield Overland Flood Studies should be undertaken using a similar methodology that was developed and selected as the preferred approach in the Canley Corridor study.

FCC subsequently commissioned SKM in 2007 to undertake an overland flood study for the Old Guildford sub-catchment. This study was undertaken in association with Fairfield Consulting Services (FCS), a business unit division of FCC.

The Old Guildford Overland Flood Study quantifies the scale of local overland flooding in the Old Guildford catchment and will form the basis for preparing the floodplain risk management study and plan for the area.

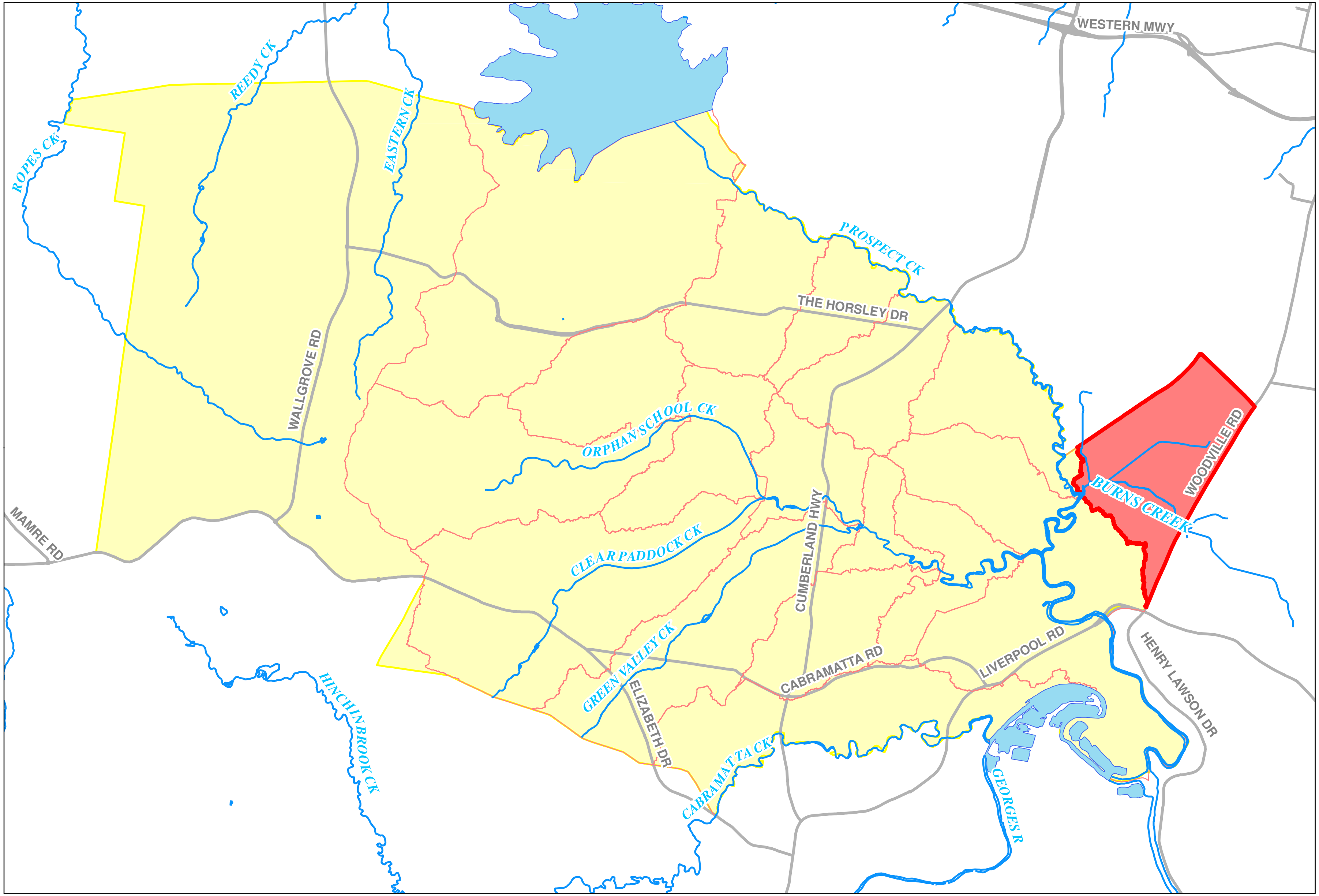
1.2. Study Area

1.2.1. Description

The 385ha Old Guildford catchment is located in the eastern most portion of Fairfield LGA, to the east of Prospect Creek and with Burns Creek running through its centre. The study area locality is shown on **Figure 1-1**.

Figure 1-2 shows the study area in detail. The catchment is centred around Burns Creek. On the southern side of the creek the majority of the catchment is residential and generally follows a north-south and east-west grid. To the north of Burns Creek the catchment is split into three different sections; the skewed north-south and east-west grid of residential development to the west of crown street, the Villawood industrial area to the north of Burns Creek, and the remaining residential area in the north of the catchment.

Barrass Drain, owned by Sydney Water, traverses the catchment and discharges into Burns Creek at Seville Street, between Victory and Crown Streets. Runoff from the north of the catchment leaves the LGA by draining via a culvert adjacent to Yennora Station, travels through a channel within the Holroyd LGA, and returns to Fairfield LGA via Stimsons Creek.



Legend

- Old Guildford Study Area
- Fairfield Council Local Catchments
- Fairfield LGA
- Creek
- Main Road

Data Sources

LGA: LPI

Creeks, Roads: Streetworks

Sinclair Knight Merz does not warrant that this document is definitive nor free of error and does not accept liability for any loss caused or arising from reliance upon information provided herein.

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A4 Kilometres

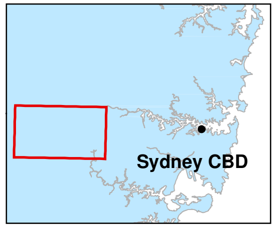

Figure 1-1 Locality

Old Guildford Overland Flood Study

Version 2

GDA 1994 MGA Zone 56

April 7, 2010

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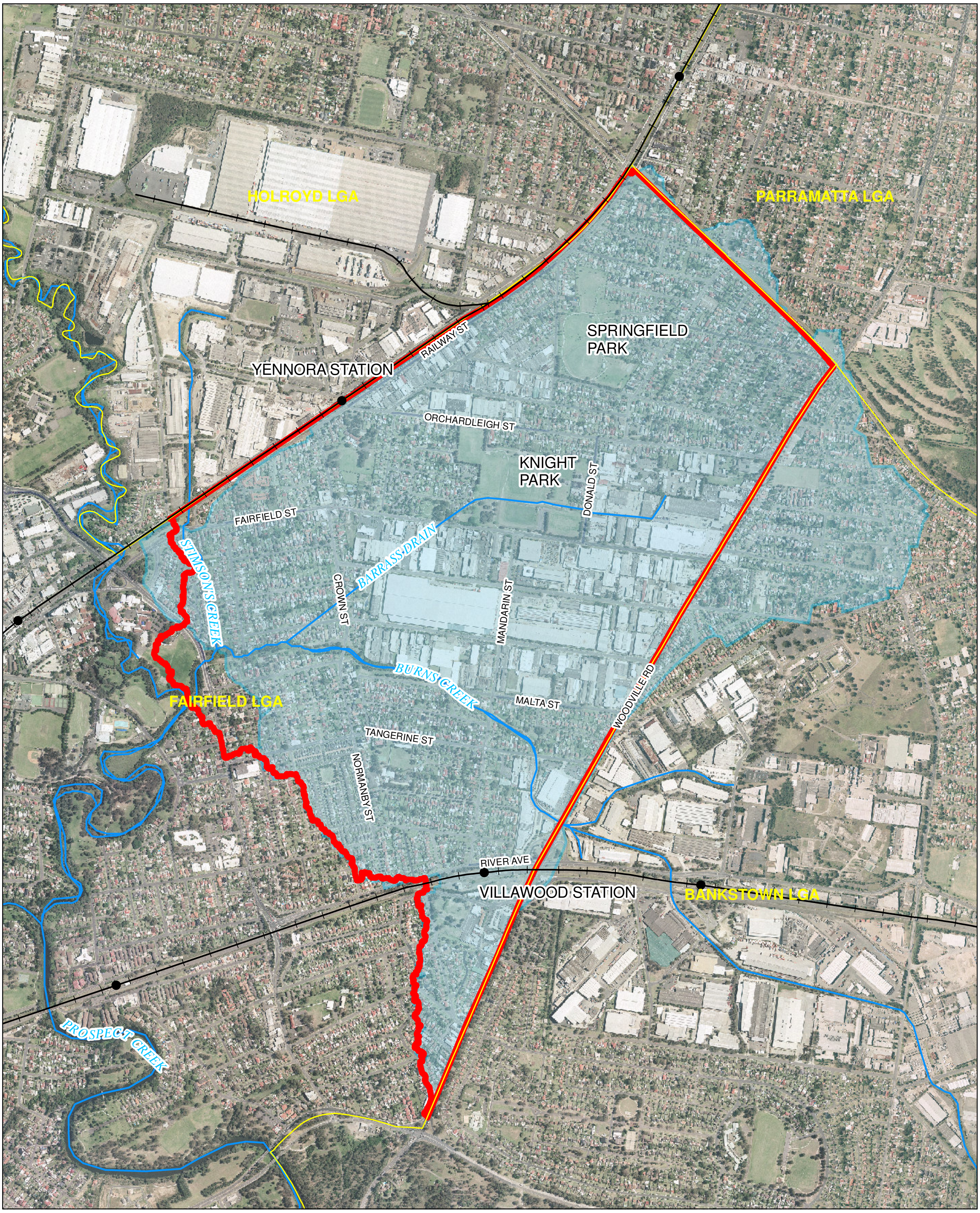

Legend

- Old Guildford Study Area
- Overland Flow Path Catchment
- LGA Boundary
- Creeks and Drainage
- Railway
- Railway Station

Data Sources
Aerial Photo: AUSIMAGE
Roads, Railway: Streetworks

0 0.5
A4 1:20,000 Kilometres

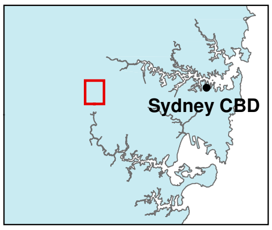

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Figure 1-2 Study Area

Old Guildford Overland Flood Study — Version 2

GDA 1994 MGA Zone 56

April 7, 2010
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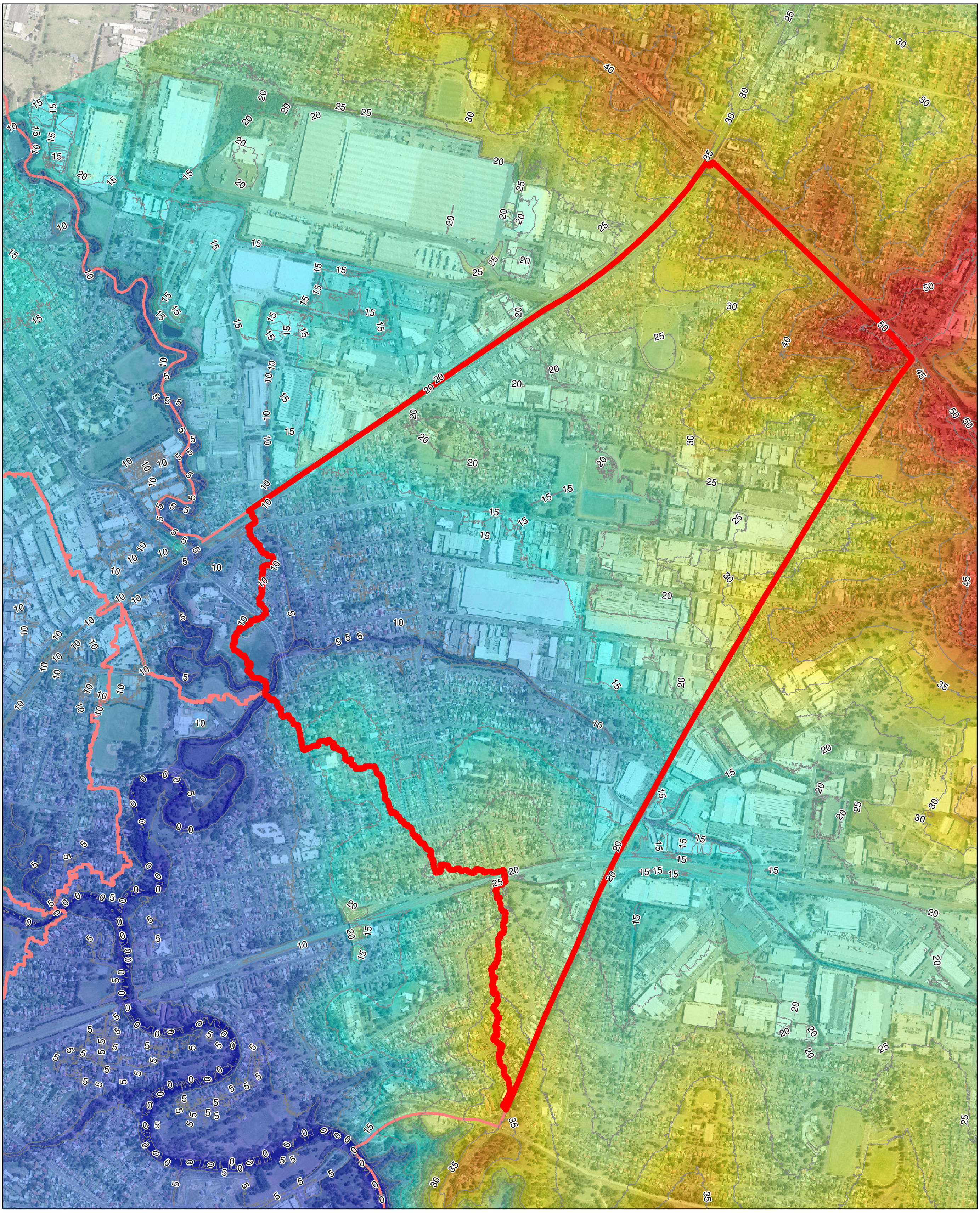
The topography of the study area is shown in **Figure 1-3**. The highest points in the catchment are at the intersection of Taralga and Springfield Streets to the north (51m AHD), near the intersection of Henry and Kay Streets also to the north (42m AHD) and near Allowrie Road to the south (34m AHD).

The Old Guildford catchment is situated on relatively flat terrain but generally drains towards Burns Creek which discharges into Prospect Creek. Typical land slopes are around 1.5 to 2% both north and south of Burns Creek, with the exception of the area flowing out of the LGA near Yennora (Matthes Street to Railway Parade) having a slope of 0.5%. Burns Creek itself has a slope of 0.65%.

The land use in the study is primarily residential, mostly characterised by low to medium density development. Villawood had a higher proportion of town houses and villas (18.8%) than the LGA (9.9%) and almost a third (30.6%) of all private dwellings were public housing (*2001 Census, ABS*). There is a significant area of industrial development located to the east of the catchment which is the second largest in the LGA at a total of 108 ha. Both Springfield and Knight Parks are large open spaces within the catchment with both containing detention basins and active recreation areas. The catchment has very little native vegetation remaining with the majority of Burns Creek in a degraded state and Stimsons Creek a concrete lined channel. There is commercial development located along Woodville Road, between Villawood Place and Tangerine Street know as Villawood shopping centre.

Rapid population increase after World War II saw the settlement of many ex-servicemen and European migrants in the Old Guildford catchment. Large scale Housing Commission development and the expansion of the commercial centre, occurred in the 1950s and swelled the population in the area. Scrub land within Villawood was levelled to prepare for pre-fabricated houses and also became a self contained shopping area as per the Housing Commission's plan in 1953. The dairy farms at Old Guildford were sold to make way for large factory complexes.

The stormwater drainage networks were, however, not designed to cater for the large increases in catchment imperviousness upstream as medium density and industrial development in the catchment expanded. Pipes were also built under private properties in the western and far north of the catchment and development extends to top of bank of both Stimsons and Burns Creeks. Today, the existing drainage network in the Old Guildford catchment is ageing and undersized in relation to current standards and, for this reason, overland flooding is a major problem within this catchment.



Legend

Old Guildford Study Area

Fairfield City Council Sub-Catchments

5m contour

DTM

60m AHD

0m AHD

Data Sources
Aerial Photo: AUSIMAGE

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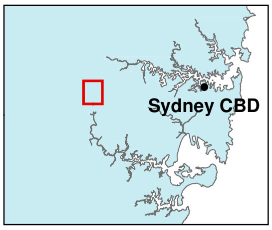

Figure 1-3 Study Area Topography

GDA 1994 MGA Zone 56

Old Guildford Overland Flood Study Version 1

March 24, 2010
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1.2.2. Drainage Conditions

The drainage conditions in the study area are described below and shown in **Figure 1-4**:

- A major overland flow path traverses east-west along Barrass Drain in the northern section of the catchment
- A second major overland flow path traverses the northern section of the catchment in an east-west direction ending in Springfield Basin
- In the western parts of the catchment the terrain is flatter leading to interflow between flowpaths
- The railway embankment that includes Yennora Train Station is an obstruction to overland flow.
- Water leaves the LGA through a culvert under the railway embankment adjacent to Yennora Station and renters the LGA through Stimsons Creek.
- All overland flow either reaches Burns Creek directly or via Stimsons Creek. The overland flowpaths generally follows the piped drainage network through the study area and includes trunk drainage lines (Barrass Drain), open channel along Stimsons Creek and open creekline along Burns Creek.
- The overland flowpaths generally follow the piped drainage network through the study area and includes trunk drainage lines (Barrass Drain), open channel along Stimsons Creek and open creekline along Burns Creek.

Areas along Burns and Stimsons Creeks are also affected by mainstream flooding with additional backwater effects from Prospect Creek and the Georges River.

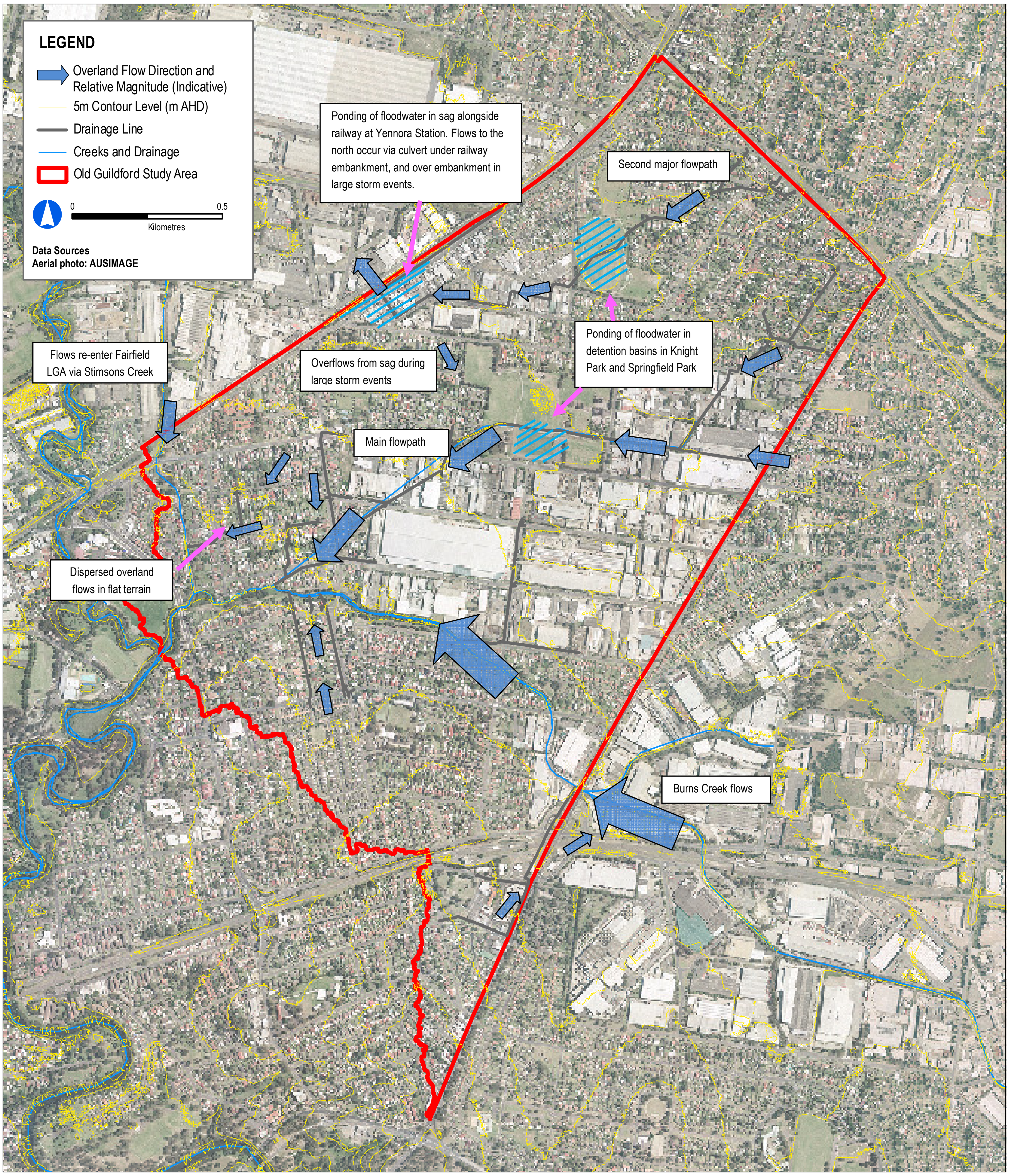
1.3. Study Objectives

Key objectives of this study are to:

- Identify the major overland flow paths within the Old Guildford catchment study area.
- Determine the nature and extent of overland flooding and flood risk in the study area.
- Identify properties at risk of local overland flooding and quantify the risk of flooding to these properties.
- Produce flood model results (flood level, velocity and flow) for the 20, 100, 200, 500, 2,000 and 10,000 year ARI and PMF storm events
- Prepare flood extent (depth and velocity) maps and flood risk precinct maps for the study area for the 100 year ARI and PMF events.
- Assess the sensitivity of flood behaviour to changes in hydrologic and hydraulic characteristics in the catchment.

Originally, it was intended to also identify “Zones of Significant Flow” to determine those sections of overland flow paths through properties which would need to be kept clear in order to reduce flood risk. Due to time constraints, these zones will be identified in the floodplain risk management study and plan.

▪ **Figure 1-4 Overland Drainage Patterns**



2. Review of Available Data

2.1. Previous Studies

A number of previous studies are relevant to the study area, including the following:

- SKM (2008) *Burns Creek Flood Study – Draft.* Stage and flow hydrographs results were extracted from the numerical model used for this study in order to model boundary conditions for the Old Guildford overland flood study.
- Water Board (1991) *Burns Creek/Barrass Drain Catchment Management Study.* This study has focus on water quality modelling and catchment management options as well as hydrologic and hydraulic modelling. Results presented for Barrass Drain only with results given as pipe velocity and overland flow depth for certain reaches for the 5, 10, 20 and 100 year ARIs.
- Fairfield City Council (1991) *Shackel Avenue Drainage Analysis.* Limited information is available on historic overland flooding in the Old Guildford Catchment, however some references were found in this report. There is a list of anecdotal evidence from previous events. There is only one previously recorded depth for a storm with no corresponding ARI.
- J Harrison Engineering Consultancy (1992) *44 Crown Street & 99-103 Seville Street, Fairfield.* This report was commissioned to determine the effect a development would have on local flooding conditions. It contains 100 year ARI peak heights for the drainage easement between Crown and Lisbon Streets (Barrass Drain)
- Fairfield City Council (1985 – present) *Drainage Investigation Records.* A record of all complaints and enquiries throughout the LGA.

2.2. Topographic Survey

2.2.1. Airborne Laser Survey

Airborne Laser Survey (ALS), conducted in January 2003, was used to generate a Digital Terrain Model (DTM) for the entire Fairfield LGA. The DTM has subsequently been used in a number of projects undertaken for FCC, including this current study. The ALS data used had been filtered to reduce the density of points and to remove non-ground points such as buildings, bridges and over/underpasses.

2.2.2. Ground Survey

Ground survey provides more accurate information than ALS in certain areas, particularly within waterway channels and in areas where there is dense vegetation. The following ground survey was therefore used in the Old Guildford study:

- Ground survey data was undertaken for significant hydraulic structures, including the culvert section of Burns Creek between Woodville Road and Tangerine Street and the bridge crossings of Burns Creek at Normanby Street and Mandarin Street as part of the Burns Creek Flood Study. This information was also used within this study.

- Survey data was also compiled for Barrass Drain, downstream of Knight Park. This survey data was requested specifically for this study and was surveyed in August 2008.

2.2.3. Design and Works as Executed Drawings

Design plans and Work As Executed (WAE) drawings were obtained for the following hydraulic structures for use in this study:

- Knight Park detention basin WAE plans, detailing finished ground surface levels and basin outlet configuration.
- Drainage Plan and Earthworks Plan for proposed bulky goods warehouse development at 702 Woodville Road, Fairfield East. The plans included details on proposed trunk drainage structures through the site.

This information is shown in **Appendix A**.

2.2.4. Pit and Pipe Survey

The levels and dimensions of key pits and pipes were surveyed by FCC surveyors in 2007/2008. Typical details surveyed include:

Pits

- Pit name/asset number
- Pit coordinates (Easting, Northing)
- Pit surface level (m AHD)
- Pit invert level (m AHD)
- Pit type
- Pit entry dimensions – lintel length and/or inlet grate dimensions.

Pipes

- Pipe name/asset number
- Upstream and downstream invert levels (m AHD)
- Pipe length
- Conduit type – circular pipe or box culvert
- Dimensions – diameter or width/height
- Upstream and downstream node.

Data on the pits and pipes is contained in **Appendix B**.

Not all pits and pipes in the stormwater network were surveyed. Only key/critical pits and pipes, as identified by FCC, were surveyed for the purpose of developing a simplified stormwater network model. This is discussed further in **Section 3.2**.

2.3. AUSIMAGE™ Aerial Photography

AUSIMAGE™ aerial photography was used extensively in this study, mainly for data validation and presentation of results in the preparation of flood extent and risk maps. The aerial photography that was used was flown in March 2007. This photography is at a resolution of 0.15m.

2.4. Spatial Data

Various layers of GIS data were made available for this study from FCC, and through SKM's previous work within Fairfield LGA. These include:

- FCC digital cadastre and Local Environment Plan (LEP);
- Building polygon layer, derived in 2003/04 from 2002 aerial photography and updated based on recent aerial photography (where required); and
- Digital pit and pipe layer for the complete stormwater network.

Data from a surface impervious area (SIA) study undertaken for FCC by Lagen Spatial Pty Ltd became available in 2009 after the Old Guildford Overland Flood Study commenced. The SIA study accurately identifies all impervious areas across the LGA, however, it was not used in this study due to the late availability of the SIA data and project time constraints.

2.5. Rainfall Intensity-Frequency-Duration Data

This study uses design rainfall intensity-frequency-duration (IFD) data, derived for 33.875° S, 150.925° E (near Fairfield), issued April 1997 by the Hydrometeorological Advisory Service of the Bureau of Meteorology. The IFD data provides average rainfall intensities for events up to and including the 100 year ARI event. The data was extrapolated to derive average rainfall intensities for the 200 and 500 year ARI events. Further detail on rainfall data is provided in **Section 3.2.5**. The IFD data is provided in **Appendix C.**

2.6. Record of Historical of Overland Flow Problems

FCC has kept a record of 'trouble spots' where the public has identified past stormwater flooding problems. This record includes a number of locations within the Old Guildford study area.

Based on investigations into these problem areas, FCC has subsequently developed their *Drainage Investigation Records* of properties historically affected by overland flooding since 1985.

Both these datasets have been made available for the study. They were used to identify the extent of the pipe network which required modelling, particularly where the trouble spot areas occur where pipe sizes are less than 900mm in diameter. The datasets were also used as a check for the final flood mapping.

3. Hydrologic and Hydraulic Model Development

3.1. Modelling Approach

The modelling approach adopted in the Old Guildford Overland Flood Study consisted of the following aspects:

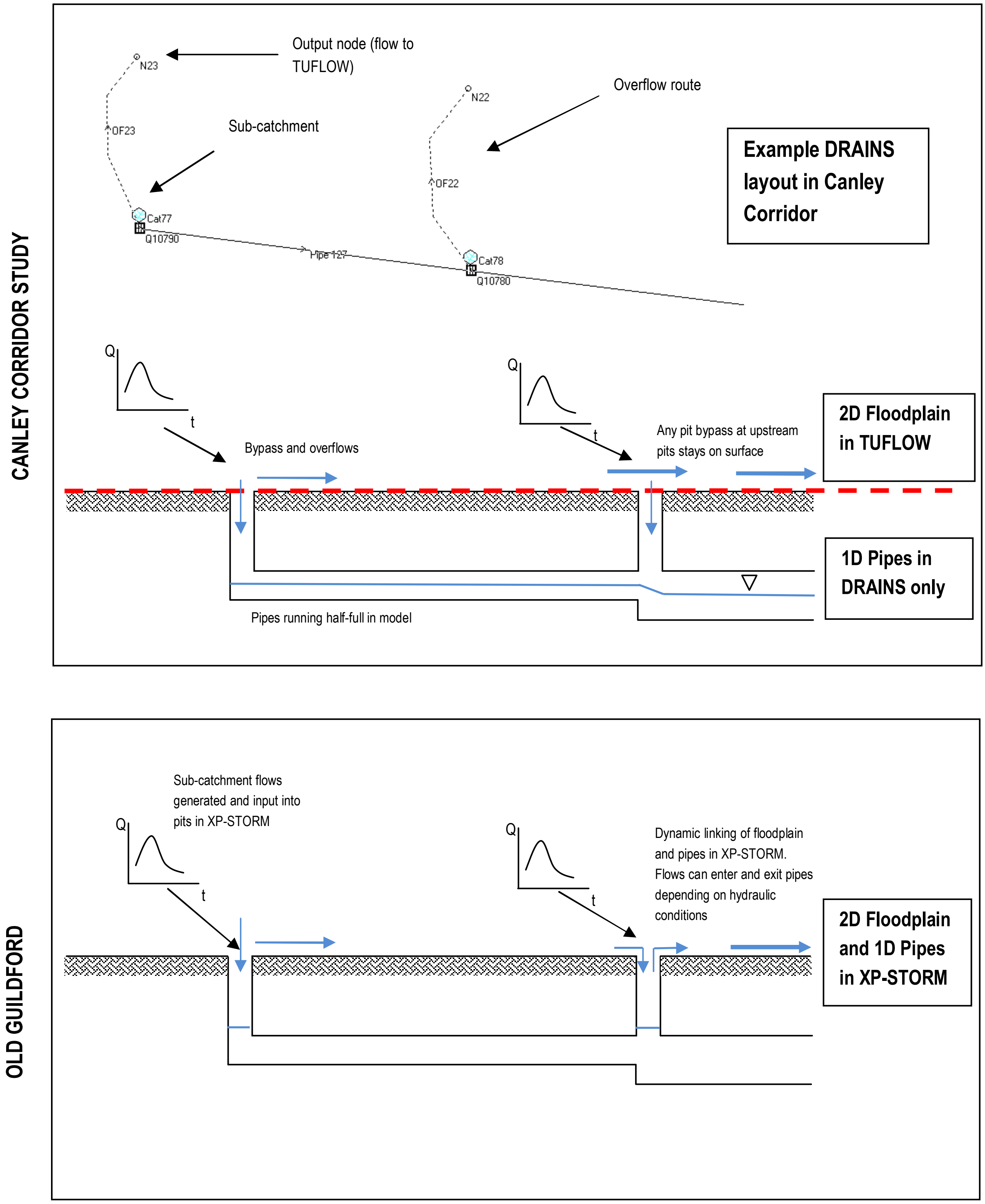
- Development of a XP-STORM model to represent the selected key/critical pits and pipes of the drainage network and the associated hydrology.
- Further development of the XP-STORM model to represent the 2D floodplain including topography, building polygons, surface roughness and boundary conditions.
- The XP-STORM model was then run for the duration of the flood events. Maximum flood levels, depths and velocities and flooding extents are output in result files.

The adopted modelling approach in XP-STORM allowed a single model to simulate the small scale urban sub-catchment hydrology, as well as the hydraulics of the pit and pipe system. Further, the approach using XP-STORM allowed modelling of the stormwater drainage system in conjunction with the overland flow in the 2D floodplain, with a dynamic link between the two components.

Previously in the Canley Corridor Overland Flood Study, water surcharged from the pit (as determined in the DRAINS model), and was not allowed to renter the drainage system in the TUFLOW model. This led to a conservative depiction of overland flooding. The adopted approach removes this conservatism through a dynamic link and hence provides a more accurate description of the overland flooding behaviour. A schematic representation comparing the Canley Corridor and Old Guildford Overland Flood Study modelling approaches is shown in **Figure 3-1.**

The preferred modelling approach chosen for this study was to incorporate modelling of the limited drainage network together with 2D flood hydraulic modelling, with some modification to suit the needs of the study as discussed above. This approach could potentially be used for modelling the remaining catchments in Fairfield LGA.

- **Figure 3-1 Comparison of Canley Corridor and Old Guildford Overland Flood Study Modelling Approaches**



3.2. Drainage Network and Hydrologic Model Development

3.2.1. Drainage Network Layout

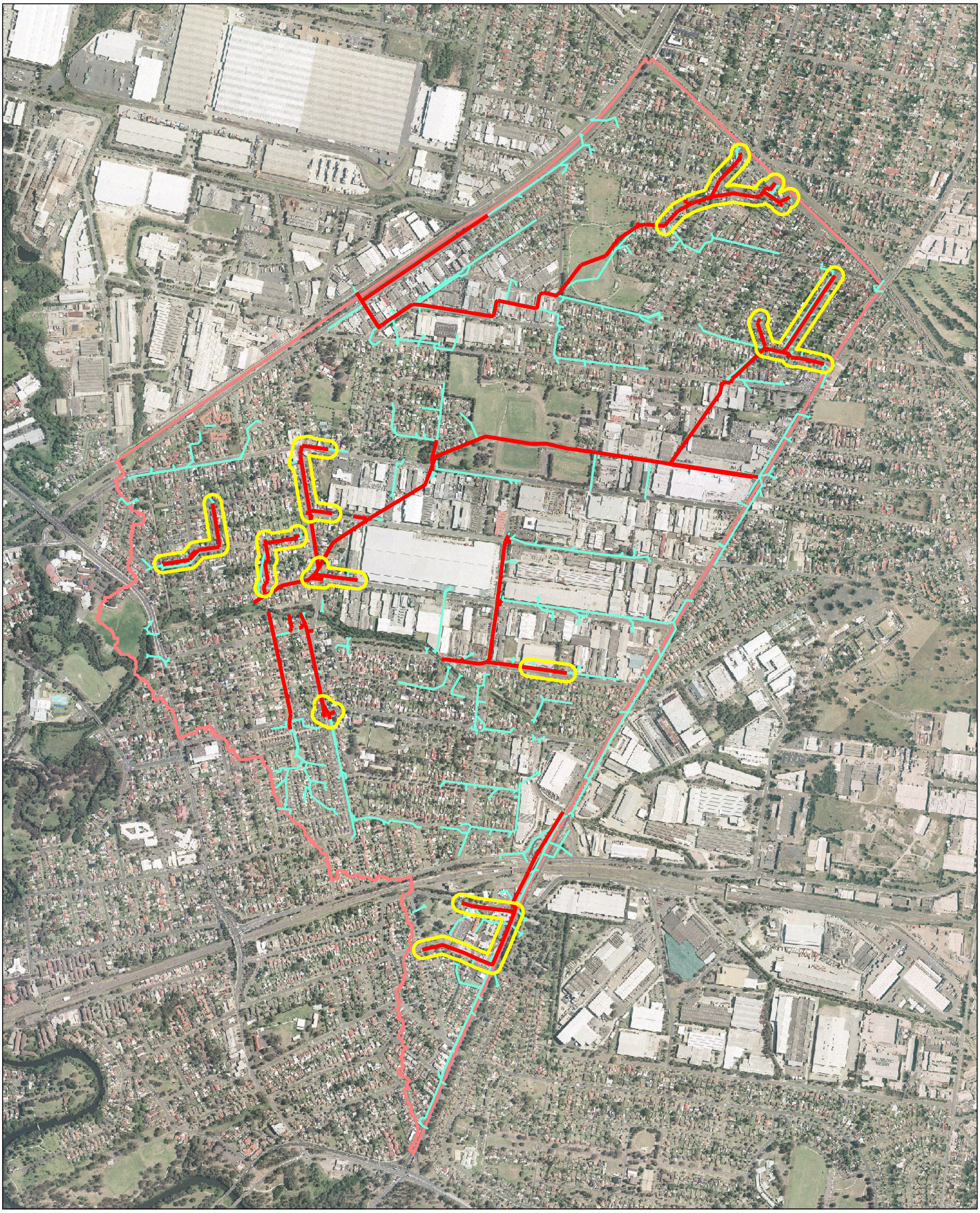
The limited drainage network to be modelled was selected by FCC staff, following a review of the data on the entire drainage network as well as the known drainage trouble spots. The modelled network typically comprised of pipes with a diameter greater than and equal to 900mm and their associated pits, with smaller pipes included as necessary at the known trouble spots to represent these locations in more detail. The modelled pipes, trouble spots and the entire pipe network are shown in **Figure 3-2**.

Following the importation of the pipe drainage network into the XP-STORM model, the open channel sections of the study area (including Burns Creek, Stimson's Creek and Barrass Drain) were incorporated into the model as 1D elements. The extent of the creek system modelled in XP-STORM was limited to approximately 200m upstream of Woodville Road (upstream boundary of Burns Creek), The Horsley Drive (downstream boundary of Burns Creek) and the Granville-Fairfield railway line (upstream boundary of Stimsons Creek).

3.2.2. Stormwater Network Parameters

- The layout, dimensions and levels of the stormwater network were extracted from the GIS layer prepared by FCC and imported into XP-STORM. Stormwater network parameters were then chosen on the following basis:
- Standard pressure loss K_u parameters were used for the pits, based on whether they were at the head of a stormwater line (where a value of 5 was used) or a junction or inlet pit (where a value of 1.5 was used). The loss coefficients were entered as pipe entry losses in XP-STORM.
- Kerb inlet pits were grouped into the following sizes in order to categorise their inlet flow relationships: 1.0, 1.2, 1.5, 1.8, 2.0, 2.4, 2.7, 3.0, 3.3, 3.6, 4.2m lintel length.

  XP-STORM requires the user to define the pit inflow location for each pit type. The default pit inflow relationships for 'Hornsby-type pits" in the DRAINS model database were therefore adopted in the XP-STORM model, with the relationships interpolated as required for non-standard DRAINS model pit sizes.
- The depth-inflow relationship for grated pits, including a number of specialised, high-inlet capacity grated pits within the study area were estimated based on concurrent weir and orifice flow equation calculations, with the lesser of the weir and orifice flow estimates (for a specified flow depth) being taken as the effective inlet inflow. The inlet dimensions, blockage due to the pit inlet grate and the number of side of the inlet exposed to flow were considered in the calculations.
- All pits with a surface inlet were set as being linked between the pit spill level and the 2D domain.



Legend

- XP-STORM Modelled Pipes
- Old Guildford Pipes All (Approx)
- Trouble Spots
- Old Guildford Study Area

Data Sources
Aerial Photo: AUSIMAGE

0 0.4
Kilometres

Sydney CBD

SKM Fairfield City

Figure 3-2 Model Pipe Network

GDA 1994 MGA Zone 56

Old Guildford Overland Flood Study Version 1

March 24, 2010
I:\ENVR\Projects\EN02296\Deliverables\Reports\Figures\Final Draft Report Figs\Figure 3-2 Model Pipe Network.mxd

- The inflows into pits with a surface inlet, including both on-grade pits and sag pits, were defined using a depth/inflow relationship, with the depth calculated from the 2D surface characteristics. This method was considered to be the most appropriate approach in XP-STORM, where the pits are linked to a 2D domain. The alternative method of defining an approach flow/pit inflow relationship produced unrealistic pipe flow results.
- Blocking factors for on-grade and sag pits adopted for the model were 30% in the 20 year ARI and 50% in both the 100 year and PMF events. The blocking factor was imposed in the model by the pit inlet Efficiency Factor. The blocking factor was not applied to pits at the upstream end of drainage lines which were truncated for the limited drainage network.

A summary of the pit and pipe data is contained in **Appendix B.**

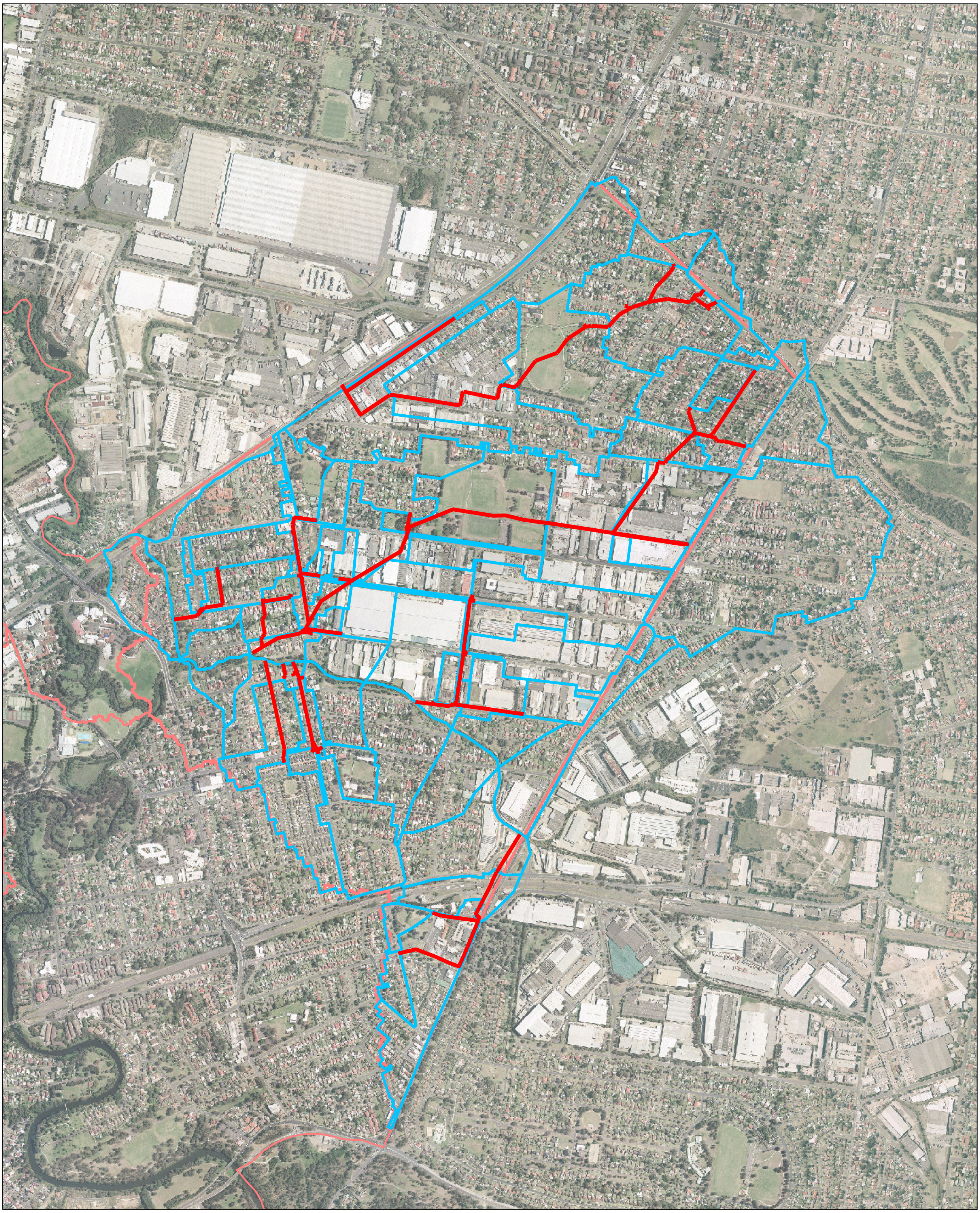
3.2.3. Sub-Catchment Data

Pit catchments were manually delineated by FCC for selected critical pits, based on topographic data, aerial photography, site observations and consideration of the likely connectivity of individual buildings to the kerb-and-gutter system and stormwater network. Model sub-catchments were only assigned to "critical pits" rather than all pits in the model. The critical pits were selected based on local knowledge of the study area, anecdotal evidence of problem areas and at most sag pits where ponding problems would occur. The pit sub-catchment boundaries were verified in the field by FCC staff.

Once the sub-catchment boundaries were finalised in GIS, the following parameters were measured or estimated for each sub-catchment:

- Sub-catchment areas were measured in GIS
- Impervious fractions were estimated using FCC LEP data on land use, plus estimated typical impervious fractions for each land use category.
- Runoff travel times (i.e. time of concentration) were estimated based on the length of each catchment and an estimated flow velocity of 1m/s for paved surfaces, and 0.5m/s for grassed surfaces.

The catchment layout is shown in **Figure 3-3** and detailed sub-catchment plans are presented in **Appendix D**. A summary of the sub-catchment data for the XP-STORM model is included in **Appendix B**.



Legend

- XP-STORM Sub-Catchments
- XP-STORM Modelled Pipes
- Old Guildford Catchment (Study Area)
- Fairfield City Council Sub-Catchments

Data Sources
Aerial Photo: AUSIMAGE

0 0.5
A4 1:20,000 Kilometres

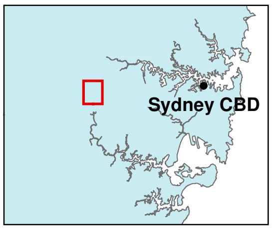


Figure 3-3 Model Catchment Layout

Old Guildford Overland Flood Study

Version 1

GDA 1994 MGA Zone 56

March 24, 2010
I:\ENVR\Projects\EN02296\Deliverables\Reports\Figures\Final Draft Report Figs\Figure 3-3 Catchment Layout.mxd

SINCLAIR KNIGHT MERZ SKM FairfieldCity Celebrating diversity

3.2.4. Hydrologic Parameters

The following hydrologic parameter values were adopted in the XP-STORM modelling:

- Rainfall Losses: Initial loss model and Horton continuing loss model. Refer to **Table 3-1** for parameter values.
- Runoff Generation: Unit Hydrograph – Time Area Method.

These are the same methods as the ILSAX model hydrologic method and the runoff method used in the Canley Corridor DRAINS model, and were adopted in order to maintain a common hydrologic modelling approach across the overland flood studies.

Table 3-1 Adopted Rainfall Loss Parameters

Losses	Parameter	Sub-Area	Value	Comment
Initial Losses	Depression Storage (mm)	Impervious Area Pervious Area	1mm 5mm	
	Manning's "n"	Impervious Area Pervious Area	0.014 0.03	
	Zero Detention (%)	Impervious Area	25%	
Continuing Losses (Horton Loss Model)	Max infiltration rate	Pervious Area	34.4mm/hr	Corresponds with DRAINS Soil Type 3 and Antecedent Moisture Condition 3*
	Min (Asymptotic) Infiltration		8.8mm/hr	
	Decay Rate of infiltration		0.0005/sec	Corresponds with DRAINS shape factor of 2 (h^{1}).*
	Max Infiltration Volume		0.0mm	

3.2.5. Design Rainfall

The storm events including the 20, 100, 200 and 500 year ARI events were modelled as Australian Rainfall and Runoff 1987 (ARR87) storms. Design storm time series were derived for these events based on the temporal patterns from *Australian Rainfall and Runoff Volume 2* (Institution of Engineers, 1987) for design storms in Australian Rainfall Zone 1, and from the average rainfall intensities produced by the FCC IFD data.

The average storm event rainfall intensity for storm events up to and including the 500 year ARI event are presented in **Appendix C**.

Design rainfall time series were derived for the Probable Maximum Precipitation (PMP) events, based on the Generalised Short Duration Method (GSDM) in *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short Duration Method* (BOM, 2003).

The Old Guildford study area is 3.1km^2. Although this is larger than the GSDM Ellipse A area of 2.6 km^2, since the study area is split into several sub-areas which drain to different outlets it was considered appropriate to adopt the Ellipse A PMP rainfall depths for all sub-catchments in the study area

The design rainfall time series for the 2,000 and 10,000 year ARI events were derived using the method for determining rainfall from extreme storm events (between 500 year ARI and the PMP) in *Australian Rainfall and Runoff –Volume 1 Book 6* (Institution of Engineers, 1997). A notional PMP event AEP of 10^{-7} was assumed given the catchment size and based on guidance in the method. A GSDM temporal pattern was adopted for all modelled extreme rainfall events, that is, the extreme storm events were assumed to have the same temporal pattern as the PMP event.

The average rainfall intensity for the extreme storm events are presented in **Appendix C**.

3.3. Two Dimensional Hydraulic Model Development

3.3.1. Model Topography

The topography of the catchment is represented in the model using a 2.5m grid. This level of precision in the grid is considered necessary in order to represent detailed flood behaviour in a fully developed catchment. Representing individual buildings and roads requires a fine grid structure to be able to represent the full flow width of the road and with grid spacing at least as small as a typical opening between properties.

The basis of the topographic grid used in the XP-STORM model is the ALS survey. **Figure 1-3** shows ground elevations within the Old Guildford catchment based on this data.

3.3.2. Open Channels

Open channels represented in the XP-STORM model include:

- The earthen section of Burns Creek within Fairfield LGA, in addition to concrete sections of Burns Creek in Bankstown LGA just upstream of Woodville Road;
- The section of Stimsons Creek within Fairfield LGA; and
- The open channel section of Barrass Drain downstream of Knight Park.

3.3.3. Building Polygons

This study considers buildings as solid objects in the floodplain. This means that buildings form impermeable boundaries within the model, and that while water can flow around buildings, it cannot flow across their footprint. This approach is consistent with the other overland flow studies that are being undertaken or have been completed within Fairfield LGA.

This approach is considered to be more appropriate than the alternative approach of including these areas within the active floodplain. Given the number of buildings within the floodplain, it was not considered practical to verify whether each building would be likely to provide storage of floodwaters during a flood (e.g. slab on ground or raised with a clear understorey space) or would not allow flood storage (e.g. raised on fill or raised with an impermeable understorey). Further, whether floodwaters enter a particular building may vary between flood events depending on factors such as whether doors or windows are open, and whether these openings are exposed to the flows. Assuming each building in the floodplain is impermeable to floodwaters is expected to give a conservative and satisfactory estimate of flood behaviour.

The buildings were removed using a GIS dataset of building polygons generated by SKM. The building polygons were then superimposed on the model grid and used to make model computational cells inactive.

3.3.4. Property Fencelines

Fencelines have not been explicitly represented in the model and floodwaters can flow across them freely. Although fences may obstruct overland flood flows in some parts of the catchment, experience indicates that representing fences in the hydraulic model requires making unvalidated assumptions about depths at which fences overflow or fail. Also, including fence lines would have required on-site identification of fence type, blockage and structural strength for individual properties. This was beyond the scope of this study.

The potential obstruction to flow caused by fences has generally been represented by increasing the cell roughness (Manning's n values) for certain land uses, as described in **Section 3.3.5**. The limitation of this approach is that the flood levels may be slightly overestimated and flow velocities slightly underestimated for flooding within properties depending on the actual locations of obstructions and the interaction of flood flows with these obstructions. However, this approach does preserve the likely typical flooding behaviour, in which floodwaters use the road corridor as the preferential flow path.

3.3.5. Surface Roughness

All parts of the study area within the XP-STORM model were assigned hydraulic roughness values according to land use type and ground cover as summarised in **Table 3-2**. These are based on standard reference values for Manning's n in *Open Channel Hydraulics* (Chow, 1959) and typical values used in previous FCC flood studies. The relatively high Manning's n values for the commercial, industrial and residential land uses account for expected obstructions such as minor structures (sheds, etc.) and fences.

- **Table 3-2 XP-STORM Model Grid Hydraulic Roughness Values**

Land Use Type	Assumed Manning's n Roughness
Roads or Car parks	0.02
Commercial / Industrial / High Density Residential	0.20
Open Space (with trees)	0.05
Open Space (grass only)	0.035
Medium and low density Residential	0.15
Heavily vegetated areas	0.10
Moderately dense vegetation along creek	0.08
Railway	0.04

3.4. Boundary Conditions

3.4.1. Local Sub-Catchment Inflows

These are flows originating from the local overland flow sub-catchments within the study area. Flow hydrographs for these sub-catchments are the hydrologic and drainage component of the XP-STORM model. These sub-catchments have been identified as "pit catchments" (those delineated upstream of a stormwater pit) and "non-pit catchments" (the remaining sub-catchments which are not attached to a pit).

Runoff generated in the pit catchments is input into the drainage network via the pit inlets. Flows in excess of the pit inlet capacity are input into the 2D model domain as point inflows, subsequently forming overland flow. The generation of these flows is discussed in **Section 3.2.3** and **Section 3.2.4**. The inflow series are applied as point inflows directly onto the grid. Applying inflows onto a two-dimensional grid in this way can overestimate the depth of the flooding at particular points. However, in this instance the sub-catchments are relatively small, and the error associated with this simplification was found to be small.

Pit surcharge flows, caused when flows in the drainage network exceed network capacity and spill out of the pits and into the 2D domain, would similarly form overland flow in the model.

Note that pits at the top of each truncated drainage line branch, which have relatively large catchments assigned to them, were modelled with zero blockage to allow a more realistic estimate of the pit inflows into the pipe network.

Flows from non-pit catchments are input directly into the modelled creek network, and therefore do not contribute to flooding in the model until the creek channel capacity is exceeded.

The location of the sub-catchment boundaries are shown in **Appendix D**.

3.4.2. Downstream Boundaries

Water level hydrographs were extracted from the existing draft mainstream Burns Creek TUFLOW model at The Horsley Drive and input as tailwater boundary conditions to the Old Guildford overland flood model. As an example, **Figure 3-4** shows the stage hydrograph taken from the Burns Creek TUFLOW model for the 100 year ARI storm event for a 2 hour duration.

The overland flood peak for the 2 hour event (which is the critical event in the downstream areas of the study area) coincides with the Burns Creek flood peak. Therefore, the overland flood modelling takes into account the overland flooding and the Burns Creek local flood peaks and the hydraulic interaction between the two events.

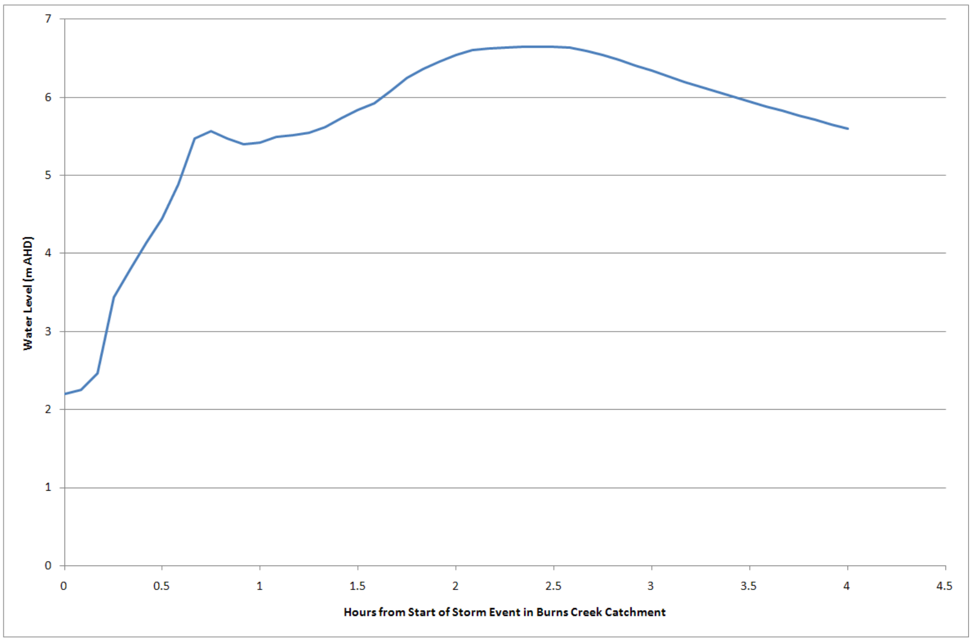
The adopted concurrent storm ARI's in the overland flooding and the mainstream creek catchment are summarised in **Table 3-3** and relate to the tailwater boundary conditions selected for each overland flood event. The overland flood storm event duration was assumed to be the same as that of the mainstream flood, for example, the 1 hour overland flood storm event was assumed to coincide with the 1 hour mainstream storm event.

3.4.3. Mainstream Channel Inflow Boundaries

Creek inflows at the upstream ends of the modelled sections of Burns Creek and Stimson's Creek were extracted from the TUFLOW model results for the *Burns Creek Flood Study - Draft* (SKM, 2008). The creeks act as hydraulic boundaries to the overland flow flood outlines being prepared for this study. The creeks are represented as 1D elements of the XP-STORM model. It is not intended to reproduce the mainstream flood levels and extents exactly, as this has been done as part of the *Burns Creek Flood Study*. However, similar flood levels in the creek are required in order to represent a realistic hydraulic boundary for the overland flooding and drainage network pipe flows.

Inflow hydrographs were extracted for the 30 minute, 1 hour, 1.5 hour, 2 hour and 3 hour storm events.

- **Figure 3-4 Water level hydrograph at downstream boundary (The Horsley Drive on Burns Creek) for 100 year ARI 2 hour mainstream flood event**



- **Table 3-3 Adopted Concurrent Storm Events**

Storm Event in Old Guildford Local Catchment	Flooding in Burns Creek
20 year ARI	20 year ARI
50 year ARI	50 year ARI
100 year ARI	100 year ARI
200, 500, 2000 and 10,000 year ARI and PMF events	100 year ARI

3.5. Initial Model Runs

3.5.1. Model Configuration and Stability

XP-STORM models, if configured appropriately, are typically numerically stable. However, models often require "debugging" during their initial development in order to rectify issues in the model which cause model instability and inaccuracy. Several such issues were encountered in the Old Guildford model. These issues are described below:

- Pit inlet flows were initially not being represented realistically. XP-Software recommended the use of pit configuration parameters "2D_WEIR_LEN" = 2, which resolved this issue.

- A review of the hydraulic grade line in the modelled pipes indicated that there was a reversal of flow in some pipes. The cause of this was identified as being the incorrect settings defining inflows at pit inlets, specifically due to the pit inflow relationships being defined as approach flow versus inflow. The model was interpreting this data in an unexpected manner. This problem was successfully rectified by defining the relationships as depth at the pit inlet versus inflow.
- Review of the hydraulic head time series at one particular pit revealed that the head was building up to 7m above the ground surface, which was considered unrealistic. The issue causing this problem was identified as the pit being a sealed pit, with a sub-catchment delineated and connected to the pit. Calculated flows for the sub-catchment which were greater than the outlet pipe capacity were being fed sub-surface into the pit, causing flows to accumulate in the pit chamber. The issue was resolved by defining the pit as an unsealed pit with a dummy pit inlet (inflow capacity of $0.01m^3/s$), which forced the model to input the sub-catchment flows at the pit surface.

3.5.2. Quality Assurance

A peer review of the model was undertaken in December 2008. XP-Software, the developers of XP-STORM, was engaged to undertake the review to ensure the model was configured appropriately. The recommendations from the review are contained in **Appendix I**.

3.6. Model Calibration and Verification

3.6.1. Historical Flood Events

Rigorous model calibration and verification of overland flood models cannot generally be carried out since direct measurements of overland flows are usually not available. There are no references available to correlate an observed flooding depth with a comparable storm event in the study area.

3.6.2. Trouble Spots

FCC has maps showing past flooding 'trouble spots', which identify the location of known problems. These maps have been used to in this study to validate the performance of the XP-STORM model, and as an indication of whether the 2D hydraulic model extends far enough into the catchment.

3.6.3. Previous Flood Studies

Burns Creek/Barrass Drain Catchment Management Study *Water Board* (1991)

This study (completed in 1991) used ILSAX to model the trunk drainage through the catchment and Burns Creek and HECCEL16 was then used to convert discharges into flood heights in open channels. The overflow from pipes were then converted into overland flow depths. There are several areas where overland flood levels correlate between the two models, mainly occurring at road crossings, as summarised in **Table 3-4**. The overflow depths through properties do not correlate as well as those near road crossings. This is most likely due to the lack of definition of the flowpaths in the 1991 model, and advances in modelling techniques.

- **Table 3-4 Comparison on flood depths – Barrass Drain Catchment Management Study**

Location	Barrass Drain 100 yr ARI overflow depth (m)	Old Guildford OLFS 100 yr ARI flood depth (m)
Lisbon St	0.2	0.22
Crown St	0.15	0.13
The Promenade	0.15	0.18
Carnation St	0.35	0.33

Shackel Avenue Drainage Analysis *Fairfield City Council* (1991)

This study (also completed in 1991) focused on upgrades needed to the pipe network in the area. It was found that the pipe network only had a capacity for the 2 year ARI flood, which they scheduled to upgrade to the 20year ARI flood. There was no quantification of overland flow depths or velocities. The study does map known flooding areas in the area of Shackel Avenue. All of these flooding areas were duplicated in this flood study, verifying the results.

44 Crown Street & 99-103 Seville Street, Fairfield *J Harrison Engineering Consultancy* (1992)

This study focuses on a development and its possible effects on flooding in the area. The site is directly over a section of Barrass Drain between Crown and Lisbon Streets. The report gives 100 year ARI flood peak height profiles with the existing surface, making it possible to determine flood depths. The flooding profile from this study follows that of the 1992 report, with shallower depths near Lisbon street, leading to depths near 0.4m at the rear of properties facing onto Crown street, and then flood depth decreases again by the time the flowpath reaches Crown Street. The 1992 report validates the work in this study, with a summary of the correlation of levels at certain cross sections from the 1992 report and their comparison shown in **Table 3-5**.

- **Table 3-5 Comparison on flood depths Crown and Seville Streets Study**

Cross Section (Distance from Crown St)	Crown & Sevillle Streets 100 yr ARI flow depth (m)	Old Guildford OLFS 100 yr ARI flood depth (m)
2 (20m)	0.4	0.42
4 (57m)	0.4	0.4
5 (87m)	0.16	0.2
7 (103m)	0.22	0.18

Burns Creek Flood Study – Draft *SKM* (2008)

Flood levels in Burns Creek in the Old Guildford overland flood model were compared against the mainstream TUFLOW model results from the *Burns Creek Flood Study – Draft* (SKM, 2008). A similar creek flood level was required in order to represent realistic tailwater conditions for the overland flooding entering the creeks, though it was not intended to exactly match the creek flood levels. The resulting flood extents and flood levels in the downstream section of the Old Guildford catchment were considered appropriate when compared to those of the mainstream flooding studies.

3.7. Sensitivity Analysis

3.7.1. Overview

Sensitivity analyses were conducted to determine the sensitivity of the flood behaviour to variations in the adopted model parameters. The following scenarios were assessed for the 100 year ARI event:

- Catchment surface roughness: The impact of a 5% increase in Manning's n in the 2D model domain was assessed;
- Stormwater pit blockage: An increase in blockage factor from the design value of 50% blocked in the 100 year ARI event to 75% blocked in the sensitivity analysis scenario (i.e. the pit inlet has 25% capacity of an unblocked pit inlet); and
- Increased rainfall intensity: An increase in the 100 year ARI rainfall intensity of 10%, to simulate the potential impacts of climate change on overland flooding.

The resulting flood depths were compared to the design 100 year ARI flood depths. The results are discussed below.

3.7.2. Impact of Increased Catchment Roughness

Flood depths are not sensitive to a 5% increase in catchment roughness. The change in flood level depth is typically less than +/- 30mm throughout the study area.

3.7.3. Impact of Increased Pit Blockage

Flood behaviour is typically insensitive to increased pit inlet blockage in the catchment, with the following exceptions:

- Flood depths are up to 200mm deeper in the industrial properties between Fairfield Street and Orchardleigh Street. This is most likely due to the pit blockages further upstream in the catchment not permitting as much flow to enter the drainage network, hence resulting in increased overland flow.

- Isolated areas of up to 150mm increased depth occur in the residential properties between Seville Street and Fairfield Street along Crown street..
- Minor decreases in flood levels of up to 50mm occur in the detention basin in Knight Park.

3.7.4. Impact of Increased Rainfall Intensity

As part of Councils plan to determine the effect of climate change on flooding, it was decided to alter the rainfall intensity in the catchment to reflect a possible climate change effect. Bewsher Consulting are preparing the Georges River and Prospect Creek Climate Change Sensitivity Assessment, which has recommended that an increase of rainfall by 10% to be used to simulate the effect of climate change on rainfall. Flood depths typically increased less than 50mm in the 100 year ARI after the 10% rainfall increase. There are some areas where depths increase by 50 – 100mm, and include the area south of Larra Street and east of Knight Park upstream to Orchardleigh Street. Flood depth increases of 100-150mm occur in the detention basins at Knight Park and Springfield Park and in isolated areas off Lisbon Street and Seville Street.

3.7.5. Conclusions from Sensitivity Analyses

In summary, flood behaviour in the overland floodplain in the Old Guilford XP-STORM model is not sensitive to variations in Manning's n. Therefore uncertainties about this parameter are not likely to affect the outcomes of any overland floodplain management measures which are implemented.

Flood levels are partially sensitive to an increase in rainfall intensity with some isolated increases of up to 150mm. This is most likely due to the infrastructure at the top of the catchment being undersized and the flowpath being confined by the surrounding topology. This water then enters the detention basins at Knight and Springfield Parks that accommodated the increased volume over the storms duration. The overland flowpath trough Lisbon and Seville Streets is confined by the surrounding topography, therefore leading to the increase in flood depths.

Increased pit blockage significantly affects the overland flood depths in the industrial precinct between Fairfield Street and Orchardleigh Street along Crown Street between Seville and Fairfield Streets. While some pit blockage has already been adopted in the design case, the occurrence of higher degrees of blockage is possible depending on catchment conditions and other circumstances which are not foreseeable. Council should take the potential increased flood depths into consideration in developing overland floodplain management strategies for Old Guildford.

4. Flood Model Results

4.1. Flood Depth and Velocity Mapping

Detailed flood depth and velocity mapping for the 20, 100 and 2,000 year ARI flood and PMF events are included in **Appendix E** and **Appendix F**. The mapping was developed by following the approach detailed below:

- The validated XP-STORM model was run for the 20, 100, 200, 500, 2,000 and 10,000 year ARI and PMF events for a range of storm durations from 30 minutes to 3 hours.
- The peak water level for each storm duration at each grid point in the model of the catchment was extracted and used to form a 'peak of peaks' grid of flood depth and velocity. The grid was then refined to remove shallow depth flooding as discussed in **Section 4.1.1.**
- The peak flood depth and velocity was mapped for the events described above. The 2,000 ARI event was selected for mapping as an intermediate flood event between the 100 year ARI and the PMF events.
- The spaces representing buildings in the floodplain which are surrounded by flooding were not filled in for the purposes of the flood depth mapping presented in this report.

4.1.1. Initial Flood Mapping

After stabilising and reviewing the model, the model was run in order to produce initial results and to map the extent of flooding. The process of mapping flood extent was then refined in order to provide the most relevant and useful information.

For instance, the initial flood depth maps produced in XP-STORM were manually refined to remove isolated patches and minor fingers of shallow-depth flooding of less than 150mm, and are not shown in the flood mapping presented in this report. The rationale for this is that such areas could be considered as areas of "nuisance" or "localised" flooding caused by local drainage rather than actual overland flooding. For example, ponding of stormwater within the roadway may not be a part of the main body of overland flood flows.

The 150mm threshold depth was chosen by FCC as it generally corresponds with the height of the road kerb, hence flow less than this depth would typically be contained in the roadway. Overall, there were very few areas of minor flooding that were removed from the flood mapping.

4.2. Overview of Flood Behaviour

The following findings on flood behaviour in the study area have been drawn from analysis of the model results and flood depth and velocity mapping.

4.2.1. General

- Overland flooding occurs in a number of individual flow paths, with the most significant overland flooding being located in the area to the north of Burns Creek. The mapping also shows significant flood depths and velocities along Burns Creek, which are caused primarily by mainstream flooding.
- The depth of flooding in road corridors is typically less than 0.3m. Some roads experience flooding greater than 0.5m deep, and include sections of Woodville Road, Fairfield Street and Orchardleigh Street. Other roads experience flooding greater than 1m deep, and include Railway Street, Larra Street, Montrose Avenue, Spring Street, Tangerine Street, Mandarin Street, Malta Street and Hanson Street.
- Depths of flooding through residential properties is typically less than 0.3 m in the 100 year ARI event, with some isolated areas of overland flooding above 0.5m depth.
- The large industrial warehouse complexes in Fairfield East are assumed to be blocked obstructions which are impervious to flow for the purposes of this study and hence cause significant obstruction to flow in the model. While the depth mapping indicates that the areas inside the complexes are flood-free, floodwaters may in reality enter the complexes, which is reflected in the risk precinct mapping.
- Properties identified as being in the high flood risk precinct caused by overland flooding are typically zoned industrial and commercial use.
- There are residential, commercial and industrial properties along Burns Creek that are within the high risk precinct caused by mainstream flooding.
- Overland flow velocities within properties in the 100 year ARI event are typically less than 0.5m/s, although there are some isolated areas with flow velocities up to and exceeding 1m/s. Flow velocities exceed 2m/s in some streets, in addition to the car park at Bunnings Warehouse in Villawood.

4.2.2. North of Fairfield Street

- Overland flooding in the 100 year ARI event occurs along the length of Barrass Drain with depths ranging from 0.15 to 1.6m in a flowpath that ranges from 15m to 100m in width in thr 100 year ARI event.
- There is a significant flowpath along the drainage network leading to Springfield Park detention basin with depths ranging from 0.15 to 0.7 m in the 100 year ARI event.

- The detention basins in Springfield Park and Knight Park reach their storage capacity in the 100 year ARI event.
- Water breaks out of the Springfield Park detention basin in the 2000 year ARI event with water heading towards the intersection of Junction Street and The Promenade.
- The railway embankment at Yennora Station is an obstruction to the natural course of overland flow in the northern part of the catchment. The drainage in this area is severely limited by the capacity of the culvert under the railway. Flows collect in the sag in Railway Parade at Yennora Station and ponds up to depths over 1.5m in the 20 year ARI event. In events larger than the 100 year ARI event the ponded floodwaters overflow to the south towards Barrass Drain.
- There are several areas where overland flow is restricted, causing over 1m depths of flooding. This includes between industrial premises south of Orchardleigh Street between Church and Broughton Streets and on Railway Street adjacent to the culvert passing under the railway embankment.

4.2.3. Between Burns Creek and Fairfield Street

- Upstream of Woodville Road, mainstream flooding from Burns Creek breaks out and flows overland over Woodville Road, rejoining the creek downstream of Tangerine Street. The flooding originating from this breakout is not differentiated from the local overland flooding in the catchment, and is included in the flood mapping.
- Due to the relatively flat topography downstream of Knight park detention basin, overland flow splits into several flowpaths with two paths flowing into Burns Creek near Seville Street and two other flowpaths, after converging, flowing into Stimsons Creek opposite James Street. These flowpaths are generally shallow at a depth of 0.15m, with a maximum depth occurring on properties on Victory Street and the east of James Street on the 100 year ARI event.
- There are several areas where overland flow is restricted, causing over 1m depths of flooding. This includes between industrial properties between Seville St and Burns Creek and behind an industrial premises in Lisbon Street between Mandarin and Crown Streets.
- Lisbon, Mandarin, Crown and Seville Streets are all major flowpaths, with flow leaving the road at the sag points to travel through properties.

4.2.4. South of Burns Creek

- Overland flow ponds behind properties in Normanby Street at depths up to 0.7m in the 100 year ARI event.

- Due to the flat topography of the area, a shallow, but widely dispersed, overland flowpath travels through the Villawood commercial precinct and crosses Woodville Road before entering Burns Creek.

4.3. Peak Flood Flows and Levels

The peak flow and peak levels at a number of selected roads in the catchment are reported in **Appendix G** for each ARI storm event. The flow given is the total overland flow passing across selected locations (not including pipe flows) at the peak of each ARI flood event. This is reported for the storm duration giving the highest peak flow for the selected event. The road locations are shown and detailed in **Appendix G**. Peak water levels in Knight Park and Springfield Park detention basins are also reported for each ARI in **Appendix G.**

The critical storm duration varies across the catchment area, and includes the 30 minute, 90 minute, 2 hour and 3 hour events. These are detailed in **Table G-1** and **Table G-2** in **Appendix G**.

4.4. Flood Risk Precincts

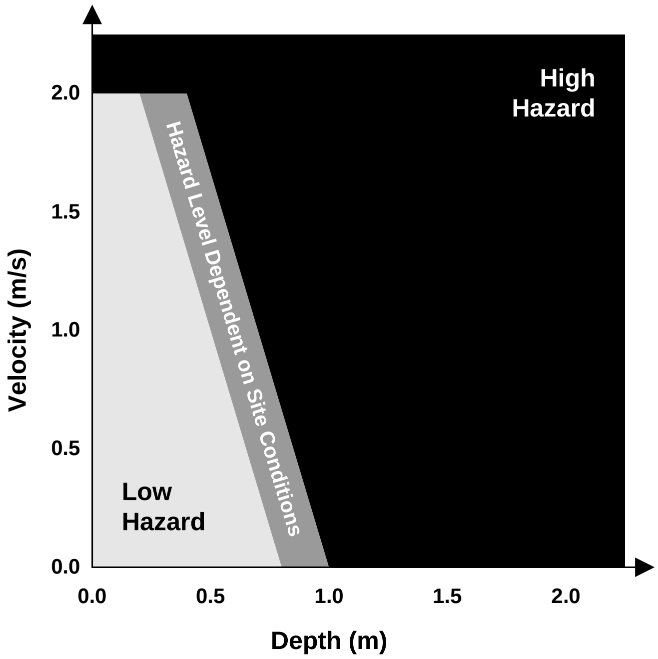
Flood risk precinct mapping has been prepared for the Old Guildford catchment and is included in **Appendix H**. The flood risk maps were developed from GIS analysis and interpretation of the 100 year ARI and PMF event peak depth and velocity grids, based on the FCC flood risk precinct categories described in **Table 4-1.** The flood risk precinct definitions were derived from the hydraulic hazard category diagram presented in the FDM, shown in **Figure 4-1**.

- **Table 4-1 FCC Flood Risk Precincts (Fairfield City Wide DCP, 2006)**

Risk Precinct	Description
High	The area of land below the 100 year ARI flood outline that is subject to high hydraulic hazard (for preparation of the draft flood risk precincts, this has been taken as the provisional 'High Hazard' zone Figure L2 of Appendix L in the NSW Floodplain Development Manual (2005) as reproduced in **Figure 4-1**.
Medium	Land below the 100 year ARI flood outline that is not in the High Risk Flood Precinct
Low	All other land within the floodplain (i.e. within the extent of the PMF) but not identified within either the High Risk or Medium Risk Precincts.

The flood risk precinct maps show solid precinct outlines, which have been reviewed and refined by FCC with consideration of flood evacuation requirements and other floodplain risk management issues. This has included some smoothing of the flood extent to account for local irregularities in the modelled ground surface, and street and property outlines.

- **Figure 4-1 Hydraulic Hazard Category Diagram (reproduced from Figure 6-1 in *NSW Floodplain* Development *Manual*)**



The Fairfield City Wide DCP requires areas which were initially assigned a medium flood risk rating but are surrounded by the high risk precinct to also be upgraded to a high flood risk. Issues relating to the evacuation of these areas, which may become cut off during flood events, necessitates that they be allocated a high flood risk. This process was undertaken for several properties along Railway parade and Larra Street, opposite to Yennora Station.

The flood risk of islands of low or no flood risk are not required to be upgraded, in accordance with the DCP. Examples include flowpaths from Fairfield Street to Seville Street both east and west of Crown Street.

As discussed in **Section 3.3.3**, buildings were treated as solid objects in the floodplain, within which floodwater cannot flow or be stored. The resulting flood depth and velocity maps show blank spots at these locations. Since Council provides the flood risk coding on the entire property and not just the building on it, the flood risk precinct maps required the appropriate risk to be shown across the entire property (as well as through the building footprint).

In order to do this, two methods were used:

- A line was drawn connecting each end of the flood profile across the building for standard residential buildings
- For larger developments ground levels across the property were reviewed and compared to the flood level. The risk precinct was extended across the property footprint if the ground level was lower than the flood level.

The flood risk mapping has identified the following about the extents of the precincts:

- 1,279 properties are included in the floodplain outline defined by the Probable Maximum Flood (PMF) flood event. This includes:
  - 267 parcels in the High Risk Precinct
  - 631 parcels in the Medium Risk Precinct
  - 381 parcels in the Low risk Precinct.
- There are high flood risk precincts located near the outlet of both Springfield Park and Knight Park detention basins due to the deep water in the 100 year ARI event.
- The high risk precinct adjacent to Lisbon Street is due to isolated deep ponding alongside an industrial premise
- The culvert underneath the railway line adjacent to Yennora Station is acting as a constraint on outflows from the sag in Railway Street. Therefore directly upstream of this culvert there is a high flood risk precinct directly related to the increased flooding depths at this location.
- There are two high flood risk precincts between The Promenade and Fairfield Street, east of Woodville Road due to obstruction to flows causing high flood water depths of up to 1.5m.
- Due to the depth of the channel, Stimsons Creek is designated a high risk precinct.
- The medium risk precinct follows the trunk drainage lines in the north-east section of the catchment and along Normanby Street south of Burns Creek.
- The medium risk precinct then spreads from the open channel section of Barrass Drain via a number of separate flow paths towards the south-west, flowing through properties in the south-west before intersecting Burns Creek and Stimsons Creek. The medium risk precinct also joins the sag at Yennora Station with Barrass Drain due to overflows from the sag at Yennora Station.
- The low risk precinct in the area north of Burns Creek is extensive due to the relatively flat terrain between Mandarin Street and Stimsons Creek causing floodwaters to spread out.
- In the north-east of the catchment, the low risk precinct closely follows the medium risk precinct.

The extent of the flood risk precincts reflects the topography of the catchment. That is, the precincts are relatively narrow in the upper parts of the catchment to the north and east and spread out across the flatter, lower parts of the catchment in the south and west. There is also a low-lying and flatter area through private properties between Fairfield Street and Seville Street, where the medium flood risk precinct is comparatively wider. These features of the topography explain the close similarity of the medium and low risk precincts in the upper catchment and why the low risk precinct outline spreads comparatively further in the lower parts of the catchment.

5. Conclusions

The Old Guildford Overland Flood Study has been successful in achieving its objectives, being:

- Define flood behaviour and identify the major overland flow paths within the Old Guildford catchment; and
- Identify properties at risk of local overland flooding and to prepare flood risk precinct maps.

The study's modelling approach consisted of a XP-STORM model that dynamically linked the 2D floodplain and 1D stormwater drainage network to assess flood behaviour and determine flood risk to properties. The model allows flows to be transferred in and out of the drainage network depending on the hydraulic conditions. This approach is considered to be able to efficiently produce a reliable representation of overland flood behaviour compared to those used by Council previously.

The amount and quality of the data available to define physical features in the study area, including the ground surface, open channels, pits and pipes and building footprints, was adequate for the development of the study models, though information on historical flood events in the study area was lacking. Council should, if practical, collect flood marks in overland flood areas following flood events to permit a more thorough model calibration and validation process for future overland flood studies.

Sensitivity analysis indicates that the overland flood behaviour is typically not sensitive to variation in floodplain roughness or increased rainfall intensity. Hence, overland flood depth estimates are not expected to be significantly impacted by uncertainties in these parameters.

Overland flood depths are likely to increase if a high degree of pit blockage occurs during a flood event. This should be taken into consideration during the development of overland flood risk management strategies during the floodplain risk management study phase.

The flood extent and risk precinct mapping has been prepared to present only the areas which are affected by significant levels of overland flooding. This has been achieved by removing "nuisance" flood areas, typically of depths less than 150mm from the mapping. The merit of this approach is that properties which are within or adjacent to these areas are not unduly coded with a flood risk.

The overland flood risk precinct delineation process itself has been developed over a number of years in consultation with FCC. It clearly and objectively defines the level of flood affectation of each part of the study area. Consideration of the flood event ARI in determining the flood risk, in addition to the hydraulic hazard posed by flood events to life and property, is particularly appropriate for the urban setting of the study area. By definition it provides an indication of the probability of a property being flood affected during a given time frame, in addition to the degree of hazard that it would experience.

The study has ultimately provided a good foundation from which to prepare the floodplain risk management study and plan as the next step in the floodplain risk management process.

6. Glossary

Term	Description
Annual Exceedance Probability (AEP)	Term used to describe the chance of a flood of a given or larger size occurring in any one year, expressed as a percentage. Eg. a 1% AEP flood means there is a 1% (ie. one-in-100) chance of a flood of that size or larger occurring in any one year (see ARI).
Australian Height Datum (AHD)	A common national plain of level corresponding approximately to mean sea level. All flood levels, floor levels and ground levels are normally provided in metres AHD (m AHD)
Average Recurrence Interval (ARI)	The long-term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.
catchment	A catchment is the area of land from which rainwater drains into a common point such as a reservoir, pond, lake, river or creek. In urban areas such as Fairfield, the majority of the rainwater is collected by gutters and pipes and then flows through stormwater drains into the stormwater system.
conveyance	A direct measure of the flow carrying capacity of a particular cross-section of a stream or stormwater channel. (For example, if the conveyance of a channel cross-section is reduced by half, then the flow carrying capacity of that channel cross-section will also be halved).
discharge	The rate of flow of water measured in terms of volume per unit time, eg. cubic metres per second (m^3/s). Also known as **flow**. Discharge is different from the speed/velocity of flow which is a measure of how fast the water is moving.
extreme flood	An estimate of the probable maximum flood, which is the largest flood likely to ever occur.
flood	A relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage as defined by the FDM before entering a watercourse.
flood awareness	An appreciation of the likely effects of flooding and a knowledge of the relevant flood warning and evacuation procedures.
flood hazard	The potential for damage to property or harm to persons during a flood or a situation with a potential to cause loss. In relation to this study, the hazard is flooding which has the potential to cause harm or loss to the community. Flood hazard is a key tool used to determine flood severity and is used for assessing the suitability of future types of land use.
flood level	The height of the flood described as either a depth of water above a particular location (eg. 1m above floor level) or as a depth of water related to a standard level such as Australian Height Datum (eg. flood level is 5m AHD).
flood liable/flood prone land	Land susceptible to flooding up to the PMF. The term flood liable or flood prone land covers the entire floodplain.

Term	Description
floodplain	The area of land that is subject to inundation by floods up to and including the PMF event.
Floodplain Development Manual (FDM)	Refers to the document dated April 2005, published by the New South Wales Government and entitled “Floodplain Development Manual: the management of flood liable land”.
Floodplain Risk Management Plan (FRMP)	A plan prepared for one or more floodplains in accordance with the requirements of the FDM or its predecessors.
Floodplain Risk Management Study (FRMS)	A study prepared for one or more floodplains in accordance with the requirements of the FDM or its predecessors.
flood risk	The chance of something happening that will have an impact. It is measured in terms of consequences and probability (likelihood). In the context of this study, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
flood risk precinct	An area of land with similar flood risks and where similar development controls may be applied by a Council to manage the flood risk. The flood risk is determined based on the existing development in the precinct or assuming the precinct is developed with normal residential uses. Usually the floodplain is categorised into three flood risk precincts 'low', 'medium' and 'high', although other classifications can sometimes be used. *High Flood Risk: T*his has been defined as the area of land below the 100-year flood event that is either subject to a high hydraulic hazard or where there are significant evacuation difficulties. *Medium Flood Risk:* This has been defined as land below the 100-year flood level that is not within a high flood risk precinct. This is land that is not subject to a high hydraulic hazard or where there are no significant evacuation difficulties. *Low Flood Risk:* This has been defined as all land within the floodplain (i.e. within the extent of the probable maximum flood) but not identified within either a high flood risk or a medium flood risk precinct. The low flood risk precinct is that area above the 100-year flood event.
flood study	A study that investigates flood behaviour, including identification of flood extents, flood levels and flood velocities for a range of flood events.
hydraulics	The study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.
hydraulic hazard	The hazard as determined by the provisional criteria outlined in the FDM in a 100 year flood event.

Term	Description
hydrology	The study of rainfall and runoff process; in particular, the evaluation of peak discharges, flow volumes and the derivation of hydrographs (graphs that show how the discharge or stage/flood level at any particular location varies with time during a flood).
local drainage	Term given to small scale inundation in urban areas outside the definition of major drainage as defined in the FDM. Local drainage problem invariably involve shallow depths (less than 0.3m) with generally little danger to personal safety.
local overland flooding	The inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
mainstream flooding	The inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
overland flow path	The path that floodwaters can follow if they leave the confines of the main flow channel or pipe system. Overland flow paths can occur through private properties or along roads.
peak discharge	The maximum discharge or flow during a flood measured in cubic metres per second (m^3/s).
probable maximum flood (PMF)	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation.
probable maximum precipitation (PMP)	The greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to the estimation of the probable maximum flood.
probability	A statistical measure of the expected chance of flooding (see ARI).
risk	See *flood risk.*
runoff	The amount of rainfall that ends up as flow in a stream. Also known as rainfall excess.
velocity	The term used to describe the speed of floodwaters, usually in metres per second (m/s).
water level	See *flood level.*
water surface profile	A graph showing the height of the flood (ie. water level or flood level) at any given location along a watercourse at a particular time.
zone of significant flow	The area of the floodplain where a significant discharge of water occurs during floods. Should the area within this boundary be fully or partially blocked, a significant distribution of flood flows or increase in flood levels would occur.

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Appendices

Appendix A Design, Work As Executed and Survey Drawings


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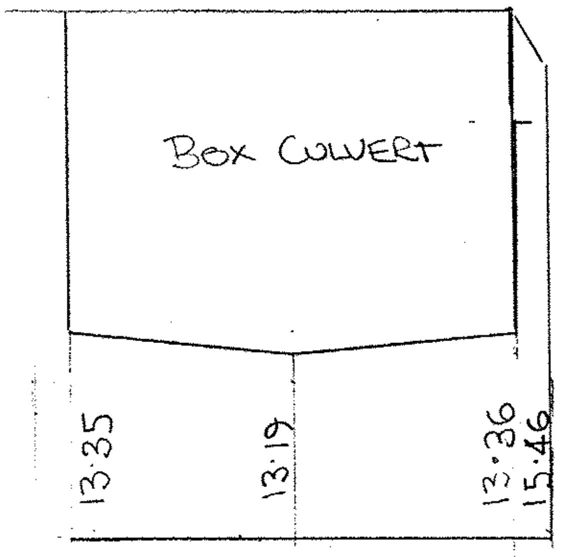

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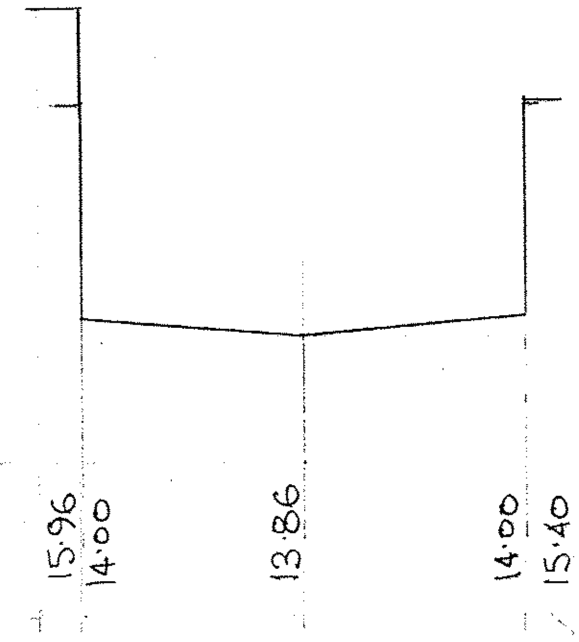

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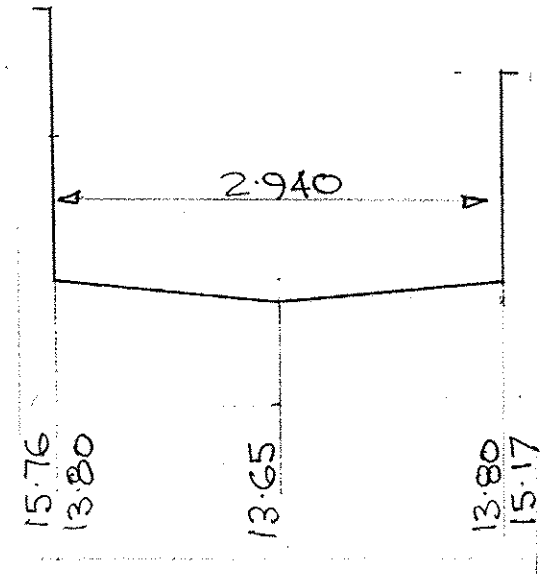

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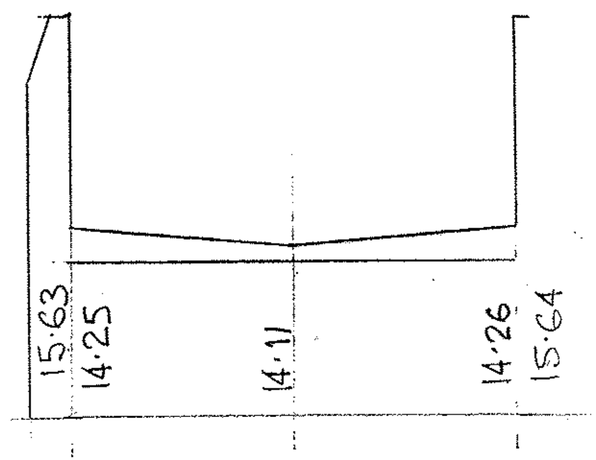

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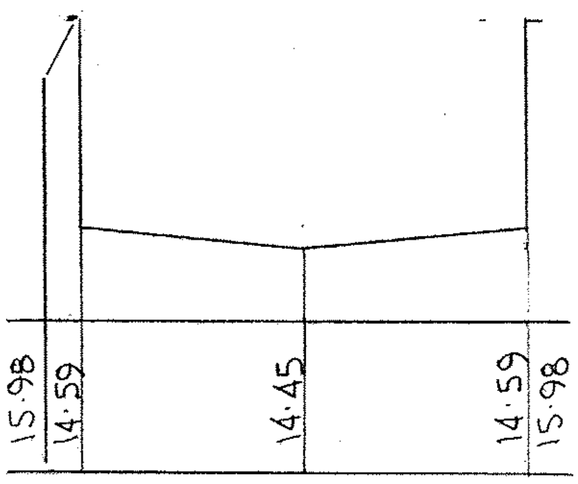

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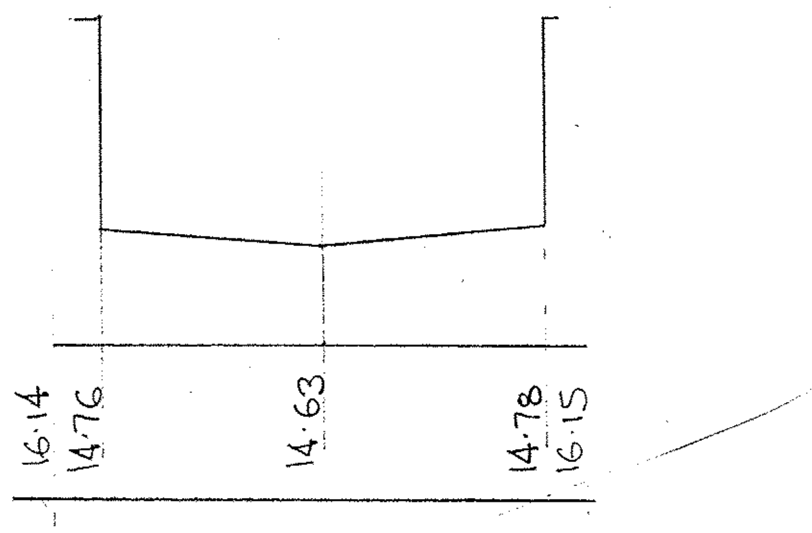

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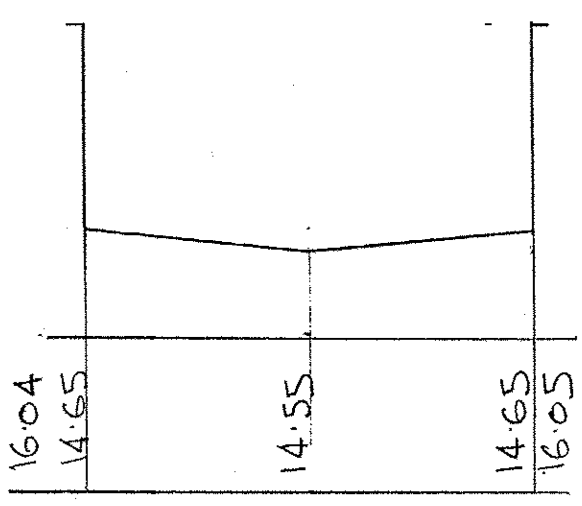

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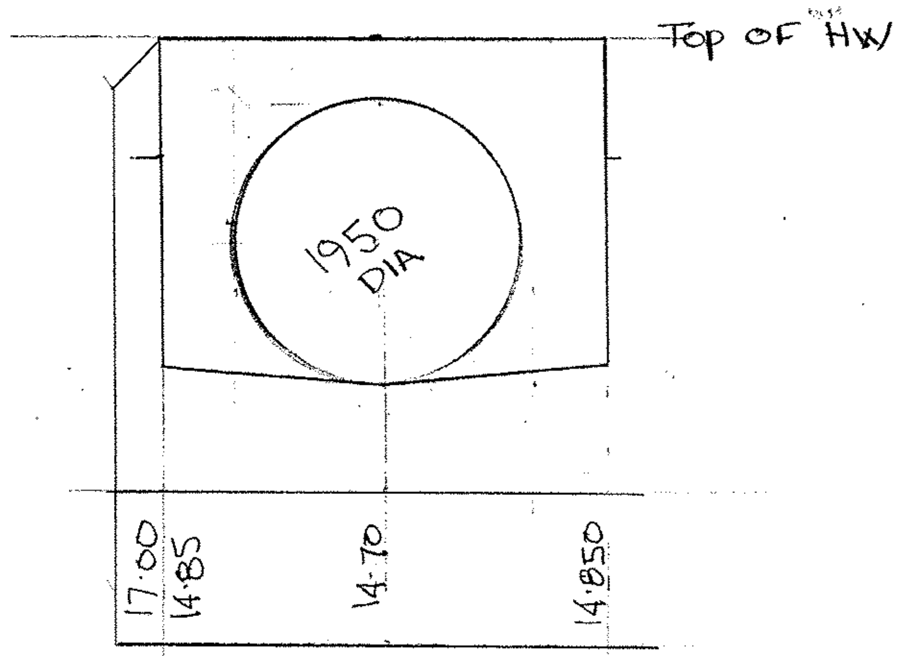
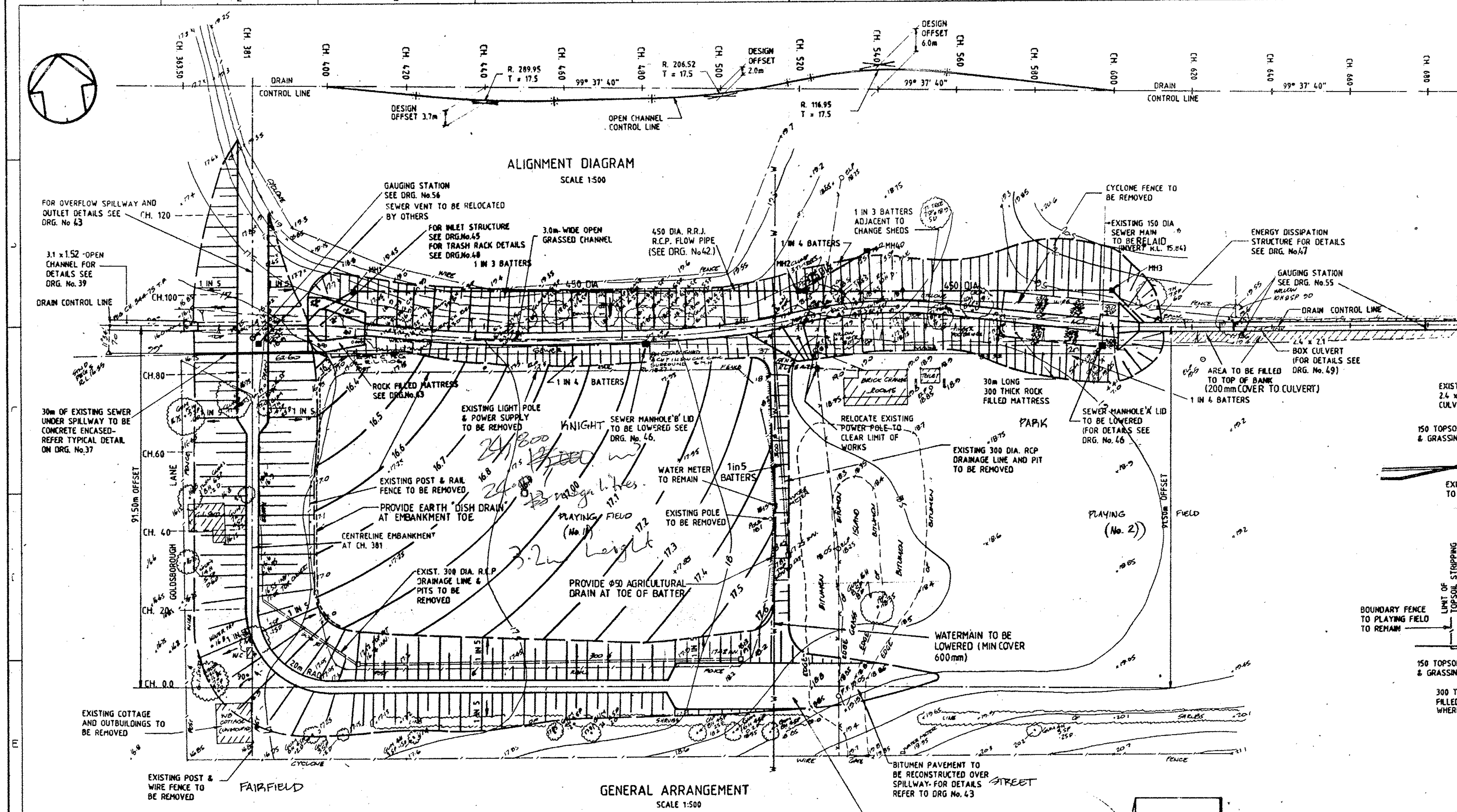


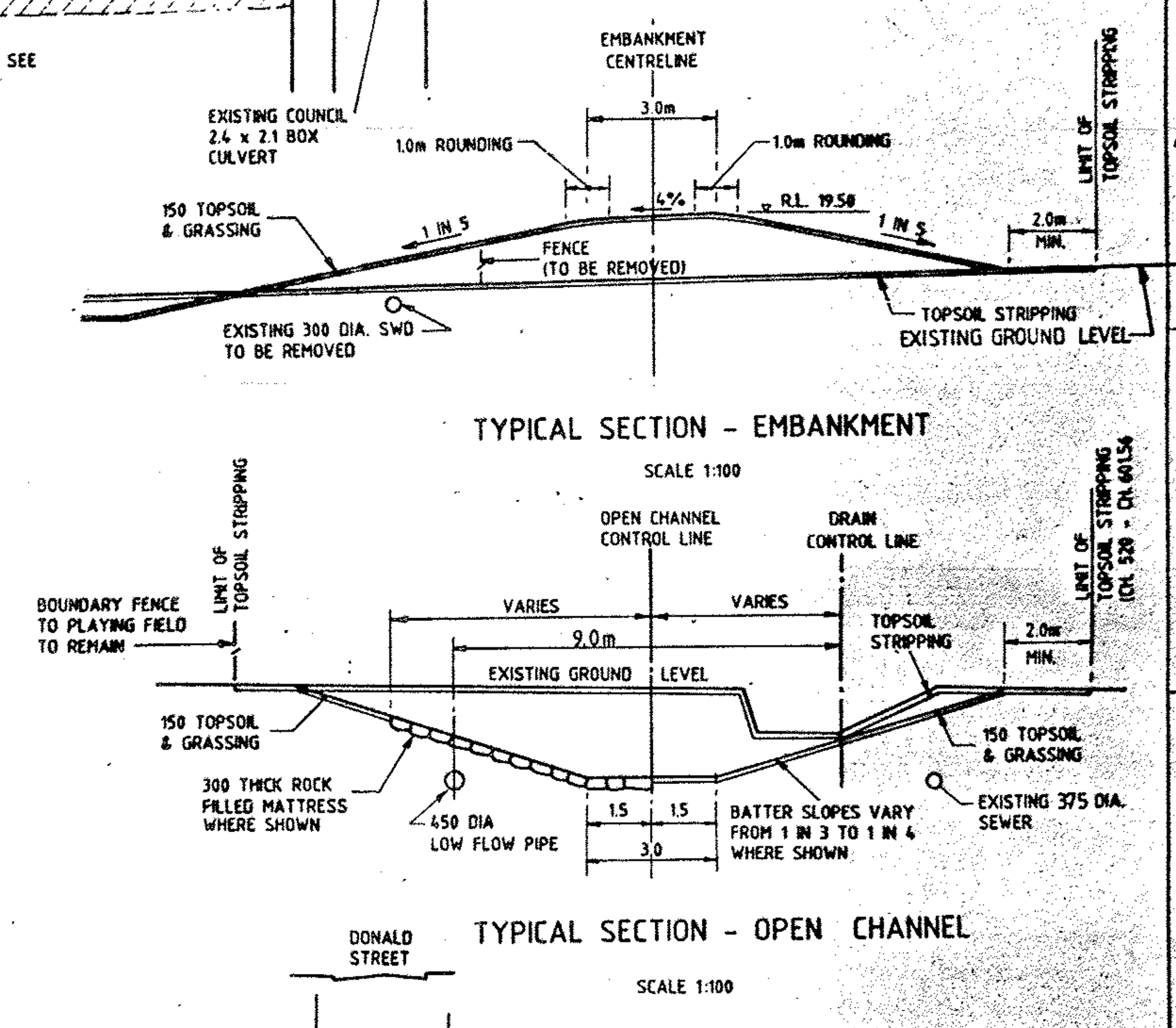


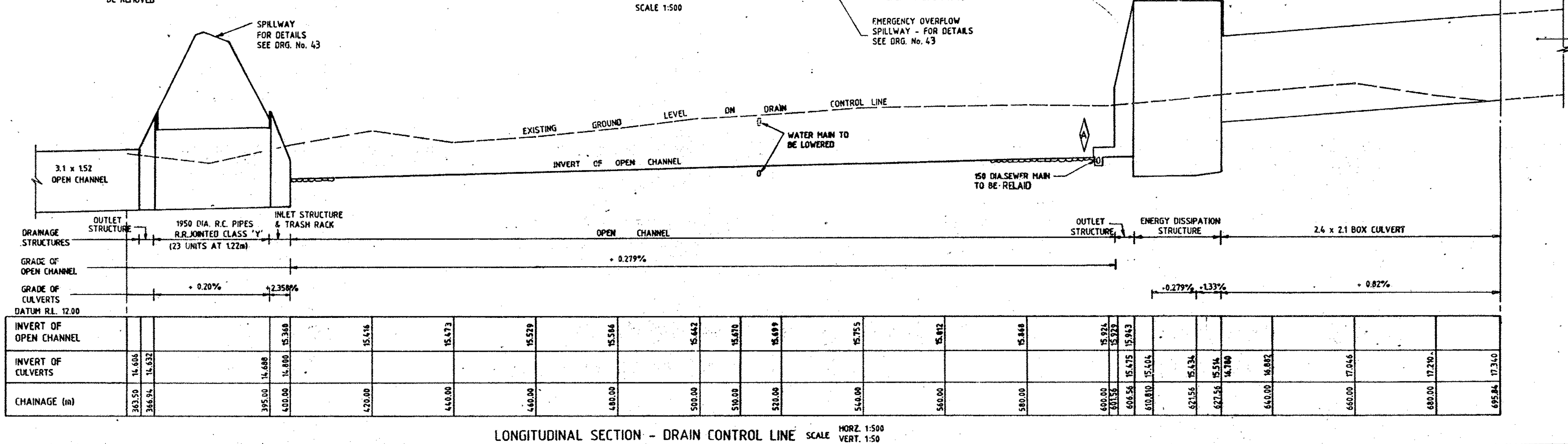
HYDRAULIC DESIGN DATA

RETURN PERIOD	Q IN (m^3/s)	Q OUT (m^3/s)	T.W.L. (m AHD)	STORAGE VOLUME(m^3)
20 YEAR	25.66	12.85	18.16	15 300
100 YEAR	30.33	15.48	18.87	24 800
1/2 P.M.F.	69.46	63.60	19.43	36 300

STAGE (mm AHD)	STORAGE (m^3)
14.69	0
16.0	110
17.0	3150
18.0	13000
19.0	26000
19.5	38000

NOTES
1. CATCHMENT MODELLED USING RORB-3
2. CATCHMENT AREA AT KNIGHT PARK = $9.54km^2$
3. PERCENTAGE IMPERVIOUS AREA = 56%
4. T.W.L. = TOP WATER LEVEL
5. 1/2 P.M.F. = HALF PROBABLE MAX. FREQUENCY EVENT





LONGITUDINAL SECTION - DRAIN CONTROL LINE SCALE HORZ. 1:500 VERT. 1:50

NOTES:
1. NO BOUNDARY SURVEY HAS BEEN UNDERTAKEN.
2. THE POSITION OF FEATURES SHOWN IS RELATIVE TO A PEGGED LINE SHOWN ON M.W.S. & D. BOARD SURVEY PLANS W.N.500034 SHEET 1 TO 10
THIS LINE IS TAKEN AS THE DRAIN CONTROL LINE AND THE GEOMETRY OF THAT LINE IS REPRODUCED HERE.
3. THE POSITION OF VISIBLE SERVICE STRUCTURES HAS BEEN SHOWN HOWEVER THE LOCATION OF UNDERGROWN SERVICES HAS NOT BEEN DETERMINED. THE CONTRACTOR SHALL DETERMINE THE LOCATION OF ALL EXISTING SITE SERVICES BEFORE COMMENCING CONSTRUCTION.
4. FOR GENERAL NOTES SEE DRG. No. 35

Cameron McNamara
Consultants
1ST. FLOOR AMPOL HOUSE
84 PACIFIC HIGHWAY
NORTH SYDNEY 2060
PHONE (02) 922 2777

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
A	PROVISION OF APRON SLAB AT OUTLET.		15/5/86

DESIGNED A.C. · DRAWN R.B. · CHECKED M.H.B.

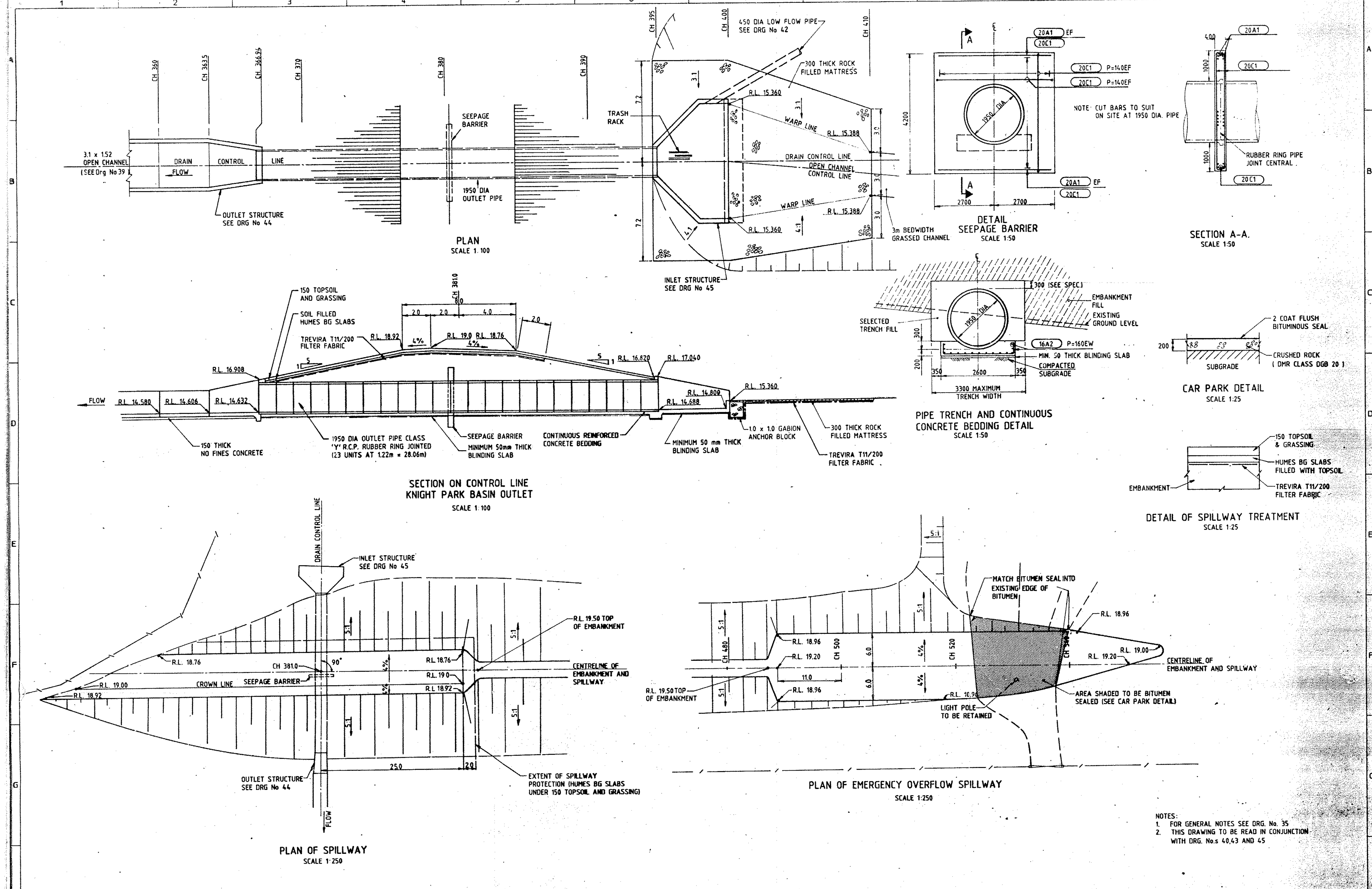
METROPOLITAN WATER SEWERAGE AND DRAINAGE BOARD
SYDNEY N.S.W.

W.N. 500034 · A/C No. · FILE No. 60/2012 · PROG. No. B1-4
APPROVED · CONSULTING ENGINEER
REVIEWED D.C. 29/4/86 · ACCEPTED 30/4/86 R.M.Ca...
PROJECT DESIGN ENGINEER · SENIOR DESIGNING ENG.

FAIRFIELD DRAINAGE
BARRASS DRAIN S.W.C. 20-STAGE 2
KNIGHT PARK BASIN
GENERAL ARRANGEMENT & LONG SECTION

DRAWING No. SWC20 40

CM. DRG. No. 48085
D-B-20
18



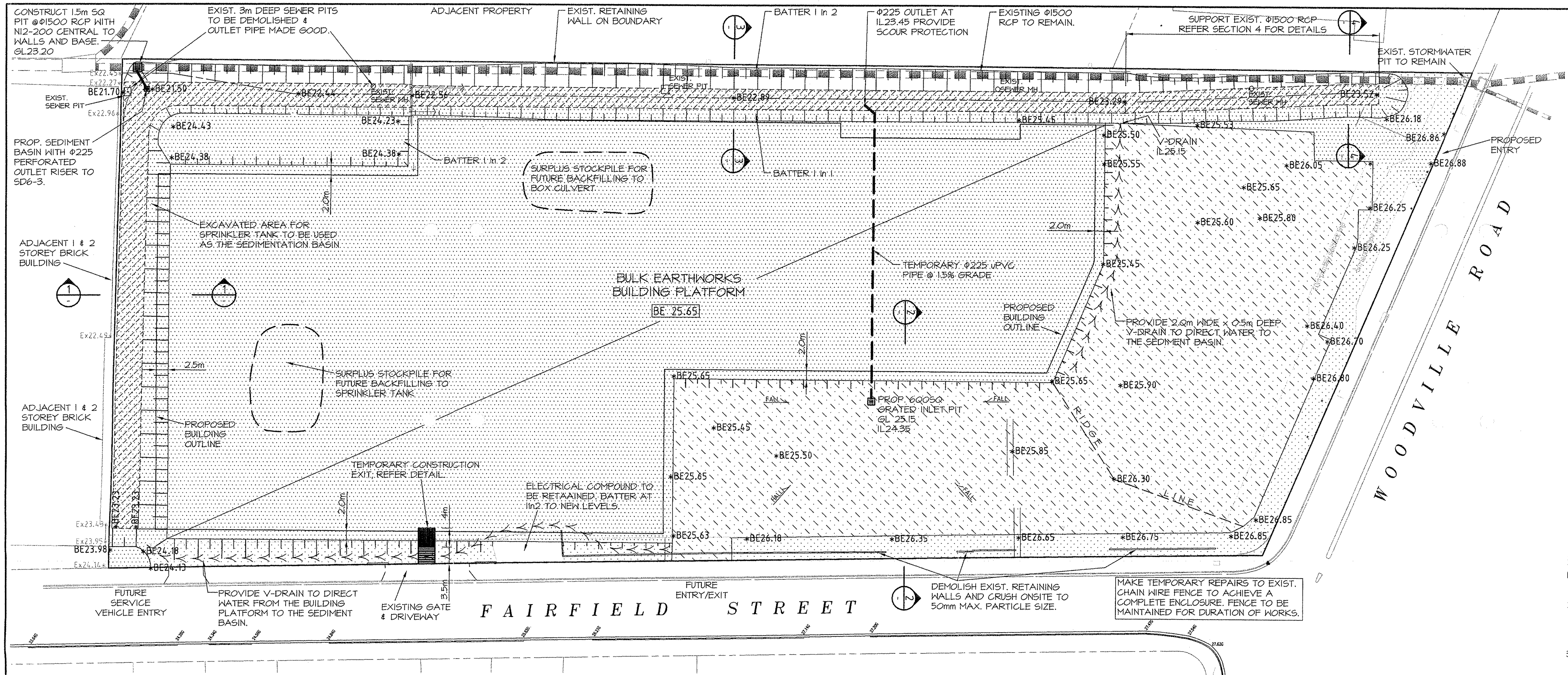
NOTES:

1. FOR GENERAL NOTES SEE DRG. No. 35
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRG. No.s 40,43 AND 45

Cameron McNamara Consultants, 1ST. FLOOR AMPOL HOUSE, 84 PACIFIC HIGHWAY, NORTH SYDNEY 2060, PHONE (02) 922 2777	DESIGNED RMcM / DRAWN A.C / CHECKED M.H.B.	METROPOLITAN WATER SEWERAGE AND DRAINAGE BOARD — W.N. 500034 — FILE No. 60/2012 — PROJ. No. B1-4	FAIRFIELD DRAINAGE BARRASS DRAIN S.W.C. 20-STAGE 2 KNIGHT PARK BASIN SPILLWAY & OUTLET DETAILS — DRAWING No. SWC20 43

LETTER | DETAILS OF AMENDMENT | APP'D | DATE

D-B-21



BULK EARTHWORKS PLAN

SCALE 1:500

BULK EARTHWORKS NOTES

1. IF GEOTECHNICAL ENGINEER IDENTIFIES AREAS CONTAMINATED WITH ROOTS AND OTHER ORGANIC MATTER, REMOVE TOP 200mm OF AFFECTED AREA AND STOCKPILE SEPARATELY. REPLACE WITH CLEAN FILL TO SPECIFICATION AND LEVELS SHOWN ON PLAN.

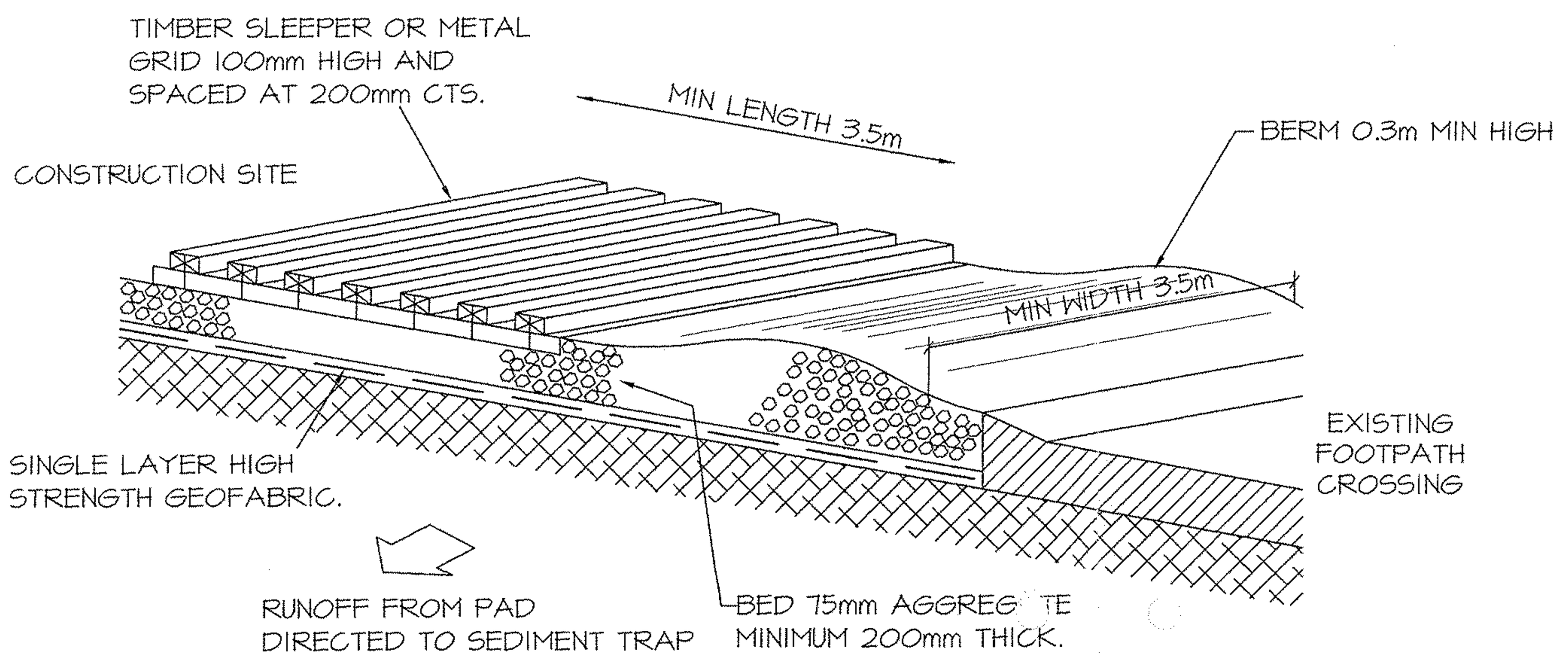
BULK EARTHWORKS LEGEND

- REMOVE AND STOCKPILE ALL EXISTING FILL DOWN TO SILTY CLAY LAYER. REPLACE FILL IN LAYERS OF 200mm THICKNESS IN ACCORDANCE WITH THE SPECIFICATION.
- BOX CULVERT & SPRINKLER TANK TO BE USED AS WATERCOURSE AND SEDIMENTATION BASIN.
- BASE OF SEDIMENTATION BASIN
- LANDSCAPED AREA
- Ø225 RCP STORMWATER PIPE
- PROPOSED GRATED SURFACE INLET PIT
- PROPOSED V-DRAIN
- *BE25.65 BULK EARTHWORKS LEVEL
- Ex22.96* EXIST. SURFACE LEVEL

ENVIRONMENTAL SITE MANAGEMENT NOTES :

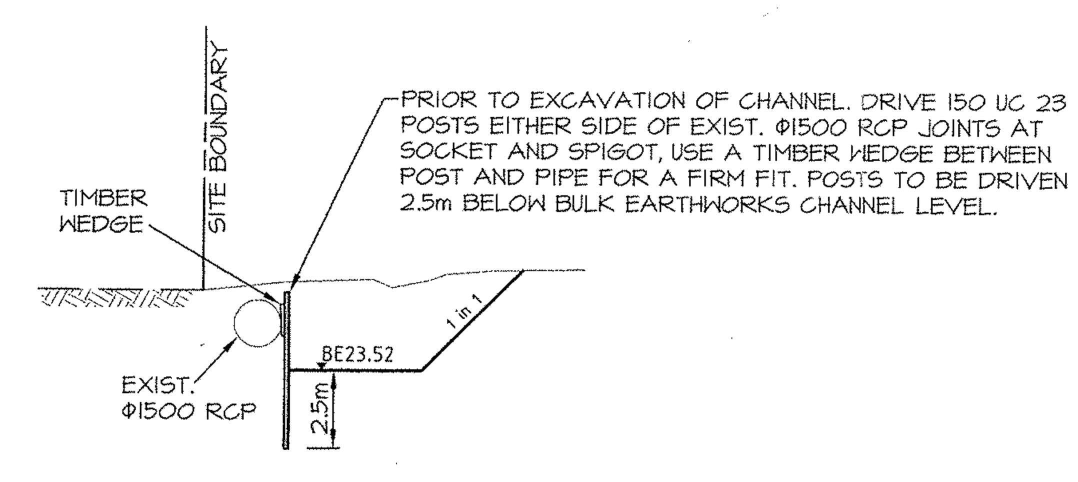
1. CUT DOWN AND REMOVE ALL TREES AND TREE ROOTS, INCLUDING STUMPS, OFFSITE. GRUB OUT ROOTS
2. EROSION & SEDIMENT CONTROLS TO BE INSTALLED IN ACCORDANCE WITH COUNCIL'S SPECIFICATIOIN & THE NSW DEPARTMENT OF HOUSING "BLUE BOOK" FOR REFERENCES TO STANDARD DRAWINGS "SD" REFER TO "BLUE BOOK".
3. RETAIN ALL EXISTING GRASS COVER WHEREVER POSSIBLE. TOPSOIL FROM ALL AREAS THAT WILL BE DISTURBED TO BE STRIPPED AND STOCKPILED WITH A SEDIMENT FENCE PLACED DOWNHILL.
4. SEDIMENT & EROSION CONTROLS MUST BE IN PLACE PRIOR TO THE COMMENCEMENT OF ANY EARTHWORKS OR DEMOLITION ACTIVITY.
5. INSTALL INLET FILTERS TO SD6-12 TO ALL INLET PITS LIKELY TO COLLECT SILT LADEN WATER, UNTIL SURROUNDING AREAS ARE PAVED OR REGRASSED.
6. ALL SILT FENCES & BARRIERS ARE TO BE MAINTAINED IN GOOD ORDER.
7. IT IS THE RESPONSIBILTY OF THE CONTRACTOR TO ENSURE THAT ALL MEASURES ARE TAKEN DURING THE COURSE OF CONSTRUCTION TO PREVENT SEDIMENT EROSION AND POLLUTION OF THE DOWNSTREAM SYSTEM, SUPERVISING ENGINEER SHOULD BE CONTACTED IF IN DOUBT. ALL SEDIMENT CONTROL STRUCTURES TO BE INSPECTED AFTER EACH RAINFALL EVENT FOR STRUCTURAL DAMAGE AND ALL TRAPPED SEDIMENT TO BE REMOVED TO A NOMINATED SOIL STOCKPILE SITE.
8. STOCKPILES OF LOOSE MATERIALS SUCH AS SAND, SOIL, GRAVEL MUST BE COVERED WITH GEOTEXTILE SILT FENCE MATERIAL. PLASTIC SHEETING OR MEMBRANE MUST NOT BE USED.
9. ALL VEHICLES LEAVING THE SITE MUST PASS OVER A STABILISED SITE ACCESS (SD6-14) TO SHAKE OFF SITE CLAY AND SOIL. IF NECESSARY WHEELS AND AXLES ARE TO BE HOSED DOWN. BALLAST IS TO BE MAINTAINED & REPLACED AS NECESSARY.
10. ALL DISTURBED AREAS ARE TO BE SEEDED & FERTILISED IN ACCORDANCE WITH CURRENT LOCAL AUTHORITY REQUIREMENTS.
11. ALL DISTURBED AREAS ARE TO BE STABILISED AS SOON AS PRACTICAL.
12. THE PROJECT MANAGER IS TO INFORM ALL CONTRACTORS AND SUB-CONTRACTORS OF THEIR OBLIGATIONS UNDER THE EROSION AND SEDIMENT CONTROL PLAN.

DEVELOPMENT CONSENT APPROVED PLANS
DA 1244/06



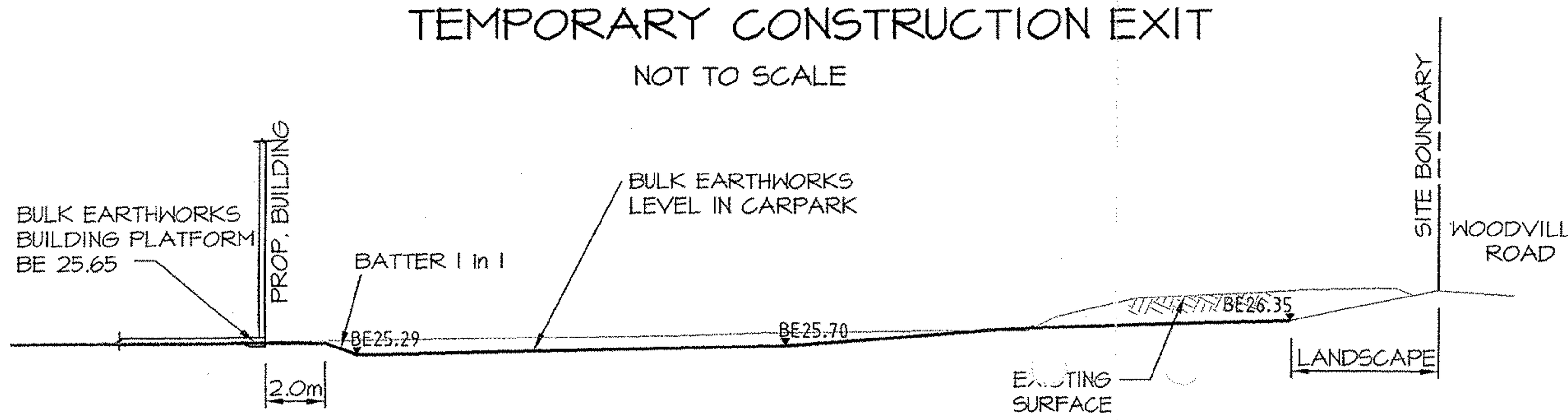
TEMPORARY CONSTRUCTION EXIT

NOT TO SCALE



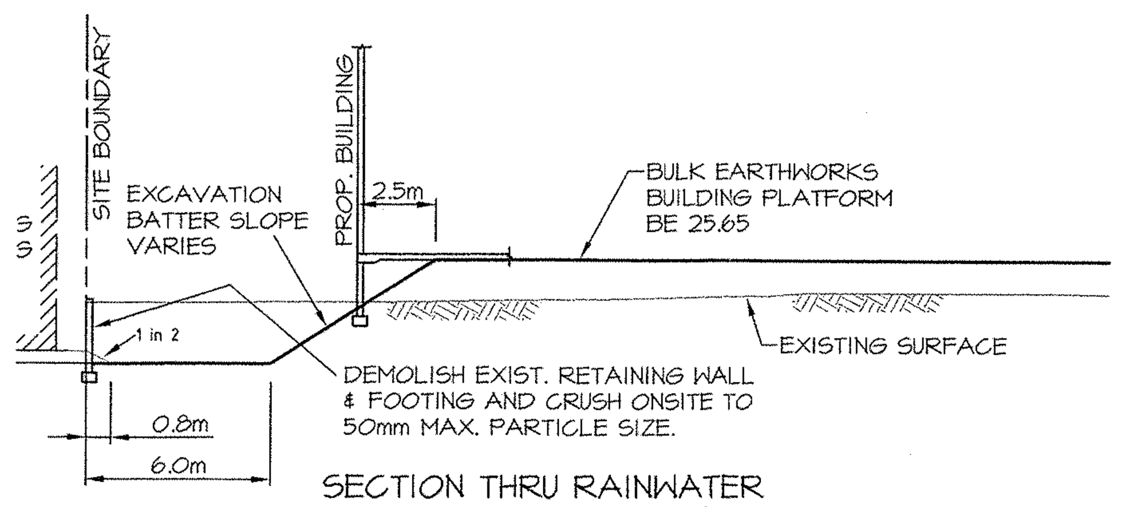
SECTION THRU CULVERT

SECTION 4
SCALE 1:200



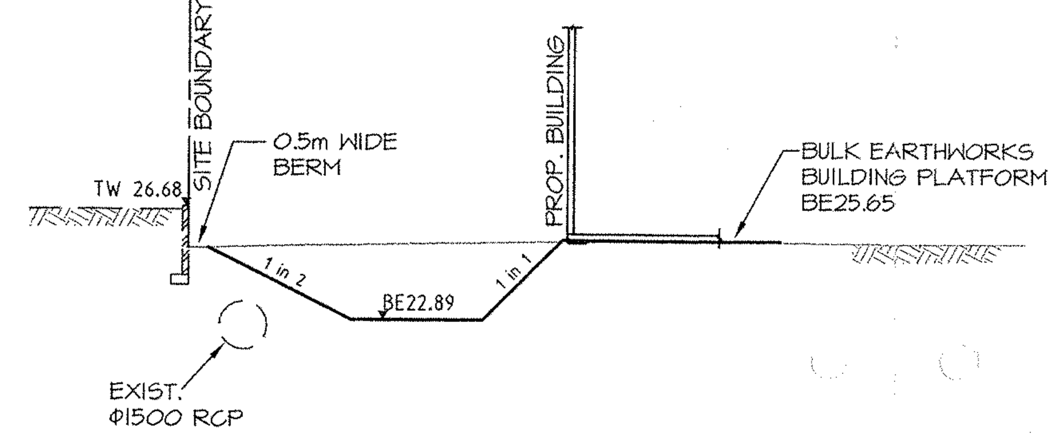
SECTION THRU CARPARK AREA

SECTION 2
SCALE 1:200



SECTION THRU RAINWATER TANK UNDER DRIVEWAY

SECTION 1
SCALE 1:200



SECTION THRU CULVERT

SECTION 3
SCALE 1:200

SCALE 1:500

PRELIMINARY DRAWING

NOT TO BE USED FOR CONSTRUCTION PURPOSES

AMDT	DATE	BY	DESCRIPTION
P2	05.10.06	TM	PRELIMINARY ISSUE - FOR INFORMATION ONLY
P1	03.08.06	TM	PRELIMINARY ISSUE - FOR INFORMATION ONLY

NORTH POINT

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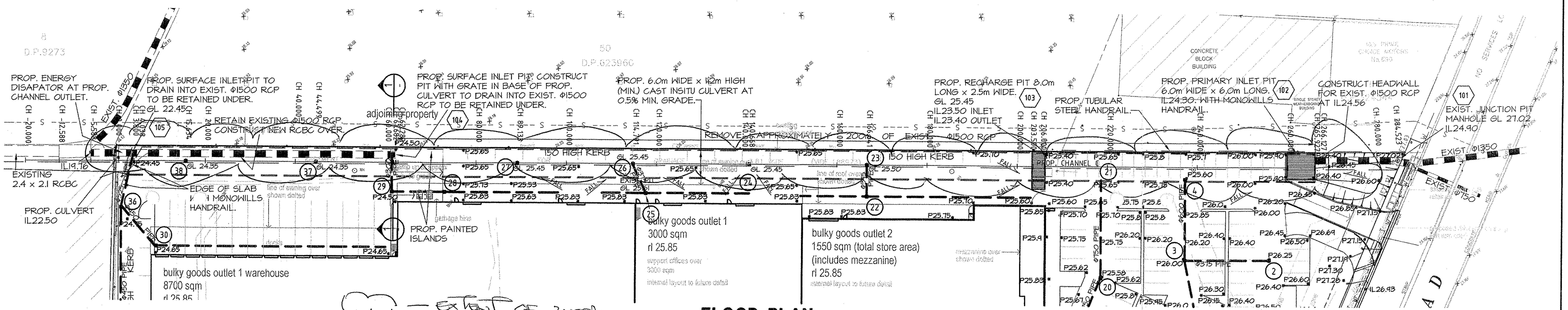
Fax (02) 4228 0599
wgong@jonesnicholson.com.au

DRAWING
BULK EARTHWORKS AND SEDIMENT EROSION PLAN

SCALE (A1 SHEET)	DATE	DESIGNED	DRAWN
1:500	Aug '06	GT/TM	TM
SCALE (A3 SHEET) 1:1000	APPROVED		

PROJECT
PROPOSED BULKY GOODS WAREHOUSE DEVELOPMENT 'FAIRFIELD GATEWAY'
702 Woodville Rd, Fairfield East
For: Bing Lee Electrics Pty Ltd

JOB No.	DRG. No.	AMDT.
050644	BE 1	P2



FLOOD PLAN

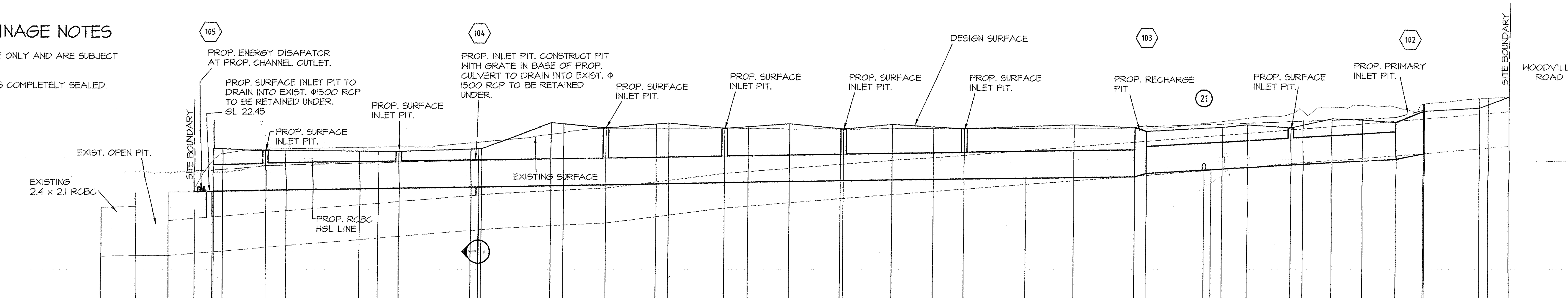
SCALE 1:500

SYMBOLS & NOTATIONS

• P25.40	DESIGN SPOT LEVEL
GL 35.05 IL34.75	DRAIANGE PIT NOTATION AND LEVELS
▪	PROP. SURFACE INLET PIT (REFER DETAIL)
36.00	EXISTING SURVEY CONTOUR
+27.03	EXISTING SURFACE LEVEL
— — —	PROPOSED STORMWATER DRAINAGE LINE
	EXIST. STORMWATER PIT & PIPE

STORMWATER DRAINAGE NOTES

1. LEVELS SHOWN ARE INDICATIVE ONLY AND ARE SUBJECT TO DETAILED DESIGN.
2. NO OSD REQUIRED AS SITE WAS COMPLETELY SEALED.



CHANNEL GRADE (%): 0.5% · 0.5% (PROP. 6.0m WIDE x 1.2m (MIN.) RCBC) · 3.3% · 1.3% · 4.2%

EXISTING GRADE (%): 0.54% EXISTING 2.4mx2.1m RCBC · EXIST. 1.77% EXIST.Ø 1500 · EXIST. 1.11% EXIST.Ø 1500 · EXIST. Ø1500 TO BE REMOVED · EXIST. 1.75% EXIST.Ø 1500

DATUM (m) 12

CHAINAGES	PROP. RCBC CHANNEL INVERT LEVELS	EXIST. Ø1500 RCP INVERT LEVELS	DESIGN SURFACE LEVELS	EXIST. SURFACE LEVELS	HGL RCBC CHANNEL	HGL SURFACE FLOWS
-20.000		19.72				
-12.588		19.76				
-5.600	19.760	19.76				
0.000	22.490 / 22.500		22.45	22.616	23.277	
3.800	22.45		22.45	23.882	23.418	
4.038	24.45		24.45	23.927		
6.0 *		19.95				
15.634	22.573			24.419	23.658	
20.000	22.593			24.440		
36.0 *		20.48				
40.000	22.685			24.540		
44.50	22.705		24.35	24.552	23.860	
60.000	22.776			24.745		
61.682	22.784			24.775	23.953	
62.282	22.787	20.95	24.50	24.800		
66.0 *		21.02				
77.200			25.65			
80.000	22.868			25.216		
89.133	22.909		25.45	25.411	24.112	
100.000	22.959			25.429		
102.70			25.65			
114.791	23.027		25.45	25.438	24.227	
120.000	23.051			25.441		
129.00			25.65			
140.000	23.142			25.432	24.342	
140.668	23.145		25.45	25.431		
151.140			25.65			
160.000	23.234			25.485		
166.641	23.264		25.50	25.500	24.464	
180.000	23.325			25.531		
190.30			25.70			
203.500	23.442		25.60	25.584	24.642	25.610
206.0	23.598		25.450	25.591	25.681	25.650
218.500			25.60			
220.000	23.772			25.846	24.961	25.680
222.40			25.65			
228.0			25.77			
237.40			25.65			
240.000	24.036			26.349	25.313	25.940
246.200			26.050			
252.80			26.00			
260.000	24.300		25.90	26.557		26.110
265.927	24.551			26.694		
266.127	24.560	24.56	26.40	26.706	25.751	26.45
278.096			26.55			
280.000	24.816			26.976		
284.523	24.900	24.90	27.02			

LONGITUDINAL ALONG PROP. CHANNEL

SCALE 1:500 (HOR)
1:100 (VER)

NOTE: * DENOTES APPROXIMATE CHANAGE FOR EXIST. Ø1500 RCP.

DEVELOPMENT CONSENT APPROVED PLANS
DA 1244/06
Note: A separate Construction Certificate shall be approved prior to works commencing on site. FairfieldCity

SCALE 1:500 (0 10 20 30 40 50m)

PRELIMINARY DRAWING

NOT TO BE USED FOR CONSTRUCTION PURPOSES

AMDT	DATE	BY	DESCRIPTION
3	12.05.06	TM	ISSUED WITH REVISED FLOOD STUDY
2	16.2.06	MD	CARPARK AMENDED ISSUED FOR DA RE-SUBMISSION
1	20.12.05	TM	ISSUED FOR DA

NORTH POINT

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DRAWING
FLOOD STUDY
CONCEPT DRAINAGE PLAN

SCALE (A1 SHEET)	DATE	DESIGNED	DRAWN
1:500	Dec '05	AW/GT	TM
SCALE (A3 SHEET) 1:1000	APPROVED		

PROJECT
PROPOSED BULKY GOODS WAREHOUSE DEVELOPMENT 'FAIRFIELD GATEWAY'
702 Woodville Rd, Fairfield East
For: Bing Lee Electrics Pty Ltd

JOB No.	DRG. No.	AMDT
050644	SK01	3

Appendix B Model Stormwater Pit, Pipe and Sub-Catchment Data

Table B-1 Old Guildford XP-STORM Node and Pit Data

Note: Table below includes data for modelled pits and nodes, including dummy nodes

Name	Node X	Node Y	Ground Elevation m AHD	Inlet Capacity Flag (Note:0 = sealed pit; 1 = pit inlet)	Approach Depth Reference (Note: all pits rated by approach depth)
A/400/10	313820.207	6251386.27	38.75	1	Sag 2.0m lintel
A/10/245	313817.717	6251379.961	38.65	1	
A/10/240	313814.418	6251383.51	38.65	0	
A/390/20	313795.642	6251358.085	37.5	1	Sag 2.0m lintel
A/390/10	313787.166	6251363.734	37.36	1	Sag 2.0m lintel
A/10/235	313784.84	6251369.923	37.1	0	
A/380/40	313772.125	6251432.88	36.85	1	Sag 2.0m lintel
A/380/30	313768.299	6251427.351	36.85	1	Sag 2.0m lintel
A/380/20	313756.005	6251409.465	36	0	
A/380/10	313743.092	6251417.393	35.68	0	
A/10/230	313733.518	6251403.416	34.98	0	
A/10/225	313723.656	6251388.769	34.6	0	
A/10/220	313706.134	6251387.279	34.1	0	
A/10/215	313651.291	6251396.168	33.52	1	Sag 2.4m lintel
A/10/210	313637.619	6251398.357	33.4	1	Sag 2.4m lintel
A/370/50	313658.258	6251529.44	36.3	1	Sag 2.0m lintel
A/370/40	313660.782	6251519.342	36.16	1	Sag 2.0m lintel
A/370/30	313647.671	6251499.327	34.9	0	
A/370/20	313590.238	6251438.549	32.35	1	Sag 3.0m lintel
A/370/10	313587.146	6251429.941	32.5	1	4.1m x 1.9m sag
A/10/205	313565.163	6251386.789	30.92	0	
A/10/200	313504.515	6251367.093	29.57	1	Sag 3.0m lintel
A/430/20	313476.619	6251372.772	29.3	1	Sag 3.0m lintel
A/430/10	313488.476	6251370.643	29.11	1	Sag 3.0m lintel
A/10/190	313492.27	6251360.625	29.3	1	Sag 3.6m lintel
A/10/180	313458.156	6251341.359	28.61	1	Sag 2.4m lintel
A/10/170	313425.404	6251306.886	27.9	1	Sag 2.0m lintel
A/10/160	313415.542	6251293.418	27.8	1	Sag 1.0m lintel
A/10/150	313352.47	6251297.857	26.95	1	SIP 1m x 0.5m
A/10/145	313324.475	6251303.446	26.9	1	Sag 1.8m lintel
A/10/140	313331.022	6251294.568	27.14	0	
A/10/130	313263.076	6251249.877	25.55	0	
A/10/120	313224.37	6251196.848	25.5	0	
A/10/110	313143.677	6251167.174	24.1	0	

Name	Node X	Node Y	Ground Elevation m AHD	Inlet Capacity Flag (Note:0 = sealed pit; 1 = pit inlet)	Approach Depth Reference (Note: all pits rated by approach depth)
A/10/106	313119.895	6251136.1	23.8	1	SIP 1.4m x 1.4m
A/10/105	313104.146	6251115.005	24.4	1	SIP 1.35x1.35
A/10/100	313078.27	6251081.172	22.23	1	Sag 1.5m lintel
A/10/90	313068.557	6251071.823	22.41	1	Sag 2.0m lintel
A/10/85	313021.292	6251078.342	21.9	1	Sag 1.5m lintel
A/10/80	313010.036	6251071.963	21.85	1	SIP 0.9 x 1m
A/10/75	312996.29	6251027.123	21.58	0	
A/10/72	312875.365	6251052.228	21.15	0	
A/10/70	312861.1	6251000.678	20.1	1	Sag 2.0m lintel
A/10/65	312630.983	6251037.361	18.27	1	Sag 2.0m lintel
A/10/60	312599.179	6251039.87	18.04	1	Sag 3.0m lintel
A/10/50	312520.802	6250987.191	17.76	1	Sag 3.3m lintel
A/10/30	312497.944	6250971.384	17.83	1	SIP 1m x 0.5m
A/10/20	312442.961	6251040.02	17.2	1	Sag 2.0m lintel
A20/30	312842.695	6251327.502	24.75	1	Sag 2.0m lintel
A/20/20	312694.797	6251227.432	20.95	1	Sag 1.0m lintel
A/20/10	312580.246	6251149.488	18.1	1	Sag 1.5m lintel
A/20/05	312438.558	6251053.117	17.39	0	Sag 3.3m lintel
A/10/10	312435.589	6251051.178	17.3	1	Sag 3.3m lintel
A/10/05	312419.568	6251078.342	16.5	0	
Node535	312173.406	6251173.526	15.5	0	
Node536	312017.736	6251319.123	14.8	0	
B1000/50	311953.298	6250397.221	9.72	1	Sag 2.0m lintel
B1000/40	311955.046	6250386.963	9.75	1	SIP 1m x 0.5m
B1000/30	311975.133	6250262.558	8.98	0	
B1000/20	311974.325	6250256.539	8.75	1	Sag 1.5m lintel
B1000/10	311907.938	6250245.932	8.43	1	Sag 2.4m lintel
B1000/05	311883.242	6250219.757	8	1	SIP 1m x 0.5m
B1010/20	311897.944	6250244.282	8.3	1	Sag 1.8m lintel
B1010/10	311882.392	6250225.576	8.16	1	Sag 2.0m lintel
B/1000/03	311879.415	6250214.738	8.06	0	
B/1000/02	311792.793	6250200.881	6.93	0	
Node539	311713.81	6250568.994	11.03	0	
Node540	311701.228	6250536.141	10.66	0	
Node541	311688.736	6250507.932	10.65	0	
Node542	311685.64	6250473.672	9.82	0	
Node543	311694.937	6250452.263	9.63	0	

Name	Node X	Node Y	Ground Elevation m AHD	Inlet Capacity Flag (Note:0 = sealed pit; 1 = pit inlet)	Approach Depth Reference (Note: all pits rated by approach depth)
Node544	311711.097	6250432.642	8.74	0	
Node514	311749.331	6250398.31	8.2	0	
Node513	311766.041	6250335.621	7.42	0	
Node512	311781.553	6250245.643	6.47	0	
Node511	311787.494	6250199.94	6.24	0	
Node510	311798.536	6250142.404	6.43	0	
C95/75	312758.208	6249106.174	21.11	1	Sag 2.0m lintel
C/95/65	312793.269	6249095.276	20.35	0	
C110/120	312631.181	6248954.605	25.75	1	Sag 2.0m lintel
C/110/70	312769.596	6248943.007	22.65	1	SIP 1m x 1m
C/110/40	312810.478	6248924.331	21.7	1	Sag 1.2m lintel
C/110/30	312851.114	6248908.434	20.85	1	Sag 2.0m lintel
C/10/90	312873.403	6248941.887	20.5	1	Sag 2.0m lintel
C/10/80	312890.034	6248979.829	19.7	1	Sag 1.5m lintel
C/10/70	312911.663	6249032.929	18.88	1	Sag 2.0m lintel
C/10/60	312929.309	6249077.11	18.19	1	
C/10/50	312918.829	6249098.285	18.4	1	Sag 1.0m lintel
C/10/40	312974.612	6249206.623	16.66	0	
C/10/30	312988.218	6249238.807	15.85	1	Sag 2.0m lintel
C/10/20	312997.882	6249257.843	15.7	1	Sag 1.0m lintel
Node548	313212.28	6249348.824	13	0	
Node550	313251.224	6249453.092	14.1	0	
Node549	313169.735	6249153.516	16.7	0	
Node549.1	313171.47	6249268.94	15.35	0	
Node533	313134.653	6249376.705	14	0	
Node478	313115.011	6249387.797	14.3	0	
C/10/10	313082.548	6249398.549	14.15	0	
Dum479A	313038.718	6249651.424	12.5	0	
Node479	313004.436	6249657.676	12	0	
Node480	312973.08	6249710.198	11.21	0	
Dum481A	312858.668	6249801.878	10.3	0	
Node481	312845.131	6249794.014	11.59	0	
Node482	312840.017	6249797.466	11.651	0	
Node483	312828.465	6249804.013	11.64	0	
Node484	312770.71	6249831.368	10.788	0	
Node485	312749.895	6249843.149	10.3	0	
Node486	312710.722	6249875.094	10.19	0	

Name	Node X	Node Y	Ground Elevation m AHD	Inlet Capacity Flag (Note:0 = sealed pit; 1 = pit inlet)	Approach Depth Reference (Note: all pits rated by approach depth)
B/20/10	312765.398	6249895.143	11.13	1	Sag 2.0m lintel
B/40/50	313098.613	6249848.383	16.05	1	Sag 2.0m lintel
B/40/40	313039.226	6249856.771	15.14	1	Sag 2.0m lintel
B/40/30	312975.338	6249865.729	14.18	1	Sag 2.0m lintel
B/40/20	312914.162	6249874.337	12.93	1	Sag 2.0m lintel
B/40/10	312858.115	6249882.096	12.17	1	Sag 2.0m lintel
B/130/10	312889.127	6250082.855	14	1	Sag 2.0m lintel
B/10/20	312913.213	6250283.664	17	1	Sag 2.0m lintel
B/220/10	312909.066	6250293.742	17.12	1	Sag 2.0m lintel
B/230/10	312918.433	6250270.976	16.93	1	Sag 2.0m lintel
B/10/12	312899.36	6250273.466	16.8	0	
B/10/11	312890.463	6250209.199	16.1	0	
B/10/10	312874.145	6250083.615	14.55	0	
B/10/09	312873.205	6250070.517	14.08	0	
B/10/08	312859.822	6249975.527	13.15	1	Sag 2.0m lintel
B/10/07	312839.438	6249884.445	12.2	1	Sag 2.0m lintel
B/10/06	312755.306	6249886.675	11.15	0	
B/10/05	312695.049	6249893.703	10.83	0	
Node488	312691.497	6249893.308	10.91	0	
Dum490A	312680.744	6249918.821	11.27	0	
Node490	312669.855	6249912.159	11.27	0	
Node491	312636.865	6249941.836	9.947	0	
Node492	312449.492	6249977.735	9.24	0	
Node493	312372.932	6249995.3	9.2	0	
Dum494A	312349.24	6250020.774	6.68	0	
Node494	312328.853	6250016.346	8.96	0	
Node495	312291.07	6250040.871	10.13	0	
Node496	312279.802	6250042.63	10.373	0	
B/560/20	312240.402	6249989.854	9.66	1	Sag 2.0m lintel
B/560/10	312237.813	6250000.422	9.6	1	Sag 2.0m lintel
B/610/10	312323.899	6249737.145	13.05	1	Sag 2.0m lintel
B/620/10	312348.975	6249724.388	13.15	1	Sag 2.0m lintel
B/550/50	312332.904	6249699.813	13.3	1	Sag 2.0m lintel
B/550/40	312329.531	6249714.79	13.22	1	
B/550/35	312318.185	6249733.846	13.13	0	
B/590/10	312318.74	6249706.04	13.15	1	Sag 2.0m lintel
B/590/05	312315.208	6249713.58	13.05	0	

Name	Node X	Node Y	Ground Elevation m AHD	Inlet Capacity Flag (Note:0 = sealed pit; 1 = pit inlet)	Approach Depth Reference (Note: all pits rated by approach depth)
B/550/30	312310.327	6249747.283	12.6	1	Sag 2.0m lintel
B/550/20	312285.738	6249861.56	11.44	1	Sag 2.0m lintel
B/550/10	312259.672	6249983.435	9.9	1	SIP 1m x 0.5m
B/550/06	312253.793	6250005.141	10.06	0	
B/550/05	312235.85	6250043.917	7.75	0	
Node497	312238.974	6250050.243	10.08	0	
B/680/20	312201.35	6249981.366	9.82	1	Sag 2.0m lintel
B/680/10	312209.266	6249994.253	9.65	1	Sag 2.0m lintel
B/680/05	312199.75	6250036.964	7.75	0	
Node498	312178.813	6250041.754	7.703	0	
B/670/50	312204.302	6249666.679	13.8	1	Sag 2.0m lintel
B/670/40	312200.715	6249684.066	13.64	1	Sag 2.0m lintel
B/670/30	312205.365	6249716.819	13.74	0	
B/670/20	312181.535	6249822.308	12.85	0	
B/670/10	312151.578	6249962.789	10.81	1	
B/670/05	312132.794	6250047.922	7.54	0	
Dum499A	312138.156	6250058.862	7.41	0	
Node499	312127.727	6250050.602	7.54	0	
B/830/30	312422.577	6250148.541	11.02	1	SIP 1m x 1m
B/830/20	312354.838	6250157.59	10.46	1	Sag 2.0m lintel
B/830/10	312309.758	6250164.138	10.3	1	Sag 2.0m lintel
B/860/10	312276.189	6250361.268	11.26	0	
B/880/30	312340.177	6250364.298	11.68	1	Sag 1.0m lintel
B/880/20	312318.853	6250367.377	11.35	1	Sag 2.0m lintel
B/880/10	312273.023	6250373.886	11.2	1	Sag 2.0m lintel
B/890/10	312228.009	6250529.684	13.39	1	SIP 1m x 0.5m
B850/100	312327.627	6250571.105	15.08	1	Sag 1.5m lintel
B/850/90	312313.584	6250573.065	14.85	1	SIP 1m x 0.5m
B/850/80	312266.409	6250580.024	14.65	1	Sag 1.0m lintel
B/850/70	312242.414	6250583.323	14.6	1	Sag 3.0m lintel
B/850/60	312236.658	6250555.629	13.7	1	Sag 1.5m lintel
B/850/50	312240.897	6250528.704	13.47	1	Sag 1.5m lintel
B/850/40	312255.632	6250437.163	12.28	1	Sag 1.8m lintel
B/850/30	312265.304	6250382.864	11.28	1	Sag 1.5m lintel
B/850/20	312265.816	6250379.654	11.4	0	
B/850/17	312266.954	6250373.076	11.15	0	
B/870/10	312254.115	6250366.197	10.9	1	Sag 2.0m lintel

Name	Node X	Node Y	Ground Elevation m AHD	Inlet Capacity Flag (Note:0 = sealed pit; 1 = pit inlet)	Approach Depth Reference (Note: all pits rated by approach depth)
B/850/16	312268.248	6250364.877	11.27	0	
B/850/10	312269.98	6250353.33	11.4	0	
B/910/05	312453.417	6250336.413	12.32	1	SIP 1m x 0.7m
B/910/10	312449.772	6250336.903	12.25	1	SIP 1m x 0.7m
B/910/40	312407.834	6250354.889	12.27	1	Sag 2.0m lintel
B/910/30	312438.533	6250350.37	12.3	1	Sag 2.0m lintel
B/910/20	312452.444	6250348.761	12.3	1	Sag 1.5m lintel
B/920/10	312466.627	6250347.071	12.32	1	0.9x1mnolintelQ3side
A/780/10	312669.466	6250509.248	15.5	1	Sag 2.0m lintel
A720/20	312677.118	6250601.689	15.46	1	Sag 1.5m lintel
A/720/10	312669.615	6250569.196	15.34	1	SIP 1m x 0.75m
A/570/20	313929.852	6250847.379	36	1	Sag 1.8m lintel
A/570/10	313883.568	6250858.677	33.1	1	Sag 2.0m lintel
A/420/90	313848.96	6250866.665	32.15	1	Sag 2.0m lintel
A/420/80	313832.007	6250866.005	31.78	1	Sag 2.0m lintel
A/420/70	313822.169	6250868.325	31.72	1	Sag 2.0m lintel
A/530/50	313964.691	6251132.751	45.9	1	Sag 1.0m lintel
A/530/40	313949.337	6251109.716	44.11	0	
A/530/30	313923.016	6251071.244	42	1	Sag 2.0m lintel
A/530/20	313881.061	6251007.477	39.58	1	Sag 2.0m lintel
A/530/10	313806.263	6250894.86	31.4	1	Sag 1.5m lintel
A/420/65	313794.084	6250885.541	30.7	0	
A/510/30	313723.599	6250994.109	32.85	1	Sag 2.0m lintel
A/510/20	313714.33	6250980.332	32.7	1	Sag 1.0m lintel
A/510/10	313739.752	6250904.827	30.25	1	Sag 2.0m lintel
A/420/55	313738.045	6250898.499	30.1	1	Sag 2.0m lintel
A/420/50	313632.985	6250798.179	27.63	1	Sag 2.0m lintel
A/420/40	313628.384	6250785.702	27.4	1	Sag 1.0m lintel
A/420/30	313601.074	6250789.311	27.51	1	Sag 2.0m lintel
Bnkstn	313838.649	6250527.592	27.7	1	SIP 13x3m
A/620/90	313717.002	6250481.884	27.12	0	
A/620/80	313702.03	6250483.828	26.1	1	SIP 6x6m flow 2 side
A/620/70	313640.6	6250493.008	25.45	1	8x2.5m flow 1 side
A/620/60	313500.98	6250513.324	24.8	1	SIP 1m x 1m
A/620/50	313439.36	6250523.76	24.45	0	
A/620/40	313430.77	6250525.08	22.8	0	
A/620/30	313189.334	6250561.927	20.1	1	Sag 2.0m lintel

Name	Node X	Node Y	Ground Elevation m AHD	Inlet Capacity Flag (Note:0 = sealed pit; 1 = pit inlet)	Approach Depth Reference (Note: all pits rated by approach depth)
A/620/29	313123.28	6250570.94	19.49	0	
A/620/28	313117.828	6250571.613	19.4	0	
A/620/27	313102.23	6250574.1	18.404	0	
Node532	313001.287	6250587.272	17.1	0	
A/620/25	312895.95	6250604.51	17	0	
Node525	312864.537	6250609.217	16.9	0	
XS5	312842.197	6250612.323	16	0	
XS4	312818.755	6250607.122	15.66	0	
XS3	312779.327	6250590.053	15.41	0	
XS2	312737.595	6250573.105	15.2	0	
Node526	312687.02	6250550.747	15.75	0	
A/620/20	312665.838	6250525.635	15.03	1	SIP 1m x 0.75m
A/620/10	312659.528	6250508.845	15.49	0	
B/930/70	312459.204	6250347.128	12.46	1	0.9x1mnolintelQ3side
B/930/60	312450.968	6250341.872	12.56	0	
B/930/50	312444.569	6250337.453	12.25	0	
B/930/45	312299.772	6250194.622	10.21	1	SIP 13x3m
B/930/40	312295.822	6250187.573	10.48	0	
B/930/30	312286.612	6250171.177	10.4	0	
B/930/20	312284.023	6250166.838	10.4	1	Sag 2.0m lintel
B/820/10	312311.654	6250151.391	10.38	1	Sag 2.0m lintel
B/930/10	312269.609	6250155.27	10.02	0	
B/940/70	312227.769	6250296.901	10.68	1	Sag 1.2m lintel
B/940/60	312229.254	6250285.304	10.9	1	Sag 2.0m lintel
B/950/10	312124.251	6250280.255	10.11	1	Sag 1.2m lintel
B/940/50	312124.251	6250268.407	10.05	1	Sag 2.0m lintel
B/940/40	312133.14	6250215.518	9.4	0	
B/940/30	312122.486	6250202.23	9.05	0	
B/940/20	312131.763	6250146.632	8.52	0	
B/940/15	312121.975	6250136.194	8.6	1	Sag 2.0m lintel
B/940/10	312118.487	6250124.096	8.25	1	Sag 1.5m lintel
B/930/06	312123.286	6250098.652	8.35	0	
B/930/05	312086.345	6250076.666	7.43	0	
Node501	312099.378	6250056.153	7.433	0	
Node502	312057.492	6250057.211	7.656	0	
Node503	311954.508	6250030.665	7.349	0	
Dum504A	311911.472	6250034.288	7.23	0	

Name	Node X	Node Y	Ground Elevation m AHD	Inlet Capacity Flag (Note:0 = sealed pit; 1 = pit inlet)	Approach Depth Reference (Note: all pits rated by approach depth)
Node504	311899.546	6250012.111	7.23	0	
Node505	311874.488	6250016.684	7.37	0	
Node506	311864.045	6250044.476	8.585	0	
Node508	311817.085	6250046.164	7.57	0	
Node515	311794.914	6249999.913	7.53	0	
Node516	311774.113	6249998.903	7.32	0	

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■ **Table B-2 Old Guildford XP-STORM Pipe and Link Data**

Note: Table below includes data for modelled pipes and links, including dummy links

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation m AHD	Downstream Invert Elevation m AHD	Shape	Diameter (Height) m	Bottom Width m	Length m	Roughness	Number of Barrels	Entrance/Exit Loss Type	Pressure Change Coefficient Ku
A10ah	A/10/235	A/10/230	35.47	34.21	Circular	0.45	0	61.24	0.014	1	Pressure Change Coeff.	1.5
A400a	A/400/10	A/10/240	37.55	37.16	Circular	0.375	0	6.4	0.014	1	Pressure Change Coeff.	5
A10aj	A/10/245	A/10/240	37.49	37.16	Circular	0.375	0	4.85	0.014	1	Pressure Change Coeff.	5
A10ai	A/10/240	A/10/235	37.16	35.55	Circular	0.375	0	32.5	0.014	1	Pressure Change Coeff.	1.5
A390b	A/390/20	A/390/10	36.48	35.97	Circular	0.375	0	10.18	0.014	1	Pressure Change Coeff.	5
A390a	A/390/10	A/10/235	35.97	35.55	Circular	0.375	0	6.62	0.014	1	Pressure Change Coeff.	1.5
A380d	A/380/40	A/380/30	35.77	35.63	Circular	0.45	0	6.73	0.014	1	Pressure Change Coeff.	5
A380c	A/380/30	A/380/20	35.63	34.93	Circular	0.45	0	21.72	0.014	1	Pressure Change Coeff.	1.5
A380b	A/380/20	A/380/10	34.93	34.59	Circular	0.45	0	15.14	0.014	1	Pressure Change Coeff.	1.5
A380a	A/380/10	A/10/230	34.59	34.21	Circular	0.45	0	16.96	0.014	1	Pressure Change Coeff.	1.5
A10ag	A/10/230	A/10/225	34.13	33.73	Circular	0.53	0	17.67	0.014	1	Pressure Change Coeff.	1.5
A10af	A/10/225	A/10/220	33.56	33.2	Circular	0.6	0	17.55	0.014	1	Pressure Change Coeff.	1.5
A10ae	A/10/220	A/10/215	33.2	32.47	Circular	0.6	0	55.45	0.014	1	Pressure Change Coeff.	1.5
A10ad	A/10/215	A/10/210	32.47	32.16	Circular	0.45	0	13.82	0.014	1	Pressure Change Coeff.	1.5
A10ac	A/10/210	A/10/205	32.16	29.85	Circular	0.45	0	73.22	0.014	1	Pressure Change Coeff.	1.5
A370e	A/370/50	A/370/40	35.14	34.84	Circular	0.375	0	10.43	0.014	1	Pressure Change Coeff.	5

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation m AHD	Downstream Invert Elevation m AHD	Shape	Diameter (Height) m	Bottom Width m	Length m	Roughness	Number of Barrels	Entrance/Exit Loss Type	Pressure Change Coefficient Ku
A370d	A/370/40	A/370/30	34.84	34.1	Circular	0.375	0	23.95	0.014	1	Pressure Change Coeff.	1.5
A370c	A/370/30	A/370/20	34.1	31.34	Circular	0.45	0	83.64	0.014	1	Pressure Change Coeff.	1.5
A370b	A/370/20	A/370/10	31.34	31.01	Circular	0.525	0	9.16	0.014	1	Pressure Change Coeff.	1.5
483.1	A/370/10	A/10/205	31.01	29.85	Circular	0.825	0	48.5	0.014	1	Pressure Change Coeff.	1.5
483.2	A/370/10	A/10/205	31.01	29.85	Circular	0.825	0	48.5	0.014	1	Pressure Change Coeff.	1.5
487.1	A/10/205	A/10/200	29.5	28.24	Circular	0.9	0	63.65	0.014	1	Pressure Change Coeff.	1.5
487.2	A/10/205	A/10/200	29.5	28.24	Circular	0.05	0	63.65	0.014	1	Pressure Change Coeff.	1.5
A10aa	A/10/200	A/10/190	28.24	27.88	Circular	0.75	0	13.83	0.014	1	Pressure Change Coeff.	1.5
A430b	A/430/20	A/430/10	28.3	28.15	Circular	0.45	0	12.02	0.014	1	Pressure Change Coeff.	1.5
A430a	A/430/10	A/10/190	28	27.88	Circular	0.6	0	10.73	0.014	1	Pressure Change Coeff.	1.5
A10z	A/10/190	A/10/180	27.88	27.24	Circular	0.75	0	39.13	0.014	1	Pressure Change Coeff.	1.5
A10y	A/10/180	A/10/170	27.24	26.75	Circular	0.75	0	47.56	0.014	1	Pressure Change Coeff.	1.5
A10x	A/10/170	A/10/160	26.75	26.55	Circular	0.825	0	16.7	0.014	1	Pressure Change Coeff.	1.5
A10w	A/10/160	A/10/150	26.55	25.8	Circular	0.9	0	63.09	0.014	1	Pressure Change Coeff.	1.5
A10v	A/10/150	A/10/140	25.8	25.64	Circular	1.05	0	21.65	0.014	1	Pressure Change Coeff.	1.5
A10u	A/10/145	A/10/140	26.05	25.64	Circular	0.375	0	11.04	0.014	1	Pressure Change Coeff.	1.5
A10t	A/10/140	A/10/130	25.64	24.27	Circular	1.05	0	81.26	0.014	1	Pressure Change Coeff.	1.5
A10s	A/10/130	A/10/120	24.27	23.4	Circular	1.05	0	65.7	0.014	1	Pressure Change Coeff.	1.5

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation m AHD	Downstream Invert Elevation m AHD	Shape	Diameter (Height) m	Bottom Width m	Length m	Roughness	Number of Barrels	Entrance/Exit Loss Type	Pressure Change Coefficient Ku
A10r	A/10/120	A/10/110	23.4	21.98	Circular	1.05	0	85.83	0.014	1	Pressure Change Coeff.	1.5
A10q	A/10/110	A/10/106	21.98	21.36	Circular	1.05	0	39.15	0.014	1	Pressure Change Coeff.	1.5
A10p	A/10/106	A/10/105	21.36	20.97	Circular	0.75	0	26.34	0.014	1	Pressure Change Coeff.	1.5
A10o	A/10/105	A/10/100	20.97	20.4	Circular	1.05	0	42.62	0.014	1	Pressure Change Coeff.	1.5
A10n	A/10/100	A/10/90	20.4	20.08	Circular	1.2	0	13.48	0.014	1	Pressure Change Coeff.	1.5
A10m	A/10/90	A/10/85	19.93	19.5	Circular	1.35	0	49.81	0.014	1	Pressure Change Coeff.	1.5
A10l	A/10/85	A/10/80	19.5	19.43	Circular	1.35	0	12.92	0.014	1	Pressure Change Coeff.	1.5
A10k	A/10/80	A/10/75	19.43	18.96	Circular	1.35	0	49.51	0.014	1	Pressure Change Coeff.	1.5
A10j	A/10/75	A/10/72	18.81	17.9	Circular	1.5	0	123.26	0.014	1	Pressure Change Coeff.	1.5
A10i	A/10/72	A/10/70	17.9	17.12	Circular	1.5	0	54.81	0.014	1	Pressure Change Coeff.	1.5
A10h	A/10/70	A/10/65	17.12	16.22	Circular	1.8	0	232.55	0.014	1	Pressure Change Coeff.	1.5
A10g	A/10/65	A/10/60	16.22	16.03	Circular	1.8	0	31.83	0.014	1	Pressure Change Coeff.	1.5
A10f	A/10/60	A/10/50	16.03	15.58	Circular	1.8	0	94.36	0.014	1	Pressure Change Coeff.	1.5
A10e	A/10/50	A/10/30	15.58	15.48	Circular	1.8	0	27.77	0.014	1	Pressure Change Coeff.	1.5
A10c	A/10/30	A/10/20	15.42	14.9	Circular	1.8	0	97.55	0.014	1	Pressure Change Coeff.	1.5
A10b	A/10/20	A/10/10	14.9	14.82	Circular	1.8	0	13.39	0.014	1	Pressure Change Coeff.	1.5
A20a	A20/30	A/20/20	23.16	19.55	Circular	1.05	0	178.43	0.014	1	Pressure Change Coeff.	1.5
A20b	A/20/20	A/20/10	19.55	16.34	Circular	1.05	0	138.44	0.014	1	Pressure Change Coeff.	1.5

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation m AHD	Downstream Invert Elevation m AHD	Shape	Diameter (Height) m	Bottom Width m	Length m	Roughness	Number of Barrels	Entrance/Exit Loss Type	Pressure Change Coefficient Ku
A20c	A/20/10	A/20/05	16.34	15.69	Circular	1.05	0	171.22	0.014	1	Pressure Change Coeff.	1.5
A20d	A/20/05	A/10/10	15.49	15.45	Circular	1.3	0	3.54	0.014	1	Pressure Change Coeff.	1.5
A10a	A/10/10	A/10/05	14.82	14.61	Circular	1.8	0	31.58	0.014	1	Pressure Change Coeff.	1.5
Dumpipe2	A/10/05	Node535	14.61	13	Circular	0.05	0	267	0.014	1	Pressure Change Coeff.	0
Link544	Node535	Node536	13	11	Trapezoidal	2	50	200	0.025	1	Energy/Loss Coeff	0
DumPipe1	Node536	Node516	11	2	Trapezoidal	2	50	300	0.02	1	Energy/Loss Coeff	0
B1000g	B1000/50	B1000/40	8.72	8.55	Circular	0.75	0	10.43	0.014	1	Pressure Change Coeff.	5
B1000f	B1000/40	B1000/30	8.55	7.57	Circular	0.75	0	126.31	0.014	1	Pressure Change Coeff.	1.5
B1000e	B1000/30	B1000/20	7.54	7.47	Circular	0.75	0	6.09	0.014	1	Pressure Change Coeff.	1.5
B1000d	B1000/20	B1000/10	7.47	7.13	Circular	0.825	0	67.09	0.014	1	Pressure Change Coeff.	1.5
B1000c	B1000/10	B1000/05	7.13	6.92	Circular	0.825	0	35.99	0.014	1	Pressure Change Coeff.	1.5
B1000b	B1000/05	B/1000/03	6.92	6.8	Circular	0.825	0	6.32	0.014	1	Pressure Change Coeff.	1.5
B1010b	B1010/20	B1010/10	7.61	6.99	Circular	0.45	0	24.34	0.014	1	Pressure Change Coeff.	5
B1010a	B1010/10	B/1000/03	6.99	6.8	Circular	0.825	0	11.26	0.014	1	Pressure Change Coeff.	1.5
B1000a	B/1000/03	B/1000/02	6.8	6.1	Circular	0.825	0	87.54	0.014	1	Pressure Change Coeff.	1.5
DummyLink6	B/1000/02	Node511	5.3	4.5	Trapezoidal	1.5	5	10	0.03	1	Energy/Loss Coeff	0
BC XS-12	Node539	Node540	8.85	7.65	Natural	0	0	40.5	0.014	1	Energy/Loss Coeff	0
BC XS-11	Node540	Node541	7.65	7.64	Natural	0	0	32.3	0.014	1	Energy/Loss Coeff	0

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BC XS-10	Node541	Node542	7.64	7.28	Rectangular	2.2	3.2	36.4	0.014	1	Energy/Loss Coeff	0
BC XS-9	Node542	Node543	7.28	7.09	Natural	0	0	21	0.014	1	Energy/Loss Coeff	0
BC XS-8	Node543	Node544	7.09	6.84	Natural	0	0	25.8	0.014	1	Energy/Loss Coeff	0
BC XS-7	Node544	Node514	6.84	6.24	Natural	0	0	50.5	0.014	1	Energy/Loss Coeff	0
BC XS-6	Node514	Node513	6.24	5.63	Natural	0	0	66	0.014	1	Energy/Loss Coeff	0
BC XS-5	Node513	Node512	5.63	4.74	Natural	0	0	92.35	0.014	1	Energy/Loss Coeff	0
BC XS-4-1	Node512	Node511	4.74	4.5	Natural	0	0	45	0.014	1	Energy/Loss Coeff	0
BC XS-4-2	Node511	Node510	4.5	4.18	Natural	0	0	58	0.014	1	Energy/Loss Coeff	0
Link540	Node510	Node508	4.18	2	Natural	0	0	95	0.014	1	Energy/Loss Coeff	0
C95c	C95/75	C/95/65	19.93	19.2	Circular	0.375	0	36.65	0.014	1	Pressure Change Coeff.	5
C95a	C/95/65	C/10/60	19.2	17.14	Circular	0.375	0	136.96	0.014	1	Pressure Change Coeff.	1.5
C110c	C110/120	C/110/70	24.81	21.32	Circular	0.375	0	144.7	0.014	1	Pressure Change Coeff.	5
C110b	C/110/70	C/110/40	21.32	20.47	Circular	0.45	0	44.89	0.014	1	Pressure Change Coeff.	1.5
C110a	C/110/40	C/110/30	20.47	19.85	Circular	0.525	0	43.57	0.014	1	Pressure Change Coeff.	1.5
C10k	C/110/30	C/10/90	19.85	19.2	Circular	0.6	0	45.71	0.014	1	Pressure Change Coeff.	1.5
C10j	C/10/90	C/10/80	19.2	18.64	Circular	0.6	0	41.5	0.014	1	Pressure Change Coeff.	1.5
C10i	C/10/80	C/10/70	18.64	17.43	Circular	0.6	0	57.43	0.014	1	Pressure Change Coeff.	1.5
C10h	C/10/70	C/10/60	17.43	17.14	Circular	0.6	0	47.66	0.014	1	Pressure Change Coeff.	1.5

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C10g	C/10/60	C/10/50	17.14	17.05	Circular	0.6	0	29.68	0.014	1	Pressure Change Coeff.	1.5
C10f	C/10/50	C/10/40	17.05	14.27	Circular	1.2	0	122.03	0.014	1	Pressure Change Coeff.	1.5
C10e	C/10/40	C/10/30	14.27	13.75	Circular	1.2	0	34.87	0.014	1	Pressure Change Coeff.	1.5
C10d	C/10/30	C/10/20	13.75	13.4	Circular	1.2	0	21.36	0.014	1	Pressure Change Coeff.	1.5
C10a	C/10/20	C/10/10	13.4	10.8	Circular	1.2	0	166.92	0.014	1	Pressure Change Coeff.	1.5
Link555	Node548	Node533	11.78	11.1	Trapezoidal	1.2	8	83	0.014	1	Energy/Loss Coeff	0
Link557	Node550	Node533	12.9	11.1	Trapezoidal	1.1	4	150	0.014	1	Energy/Loss Coeff	0
Link556	Node549	Node549.1	14.94	13.02	Trapezoidal	1.7	4	114	0.014	1	Energy/Loss Coeff	0
Link556.1	Node549.1	Node533	13.02	11.1	Trapezoidal	1.8	4	114	0.014	1	Energy/Loss Coeff	0
Link539	Node533	Node478	11.1	10.89	Trapezoidal	2.9	8	23	0.014	1	Energy/Loss Coeff	0
Woodville	Node478	C/10/10	10.89	10.8	Rectangular	1.92	2.89	30	0.014	3	Energy/Loss Coeff	0.5
Bunnings B	C/10/10	Node479	10.8	9.45	Rectangular	1.92	2.89	312	0.014	3	Energy/Loss Coeff	0.1
Link521	Dum479A	Node479	9.39	9.39	Trapezoidal	1	20	10	0.03	1	Energy/Loss Coeff	0
BC XS-41	Node479	Node480	9.39	8.91	Natural	0	0	53.5	0.014	1	Energy/Loss Coeff	0
BC XS-40	Node480	Node481	8.91	9.282	Natural	0	0	153.7	0.014	1	Energy/Loss Coeff	0
Link520	Dum481A	Node481	9.3	9.2	Trapezoidal	1	20	10	0.03	1	Energy/Loss Coeff	0
BC XS-39	Node481	Node482	9.282	8.841	Natural	0	0	6.01	0.014	1	Energy/Loss Coeff	0
Mandarin B	Node482	Node483	8.841	8.83	User Defined	2.8	0	13.27	0.04	1	Energy/Loss Coeff	0

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Mandarin W	Node482	Node483	8.841	8.83	User Defined	2.8	0	13.27	0.04	1	Energy/Loss Coeff	0
Mandarin W	Node482	Node483	0.05	0	Circular	0.05	0	10	0.014	1	Pressure Change Coeff.	0
BC XS-36	Node483	Node484	8.83	8.3	Natural	0	0	63.7	0.014	1	Energy/Loss Coeff	0
BC XS-35a	Node484	Node485	7.868	7.373	Natural	0	0	22.6	0.014	1	Energy/Loss Coeff	0
BC XS-35	Node485	Node486	7.373	7.269	Natural	0	0	50.62	0.014	1	Energy/Loss Coeff	0
Malta US	Node486	Node488	7.269	8	Natural	0	0	26.77	0.014	1	Energy/Loss Coeff	0
B20a	B/20/10	B/10/06	9.83	9.7	Circular	0.45	0	13.17	0.014	1	Pressure Change Coeff.	5
B40e	B/40/50	B/40/40	14.69	13.72	Circular	0.825	0	59.85	0.014	1	Pressure Change Coeff.	1.5
B40d	B/40/40	B/40/30	13.72	12.58	Circular	0.825	0	64.38	0.014	1	Pressure Change Coeff.	1.5
B40c	B/40/30	B/40/20	12.58	11.46	Circular	0.9	0	61.65	0.014	1	Pressure Change Coeff.	1.5
B40b	B/40/20	B/40/10	11.46	10.97	Circular	0.9	0	56.46	0.014	1	Pressure Change Coeff.	1.5
B40a	B/40/10	B/10/07	10.97	10.78	Circular	1.2	0	18.78	0.014	1	Pressure Change Coeff.	1.5
B130a	B/130/10	B/10/09	12.7	12.5	Circular	0.825	0	20.13	0.014	1	Pressure Change Coeff.	1.5
B10h	B/10/20	B/10/12	15.87	15.7	Circular	0.675	0	17.19	0.014	1	Pressure Change Coeff.	5
B220a	B/220/10	B/10/12	16.27	15.74	Circular	0.375	0	22.51	0.014	1	Pressure Change Coeff.	5
B230a	B/230/10	B/10/12	15.91	15.72	Circular	0.375	0	19.19	0.014	1	Pressure Change Coeff.	1.5
B10g	B/10/12	B/10/11	15.07	14.36	Circular	0.9	0	65.07	0.014	1	Pressure Change Coeff.	1.5
B10f	B/10/11	B/10/10	14.28	12.87	Circular	1.05	0	126.91	0.014	1	Pressure Change Coeff.	1.5

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B10e	B/10/10	B/10/09	12.87	12.33	Circular	1.05	0	13.16	0.014	1	Pressure Change Coeff.	1.5
B10d	B/10/09	B/10/08	12.33	10.77	Circular	1.05	0	96.15	0.014	1	Pressure Change Coeff.	1.5
B10c	B/10/08	B/10/07	10.77	9.82	Circular	1.2	0	95.59	0.014	1	Pressure Change Coeff.	1.5
B10b	B/10/07	B/10/06	9.67	8.82	Circular	1.5	0	85.31	0.014	1	Pressure Change Coeff.	1.5
B10a	B/10/06	B/10/05	8.82	8.08	Circular	1.5	0	60.68	0.014	1	Pressure Change Coeff.	1.5
Dummylink1	B/10/05	Node488	8.08	8	Trapezoidal	0.5	5	10	0.03	1	Energy/Loss Coeff	0
Malta DS	Node488	Node490	8	8.43	Natural	0	0	28.39	0.014	1	Energy/Loss Coeff	0
Link519	Dum490A	Node490	8.43	8.43	Trapezoidal	1	20	10	0.03	1	Energy/Loss Coeff	0
BC XS-35DS	Node490	Node491	8.43	7.067	Natural	0	0	44.92	0.014	1	Energy/Loss Coeff	0
BC XS-34	Node491	Node492	7.067	6.27	Natural	0	0	190.9	0.014	1	Energy/Loss Coeff	0
BC XS-33	Node492	Node493	6.27	6.22	Natural	0	0	80.64	0.014	1	Energy/Loss Coeff	0
BC XS-32	Node493	Node494	6.22	5.67	Natural	0	0	49.38	0.014	1	Energy/Loss Coeff	0
Link518	Dum494A	Node494	5.67	5.67	Trapezoidal	1	20	10	0.03	1	Energy/Loss Coeff	0
BC XS-31	Node494	Node495	5.67	6.839	Natural	0	0	49.1	0.014	1	Energy/Loss Coeff	0
Normanby B	Node495	Node496	6.839	6.483	User Defined	0	0	14.05	0.04	1	Energy/Loss Coeff	0
Normanby W	Node495	Node496	6.839	6.483	User Defined	0	0	14.05	0.04	1	Energy/Loss Coeff	0
Normanby W	Node495	Node496	0.05	0	Circular	0.05	0	10	0.014	1	Pressure Change Coeff.	0
BC XS-29	Node496	Node497	6.483	6.185	Natural	0	0	42.19	0.014	1	Energy/Loss Coeff	0

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B550c	B/560/20	B/560/10	9.05	8.88	Circular	0.375	0	10.9	0.014	1	Pressure Change Coeff.	5
B550b	B/560/10	B/550/06	8.88	8.3	Circular	0.375	0	16.63	0.014	1	Pressure Change Coeff.	1.5
B610a	B/610/10	B/550/35	12.18	11.9	Circular	0.375	0	6.59	0.014	1	Pressure Change Coeff.	5
B620a	B/620/10	B/550/40	12.78	12.44	Circular	0.225	0	21.65	0.014	1	Pressure Change Coeff.	5
B550j	B/550/50	B/550/40	12.5	12.44	Circular	0.6	0	15.39	0.014	1	Pressure Change Coeff.	1.5
B550h	B/550/40	B/550/35	12.44	11.9	Rectangular	0.5	1.2	22.21	0.014	1	Energy/Loss Coeff	1.5
B550g	B/550/35	B/550/30	11.9	11.35	Rectangular	0.5	1.2	15.59	0.014	1	Energy/Loss Coeff	1.5
B590b	B/590/10	B/590/05	12.67	12.2	Circular	0.3	0	8.34	0.014	1	Pressure Change Coeff.	5
B590a	B/590/05	B/550/30	12.2	11.35	Circular	0.3	0	34.14	0.014	1	Pressure Change Coeff.	1.5
B550f	B/550/30	B/550/20	11.35	10.09	Circular	0.9	0	117.16	0.014	1	Pressure Change Coeff.	1.5
B550e	B/550/20	B/550/10	10.09	8.12	Circular	0.9	0	124.91	0.014	1	Pressure Change Coeff.	1.5
B550d	B/550/10	B/550/06	8.12	7.8	Circular	0.9	0	22.54	0.014	1	Pressure Change Coeff.	1.5
B550a	B/550/06	B/550/05	7.8	6.52	Circular	0.9	0	43.06	0.014	1	Pressure Change Coeff.	1.5
DummyLink2	B/550/05	Node497	6.52	6.185	Trapezoidal	0.5	5	10	0.03	1	Energy/Loss Coeff	0
BC XS-28	Node497	Node498	6.185	5.623	Natural	0	0	62.24	0.014	1	Energy/Loss Coeff	0
B680b	B/680/20	B/680/10	8.24	8.05	Circular	0.675	0	15.14	0.014	1	Pressure Change Coeff.	1.5
B680a	B/680/10	B/680/05	8.05	6.85	Circular	0.75	0	43.86	0.014	1	Pressure Change Coeff.	1.5
DummyLink3	B/680/05	Node498	6.75	5.623	Trapezoidal	1	5	10	0.03	1	Energy/Loss Coeff	0

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BC XS-27	Node498	Node499	5.623	5.32	Natural	0	0	51.19	0.014	1	Energy/Loss Coeff	0
B670f	B/670/50	B/670/40	12.17	11.79	Circular	0.825	0	17.79	0.014	1	Pressure Change Coeff.	1.5
B670e	B/670/40	B/670/30	11.79	10.24	Circular	0.9	0	33.16	0.014	1	Pressure Change Coeff.	1.5
B670d	B/670/30	B/670/20	10.24	9.55	Circular	0.9	0	108.39	0.014	1	Pressure Change Coeff.	1.5
B670c	B/670/20	B/670/10	9.55	8.36	Circular	0.9	0	143.97	0.014	1	Pressure Change Coeff.	1.5
B670a	B/670/10	B/670/05	7.36	5.86	Circular	0.9	0	87.38	0.014	1	Pressure Change Coeff.	1.5
DummyLink4	B/670/05	Node499	5.86	5.32	Trapezoidal	1.5	5	10	0.03	1	Energy/Loss Coeff	0
Link517	Dum499A	Node499	5.32	5.32	Trapezoidal	1	30	10	0.03	1	Energy/Loss Coeff	0
BC XS-26	Node499	Node501	5.32	4.943	Natural	0	0	29.39	0.014	1	Energy/Loss Coeff	0
B830c	B/830/30	B/830/20	10.2	9.28	Circular	0.525	0	68.2	0.014	1	Pressure Change Coeff.	1.5
B830b	B/830/20	B/830/10	9.28	9	Circular	0.525	0	45.46	0.014	1	Pressure Change Coeff.	1.5
B830a	B/830/10	B/930/20	9	8.74	Circular	0.6	0	25.82	0.014	1	Pressure Change Coeff.	1.5
B860a	B/860/10	B/850/10	10.58	10.48	Circular	0.375	0	10.08	0.014	1	Pressure Change Coeff.	5
B880c	B/880/30	B/880/20	10.76	10.5	Circular	0.375	0	21.5	0.014	1	Pressure Change Coeff.	5
B880b	B/880/20	B/880/10	10.5	10.25	Circular	0.375	0	46.19	0.014	1	Pressure Change Coeff.	1.5
B880a	B/880/10	B/850/17	10.45	10.35	Circular	0.375	0	6.11	0.014	1	Pressure Change Coeff.	1.5
B890a	B/890/10	B/850/50	12.14	11.72	Circular	0.375	0	12.9	0.014	1	Pressure Change Coeff.	5
B850o	B850/100	B/850/90	14.28	14.1	Circular	0.3	0	14.15	0.014	1	Pressure Change Coeff.	5

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B850n	B/850/90	B/850/80	14.1	13.55	Circular	0.3	0	47.59	0.014	1	Pressure Change Coeff.	1.5
B850m	B/850/80	B/850/70	13.55	13.18	Circular	0.525	0	24.17	0.014	1	Pressure Change Coeff.	1.5
B850l	B/850/70	B/850/60	13.18	12.78	Circular	0.6	0	28.35	0.014	1	Pressure Change Coeff.	1.5
B850k	B/850/60	B/850/50	12.78	11.61	Circular	0.6	0	27.32	0.014	1	Pressure Change Coeff.	1.5
B850j	B/850/50	B/850/40	11.61	10.73	Circular	0.6	0	92.94	0.014	1	Pressure Change Coeff.	1.5
B850i	B/850/40	B/850/30	10.73	10.31	Circular	0.75	0	55.28	0.014	1	Pressure Change Coeff.	1.5
B850g	B/850/30	B/850/20	10.31	10.29	Circular	0.675	0	3.26	0.014	1	Pressure Change Coeff.	1.5
B850e	B/850/20	B/850/17	10.29	10.24	Circular	0.9	0	6.69	0.014	1	Pressure Change Coeff.	1.5
B850d	B/850/17	B/850/16	10.24	10.18	Circular	0.9	0	8.32	0.014	1	Pressure Change Coeff.	1.5
B870a	B/870/10	B/850/16	10.4	10.26	Circular	0.375	0	14.16	0.014	1	Pressure Change Coeff.	5
B850c	B/850/16	B/850/10	10.18	10.09	Circular	0.9	0	11.7	0.014	1	Pressure Change Coeff.	1.5
B850a	B/850/10	B/930/40	10.09	8.92	Circular	0.9	0	168.15	0.014	1	Pressure Change Coeff.	1.5
B910b	B/910/05	B/910/10	10.45	10.43	Circular	0.9	0	3.67	0.014	1	Pressure Change Coeff.	1.5
B910a	B/910/10	B/930/50	10.43	10.38	Circular	0.9	0	5.22	0.014	1	Pressure Change Coeff.	1.5
B910e	B/910/40	B/910/30	11.3	10.8	Circular	0.45	0	30.97	0.014	1	Pressure Change Coeff.	5
B910d	B/910/30	B/910/20	10.8	10.3	Circular	0.45	0	13.97	0.014	1	Pressure Change Coeff.	1.5
B910c	B/910/20	B/930/60	10.3	10.2	Circular	0.675	0	7.06	0.014	1	Pressure Change Coeff.	1.5
B920a	B/920/10	B/930/70	10.47	10.35	Circular	0.9	0	6.75	0.014	1	Pressure Change Coeff.	1.5

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A780a	A/780/10	A/620/10	14.06	13.88	Circular	0.825	0	9.22	0.014	1	Pressure Change Coeff.	1.5
A720c	A720/20	A/720/10	13.24	13.07	Circular	0.9	0	33.42	0.014	1	Pressure Change Coeff.	1.5
A720b	A/720/10	A/620/20	13.07	12.77	Circular	0.9	0	43.83	0.014	1	Pressure Change Coeff.	1.5
A420j	A/570/20	A/570/10	34.28	32.02	Circular	0.675	0	47.55	0.014	1	Pressure Change Coeff.	1.5
A420i	A/570/10	A/420/90	32.02	31.15	Circular	0.675	0	35.45	0.014	1	Pressure Change Coeff.	1.5
A420h	A/420/90	A/420/80	30.49	30.1	Circular	0.675	0	16.93	0.014	1	Pressure Change Coeff.	1.5
A420g	A/420/80	A/420/70	30.02	29.7	Circular	0.75	0	10.09	0.014	1	Pressure Change Coeff.	1.5
A420f	A/420/70	A/420/65	29.7	28.82	Circular	0.75	0	35.78	0.014	1	Pressure Change Coeff.	1.5
A530e	A/530/50	A/530/40	44.96	43.04	Circular	0.375	0	27.71	0.014	1	Pressure Change Coeff.	5
A530d	A/530/40	A/530/30	43.04	41.02	Circular	0.375	0	46.66	0.014	1	Pressure Change Coeff.	1.5
A530c	A/530/30	A/530/20	41.02	38.46	Circular	0.375	0	76.41	0.014	1	Pressure Change Coeff.	1.5
A530b	A/530/20	A/530/10	38.46	29.68	Circular	0.375	0	135.32	0.014	1	Pressure Change Coeff.	1.5
A530a	A/530/10	A/420/65	29.68	29.3	Circular	0.45	0	15.33	0.014	1	Pressure Change Coeff.	1.5
A420e	A/420/65	A/420/55	28.74	27.93	Circular	0.825	0	57.41	0.014	1	Pressure Change Coeff.	1.5
A510c	A/510/30	A/510/20	31.45	31.1	Circular	0.375	0	16.62	0.014	1	Pressure Change Coeff.	5
A510b	A/510/20	A/510/10	31.1	29.03	Circular	0.45	0	79.83	0.014	1	Pressure Change Coeff.	1.5
A510a	A/510/10	A/420/55	29.03	28.75	Circular	0.75	0	6.57	0.014	1	Pressure Change Coeff.	1.5
A420d	A/420/55	A/420/50	27.93	26.48	Circular	1.05	0	148.27	0.014	1	Pressure Change Coeff.	1.5

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation m AHD	Downstream Invert Elevation m AHD	Shape	Diameter (Height) m	Bottom Width m	Length m	Roughness	Number of Barrels	Entrance/Exit Loss Type	Pressure Change Coefficient Ku
A420c	A/420/50	A/420/40	26.43	25.77	Circular	1.05	0	13.32	0.014	1	Pressure Change Coeff.	1.5
A420b	A/420/40	A/420/30	25.77	25.1	Circular	1.05	0	27.49	0.014	1	Pressure Change Coeff.	1.5
A420a	A/420/30	A/620/40	25.1	19.72	Circular	1.2	0	317.51	0.014	1	Pressure Change Coeff.	1.5
DumBkstn	Bnkstn	A/620/90	25.75	24.9	Circular	1.35	0	130	0.014	1	Pressure Change Coeff.	0
A620m	A/620/90	A/620/80	24.9	24.55	Circular	1.5	0	15.11	0.014	1	Pressure Change Coeff.	1.5
A620l	A/620/80	A/620/70	24.3	23.6	Rectangular	1.2	6	61.99	0.014	1	Energy/Loss Coeff	1.5
A620k	A/620/70	A/620/60	23.44	22.78	Rectangular	1.2	6	140.92	0.014	1	Energy/Loss Coeff	1.5
619.1	A/620/60	A/620/50	22.78	22.45	Rectangular	1.2	6	62.2	0.014	1	Energy/Loss Coeff	1.5
619.2	A/620/60	A/620/50	20.95	19.95	Circular	1.5	0	62.2	0.014	1	Pressure Change Coeff.	1.5
A620i	A/620/50	A/620/40	19.95	19.72	Circular	1.5	0	8.67	0.014	1	Pressure Change Coeff.	1.5
A620h	A/620/40	A/620/30	19.72	17.3	Rectangular	2.1	2.4	243.73	0.014	1	Energy/Loss Coeff	1.5
A620g	A/620/30	A/620/29	17.3	16.78	Rectangular	2.1	2.4	66.56	0.014	1	Energy/Loss Coeff	1.5
A620f	A/620/29	A/620/28	15.514	15.434	Natural	3.75	2.4	6	0.014	1	Energy/Loss Coeff	1.5
A620e	A/620/28	A/620/27	15.434	15.404	Natural	3	2.4	15	0.014	1	Energy/Loss Coeff	1.5
Link537	A/620/27	Node532	15.943	15.67	Natural	1.4	3	95.56	0.2	1	Energy/Loss Coeff	0
Link538	Node532	A/620/25	15.67	15.36	Natural	1	3	110	0.014	1	Energy/Loss Coeff	0
Link524	A/620/25	Node525	14.688	14.632	Circular	1.95	3.05	31.5	0.014	1	Energy/Loss Coeff	0
Link530	Node525	XS5	14.7	14.45	Natural	1.55	2.94	36	0.014	1	Energy/Loss Coeff	0

SKM

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation m AHD	Downstream Invert Elevation m AHD	Shape	Diameter (Height) m	Bottom Width m	Length m	Roughness	Number of Barrels	Entrance/Exit Loss Type	Pressure Change Coefficient Ku
Link531	XS5	XS4	14.45	14.11	Natural	1.55	2.94	33	0.014	1	Energy/Loss Coeff	0
Link532	XS4	XS3	14.11	13.86	Natural	1.55	2.94	30	0.014	1	Energy/Loss Coeff	0
Link533	XS3	XS2	13.86	13.65	Natural	1.55	2.94	26	0.014	1	Energy/Loss Coeff	0
Link534	XS2	Node526	13.65	13.19	Natural	1.55	1.94	50	0.014	1	Energy/Loss Coeff	0
Link525	Node526	A/620/20	13.19	12.77	Rectangular	2.1	3.05	34.5	0.014	1	Energy/Loss Coeff	0.5
A620a	A/620/20	A/620/10	12.77	12.66	Rectangular	2.1	3.05	17.07	0.014	1	Energy/Loss Coeff	1.5
B930j	A/620/10	B/930/70	12.66	10.35	Rectangular	2.1	3.05	267.12	0.014	1	Energy/Loss Coeff	1.5
B930i	B/930/70	B/930/60	10.35	10.2	Rectangular	2.1	3.05	10.73	0.014	1	Energy/Loss Coeff	1.5
B930h	B/930/60	B/930/50	10.2	10.1	Rectangular	2.1	3.05	7.77	0.014	1	Energy/Loss Coeff	1.5
B930g	B/930/50	B/930/45	10.1	7.8	Rectangular	2.1	3.05	208.87	0.014	1	Energy/Loss Coeff	1.5
B930f	B/930/45	B/930/40	7.8	7.72	Rectangular	2.1	3.05	8.09	0.014	1	Energy/Loss Coeff	1.5
B930e	B/930/40	B/930/30	7.72	7.5	Rectangular	2.1	3.05	18.83	0.014	1	Energy/Loss Coeff	1.5
B930d	B/930/30	B/930/20	7.5	7.47	Rectangular	2.1	3.05	5.06	0.014	1	Energy/Loss Coeff	1.5
B930c	B/930/20	B/930/10	7.47	7.36	Rectangular	2.1	3.05	18.47	0.014	1	Energy/Loss Coeff	1.5
B820a	B/820/10	B/930/10	9.87	9.13	Circular	0.3	0	42.13	0.014	1	Pressure Change Coeff.	5
B930b	B/930/10	B/930/06	7.36	5.76	Rectangular	2.1	3.05	159.33	0.014	1	Energy/Loss Coeff	1.5
B940h	B/940/70	B/940/60	10.08	9.85	Circular	0.375	0	11.72	0.014	1	Pressure Change Coeff.	5
B940g	B/940/60	B/940/50	9.85	9.35	Circular	0.45	0	106.13	0.014	1	Pressure Change Coeff.	1.5

SKM

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation m AHD	Downstream Invert Elevation m AHD	Shape	Diameter (Height) m	Bottom Width m	Length m	Roughness	Number of Barrels	Entrance/Exit Loss Type	Pressure Change Coefficient Ku
B950a	B/950/10	B/940/50	9.41	9.35	Circular	0.375	0	11.88	0.014	1	Pressure Change Coeff.	5
B940f	B/940/50	B/940/40	9.35	8.42	Circular	0.45	0	53.76	0.014	1	Pressure Change Coeff.	1.5
B940e	B/940/40	B/940/30	8.42	8.17	Circular	0.45	0	17.04	0.014	1	Pressure Change Coeff.	1.5
B940d	B/940/30	B/940/20	8.17	7.42	Circular	0.45	0	56.5	0.014	1	Pressure Change Coeff.	1.5
B940c	B/940/20	B/940/15	7.3	7.21	Circular	0.45	0	14.31	0.014	1	Pressure Change Coeff.	1.5
B940b	B/940/15	B/940/10	7.21	6.95	Circular	0.75	0	12.62	0.014	1	Pressure Change Coeff.	1.5
B940a	B/940/10	B/930/06	6.95	6.69	Circular	0.75	0	25.95	0.014	1	Pressure Change Coeff.	1.5
B930a	B/930/06	B/930/05	5.76	5.33	Rectangular	2.1	3.05	42.94	0.014	1	Energy/Loss Coeff	1.5
DummyLink5	B/930/05	Node501	5.33	5.33	Trapezoidal	2	5	10	0.03	1	Energy/Loss Coeff	0
BC XS-25	Node501	Node502	4.943	4.569	Natural	0	0	47.18	0.014	1	Energy/Loss Coeff	0
BC XS-24	Node502	Node503	4.569	3.629	Natural	0	0	107.5	0.014	1	Energy/Loss Coeff	0
BC XS-23	Node503	Node504	3.629	3.508	Natural	0	0	56.55	0.014	1	Energy/Loss Coeff	0
Dummylink	Dum504A	Node504	3.5	3.5	Trapezoidal	1	20	10	0.03	1	Energy/Loss Coeff	0
BC XS-22	Node504	Node505	3.508	2.95	Natural	0	0	22	0.014	1	Energy/Loss Coeff	0
BC XS-21	Node505	Node506	2.95	2.395	Natural	0	0	29.9	0.014	1	Energy/Loss Coeff	0
Link541	Node506	Node508	2.395	2	Natural	0	0	45	0.014	1	Energy/Loss Coeff	0
BC XS-17-2	Node508	Node515	1.85	1.8	Natural	0	0	45.6	0.014	1	Energy/Loss Coeff	0
Link535	Node515	Node516	1.8	1.7	Natural	0	30	20	0.014	1	Energy/Loss Coeff	0

SKM

Table B-3 Old Guildford XP-STORM Sub-Catchment Data

Catchment code	XP-STORM node	Area (ha)			Travel Length (m)	Travel Time (min)		Slope (%)
		Total	Sub-Catch1 (Impervious)	Sub-Catch 2 (Pervious)		Sub-Catch1 (Impervious)	Sub-Catch 2 (Pervious)	
O1	A/20/30	12.44	7.332	5.108	776	12.94	25.88	2.06
O2	A/370/50	2.88	1.72	1.16	73	1.22	2.45	3.44
O3	A/380/40	3.08	1.864	1.216	220	3.67	7.33	2.98
O4	A/400/10	1.4	0.904	0.496	287	4.78	9.57	4.36
O5	A/10/160	17.13	8.465	8.665	379	6.31	12.62	2.77
O6	A/530/50	0.88	0.44	0.44	90	1.50	3.00	6.11
O7	A/570/20	6.79	4.163	2.627	323	5.38	10.77	4.02
O8	A/510/30	2.31	1.155	1.155	284	4.73	9.47	4.83
O9	A/420/55	14.68	7.836	6.844	617	10.28	20.57	3.76
O10	A/10/85	17.15	5.827	11.323	570	9.50	19.00	3.05
O11	A/10/60	20.5	14.63	5.87	581	9.69	19.37	1.80
O12	A/10/10	15.83	11.119	4.711	612	10.20	20.41	1.63
O13	A/620/90	41.51	19.799	21.711	751	12.52	25.03	2.86
O14	A/620/40	9.29	7.513	1.777	535	8.92	17.84	2.43
O15	A/620/30	15.78	13.954	1.826	355	5.92	11.84	3.44
O16	A/620/20	15.58	2.882	12.698	602	10.03	20.05	1.92
O17	A/720/20	7.62	3.81	3.81	304	5.07	10.14	1.03
O18	B/850/100	2.28	1.18	1.1	248	4.13	8.26	2.01
O19	B/850/80	3.8	2.192	1.608	251	4.19	8.38	2.27
O20	B/10/20	10.64	9.576	1.064	657	10.95	21.90	2.33
O21	A/780/10	4.06	3.654	0.406	533	8.89	17.78	1.61
O22	B/920/10	3.85	3.465	0.385	455	7.58	15.15	1.22
O23	B/930/70	4.97	3.857	1.113	790	13.17	26.34	1.15
O24	B/910/20	1.24	0.124	1.116	192	3.20	6.40	1.06
O25	B/880/30	1.25	1.117	0.133	187	3.12	6.24	1.95
O26	B/880/10	0.4	0.264	0.136	122	2.03	4.06	1.49
O27	B/850/30	2.73	1.801	0.929	518	8.64	17.28	1.24
O28	B/130/10	9.49	8.309	1.181	721	12.02	24.04	2.92
O29	B/10/10	4.07	3.663	0.407	564	9.40	18.80	1.51
O30	B/40/50	3.2	2.828	0.372	280	4.67	9.35	3.02
O31	B/40/10	4.03	3.359	0.671	289	4.82	9.64	2.03
O32	B/10/07	0.53	0.469	0.061	185	3.08	6.17	1.08
O33	B/20/10	1.26	1.11	0.15	205	3.42	6.83	1.16
O34	B/830/30	3.48	3.132	0.348	274	4.57	9.13	0.70
O35	B/930/45	2	1.22	0.78	659	10.98	21.97	0.96
O36	B/830/10	0.86	0.474	0.386	144	2.40	4.80	1.06
O37	B/930/20	1.56	0.812	0.748	313	5.21	10.42	0.56
O38	B/1000/50	4.83	2.415	2.415	273	4.55	9.10	1.22
O39	B/1000/05	4.34	2.17	2.17	428	7.14	14.28	1.11
O40	B/1010/10	1.18	0.59	0.59	280	4.66	9.32	0.77
O41	B/940/50	1.02	0.51	0.51	170	2.83	5.66	0.56
O42	B/940/15	2.74	1.37	1.37	188	3.13	6.26	0.86

O43	B/550/10	1.93	0.965	0.965	306	5.10	10.20	1.18
O44	B/670/10	5.67	2.859	2.811	435	7.25	14.50	1.25
O45	B/620/10	3.01	1.561	1.449	290	4.83	9.65	1.98
O46	B/590/10	1.09	0.545	0.545	194	3.23	6.45	1.18
O47	B/550/50	9.3	4.738	4.562	561	9.35	18.71	2.12
O48	B/670/50	7.84	3.92	3.92	529	8.81	17.63	1.26
O49	C/10/20	4.81	4.297	0.513	397	6.62	13.24	2.32
O50	C/110/120	2.05	1.025	1.025	185	3.08	6.17	1.86
O51	C/110/30	12.57	8.189	4.381	853	14.22	28.43	1.72
O53	Node513	13.08	6.836	6.244	304	5.07	10.13	0.89
O54	Node512	7.23	3.779	3.451	489	8.15	16.30	1.20
O56	Node504A	2.79	1.375	1.415	284	4.73	9.45	1.00
O58	Node504	3.1	1.39	1.71	295	4.91	9.82	2.88
O59	Node499	2.17	1.105	1.065	262	4.37	8.74	0.79
O60	Node499A	4.64	2.292	2.348	409	6.82	13.64	1.81
O61	Node494	3.85	2.857	0.993	283	4.72	9.43	0.99
O62	Node494A	4.71	2.079	2.631	390	6.50	13.00	1.46
O63	Node490	10.42	8.81	1.61	510	8.50	17.01	1.25
O64	Node490A	10.48	4.9	5.58	612	10.21	20.42	1.67
O65	Node481	4.19	1.915	2.275	400	6.66	13.33	1.88
O66	Node481A	6.85	3.717	3.133	432	7.20	14.39	2.57
O67	Node479	10.79	7.419	3.371	570	9.51	19.01	2.08
O68	Node479A	10.29	7.237	3.053	814	13.57	27.15	3.05
O69	C/95/75	1.75	0.891	0.859	260	4.33	8.66	1.83
O70	A/420/50	4.34	2.17	2.17	266	4.43	8.86	3.07
O71	A/620/60	2.08	1.872	0.208	280	4.67	9.34	1.01

Appendix C IFD and Design Rainfall Intensity Data

- **Table C-1 Average Rainfall Intensities for Storm Events up to 500 year ARI (mm/hr)**

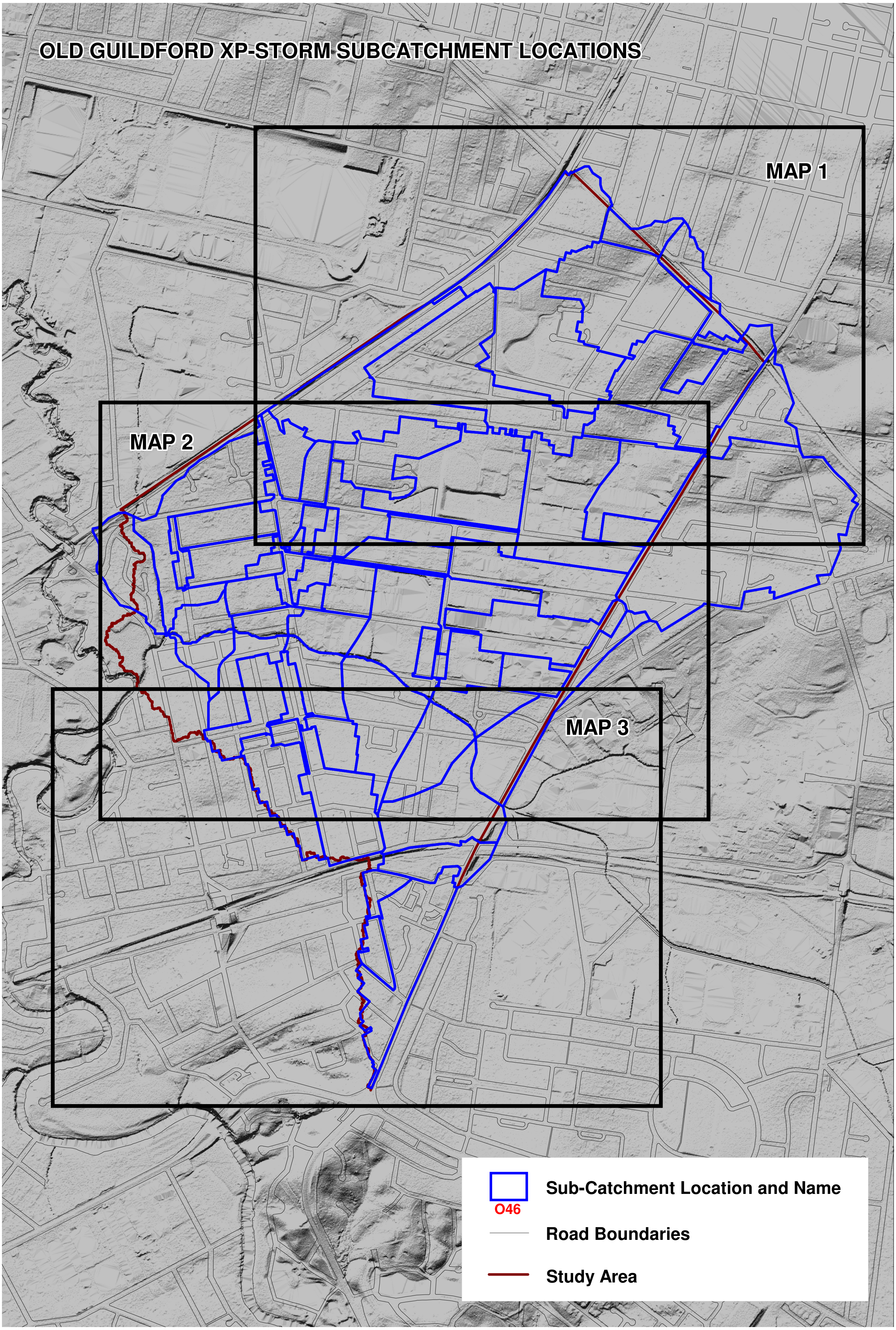
Duration	Event ARI			
	20 year	100 year	200 year	500 year
15min	109.2	140.0	N/A	N/A
30min	77.2	98.9	108.6	121.4
45min	61.8	79.3	N/A	N/A
1hr	52.5	67.3	73.8	82.4
1.5hr	41.3	53.1	58.3	65.3
2hr	34.7	44.7	49.2	55.2
3hr	27.0	34.9	38.6	43.4

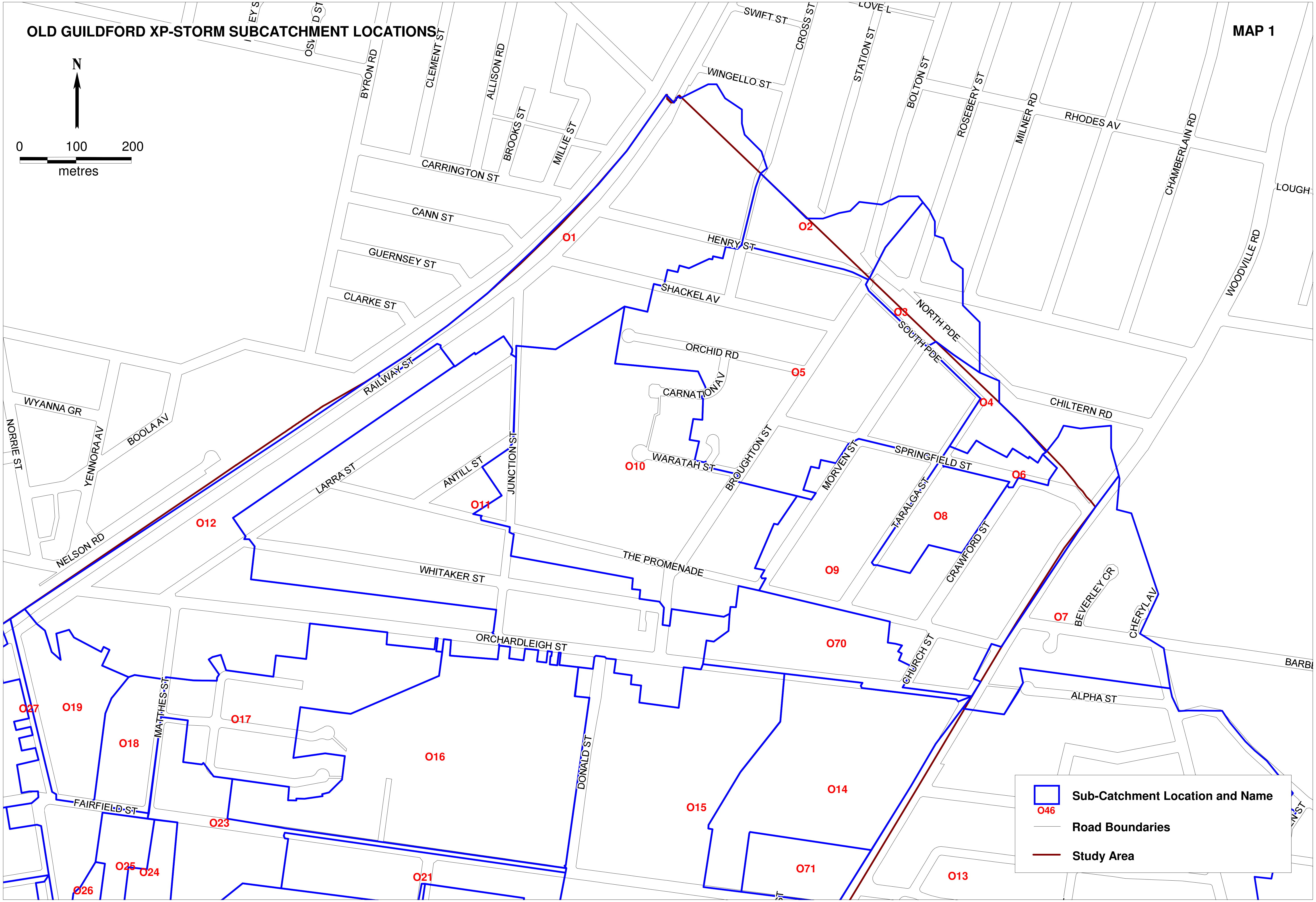
* N/A = Not estimated

- **Table C-2 Average Rainfall Intensities for Extreme Storm Events (mm/hr)**

Duration	Event ARI		
	2,000 year	10,000 year	PMP
30min	166.6	214.0	460
1hr	117.1	152.7	340
1.5hr	91.3	118.5	260
2hr	77.1	100.1	220
3hr	59.3	76.2	163

Appendix D Detailed Sub-Catchment Plans


OLD GUILDFORD XP-STORM SUBCATCHMENT LOCATIONS
MAP 1
MAP 2
MAP 3
O46
Sub-Catchment Location and Name
Road Boundaries
Study Area


OLD GUILDFORD XP-STORM SUBCATCHMENT LOCATIONS
MAP 1
N
0
100
200
metres
Sub-Catchment Location and Name
O46
Road Boundaries
Study Area
SWIFT ST
LOVE L
CROSS ST
STATION ST
WINGELLO ST
BOLTON ST
ROSEBERY ST
MILNER RD
RHODES AV
CHAMBERLAIN RD
LOUGH
WOODVILLE RD
BYRON RD
CLEMENT ST
ALLISON RD
BROOKS ST
MILLIE ST
CARRINGTON ST
CANN ST
GUERNSEY ST
CLARKE ST
HENRY ST
SHACKEL AV
ORCHID RD
CARNATION AV
WARATAH ST
BROUGHTON ST
NORTH PDE
SOUTH PDE
CHILTERN RD
SPRINGFIELD ST
MORVEN ST
TARALGA ST
CRAWFORD ST
BEVERLEY CR
CHERYL AV
BARB
ALPHA ST
CHURCH ST
RAILWAY ST
WYANNA GR
NORRIE ST
YENNORA AV
BOOLA AV
NELSON RD
LARRA ST
ANTILL ST
JUNCTION ST
THE PROMENADE
WHITAKER ST
ORCHARDLEIGH ST
MATTHES ST
DONALD ST
FAIRFIELD ST
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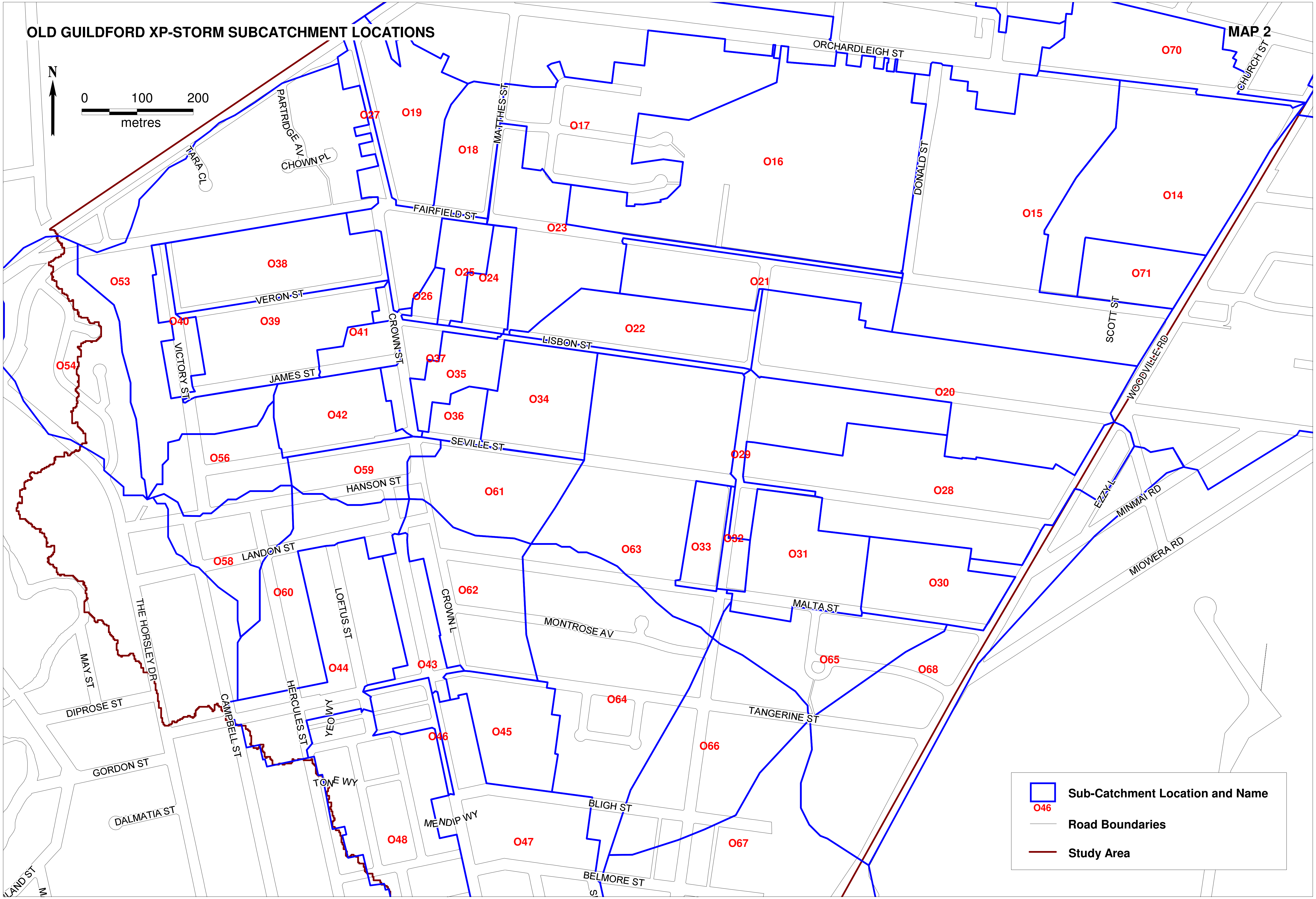
OLD GUILDFORD XP-STORM SUBCATCHMENT LOCATIONS
MAP 2
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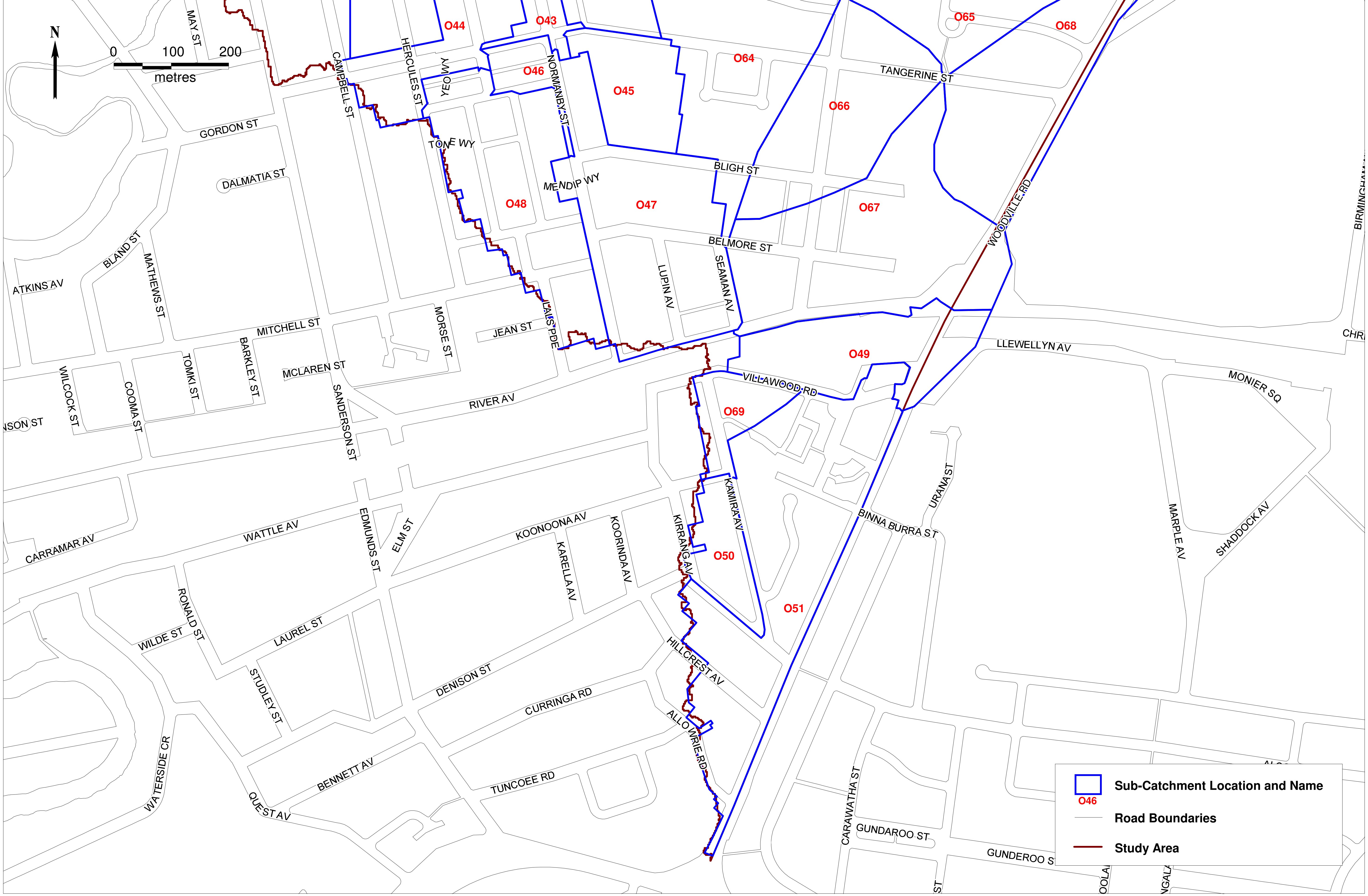
CHURCH ST
FAIRFIELD ST
MATTHES ST
DONALD ST
PARTRIDGE AV
CHOWN PL
TARA CL
VERON ST
VICTORY ST
JAMES ST
CROWN ST
LISBON ST
SCOTT ST
WOODVILLE RD
SEVILLE ST
HANSON ST
LANDON ST
LOFTUS ST
CROWN L
MONTROSE AV
MALTA ST
EZZY L
MINMAI RD
MIOWERA RD
THE HORSLEY DR
MAY ST
DIPROSE ST
CAMPBELL ST
HERCULES ST
YEO WY
TANGERINE ST
GORDON ST
DALMATIA ST
TONE WY
MENDIP WY
BLIGH ST
BELMORE ST
Sub-Catchment Location and Name
O46
Road Boundaries
Study Area

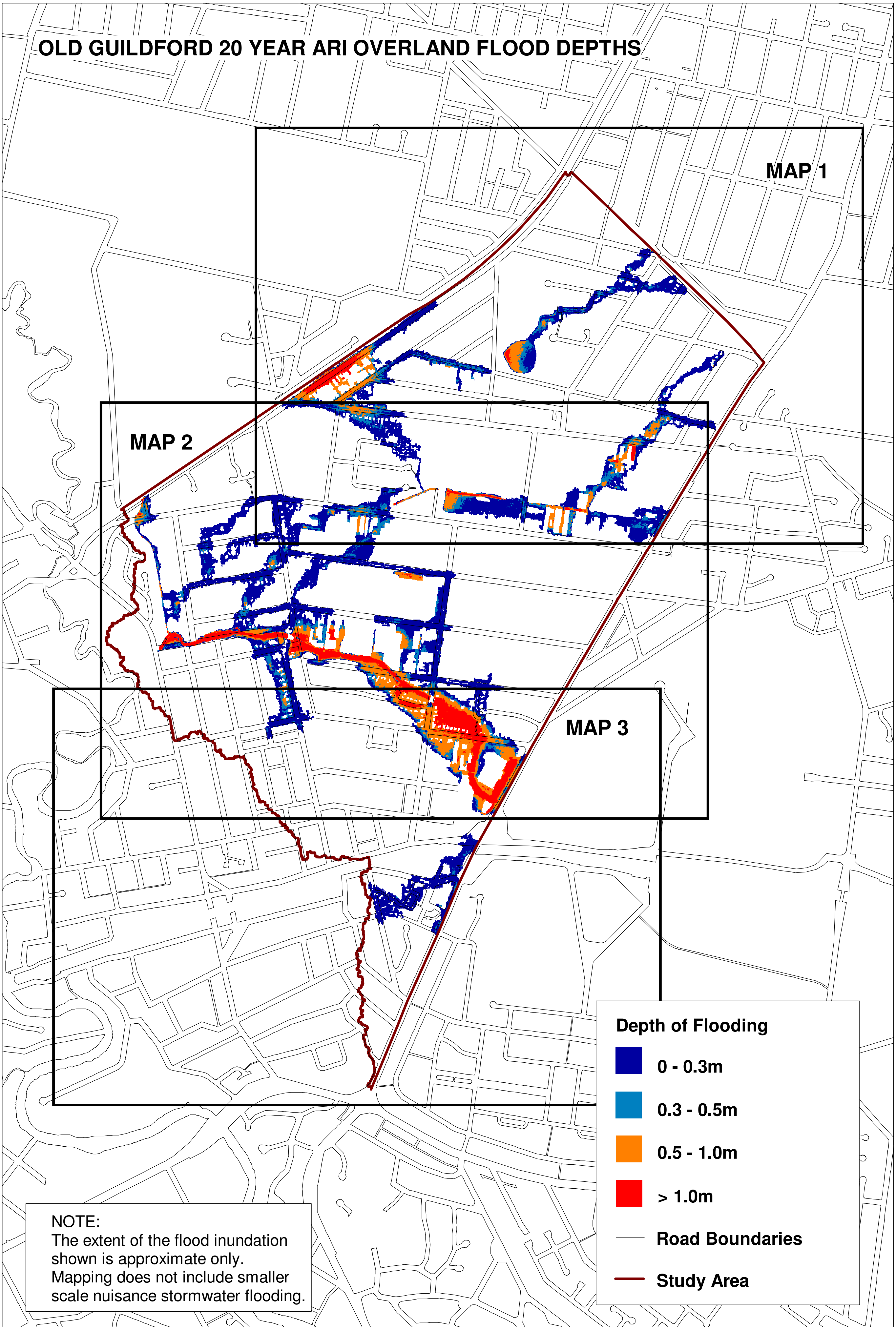
OLD GUILDFORD XP-STORM SUBCATCHMENT LOCATIONS

MAP 3

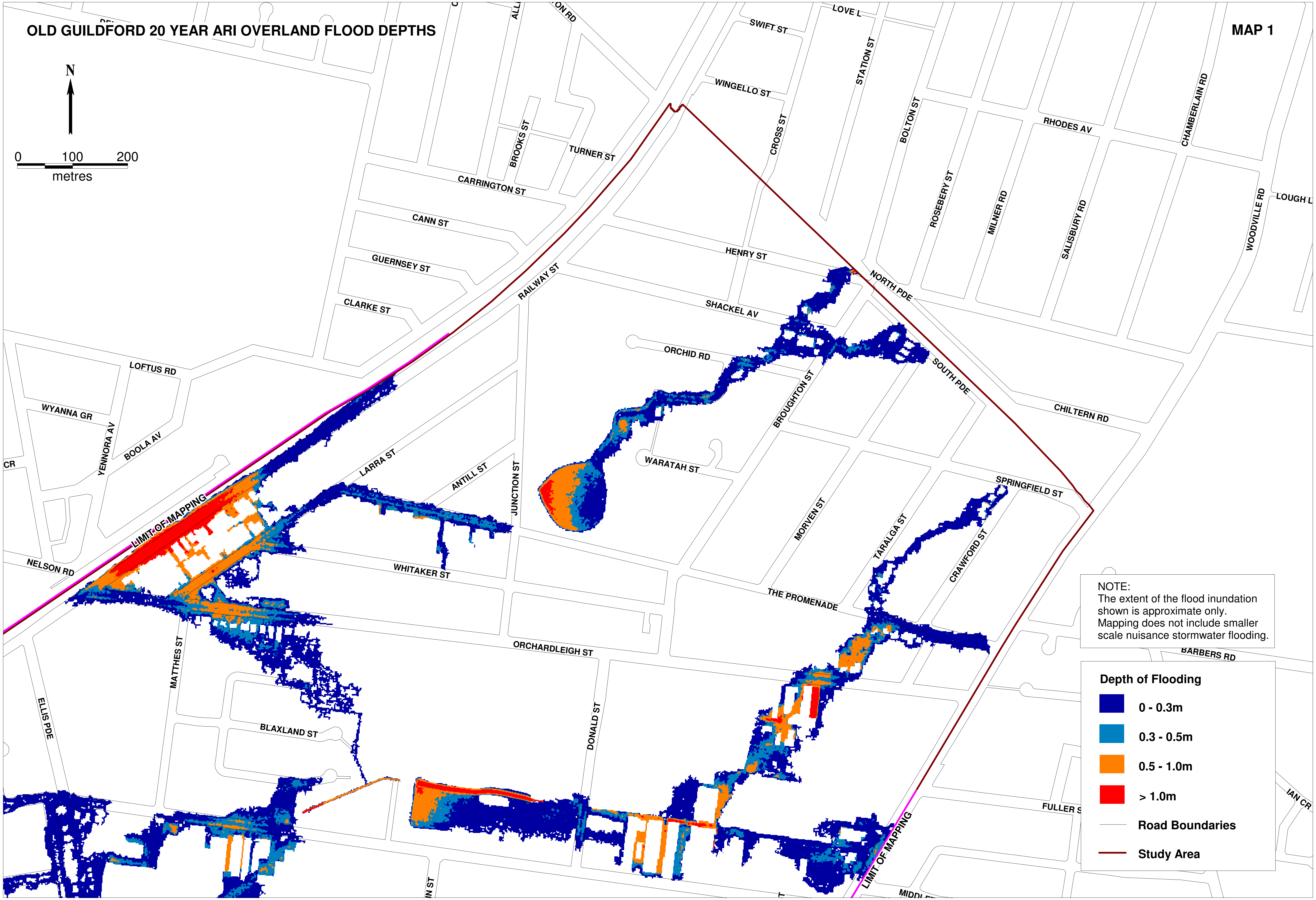


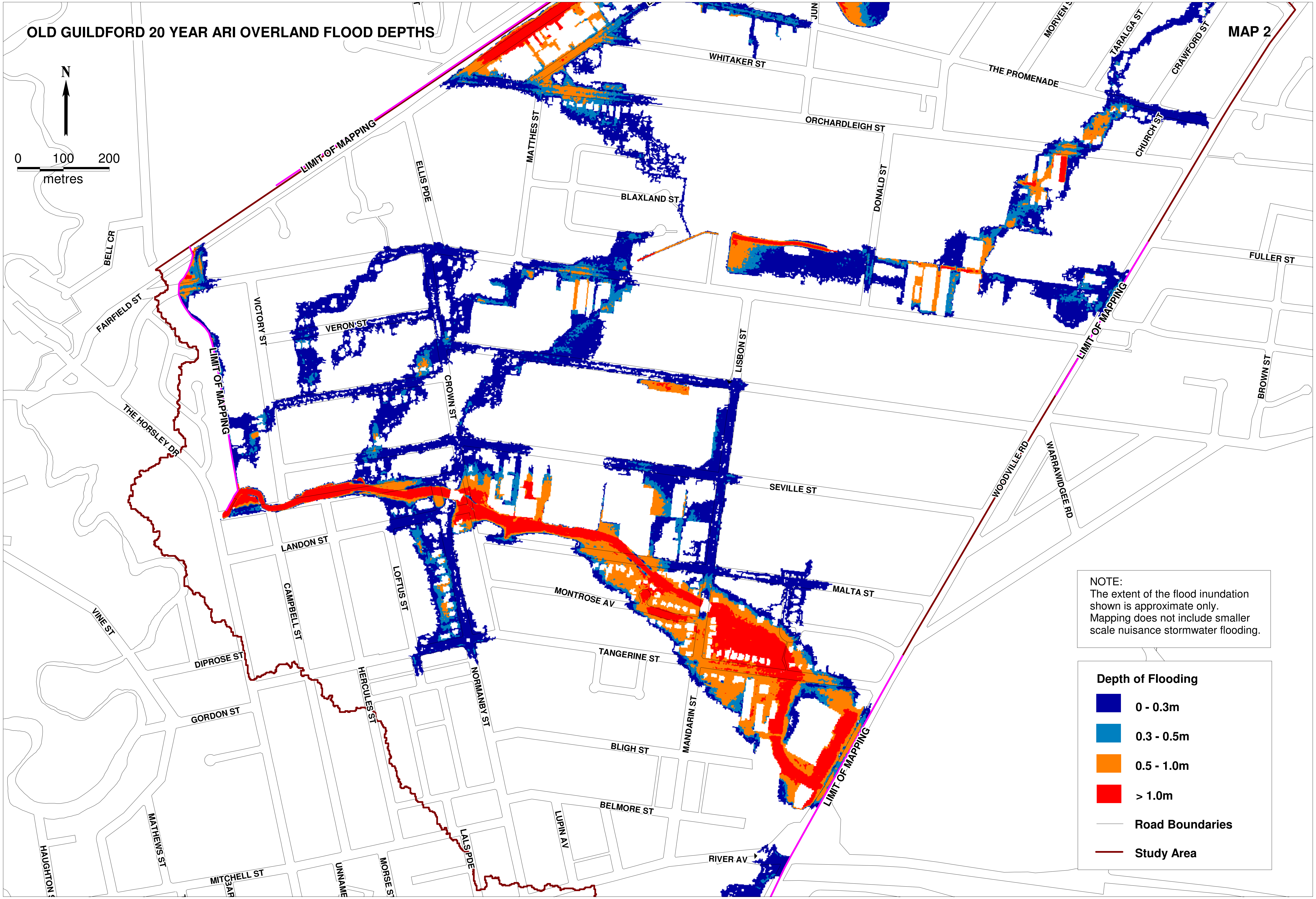
Appendix E Flood Depth Mapping

- Flood depths for 20, 100, 2,000 year ARI and PMF events presented
- Flood levels for 100 year ARI event presented



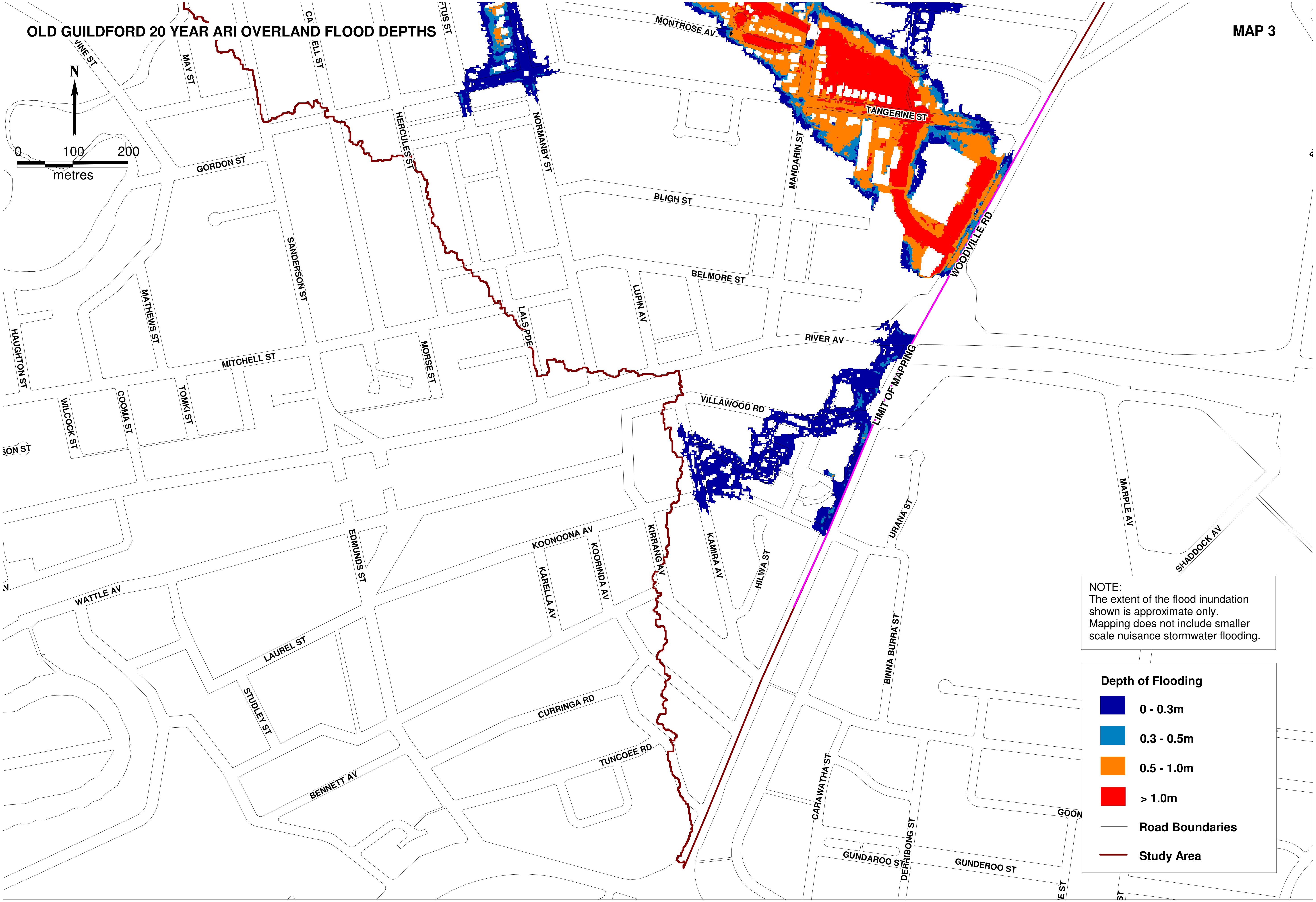
OLD GUILDFORD 20 YEAR ARI OVERLAND FLOOD DEPTHS
MAP 1
MAP 2
MAP 3
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.

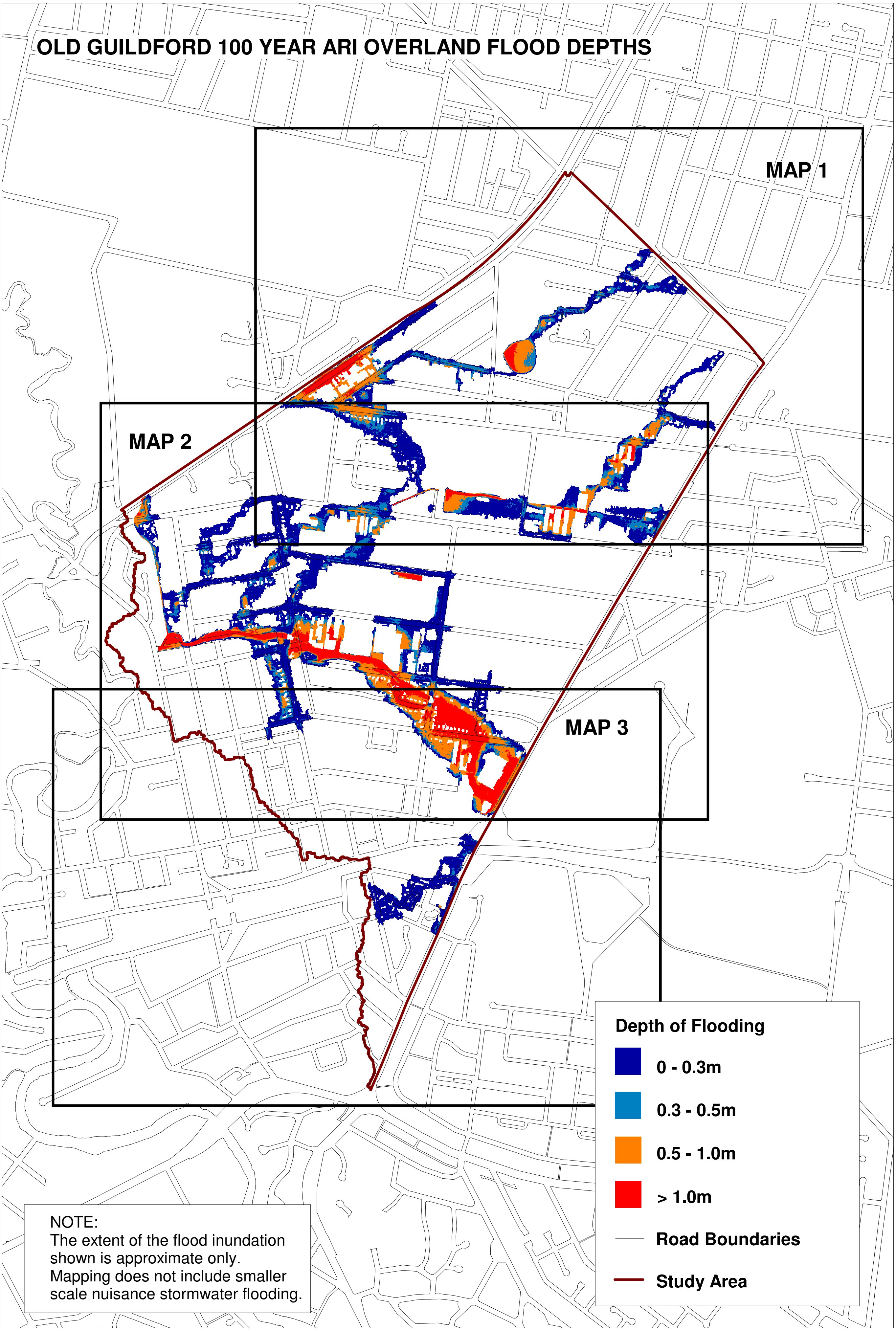

OLD GUILDFORD 20 YEAR ARI OVERLAND FLOOD DEPTHS
MAP 1
N
0 100 200
metres
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area
LIMIT OF MAPPING
LIMIT OF MAPPING
SWIFT ST
LOVE L
WINGELLO ST
STATION ST
CROSS ST
BOLTON ST
RHODES AV
CHAMBERLAIN RD
ROSEBERY ST
MILNER RD
SALISBURY RD
WOODVILLE RD
LOUGH L
TURNER ST
BROOKS ST
CARRINGTON ST
CANN ST
GUERNSEY ST
CLARKE ST
HENRY ST
NORTH PDE
SHACKEL AV
RAILWAY ST
ORCHID RD
SOUTH PDE
CHILTERN RD
BROUGHTON ST
LOFTUS RD
WYANNA GR
YENNORA AV
BOOLA AV
LARRA ST
ANTILL ST
JUNCTION ST
WARATAH ST
SPRINGFIELD ST
MORVEN ST
TARALGA ST
CRAWFORD ST
NELSON RD
WHITAKER ST
THE PROMENADE
BARBERS RD
MATHES ST
ORCHARDLEIGH ST
ELLIS PDE
BLAXLAND ST
DONALD ST
FULLER S
IAN CR


OLD GUILDFORD 20 YEAR ARI OVERLAND FLOOD DEPTHS
MAP 2
N
0
100
200
metres
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area
LIMIT OF MAPPING
WHITAKER ST
THE PROMENADE
TARALGA ST
CRAWFORD ST
ORCHARDLEIGH ST
CHURCH ST
MATTHES ST
ELLIS PDE
BLAXLAND ST
DONALD ST
FULLER ST
BELL CR
FAIRFIELD ST
VICTORY ST
VERON ST
LISBON ST
BROWN ST
THE HORSLEY DR
CROWN ST
SEVILLE ST
WOODVILLE RD
WARRAWIDGEE RD
LANDON ST
LOFTUS ST
CAMPBELL ST
MONTROSE AV
MALTA ST
VINE ST
TANGERINE ST
DIPROSE ST
GORDON ST
HERCULES ST
NORMANBY ST
MANDARIN ST
BLIGH ST
BELMORE ST
LUPIN AV
MATHEWS ST
HAUGHTON S
LALS PDE
RIVER AV
MITCHELL ST
MORSE ST

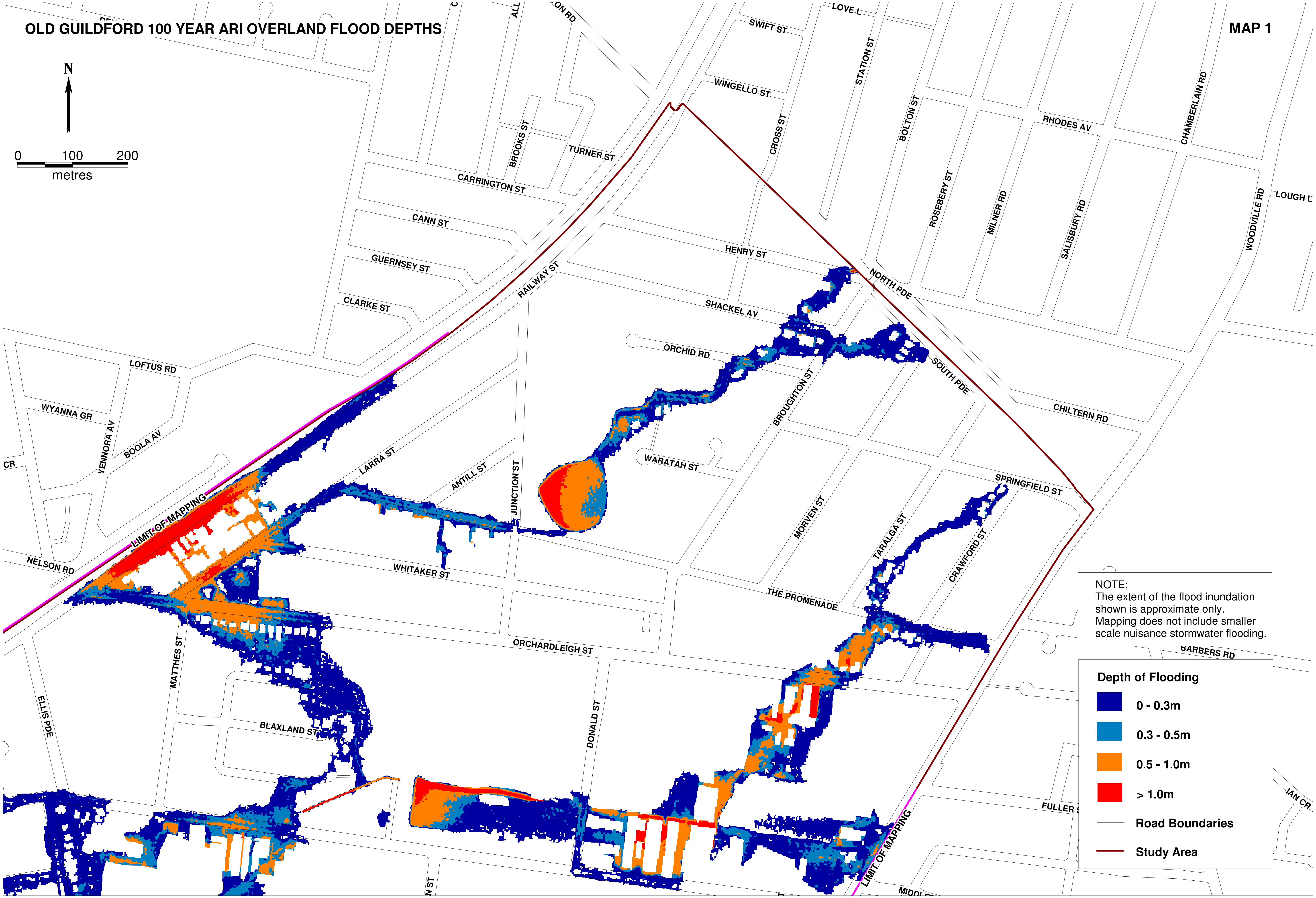
OLD GUILDFORD 20 YEAR ARI OVERLAND FLOOD DEPTHS

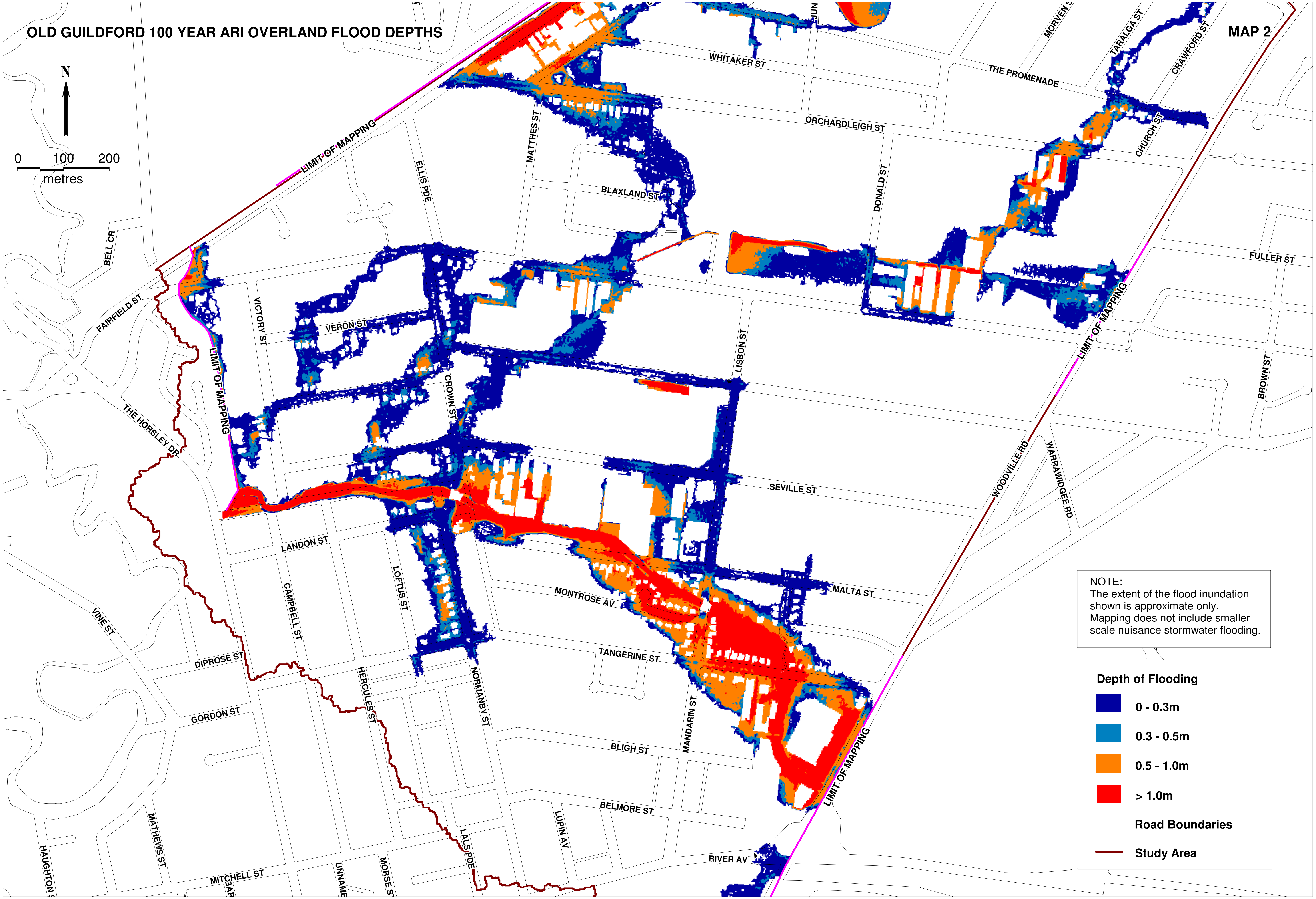
MAP 3





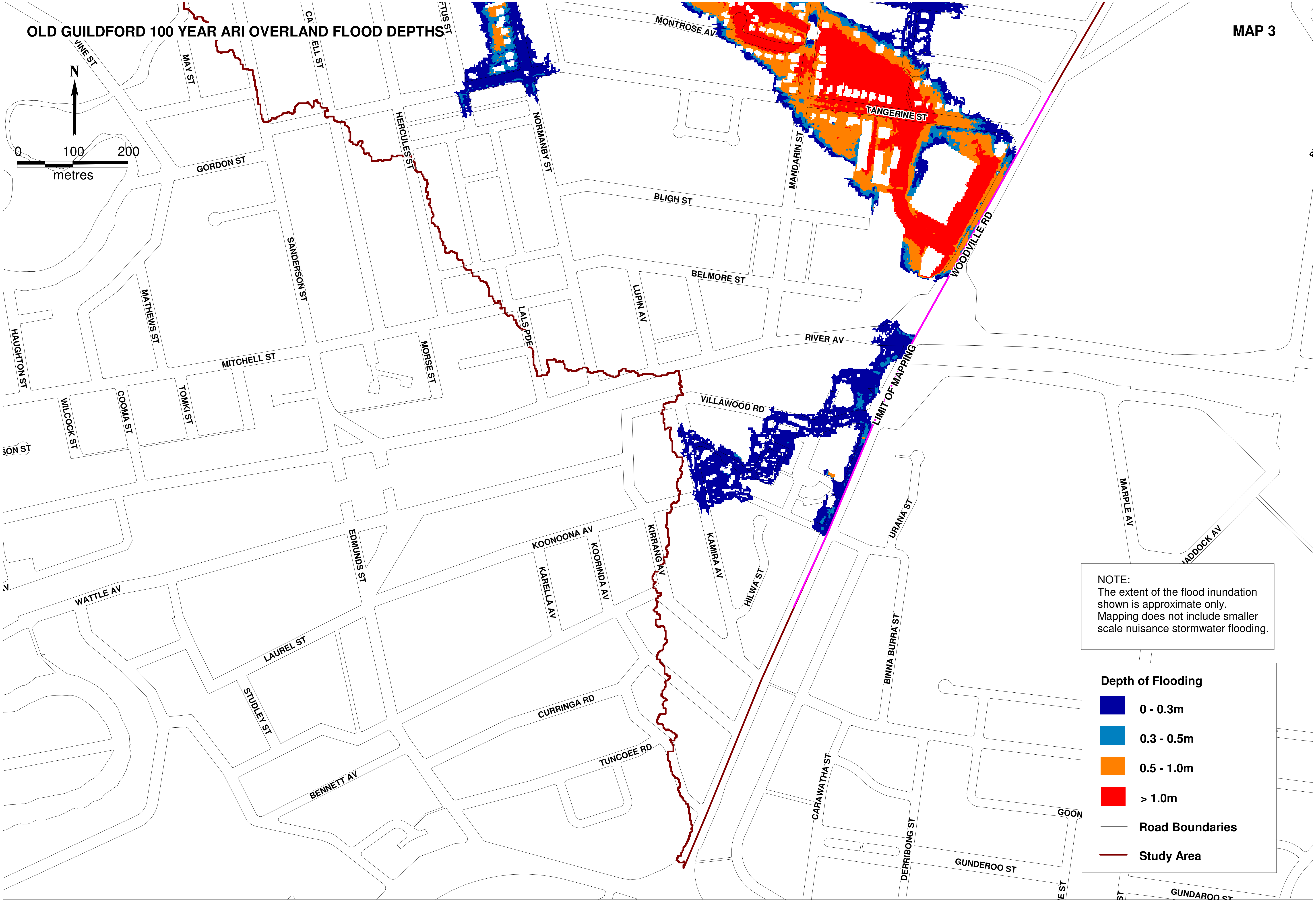
OLD GUILDFORD 100 YEAR ARI OVERLAND FLOOD DEPTHS
MAP 1
MAP 2
MAP 3
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.


OLD GUILDFORD 100 YEAR ARI OVERLAND FLOOD DEPTHS
MAP 1
N
0
100
200
metres
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area
LIMIT OF MAPPING
LIMIT OF MAPPING
LOVE L
SWIFT ST
WINGELLO ST
STATION ST
CROSS ST
BOLTON ST
CHAMBERLAIN RD
RHODES AV
ROSEBERY ST
MILNER RD
SALISBURY RD
WOODVILLE RD
LOUGH L
BROOKS ST
TURNER ST
CARRINGTON ST
CANN ST
GUERNSEY ST
CLARKE ST
HENRY ST
NORTH PDE
SHACKEL AV
RAILWAY ST
ORCHID RD
SOUTH PDE
CHILTERN RD
LOFTUS RD
WYANNA GR
YENNORA AV
BOOLA AV
BROUGHTON ST
WARATAH ST
LARRA ST
ANTILL ST
JUNCTION ST
SPRINGFIELD ST
MORVEN ST
TARALGA ST
CRAWFORD ST
NELSON RD
WHITAKER ST
THE PROMENADE
ORCHARDLEIGH ST
BARBERS RD
MATTHES ST
ELLIS PDE
BLAXLAND ST
DONALD ST
IAN CR


OLD GUILDFORD 100 YEAR ARI OVERLAND FLOOD DEPTHS
MAP 2
N
0
100
200
metres
LIMIT OF MAPPING
WHITAKER ST
THE PROMENADE
ORCHARDLEIGH ST
MATTHES ST
ELLIS PDE
BLAXLAND ST
DONALD ST
FULLER ST
TARALGA ST
CRAWFORD ST
MORVEN ST
CHURCH ST
BELL CR
FAIRFIELD ST
VICTORY ST
VERON ST
LISBON ST
CROWN ST
BROWN ST
THE HORSLEY DR
SEVILLE ST
WOODVILLE RD
WARRAWIDGEE RD
LANDON ST
LOFTUS ST
CAMPBELL ST
MONTROSE AV
MALTA ST
TANGERINE ST
VINE ST
DIPROSE ST
GORDON ST
HERCULES ST
NORMANBY ST
MANDARIN ST
BLIGH ST
BELMORE ST
LUPIN AV
RIVER AV
MATHEWS ST
HAUGHTON ST
MITCHELL ST
LALS PDE
MORSE ST
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area

OLD GUILDFORD 100 YEAR ARI OVERLAND FLOOD DEPTHS

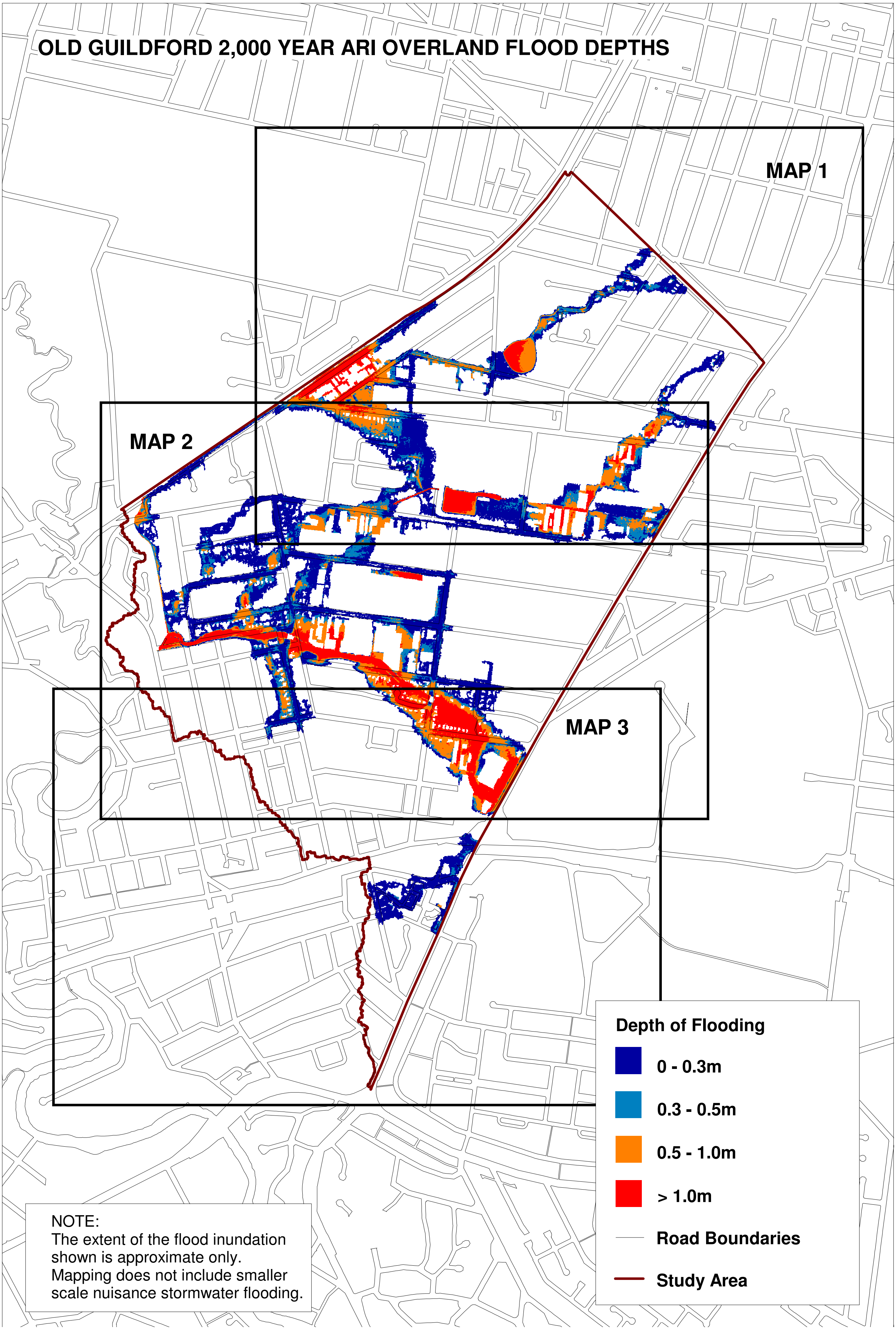
MAP 3

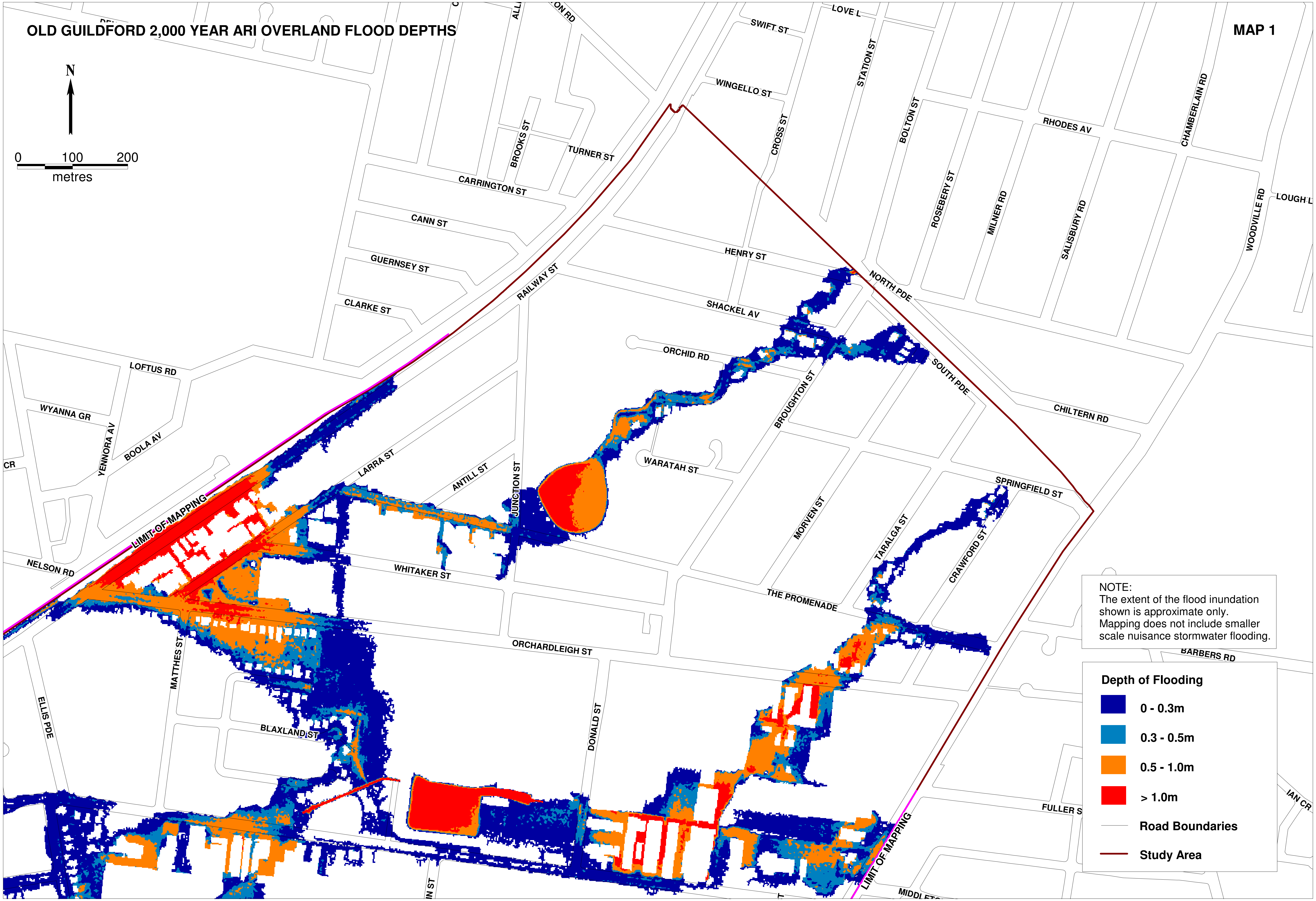


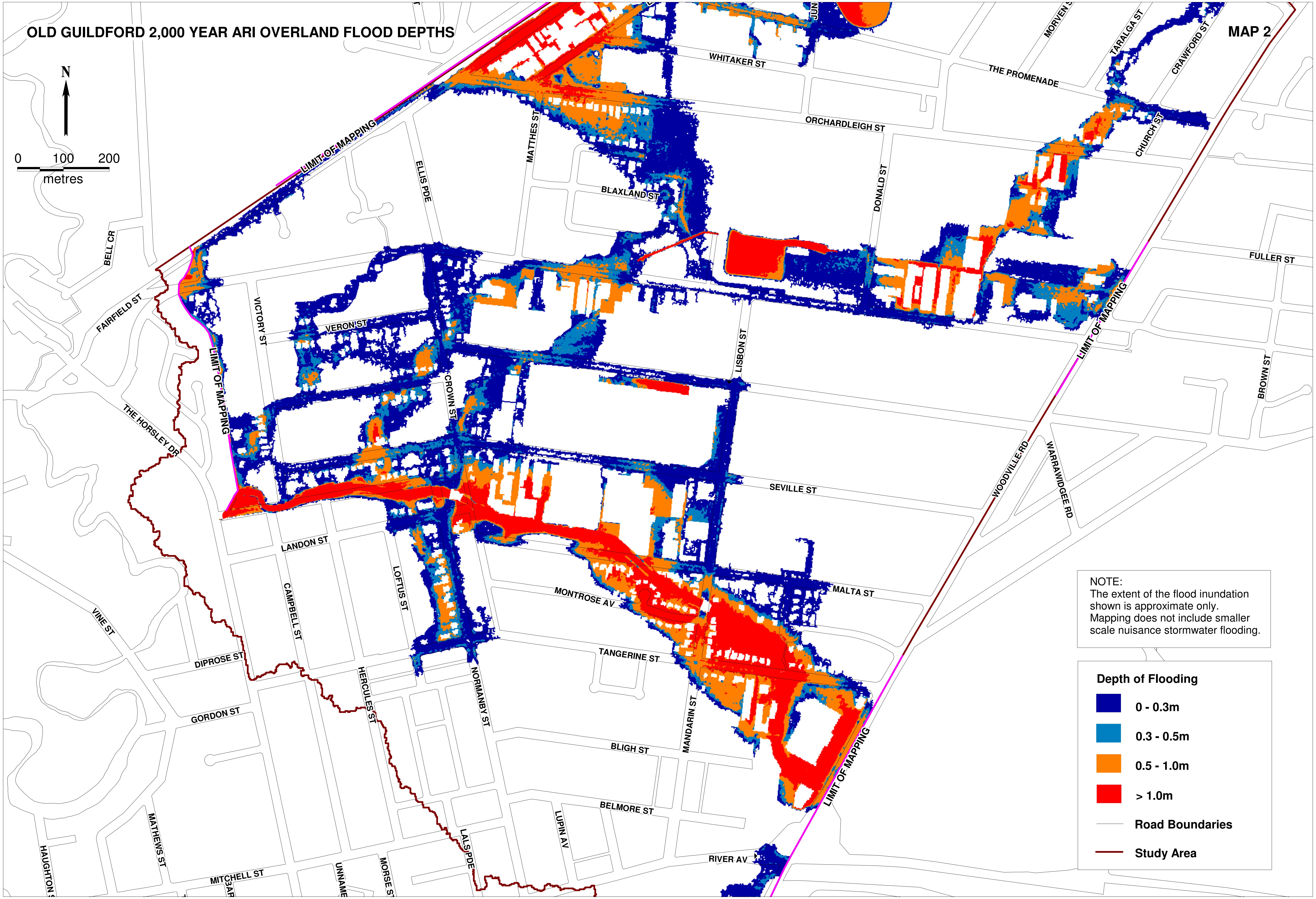
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.

Depth of Flooding

- 0 - 0.3m
- 0.3 - 0.5m
- 0.5 - 1.0m
- > 1.0m
- Road Boundaries
- Study Area

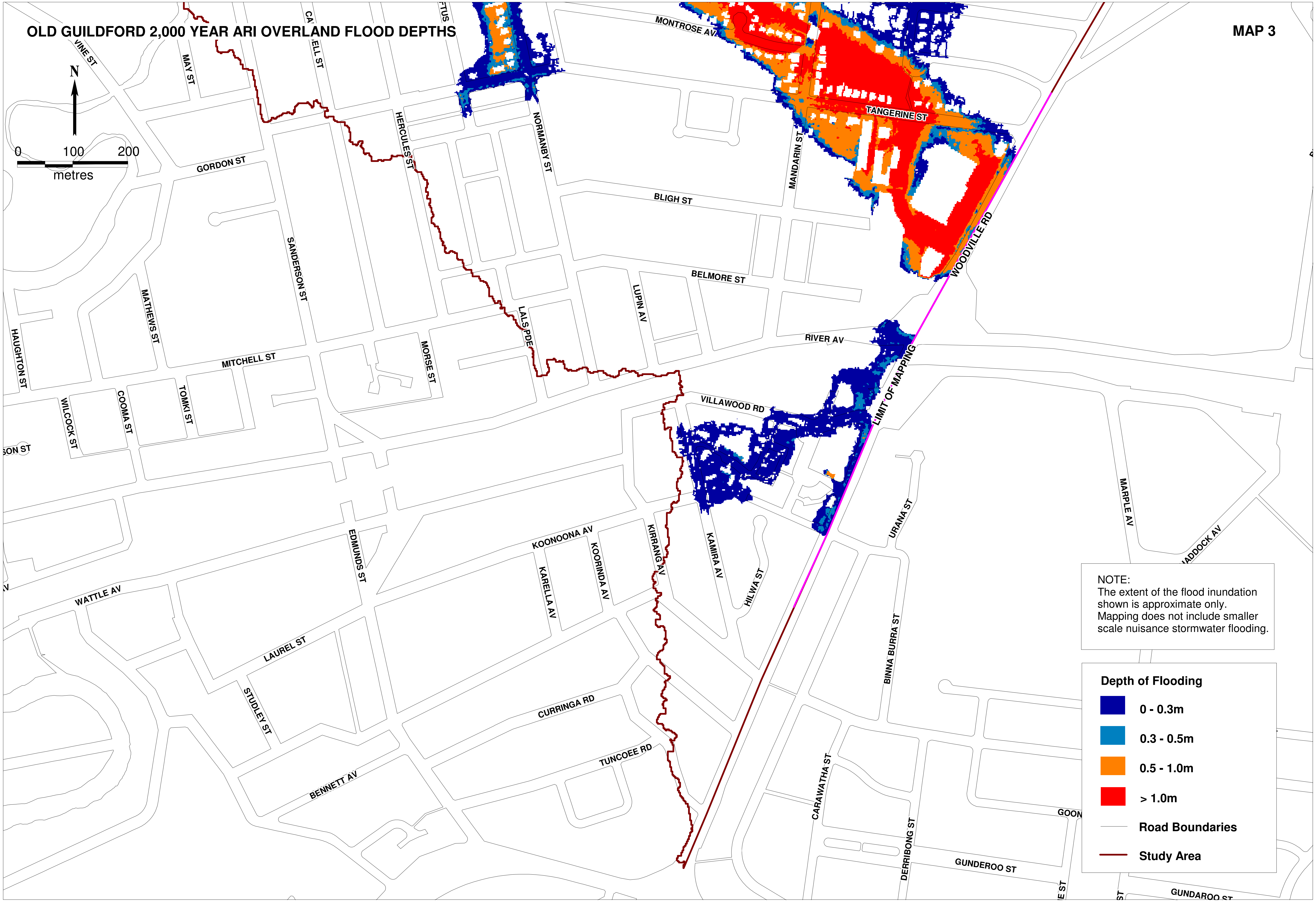

OLD GUILDFORD 2,000 YEAR ARI OVERLAND FLOOD DEPTHS
MAP 1
MAP 2
MAP 3
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.

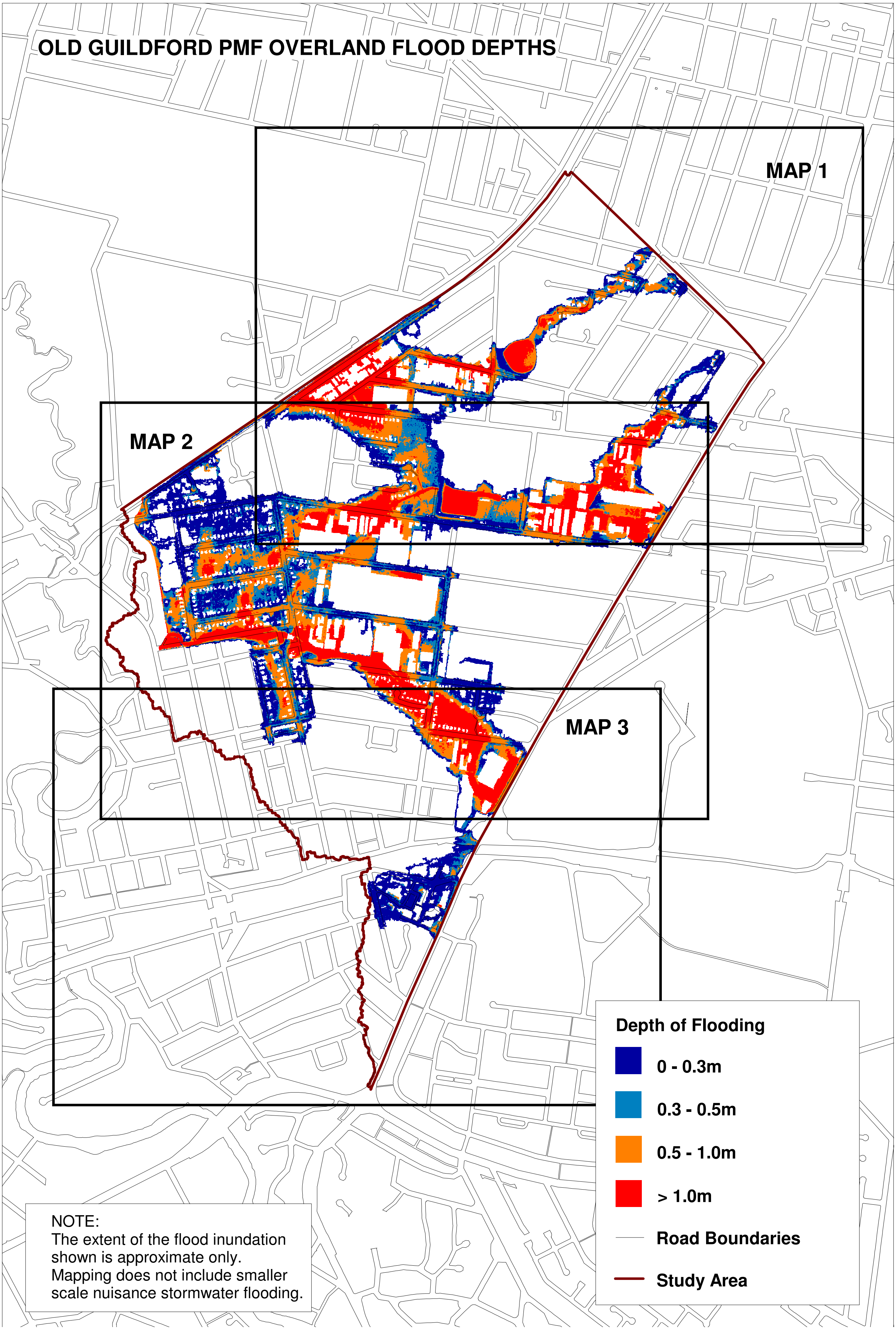

OLD GUILDFORD 2,000 YEAR ARI OVERLAND FLOOD DEPTHS
MAP 1
N
0 100 200
metres
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area
LIMIT OF MAPPING
LIMIT OF MAPPING
LOVE L
SWIFT ST
WINGELLO ST
STATION ST
CROSS ST
BOLTON ST
RHODES AV
CHAMBERLAIN RD
ROSEBERY ST
MILNER RD
SALISBURY RD
WOODVILLE RD
LOUGH L
TURNER ST
BROOKS ST
CARRINGTON ST
CANN ST
GUERNSEY ST
CLARKE ST
HENRY ST
NORTH PDE
SHACKEL AV
RAILWAY ST
ORCHID RD
SOUTH PDE
CHILTERN RD
LOFTUS RD
WYANNA GR
YENNORA AV
BOOLA AV
BROUGHTON ST
WARATAH ST
LARRA ST
ANTILL ST
JUNCTION ST
SPRINGFIELD ST
MORVEN ST
TARALGA ST
CRAWFORD ST
NELSON RD
WHITAKER ST
THE PROMENADE
ORCHARDLEIGH ST
BARBERS RD
MATHES ST
ELLIS PDE
BLAXLAND ST
DONALD ST
FULLER S
IAN CR
MIDDLE

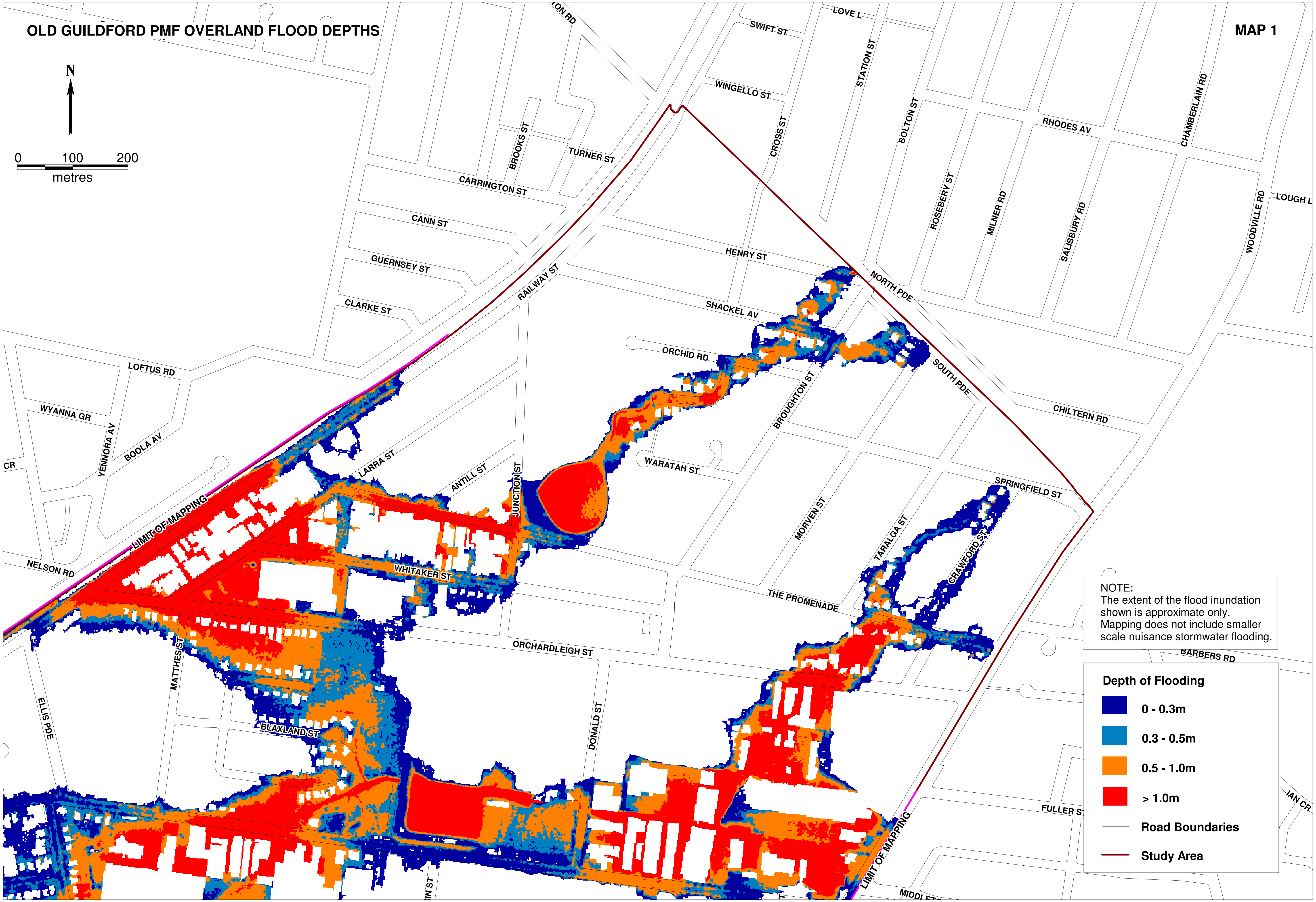

OLD GUILDFORD 2,000 YEAR ARI OVERLAND FLOOD DEPTHS
MAP 2
N
0
100
200
metres
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area
LIMIT OF MAPPING
WHITAKER ST
THE PROMENADE
MORVEN ST
TARALGA ST
CRAWFORD ST
ORCHARDLEIGH ST
CHURCH ST
MATTHES ST
ELLIS PDE
BLAXLAND ST
DONALD ST
FULLER ST
BELL CR
FAIRFIELD ST
VICTORY ST
VERON ST
LISBON ST
CROWN ST
BROWN ST
THE HORSLEY DR
WOODVILLE RD
WARRAWIDGEE RD
SEVILLE ST
LANDON ST
LOFTUS ST
CAMPBELL ST
MONTROSE AV
MALTA ST
VINE ST
TANGERINE ST
DIPROSE ST
HERCULES ST
NORMANBY ST
GORDON ST
MANDARIN ST
BLIGH ST
BELMORE ST
LUPIN AV
MATHEWS ST
LALS PDE
RIVER AV
HAUGHTON ST
MITCHELL ST
MORSE ST

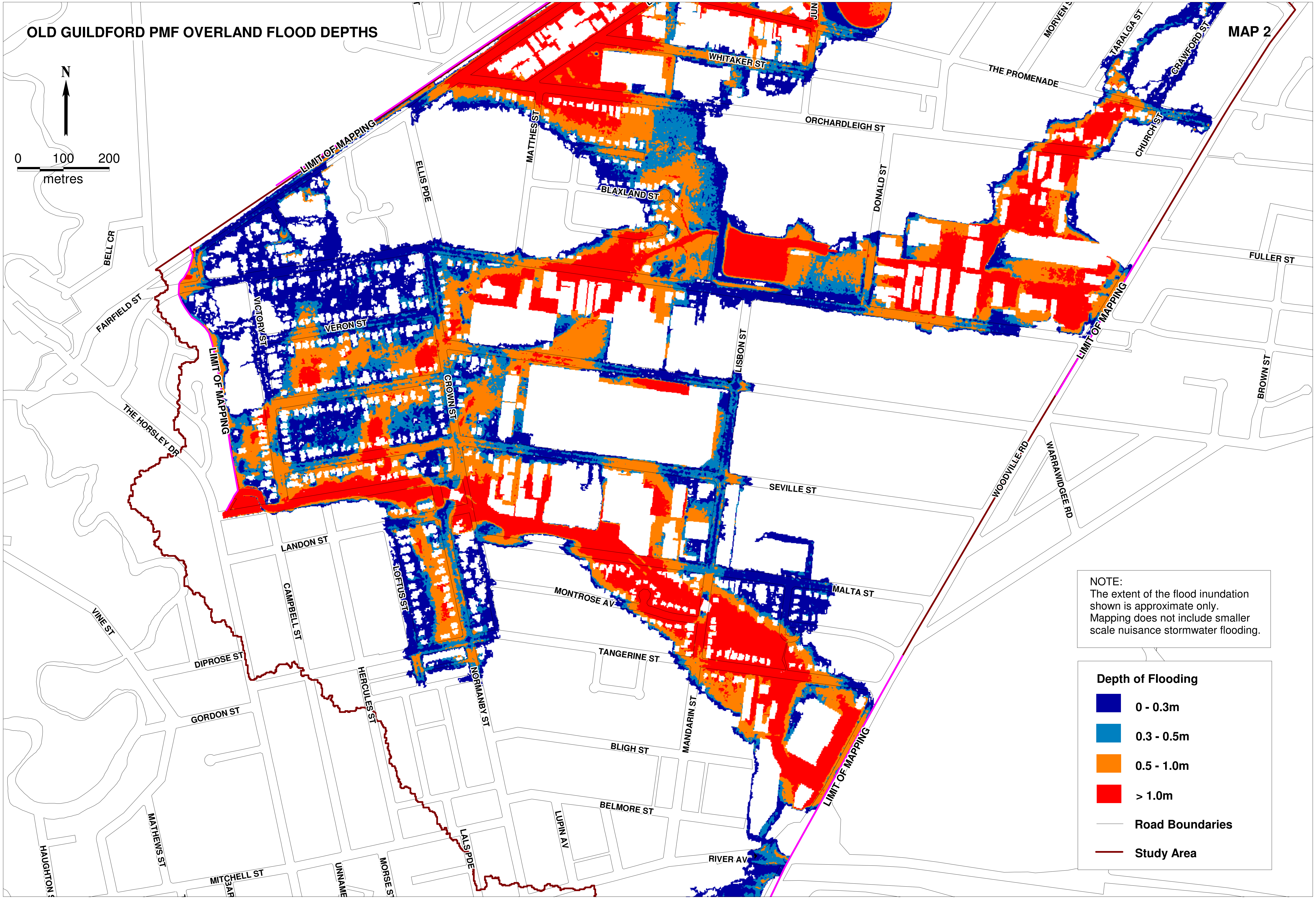
OLD GUILDFORD 2,000 YEAR ARI OVERLAND FLOOD DEPTHS

MAP 3



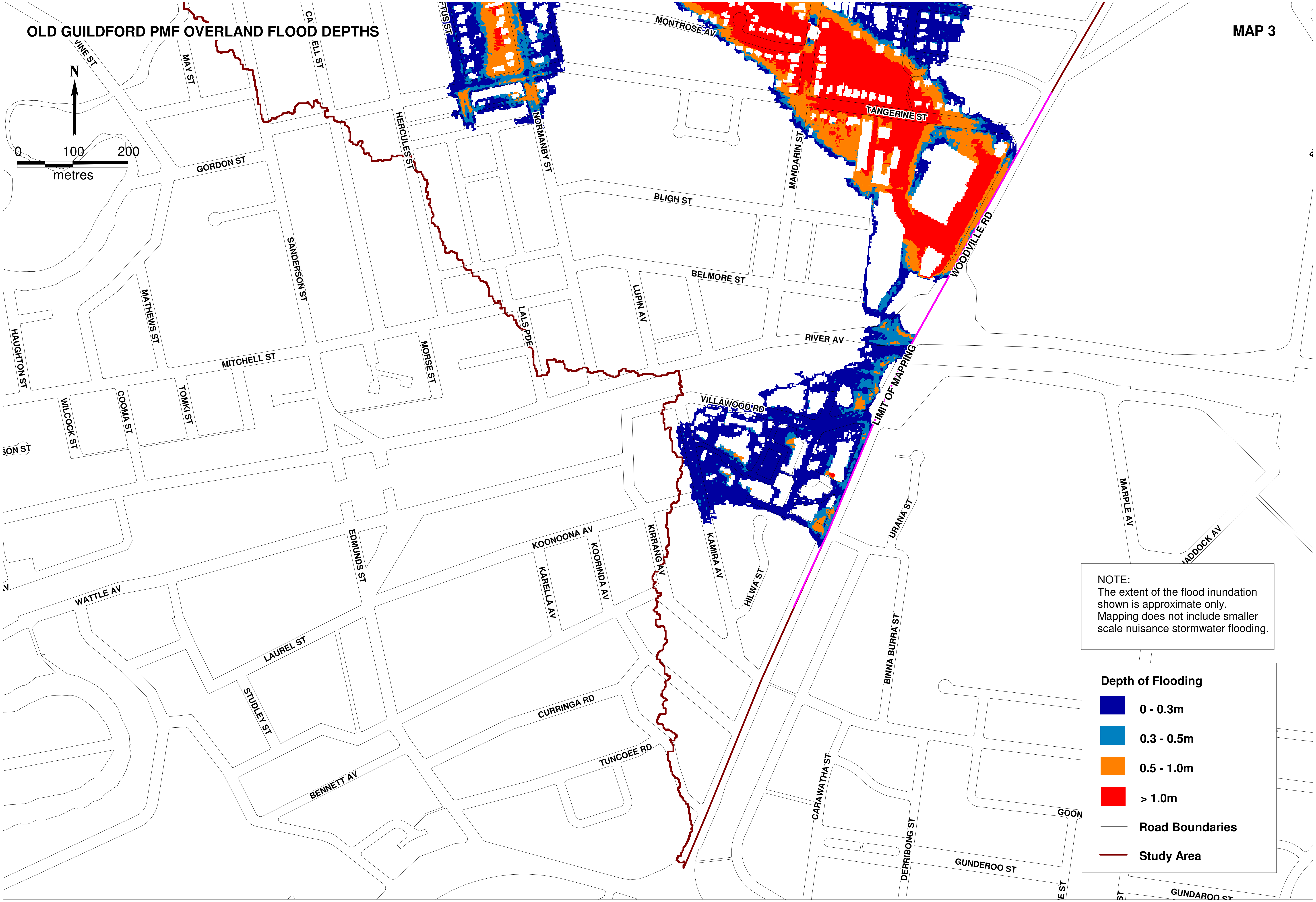

OLD GUILDFORD PMF OVERLAND FLOOD DEPTHS
MAP 1
MAP 2
MAP 3
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.


OLD GUILDFORD PMF OVERLAND FLOOD DEPTHS
MAP 1
N
0
100
200
metres
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area
SWIFT ST
LOVE L
WINGELLO ST
STATION ST
CROSS ST
BOLTON ST
RHODES AV
CHAMBERLAIN RD
BROOKS ST
TURNER ST
CARRINGTON ST
CANN ST
GUERNSEY ST
CLARKE ST
RAILWAY ST
HENRY ST
SHACKEL AV
NORTH PDE
ROSEBERY ST
MILNER RD
SALISBURY RD
WOODVILLE RD
LOUGH L
ORCHID RD
SOUTH PDE
CHILTERN RD
LOFTUS RD
WYANNA GR
YENNORA AV
BOOLA AV
LARRA ST
ANTILL ST
JUNCTION ST
BROUGHTON ST
WARATAH ST
SPRINGFIELD ST
MORVEN ST
TARALGA ST
CRAWFORD ST
LIMIT OF MAPPING
NELSON RD
WHITAKER ST
THE PROMENADE
ORCHARDLEIGH ST
BARBERS RD
MATTHES ST
ELLIS PDE
BLAXLAND ST
DONALD ST
FULLER ST
IAN CR
MIDDLETON ST

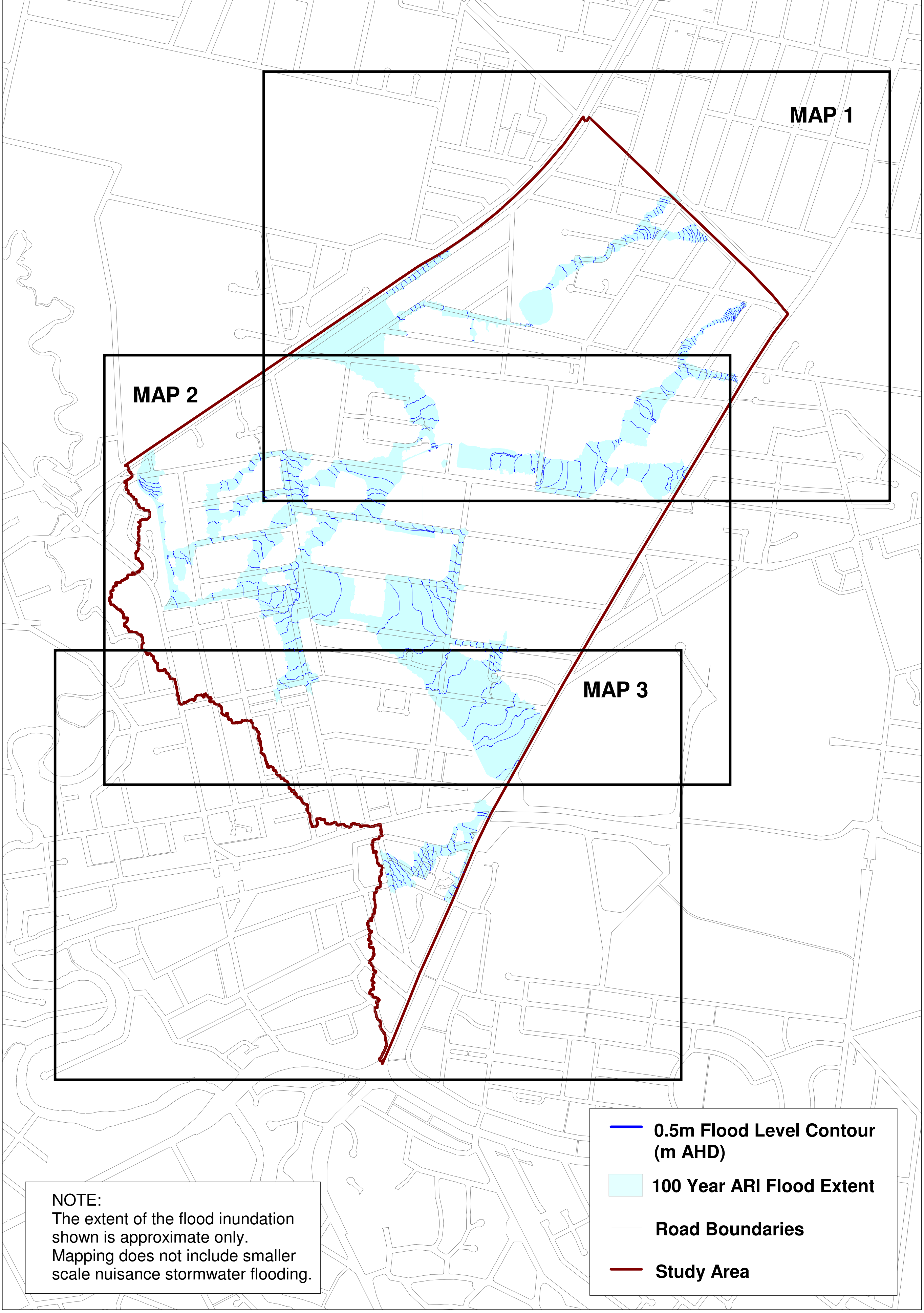

OLD GUILDFORD PMF OVERLAND FLOOD DEPTHS
MAP 2
N
0 100 200
metres
LIMIT OF MAPPING
WHITAKER ST
THE PROMENADE
ORCHARDLEIGH ST
MORVEN ST
TARALGA ST
CRAWFORD ST
CHURCH ST
MATTHES ST
ELLIS PDE
BLAXLAND ST
DONALD ST
FULLER ST
BELL CR
FAIRFIELD ST
VICTORIA ST
VERON ST
LISBON ST
BROWN ST
CROWN ST
THE HORSLEY DR
WOODVILLE RD
WARRAWIDGEE RD
SEVILLE ST
LANDON ST
LOFTUS ST
CAMPBELL ST
MONTROSE AV
MALTA ST
VINE ST
TANGERINE ST
DIPROSE ST
HERCULES ST
NORMANBY ST
GORDON ST
MANDARIN ST
BLIGH ST
BELMORE ST
LUPIN AV
LALS PDE
MATHEWS ST
HAUGHTON ST
MITCHELL ST
MORSE ST
RIVER AV
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.
Depth of Flooding
0 - 0.3m
0.3 - 0.5m
0.5 - 1.0m
> 1.0m
Road Boundaries
Study Area

OLD GUILDFORD PMF OVERLAND FLOOD DEPTHS

MAP 3

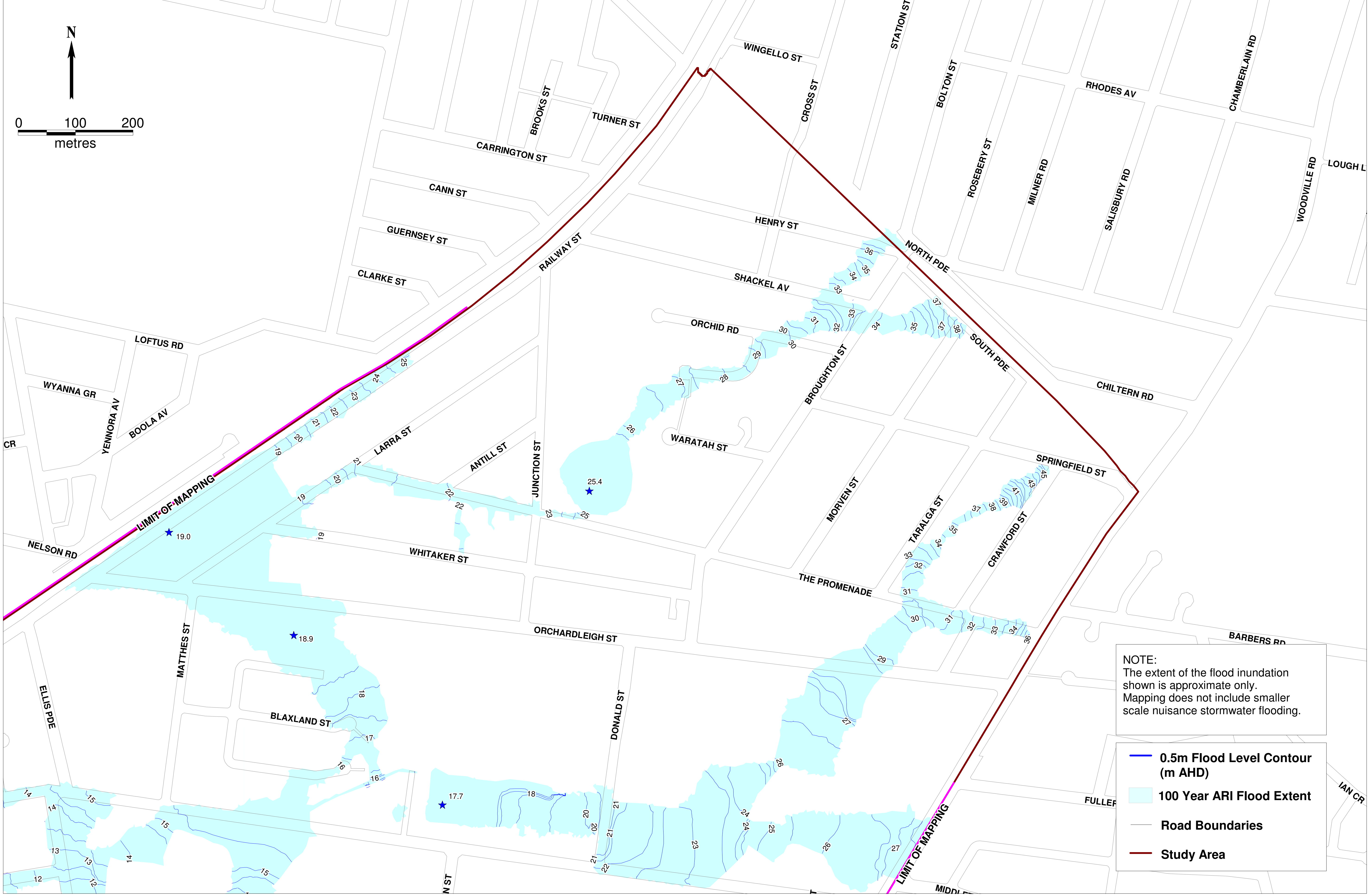


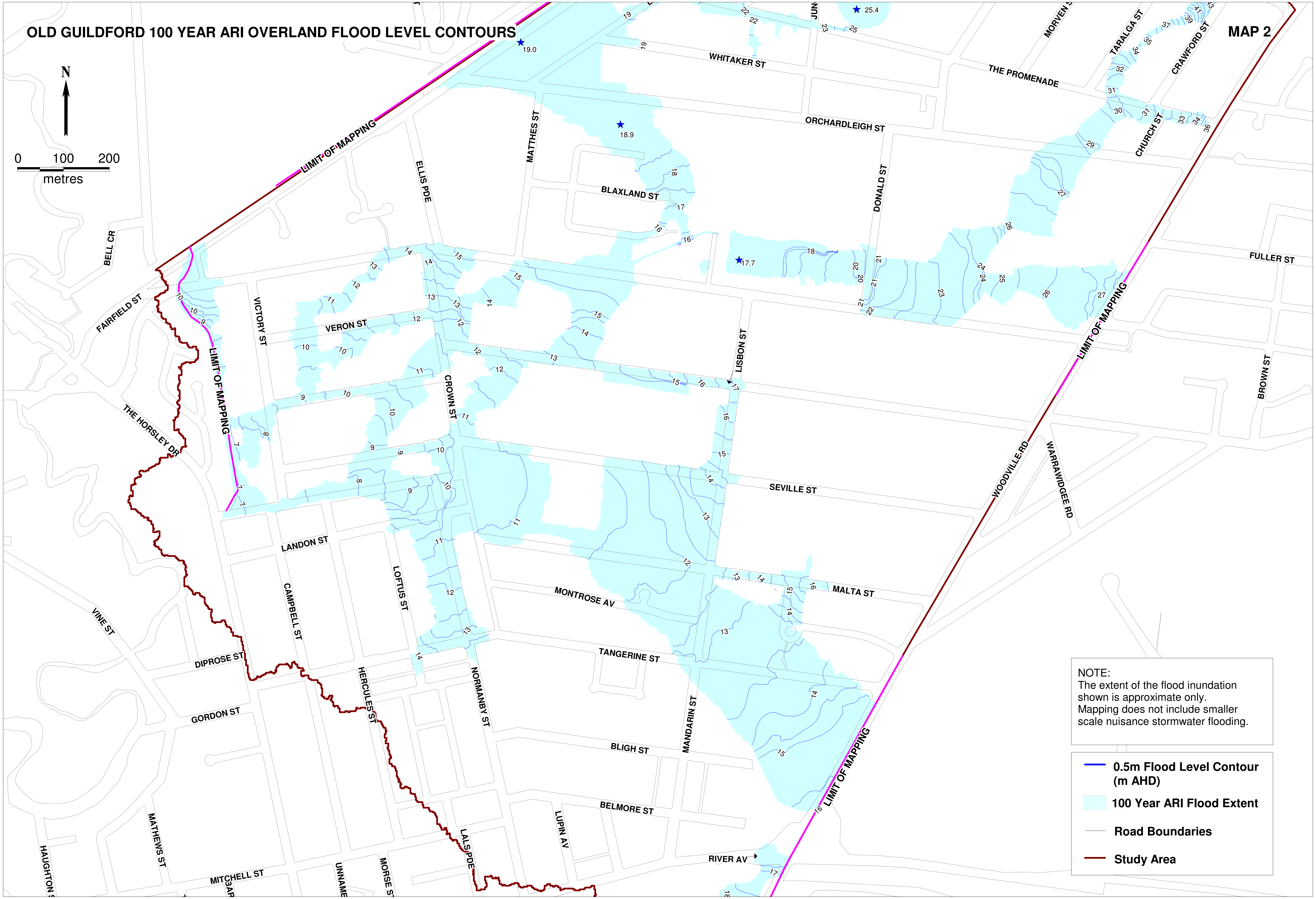
OLD GUILDFORD 100 YEAR ARI OVERLAND FLOOD LEVEL CONTOURS



OLD GUILDFORD 100 YEAR ARI OVERLAND FLOOD LEVEL CONTOURS

MAP 1

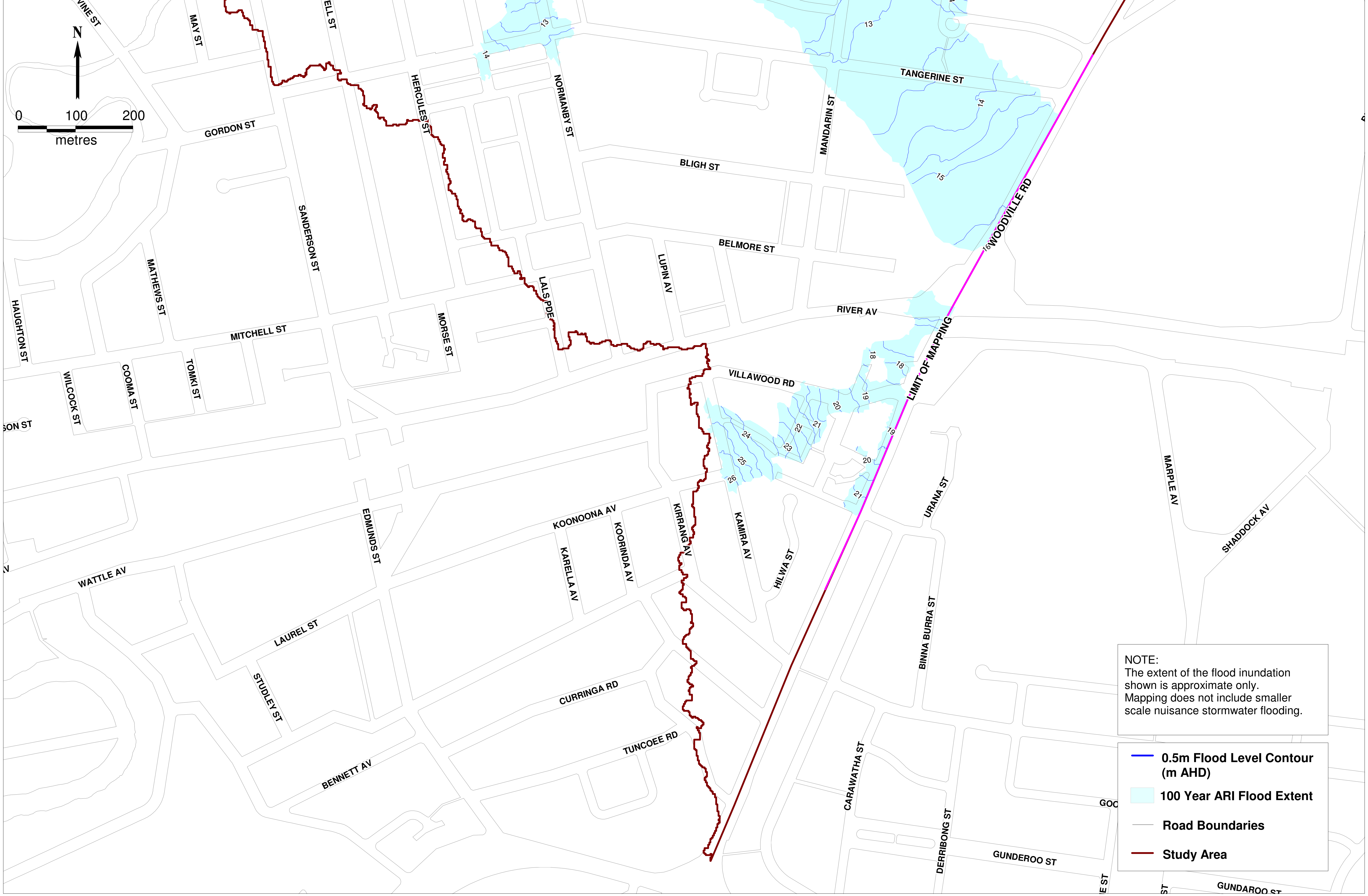




OLD GUILDFORD 100 YEAR ARI OVERLAND FLOOD LEVEL CONTOURS
MAP 2
N
0 100 200
metres
LIMIT OF MAPPING
WHITAKER ST
THE PROMENADE
ORCHARDLEIGH ST
MORVEN ST
TARALGA ST
CRAWFORD ST
CHURCH ST
MATTHES ST
ELLIS PDE
BLAXLAND ST
DONALD ST
FULLER ST
BELL CR
FAIRFIELD ST
VICTORY ST
VERON ST
CROWN ST
LISBON ST
BROWN ST
THE HORSLEY DR
SEVILLE ST
WOODVILLE RD
WARRAWIDGEE RD
LANDON ST
LOFTUS ST
CAMPBELL ST
MONTROSE AV
MALTA ST
VINE ST
DIPROSE ST
TANGERINE ST
HERCULES ST
NORMANBY ST
GORDON ST
BLIGH ST
MANDARIN ST
BELMORE ST
LUPIN AV
LALS PDE
MATHEWS ST
HAUGHTON ST
MITCHELL ST
MORSE ST
RIVER AV
19.0
18.9
17.7
25.4
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.
0.5m Flood Level Contour (m AHD)
100 Year ARI Flood Extent
Road Boundaries
Study Area

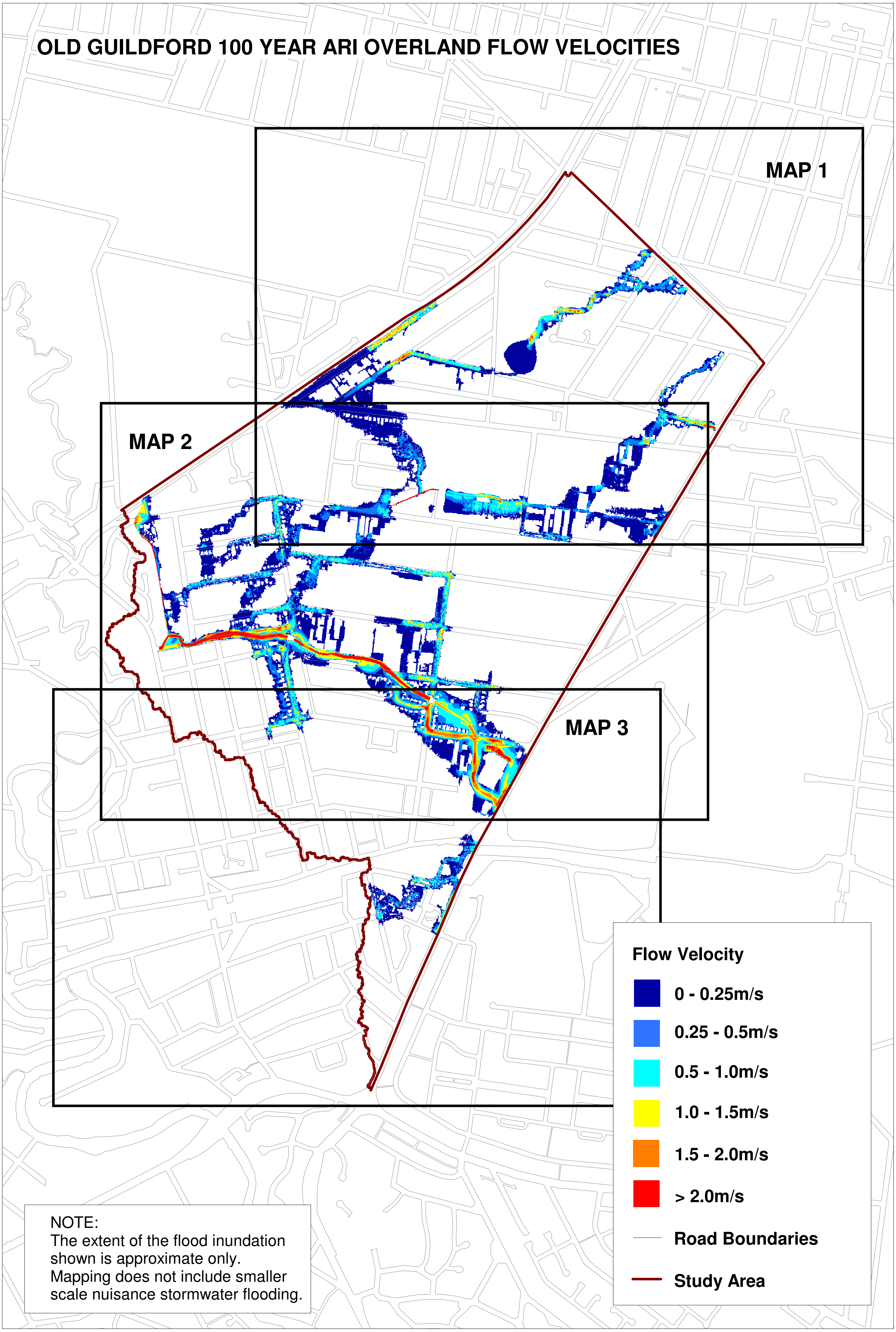
OLD GUILDFORD 100 YEAR ARI OVERLAND FLOOD LEVEL CONTOURS

MAP 3

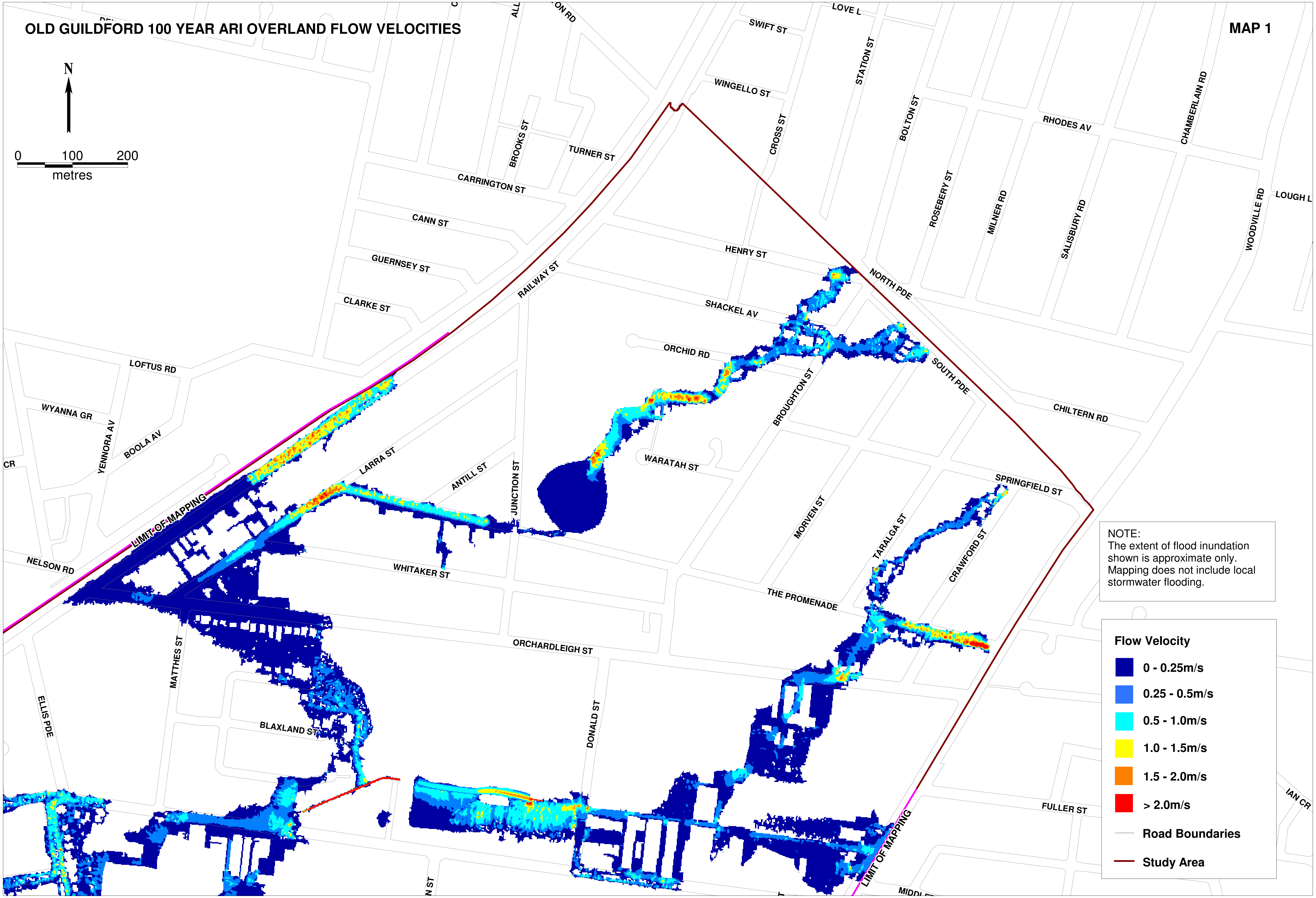


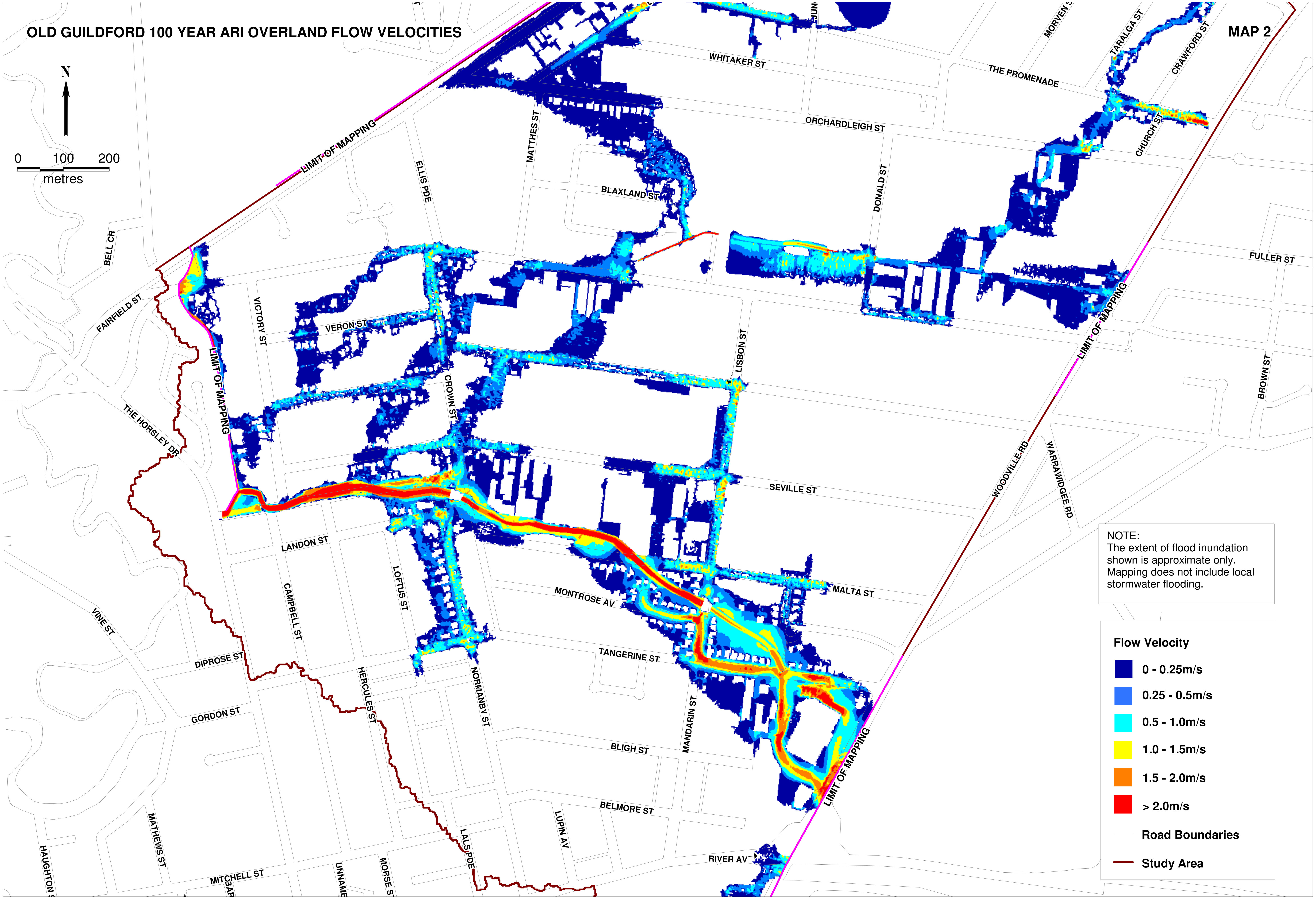
Appendix F   Flow Velocity Mapping

- Flow velocity grids for 100 year ARI and PMF events presented



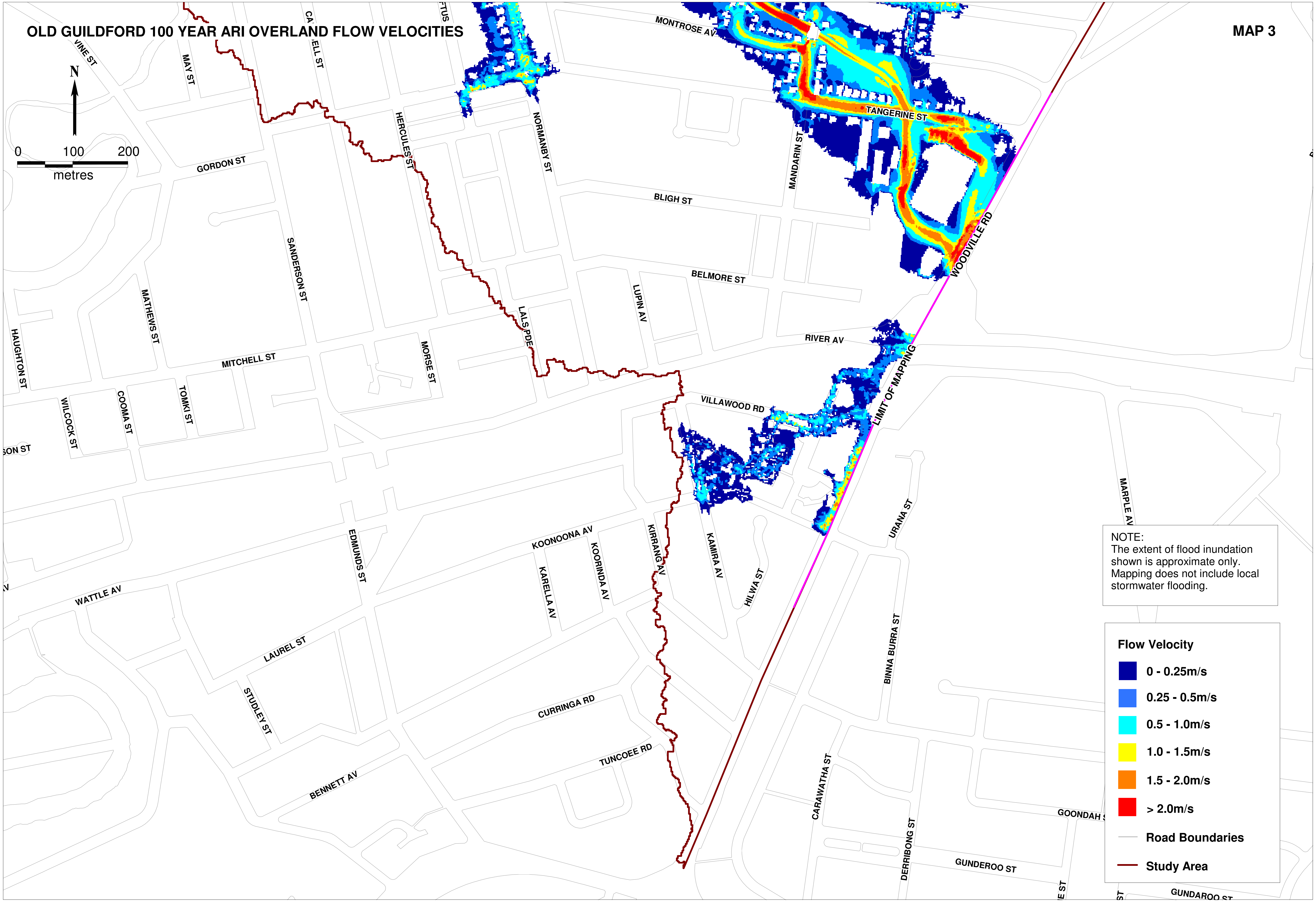
OLD GUILDFORD 100 YEAR ARI OVERLAND FLOW VELOCITIES
MAP 1
MAP 2
MAP 3
Flow Velocity
0 - 0.25m/s
0.25 - 0.5m/s
0.5 - 1.0m/s
1.0 - 1.5m/s
1.5 - 2.0m/s
> 2.0m/s
Road Boundaries
Study Area
NOTE:
The extent of the flood inundation shown is approximate only. Mapping does not include smaller scale nuisance stormwater flooding.


OLD GUILDFORD 100 YEAR ARI OVERLAND FLOW VELOCITIES
MAP 1
N
0 100 200
metres
NOTE:
The extent of flood inundation shown is approximate only. Mapping does not include local stormwater flooding.
Flow Velocity
0 - 0.25m/s
0.25 - 0.5m/s
0.5 - 1.0m/s
1.0 - 1.5m/s
1.5 - 2.0m/s
> 2.0m/s
Road Boundaries
Study Area
LIMIT OF MAPPING
LIMIT OF MAPPING
LOVE L
SWIFT ST
WINGELLO ST
STATION ST
CROSS ST
BOLTON ST
RHODES AV
CHAMBERLAIN RD
ROSEBERY ST
MILNER RD
SALISBURY RD
WOODVILLE RD
LOUGH L
BROOKS ST
TURNER ST
CARRINGTON ST
CANN ST
GUERNSEY ST
CLARKE ST
HENRY ST
NORTH PDE
SHACKEL AV
RAILWAY ST
ORCHID RD
SOUTH PDE
CHILTERN RD
BROUGHTON ST
LOFTUS RD
WYANNA GR
YENNORA AV
BOOLA AV
LARRA ST
ANTILL ST
JUNCTION ST
WARATAH ST
SPRINGFIELD ST
MORVEN ST
TARALGA ST
CRAWFORD ST
NELSON RD
WHITAKER ST
THE PROMENADE
ORCHARDLEIGH ST
MATTHES ST
ELLIS PDE
BLAXLAND ST
DONALD ST
FULLER ST
IAN CR


OLD GUILDFORD 100 YEAR ARI OVERLAND FLOW VELOCITIES
MAP 2
N
0 100 200
metres
LIMIT OF MAPPING
WHITAKER ST
THE PROMENADE
ORCHARDLEIGH ST
MATTHES ST
BLAXLAND ST
ELLIS PDE
DONALD ST
MORVEN ST
TARALGA ST
CRAWFORD ST
CHURCH ST
FULLER ST
BELL CR
FAIRFIELD ST
VICTORY ST
VERON ST
LISBON ST
CROWN ST
THE HORSLEY DR
SEVILLE ST
WOODVILLE RD
WARRAWIDGEE RD
BROWN ST
LANDON ST
MONTROSE AV
MALTA ST
LOFTUS ST
CAMPBELL ST
VINE ST
DIPROSE ST
TANGERINE ST
GORDON ST
HERCULES ST
NORMANBY ST
MANDARIN ST
BLIGH ST
BELMORE ST
LUPIN AV
MATHEWS ST
LALS PDE
RIVER AV
HAUGHTON ST
MITCHELL ST
MORSE ST
NOTE:
The extent of flood inundation shown is approximate only. Mapping does not include local stormwater flooding.
Flow Velocity
0 - 0.25m/s
0.25 - 0.5m/s
0.5 - 1.0m/s
1.0 - 1.5m/s
1.5 - 2.0m/s
> 2.0m/s
Road Boundaries
Study Area

OLD GUILDFORD 100 YEAR ARI OVERLAND FLOW VELOCITIES

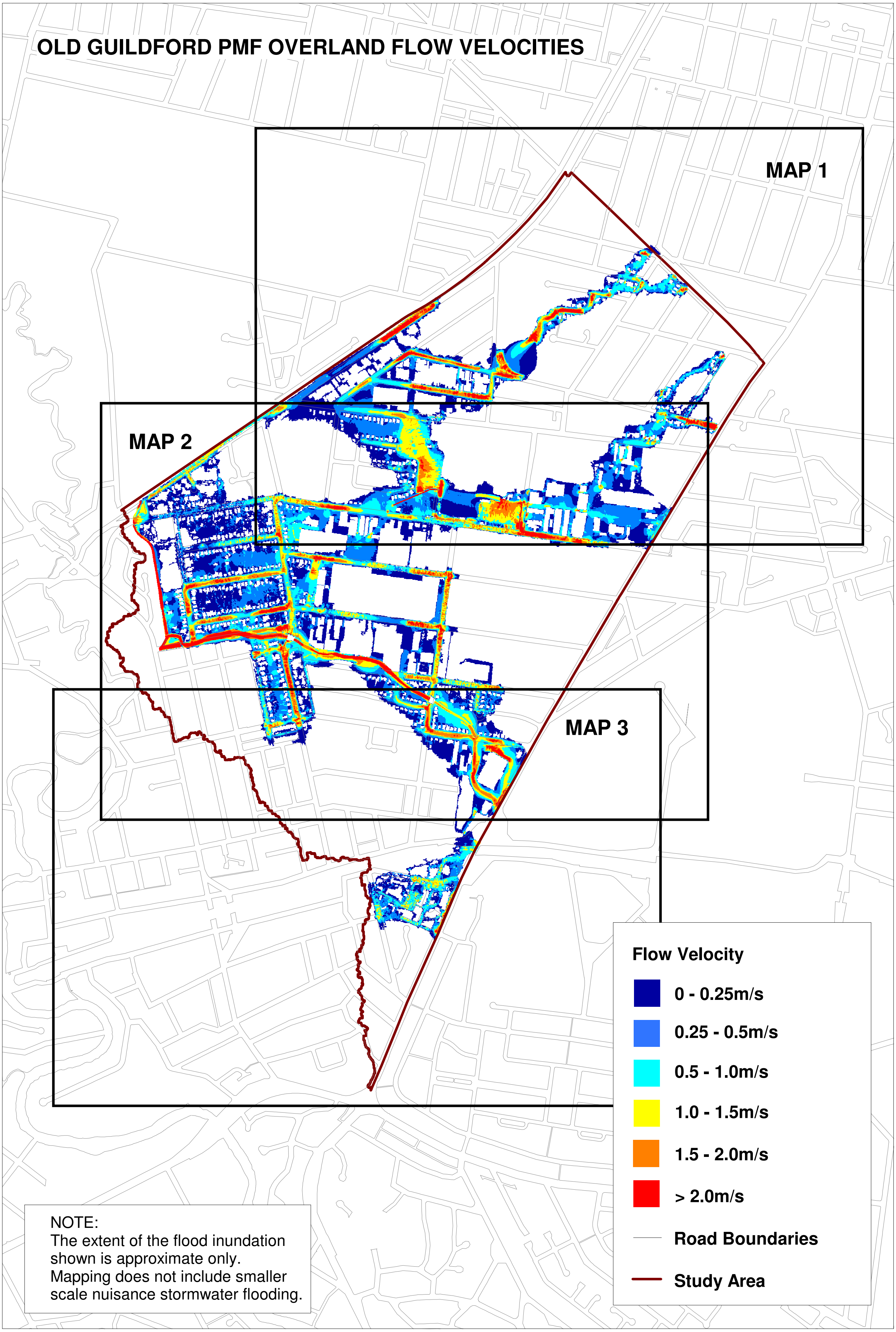
MAP 3



NOTE:
The extent of flood inundation shown is approximate only. Mapping does not include local stormwater flooding.

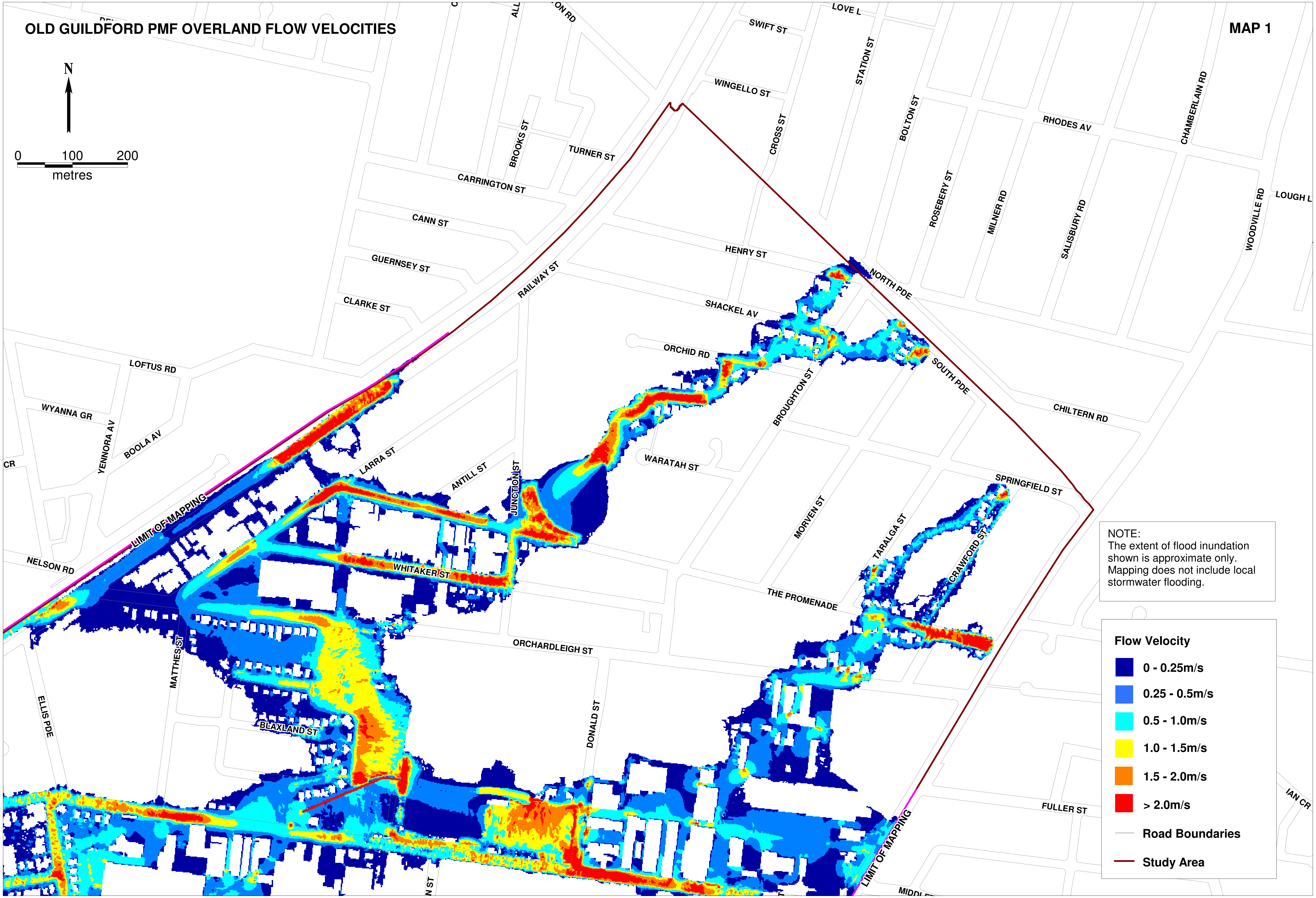
Flow Velocity

- 0 - 0.25m/s
- 0.25 - 0.5m/s
- 0.5 - 1.0m/s
- 1.0 - 1.5m/s
- 1.5 - 2.0m/s
- > 2.0m/s
- Road Boundaries
- Study Area

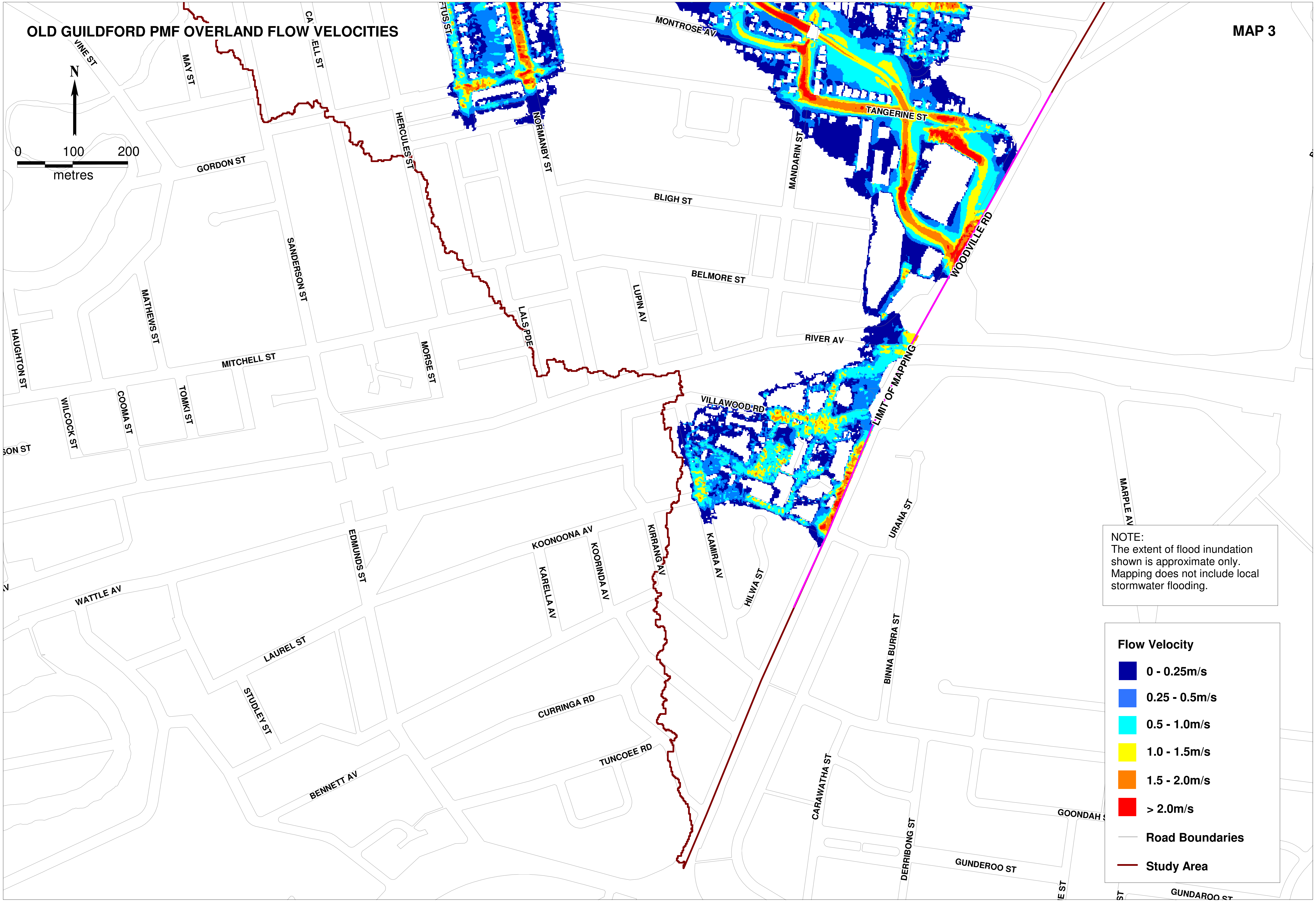

OLD GUILDFORD PMF OVERLAND FLOW VELOCITIES
MAP 1
MAP 2
MAP 3
Flow Velocity
0 - 0.25m/s
0.25 - 0.5m/s
0.5 - 1.0m/s
1.0 - 1.5m/s
1.5 - 2.0m/s
> 2.0m/s
Road Boundaries
Study Area
NOTE:
The extent of the flood inundation shown is approximate only.
Mapping does not include smaller scale nuisance stormwater flooding.

OLD GUILDFORD PMF OVERLAND FLOW VELOCITIES

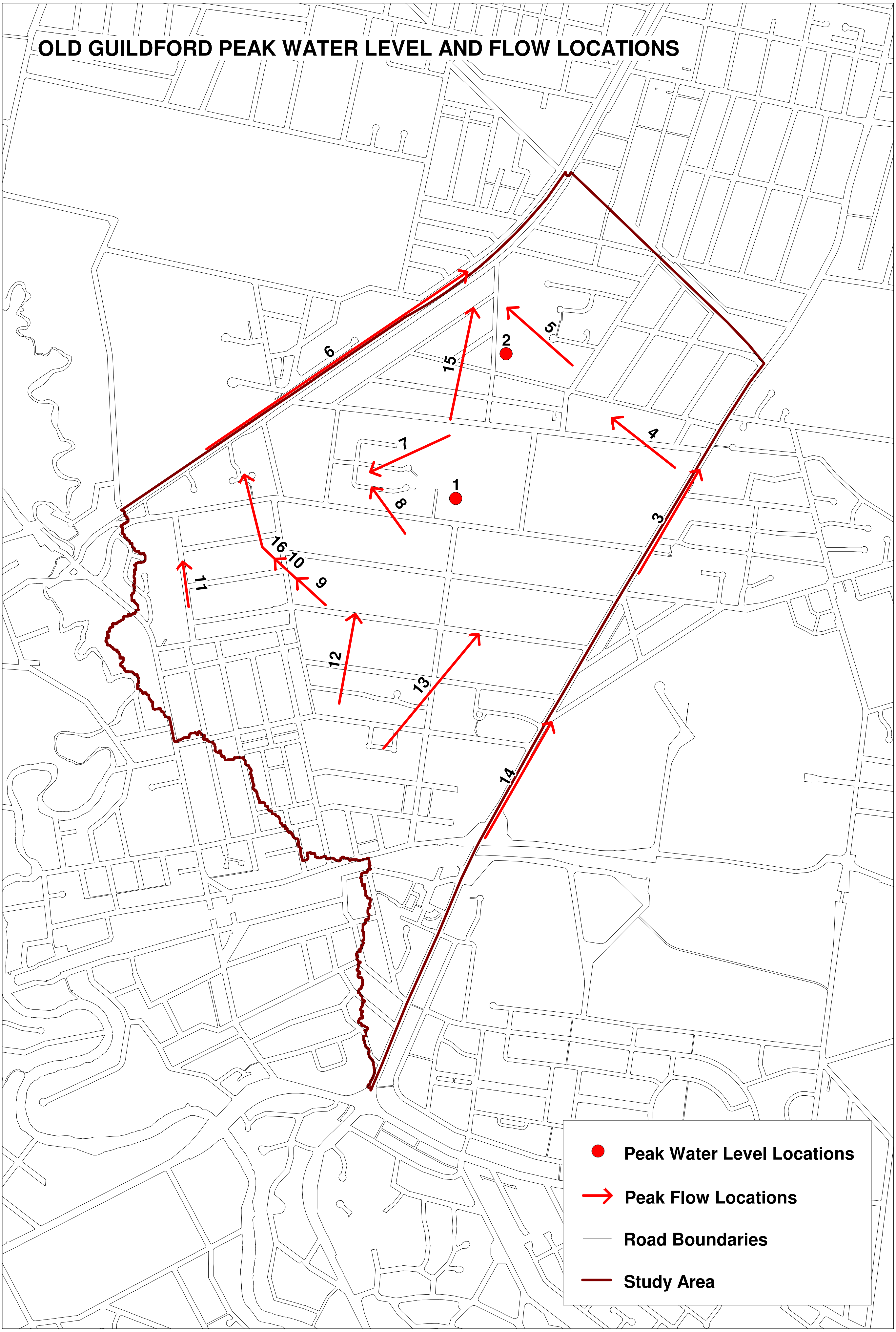
MAP 1



OLD GUILDFORD PMF OVERLAND FLOW VELOCITIES


OLD GUILDFORD PMF OVERLAND FLOW VELOCITIES
MAP 3
N
0
100
200
metres
NOTE:
The extent of flood inundation shown is approximate only. Mapping does not include local stormwater flooding.
Flow Velocity
0 - 0.25m/s
0.25 - 0.5m/s
0.5 - 1.0m/s
1.0 - 1.5m/s
1.5 - 2.0m/s
> 2.0m/s
Road Boundaries
Study Area
LIMIT OF MAPPING
WOODVILLE RD
MONTROSE AV
TANGERINE ST
MANDARIN ST
BLIGH ST
BELMORE ST
RIVER AV
VILLAWOOD RD
LUPIN AV
NORMANBY ST
HERCULES ST
LALS PDE
MORSE ST
GORDON ST
MITCHELL ST
SANDERSON ST
MATHEWS ST
HAUGHTON ST
WILLCOCK ST
COOMA ST
TOMKI ST
MAY ST
VINE ST
WATTLE AV
LAUREL ST
STUDLEY ST
EDMUNDS ST
KOONOONA AV
KARELLA AV
KOORINDA AV
KIRRANG AV
KAMIRA AV
HILWA ST
CURRINGA RD
TUNCOEE RD
BENNETT AV
URANA ST
BINNA BURRA ST
CARAWATHA ST
DERRIBONG ST
GUNDEROO ST
GOONDAH
GUNDAROO ST
MARPLE AV

Appendix G Peak Flows and Water Levels

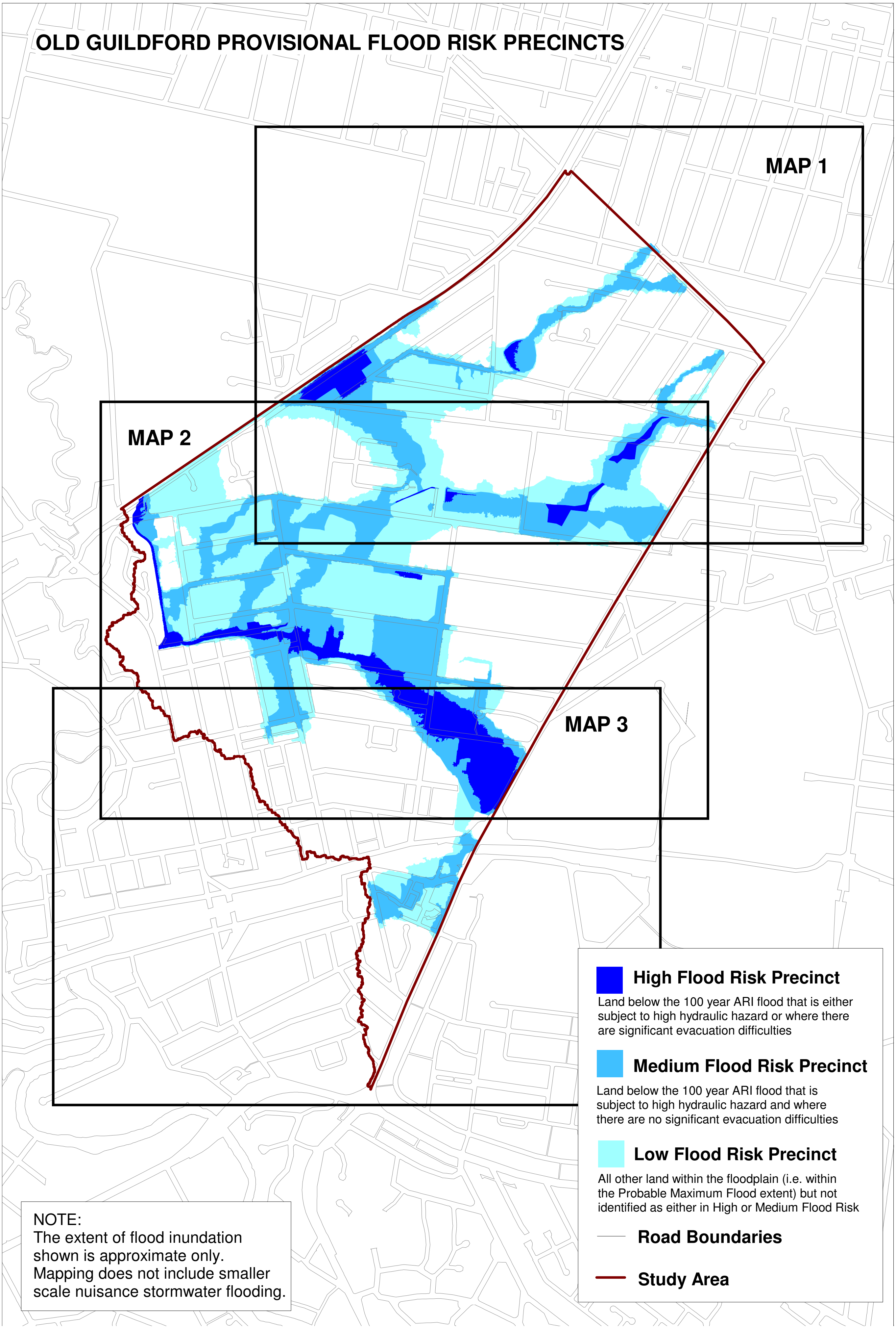


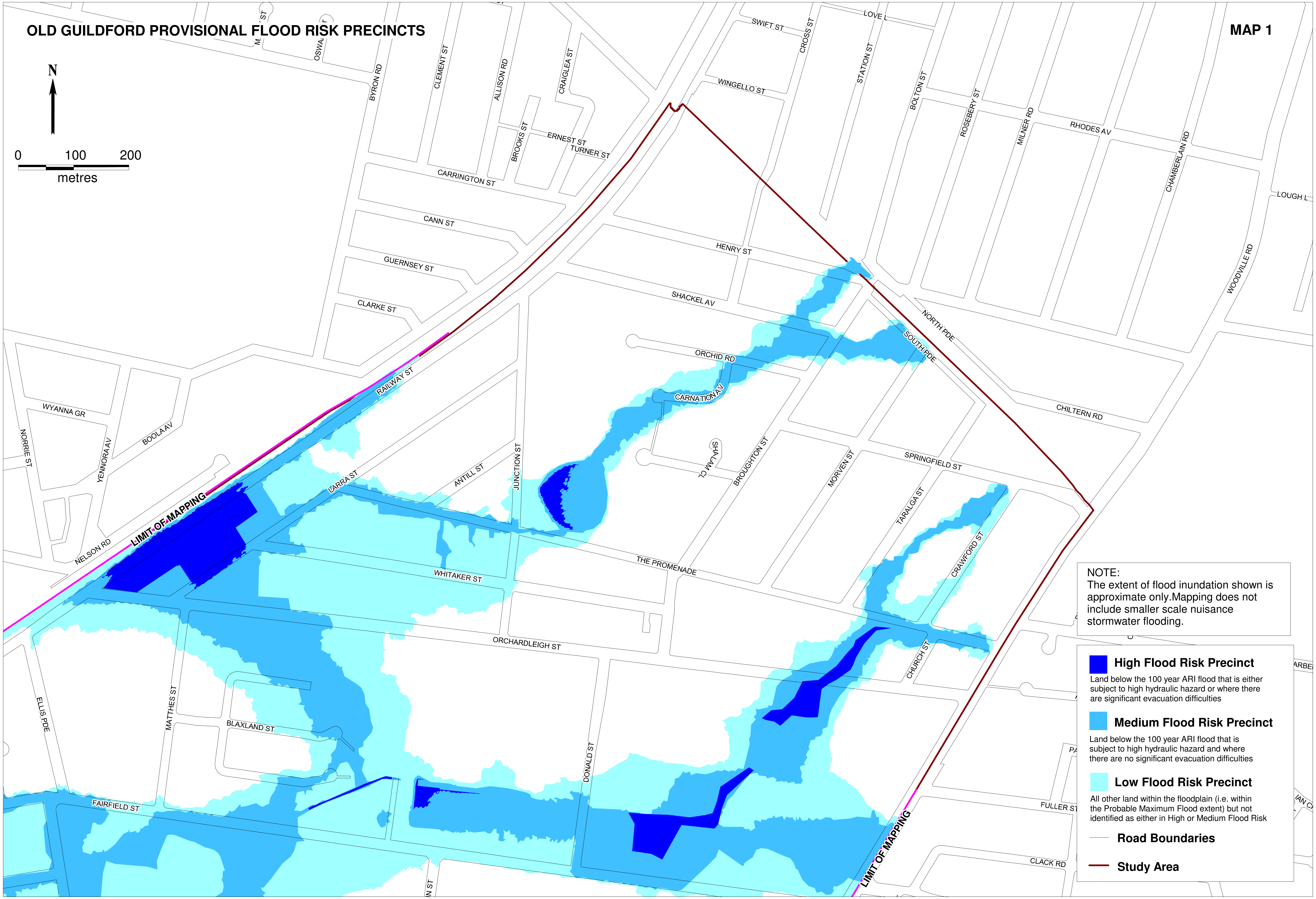
OLD GUILDFORD PEAK WATER LEVEL AND FLOW LOCATIONS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Peak Water Level Locations
Peak Flow Locations
Road Boundaries
Study Area

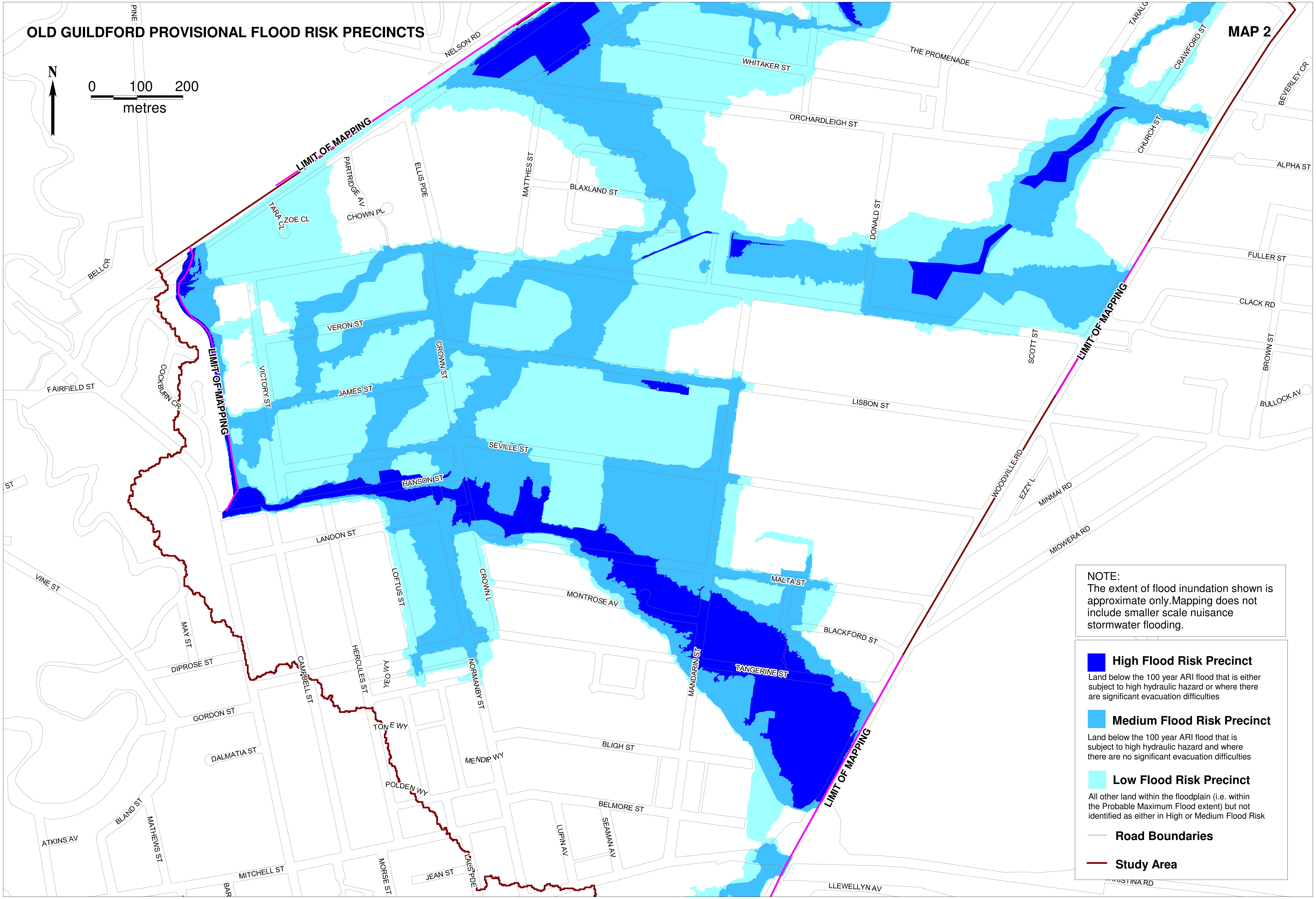
Table G-1 Peak Flows and Water Levels at Selected Locations

ID	Name	Event ARI (years)						
		20	100	200	500	2,000	10,000	PMF
Peak Water Level (m AHD)								
1	Knight Park	17.49	17.67	17.80	17.99	18.52	18.91	19.54
2	Springfield Park	25.06	25.35	25.45	25.51	25.60	25.65	25.85
Peak Flow (m^3/s)								
3	Woodville Rd at Fairfield St	5.7	7.8	9.1	10.4	13.4	18.0	43.9
4	Orchardleigh St near Church St	4.6	6.4	7.3	8.5	10.7	14.5	37.6
5	U/S of Springfield Park	4.3	5.9	6.7	8.3	10.3	14.9	41.1
6	Railway line at Yennora Stn	0.0	0.0	0.0	0.0	0.2	2.4	24.4
7	Orchardleigh St flowpath	0.1	1.2	2.3	4.3	12.5	20.4	66.0
8	Fairfield St	2.3	3.0	3.2	3.5	3.7	7.1	67.9
9	Crown St flowpath	0.4	1.7	2.0	2.6	5.1	8.3	24.1
10	Crown St flowpath East	0.6	0.9	1.1	1.6	2.5	4.8	31.3
11	Victory St	0.1	0.7	1.0	1.4	2.3	4.1	27.4
12	Veron St	1.5	2.2	2.5	2.9	3.3	5.1	22.6
13	Burns Ck D/S of Malta St	12.6	16.9	17.1	17.3	18.7	19.3	26.0
14	Burns Ck U/S of Malta St	32.4	47.2	47.4	47.8	49.9	51.6	65.2
15	Woodville Rd at Burns Ck	85.4	108.1	108.3	108.5	109.7	110.9	120.8
16	D/S of Springfield Park	3.0	4.2	4.7	5.4	8.2	13.5	55.3

Appendix H Flood Risk Precinct Mapping


OLD GUILDFORD PROVISIONAL FLOOD RISK PRECINCTS
MAP 1
MAP 2
MAP 3
High Flood Risk Precinct
Land below the 100 year ARI flood that is either subject to high hydraulic hazard or where there are significant evacuation difficulties
Medium Flood Risk Precinct
Land below the 100 year ARI flood that is subject to high hydraulic hazard and where there are no significant evacuation difficulties
Low Flood Risk Precinct
All other land within the floodplain (i.e. within the Probable Maximum Flood extent) but not identified as either in High or Medium Flood Risk
Road Boundaries
Study Area
NOTE:
The extent of flood inundation shown is approximate only. Mapping does not include smaller scale nuisance stormwater flooding.


OLD GUILDFORD PROVISIONAL FLOOD RISK PRECINCTS
MAP 1
N
0
100
200
metres
NOTE:
The extent of flood inundation shown is approximate only.Mapping does not include smaller scale nuisance stormwater flooding.
High Flood Risk Precinct
Land below the 100 year ARI flood that is either subject to high hydraulic hazard or where there are significant evacuation difficulties
Medium Flood Risk Precinct
Land below the 100 year ARI flood that is subject to high hydraulic hazard and where there are no significant evacuation difficulties
Low Flood Risk Precinct
All other land within the floodplain (i.e. within the Probable Maximum Flood extent) but not identified as either in High or Medium Flood Risk
Road Boundaries
Study Area
LIMIT OF MAPPING
LIMIT OF MAPPING
BYRON RD
CLEMENT ST
ALLISON RD
CRAIGLEA ST
BROOKS ST
ERNEST ST
TURNER ST
CARRINGTON ST
CANN ST
GUERNSEY ST
CLARKE ST
SWIFT ST
CROSS ST
LOVE L
STATION ST
WINGELLO ST
BOLTON ST
ROSEBERY ST
MILNER RD
RHODES AV
CHAMBERLAIN RD
LOUGH L
WOODVILLE RD
HENRY ST
SHACKEL AV
NORTH PDE
SOUTH PDE
ORCHID RD
CARNATION AV
CHILTERN RD
RAILWAY ST
WYANNA GR
BOOLA AV
YENNORA AV
NORRIE ST
NELSON RD
LARRA ST
ANTILL ST
JUNCTION ST
SHALAM CL
BROUGHTON ST
MORVEN ST
SPRINGFIELD ST
TARALGA ST
CRAWFORD ST
THE PROMENADE
WHITAKER ST
ORCHARDLEIGH ST
CHURCH ST
ELLIS PDE
MATTHES ST
BLAXLAND ST
DONALD ST
FAIRFIELD ST
FULLER ST
CLACK RD



OLD GUILDFORD PROVISIONAL FLOOD RISK PRECINCTS
MAP 2
N
0 100 200
metres
LIMIT OF MAPPING
NELSON RD
PINE
WHITAKER ST
THE PROMENADE
CRAWFORD ST
BEVERLEY CR
ORCHARDLEIGH ST
CHURCH ST
ALPHA ST
PARTRIDGE AV
ELLIS PDE
MATTHES ST
BLAXLAND ST
TARA CL
ZOE CL
CHOWN PL
DONALD ST
FULLER ST
BELL CR
CLACK RD
VERON ST
CROWN ST
SCOTT ST
BROWN ST
FAIRFIELD ST
COCKBURN CR
VICTORY ST
JAMES ST
LISBON ST
BULLOCK AV
SEVILLE ST
HANSON ST
WOODVILLE RD
EZZY L
MINMAI RD
LANDON ST
MIOWERA RD
VINE ST
LOFTUS ST
CROWN L
MONTROSE AV
MALTA ST
BLACKFORD ST
MAY ST
DIPROSE ST
CAMPBELL ST
HERCULES ST
YEO WY
NORMANBY ST
MANDARIN ST
TANGERINE ST
GORDON ST
TONE WY
BLIGH ST
DALMATIA ST
MENDIP WY
POLDEN WY
BELMORE ST
BLAND ST
MATHEWS ST
LUPIN AV
SEAMAN AV
ATKINS AV
MITCHELL ST
MORSE ST
JEAN ST
LLEWELLYN AV
CHRISTINA RD
NOTE:
The extent of flood inundation shown is approximate only.Mapping does not include smaller scale nuisance stormwater flooding.
High Flood Risk Precinct
Land below the 100 year ARI flood that is either subject to high hydraulic hazard or where there are significant evacuation difficulties
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Low Flood Risk Precinct
All other land within the floodplain (i.e. within the Probable Maximum Flood extent) but not identified as either in High or Medium Flood Risk
Road Boundaries
Study Area

Appendix I Model Quality Assurance Review Recommendations

A Quality Assurance review of the Old Guildford Overland Flood Study XP-STORM model was undertaken by Ashis Dey, XP-Software, in December 2008. **Table I-1** presents the comments from the QA review and responses in consideration of the comments.

- **Table I-1 QA review comments and recommendations**

Comment	Response
Node533 has user inflow – 110m3/s peak. Node539 has user inflow – 75m3/s peak. How were these flow calculated? Correct prediction is essential for accurate flood modelling.	Flows were extracted from Burns Creek TUFLOW model
Multiple entry of same variable is not recommended in XP-Table. 2nd entry of SLOPE, AREA, SUBCATCHMENT FLAG etc has been deleted in "Catchment Data" Table.	OK
Same loss rate (HORTON infiltration) has been applied for all catchments. Impervious catchments should have less loss rate than pervious catchments. Has any calibration been done to set up the loss rate?	No suitable data available to perform model calibration. Loss rates were selected to be consistent with Canley Corridor Overland Flood Study DRAINS model.
40ha catchment's runoff is draining to node A/620/90 (peak flow =$55m^3/s$). Although the subsurface pipe (1.5m dia) should have a capacity to drain a significant amount of water, but it is not draining any water because of inlet restriction (max capture $0.01m^3/s$). Not sure about modelling objective here.	This pit is a sealed pit. By default sub-catchment flows are input into the pipe system in the pit if a sub-catchment is linked to the pit, as was the case here. This caused unrealistic buildup of flow volume and head in the pit causing flow reversal in upstream pipes. Application of dummy pit inlet with limited capacity forces the model to input flows on the surface.
Flood extent has extended to model boundary (there is huge inactive zone around bottom right part of Node533), which is not expected. Flood depth is over 1.5m along inactive boundary line. Well defined physical boundary is essential to predict the accurate flood extent.	The model extent has been defined well beyond the area of interest for this study (i.e. LGA boundary) to allow for such interaction of flow with the model boundary. Flow behaviour along the LGA boundary/study area was considered to be realistic and beyond the influence of the flow/model boundary interaction. Topographic data was not available in adjacent LGAs to extend the model any further.
Buildings have been modelled as inactive area – have other options been considered?	The adopted methodology was selected in agreement with FCC and is consistent with the other overland flood studies for FCC.

	Other methods have been considered in the selection process.
2D head and 1D stage history at downstream of Node516 – seems setting are appropriate; however, how was the data obtained? Correct prediction is essential for accurate flood modelling.	Data was extracted from Burns Creek TUFLOW model
What does DumPipe1/Link544/DumPipe2 represent? Link DumPipe2 diameter =0.05m ????	Dummy link defined here to allow flows into Holroyd LGA at Yennora Station to be captured and fed to the model outlet. This was necessary as XP-STORM does not permit multiple model outlets.
What does 19m (RL) break line around Node536 represent? Although it has no significant effect on results.	Required to capture Yennora Station overflows and feed into dummy channel for discharge at model outlet.
2D_WEIR_LEN and 2D_ORIF_AREA > only one should be used. If both are used only the last one is considered. 2D_WEIR_LEN=10 seems very high. Suggestion is 2.	OK. No guidance was given in user manual.
MINLEN configuration parameter should be used with care. Very short MINLEN may create model instability. This model has pipes less than 1m. If possible, it would be wise to exclude or modify those short pipes.	Noted.
It is suggested that VERT_WALLS configuration parameter should be used when open channels are connected to 2D.	OK. No guidance was given in user manual.
0.05sec time step in Hydraulics is not used during simulation. XPSWMM uses adaptive time step to maintain the model stability. Minimum time step in xpswmm is 0.5sec.	Noted.
Some nodes (such as A/10/205) are modeled as “Sealed”. Sealed option should only be used to model the bolted manhole.	Sealed option was specifically used to model bolted lid pits.
Some nodes (such as B/680/05) are modeled as “Ponding Allowed”. “Ponding Allowed” option is not usually recommended. What does the downstream dummy link represent?	Ponding allowed option required for pipe line outlets (headwalls) at the creeks. other options did not provide desirable hydraulic outcomes. Dummy links required to link the headwall nodes to the creek channel model nodes.
2D Roughness in Residential/Commercial/Industrial area is 0.15-0.20 seems a bit high. Also all the buildings are blocked as inactive area. Has any calibration been done to judge the roughness? The combined effect of high roughness and blocked building may cause higher flood depths.	Calibration data was not available. High Manning’s n was selected in agreement with FCC to account for unmodelled obstructions on urban lots including fences.