Engineering Value

Reference: 2015.0298-L02

Date: May 31, 2016

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Suite 101, 24 Springfield Avenue
Potts Point NSW 2011

RE: RESIDENTIAL FLAT BUILDING – 32-36 LETHBRIDGE STREET, PENRITH

INTRODUCTION

A residential development is proposed at the above site address, which is traversed by a minor overland flow from the local upstream catchment.

Penrith City Council (PCC) requires a flood impact study to determine if the proposed development will adversely affect the flooding behaviour elsewhere in the floodplain. The objective of the study is to propose flood mitigation measures to reduce any impacts to acceptable levels.

NATURAL & BUILT ENVIRONMENT

The site is located in an urban residential area in Penrith, approximately 48kms west of Sydney CBD. The site falls in the Local Government Area of Penrith City Council.

The site is bounded by adjoining properties to the South, to the East and to the West, and Lethbridge Street to the North. The site covers three existing residential lots with an existing dwelling on each lot.

The site has a rectangular shape and is characterised by a natural gradient from North to South. *Figure 1* shows the location of the site.

The site is located within the Penrith CBD overland flooding study carried out by Council. The site is located within a low-lying gully which is traversed by a trunk main at the lower rear end of the site. The site is affected by overland flooding which exceeds the capacity of the trunk main and also by overland flows from the low point in Lethbridge Street.

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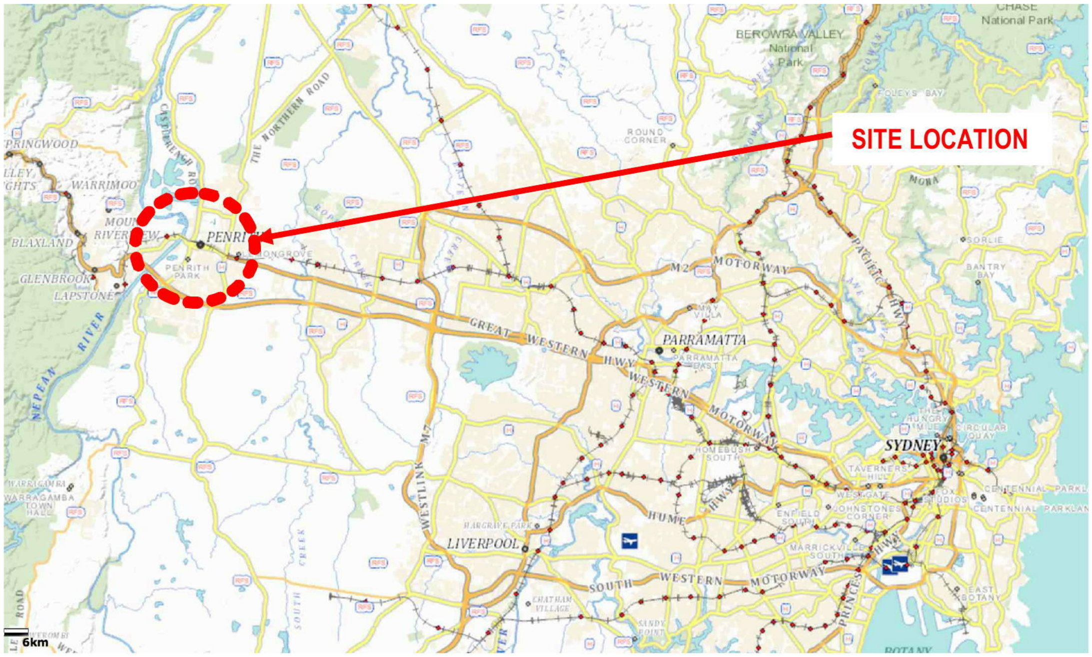

Figure 1 Locality Plan

Figure 2 View upstream in Lethbridge Street

Figure 3 View downstream in Lethbridge Street

Figure 4 View of Lethbridge Street opposite side of site looking upstream

Figure 5 View of stormwater infrastructure in Lethbridge Street

The Morson Group have prepared the architectural drawings for the proposed development. A copy of the site plan is included in *Figure 14* below. It is proposed to develop the site with a multi-unit residential development with one level of basement car park.

AUTHORITIES REQUIREMENTS

PCC requirements ore summarised in the following extract from DCP 2014.

"13) Overland Flow Flooding

a) Council has undertaken a Penrith Overland Flow Flood 'Overview' Study. Consideration must be given to the impact on any overland flow path. Generally, Council will not support development obstructing overland flow paths. Development is required to demonstrate that any overland flow is maintained for the 1% AEP (100 year ARI) overland flow. A merit based approach will be taken when assessing development applications that affect the overland flow."

OBJECTIVES

The purpose of this flood study is to determine how the proposed development will be constructed without affecting the flood characteristics (i.e. flood level, velocity and impact on adjoining properties). In particular, the study will address how the overland flowpath will be managed through the site without creating an impact on the flood levels in the surrounding properties and retain and/or improve the flooding in the vicinity of the site.

In summary, the objectives are as follows:-

- Develop a computer model that can be used to predict the magnitude and extent of future flood events;

- Define design flood levels, velocities and depths for the catchment;
- Determine the Flood Planning Level from the development;
- Determine if the proposed development has an impact on the flooding; and
- Propose mitigation measures to reduce the adverse impacts of the development on flooding (if any).

HYDRAULIC MODEL

A 1D/2D fully dynamic hydraulic model was established for the study area. XP-STORM (1D) and XP-2D, a dynamic hydraulic modelling system developed by XP SOLUTIONS was used in this study. XP-2D is a 2-Dimensional model which uses TUFLOW as its 2D engine. TUFLOW is used world-wide and has been shown to provide reliable, robust simulation of flood behaviour in urban and rural areas through a vast number of applications.

The model allows addition of a 2-Dimensional (2D) domain (representing the study area topography) to a 1-Dimensional (1D) network (representing the pipes in the study area) with the two components dynamically coupled and solved simultaneously.

An important feature of the model is the ability to model the hydraulic structures in the 1D component rather than in the 2D domain. The benefit of this approach is that structure hydraulics are modelled more precisely than the approximate representation possible in a 2D domain.

Stormwater drainage pits, pipes and channels are represented in the model as 1-Dimensional elements which are dynamically linked to the water conveyed across the elevation grid.

CRITICAL DURATION

The 100-year ARI design event was run for standard durations of 25mins, 45mins, 1hr, 1.5hrs & 2 hours. The results of this modelling were then used to establish the critical duration adopted. The 2hr storm is adopted as the critical duration.

Subsequently, the model runs were carried out for the 2hr critical duration only (the duration of rainfall over the catchment that will result in the greatest depth of flooding).

RAINFALL LOSSES & 2D LANDUSE ROUGHNESS

The model adopts the following rainfall losses.

Table 1   Model Land Use Roughness & Losses

Land Use	Roughness	Initial Loss (mm)	Continuing Loss (mm/hr)
Road	0.01	0	0
Parks	0.15	10	2.5
Residential	0.08	5	1.5
Commercial	0.05	5	1.5
Roof	0.015	0	0

Land Use	Roughness	Initial Loss (mm)	Continuing Loss (mm/hr)
Buildings	0.3	0	0

2D MODEL SETUP

Two-dimensional (2D) hydraulic modelling was carried out to determine the flood behaviour in the study area. A fine grid size (2.0m x 2.0m) was deemed necessary to define the extent of the flooding through the developed areas.

Existing and new buildings outside of the site were modeled with a variable Manning's roughness in the topographic grids, n=0.015 up to a depth of 0.09m and n=0.3 for depth exceeding 0.1m. This was based on existing building outlines extracted from ortho-rectified imagery.

BLOCKAGES

For the in-ground stormwater infrastructure, a blockage factor of 50% is adopted.

BOUNDARY CONDITIONS

A free discharge is assumed at the open drain downstream of Evan Street. This level has no impact on the flood modeling results as it is taken approximately 500m downstream from the site where the terrain is much lower (approximately 8m).

EXISTING FLOOD BEHAVIOUR

In this existing scenario (base case), the existing houses are modelled as total obstructions to the flows and have been modelled as inactive cells. The flood modelling indicates that the site is affected by overland flooding in 100-yr ARI storm event. The flooding occurs from the local upstream catchment east and north of the site.

The hydraulic hazard through the site is a low hazard. The flood modelling results for the existing base case scenario are shown in *Figure 8* and *Figure 9*.

PROPOSED FLOOD BEHAVIOUR (ULTIMATE)

In the proposed scenario (proposed), the existing building footprint is replaced with the footprint of the proposed development. The proposed footprint is also assumed to completely block the flooding and is made inactive in the grid.

In this scenario, the proposed development at 18-22 Colless Street is also included in the model to provide a whole precinct approach to flooding and to demonstrate to Council that when both developments have been constructed the flooding is improved in the floodplain.

The results of the modelling for the proposed scenario are shown in ***Figure 10*** and ***Figure 11***.

INETRIM FLOOD BEHAVIOUR

In this scenario, the proposed development is assessed in isolation of the development along Colless Street to determine, in the event that the Colless Street development does not go ahead, if the development on 32-36 lethbridge will have any impact on the existing floodplain.

The results of the modelling for the proposed scenario are shown in *Figure 10* and *Figure 11*.

IMPACT ANALYSIS

An assessment of the impact the development could potentially have on the flooding behaviour elsewhere in the floodplain is made and is included in ***Figure 12*** and ***Figure 18*** below.

The overall impact on the adjoining properties is minimal as can be seen in the flood impact map. This is because of the proposed overland flowpaths which convey the flows through the site in an effective manner without creating an afflux upstream of the site or increasing the flows and the velocities downstream of the site. It is also because of the proposed drainage along Lethbridge Street and through the site under the proposed side overland flowpath. The proposed drainage has an increased inlet capacity which in turn increases the flows into the existing trunk main hence increasing its capacity as well.

The dedicated overland flowpath proposed through the site are as per ***Figure 15*** and as follows:-

- 4m wide overland flowpath along the eastern boundary. It is proposed to lower the existing site levels by 250mm approximately to increase the conveyance capacity of the overland flows through the site;
- 4m wide overland flowpath along the rear of the site. It is proposed to lower the existing levels by 250mm along this overland flow route;
- 1m wide overland flowpath along the western boundary of the site lowered by 250mm below existing levels; and
- Lower the front setback of the site by 200mm average and construct two inlet pits within the lowered area to convey flows to the trunk drainage system.

It is also proposed to construct series of inlet gully pits and pipes under Lethbridge Street in front of the site to increase the inflow capacity of the system. The proposed drainage will be carried through the site under the eastern overland flowpath with additional inlet pits to maximise its capacity. Additional inlet pits are also proposed in the front setback which is lowered to accept and convey inflows.

As such, it is concluded that the proposed development will have negligible impact on the flow conveyance and the flood behavior in its vicinity in relation to loss of flood storage, flow velocities and cumulative impacts of similar developments in the floodplain. The increase in flood depths shown in the flood impact map indicate that the increase in depth is confined to a small localised area in the road reserve in Lethbridge Street. No private properties experience any increase in flooding, on the contrary, the flooding is reduced or neutral across the floodplain.

This is demonstrated in the flood maps included in ***Figure 12*** and ***Figure 18*** showing that there is no increase in velocities, peak flows and loss of storage.

The development does not increase the flood hazard or risk to other properties in its vicinity. The results of the hydraulic modeling of the overland flows indicate that the proposed development does not have a major adverse impact on the flooding behaviour and is manageable.

In our opinion, the development should be acceptable from a flooding perspective and Council should recommend it for approval.

RECOMMENDATIONS

The following measures should be implemented in conjunction with the construction of the proposed development.

- Raise the floor level of the ground floor habitable levels to 500mm above the 100-yr flood level;
- Provide for a failsafe overland flow paths within the site as detailed above to allow for the overland flow to be carried across the site. This is documented in the stormwater plans issued with the development application;
- Flow paths to be 200mm-250mm deep on average below the existing natural level along the northern boundary (refer ***Figure 15***); and
- Overland flowpath to be rock mulched or grass finish or similar to ensure there are no floatables during heavy rainfall events and to achieve a Manning's n of 0.05 maximum.

This letter provides a flood impact assessment for the proposed development at 32-36 Lethbridge Street, Penrith. Should you have any further queries or questions, please do not hesitate to contact the undersigned.

Yours faithfully

S&G Consultants Pty Limited

Sam Haddad

Director & Principal Engineer (Civil)

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Figure 6 Study Extents

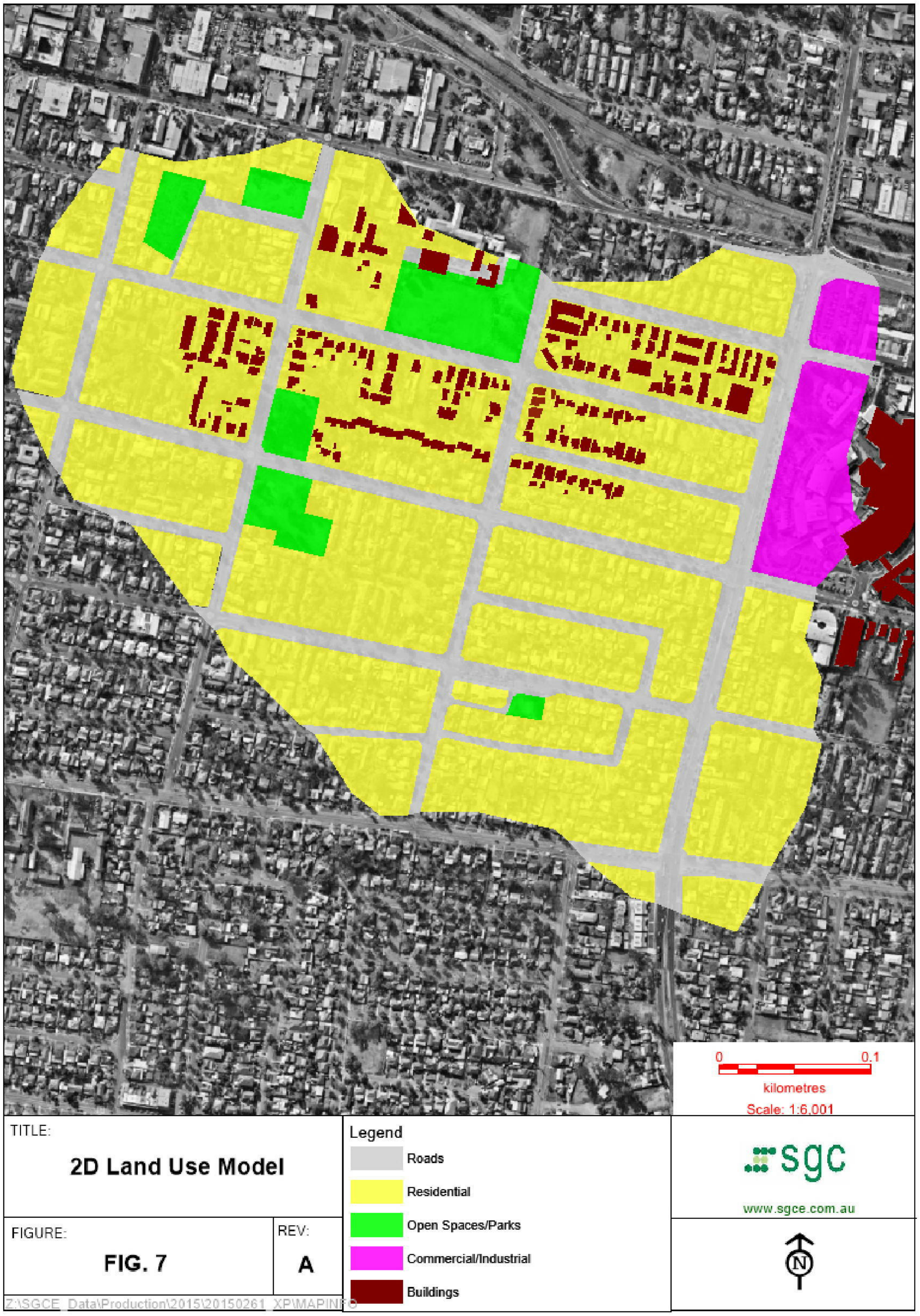

Figure 7 2D Land-use Model

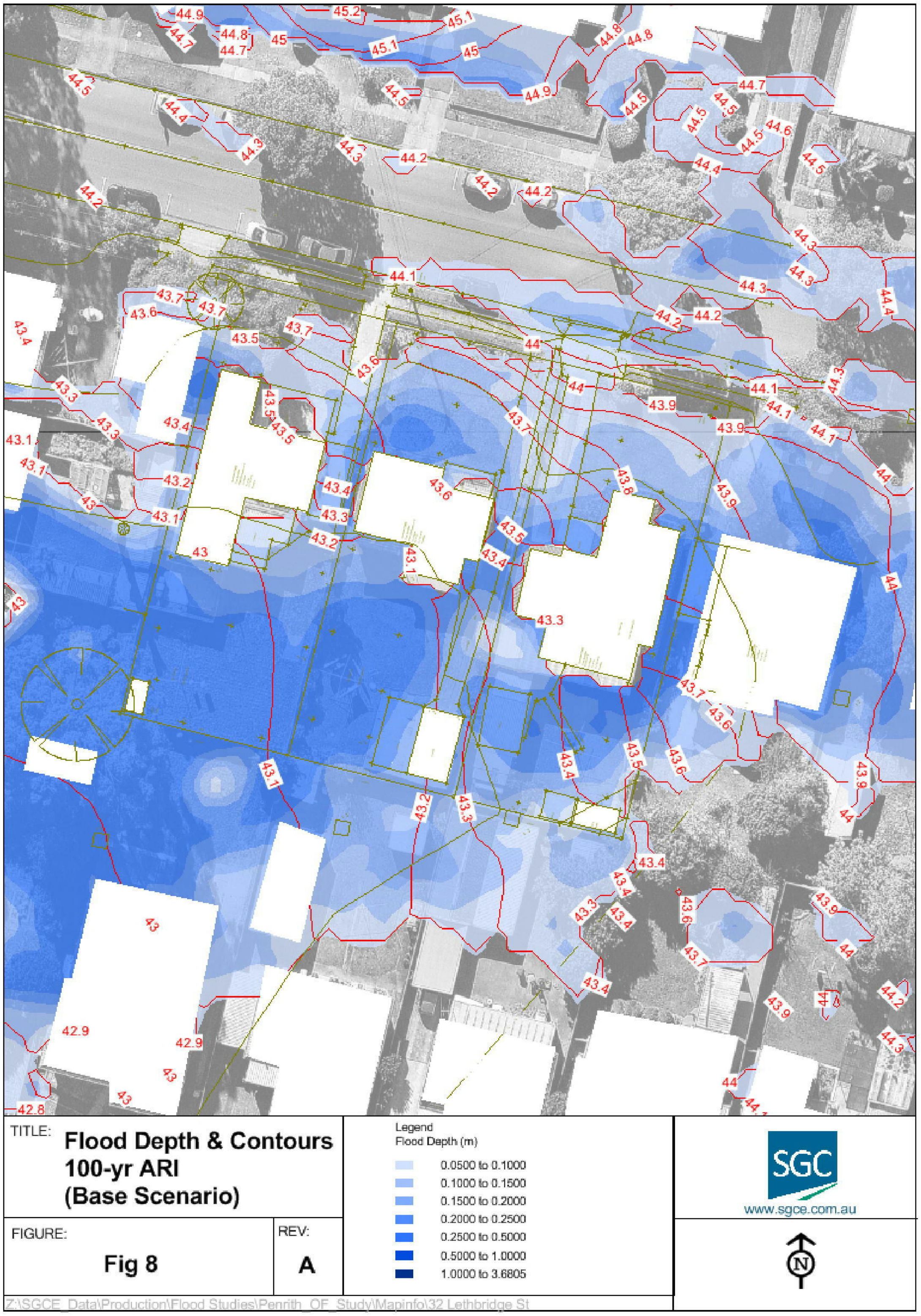

Figure 8 Flood Depth & Contours (100yr ARI) – Base Case

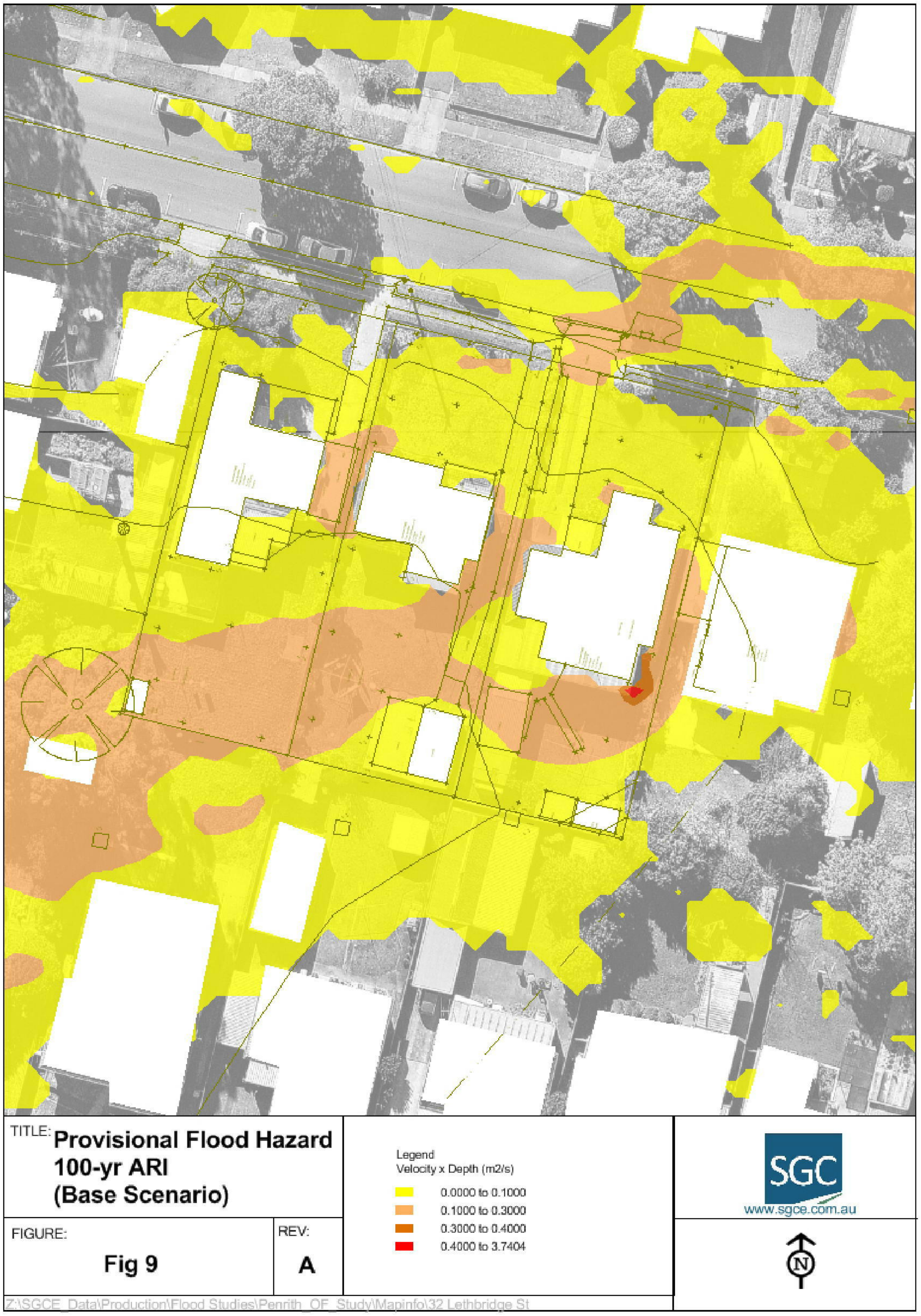

Figure 9 Provisional Flood Hazard (100yr ARI) – Base Case

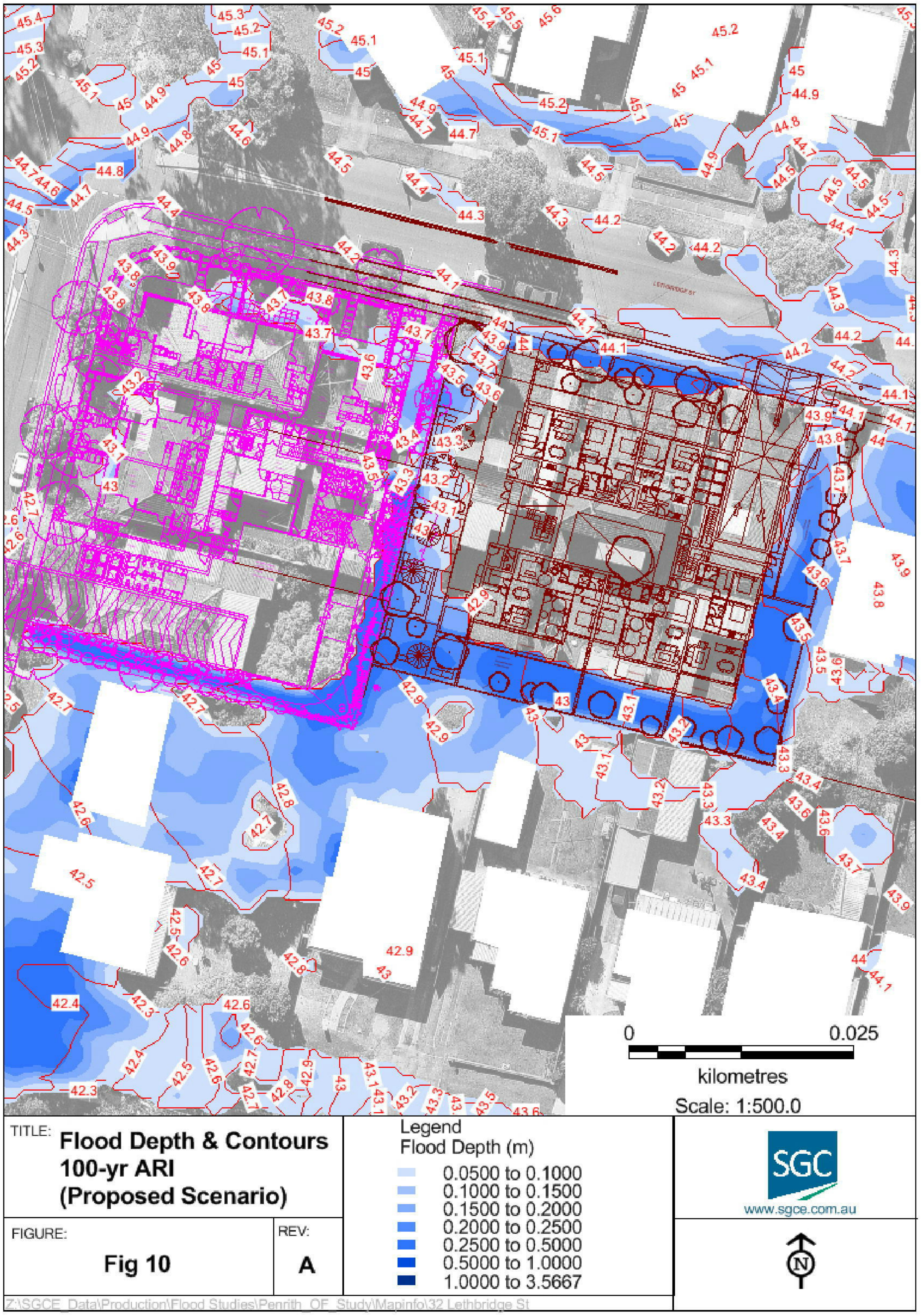

Figure 10 Flood Depth & Contours (100yr ARI) – Proposed

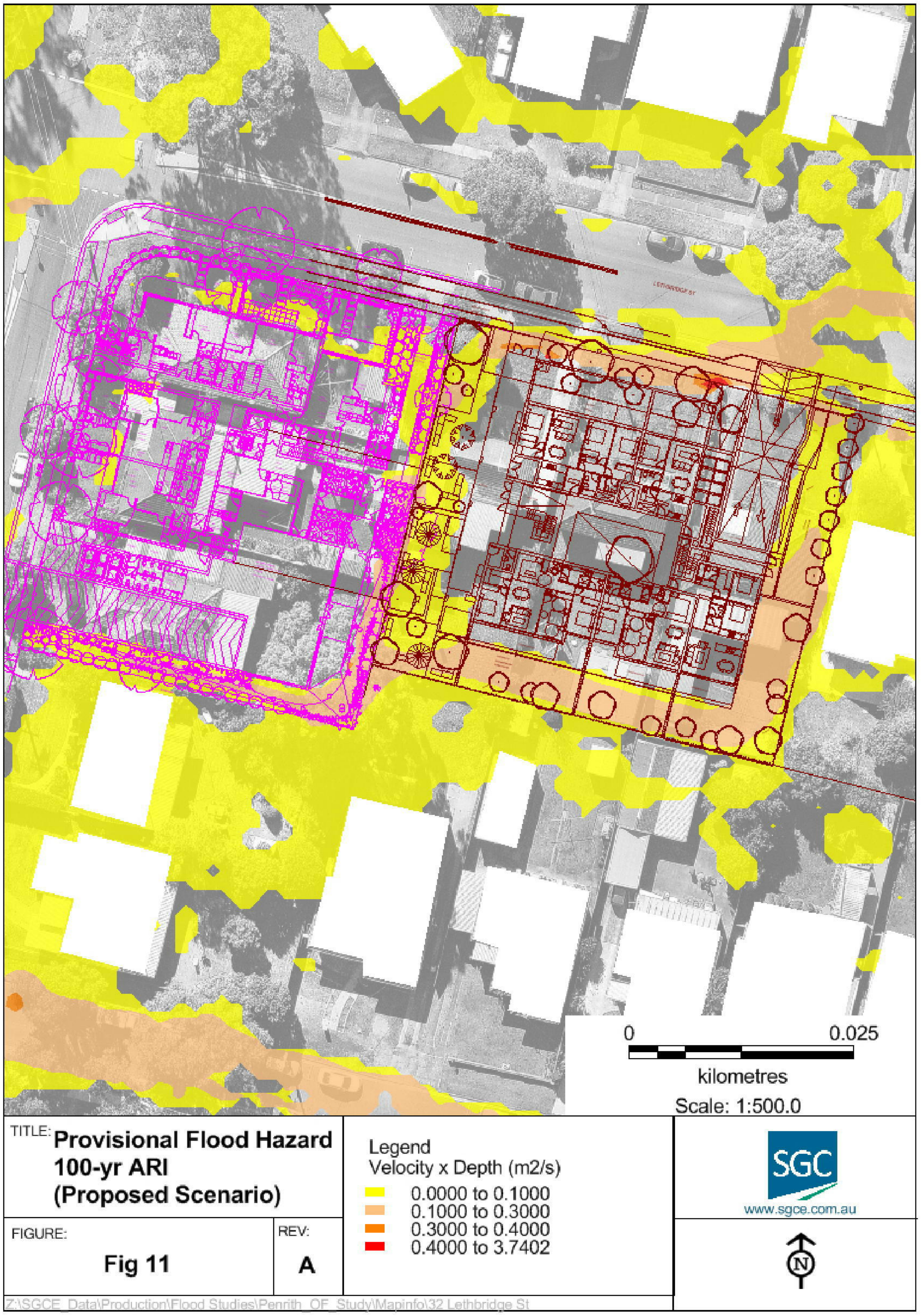

Figure 11 Provisional Flood Hazard (100yr ARI) – Proposed

Figure 12 Flood Impact Map – 100yr ARI – Proposed

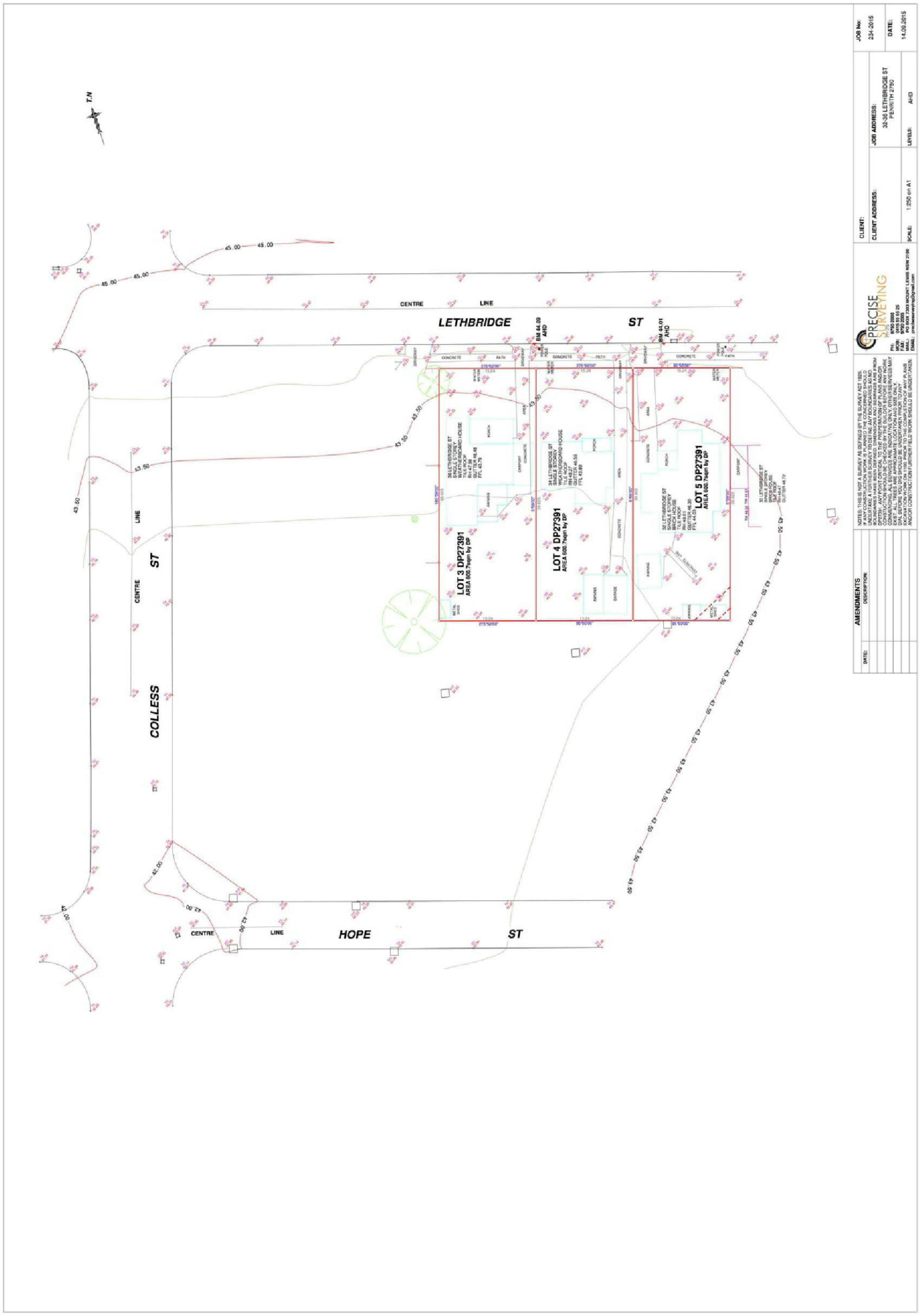

Figure 13 Survey Plan

Figure 14 *Site/Ground Floor Plan*

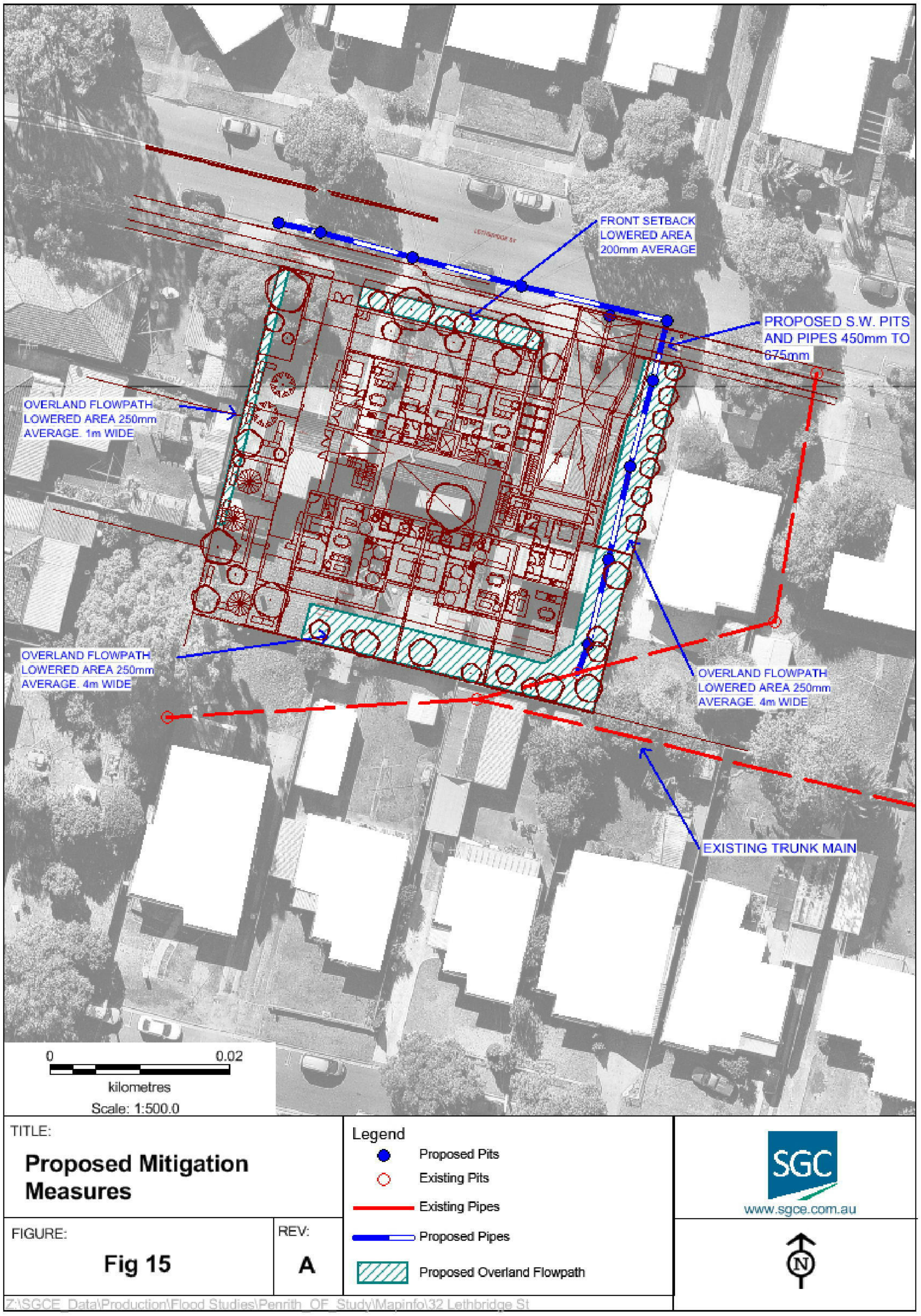

Figure 15 Proposed Mitigation Measures

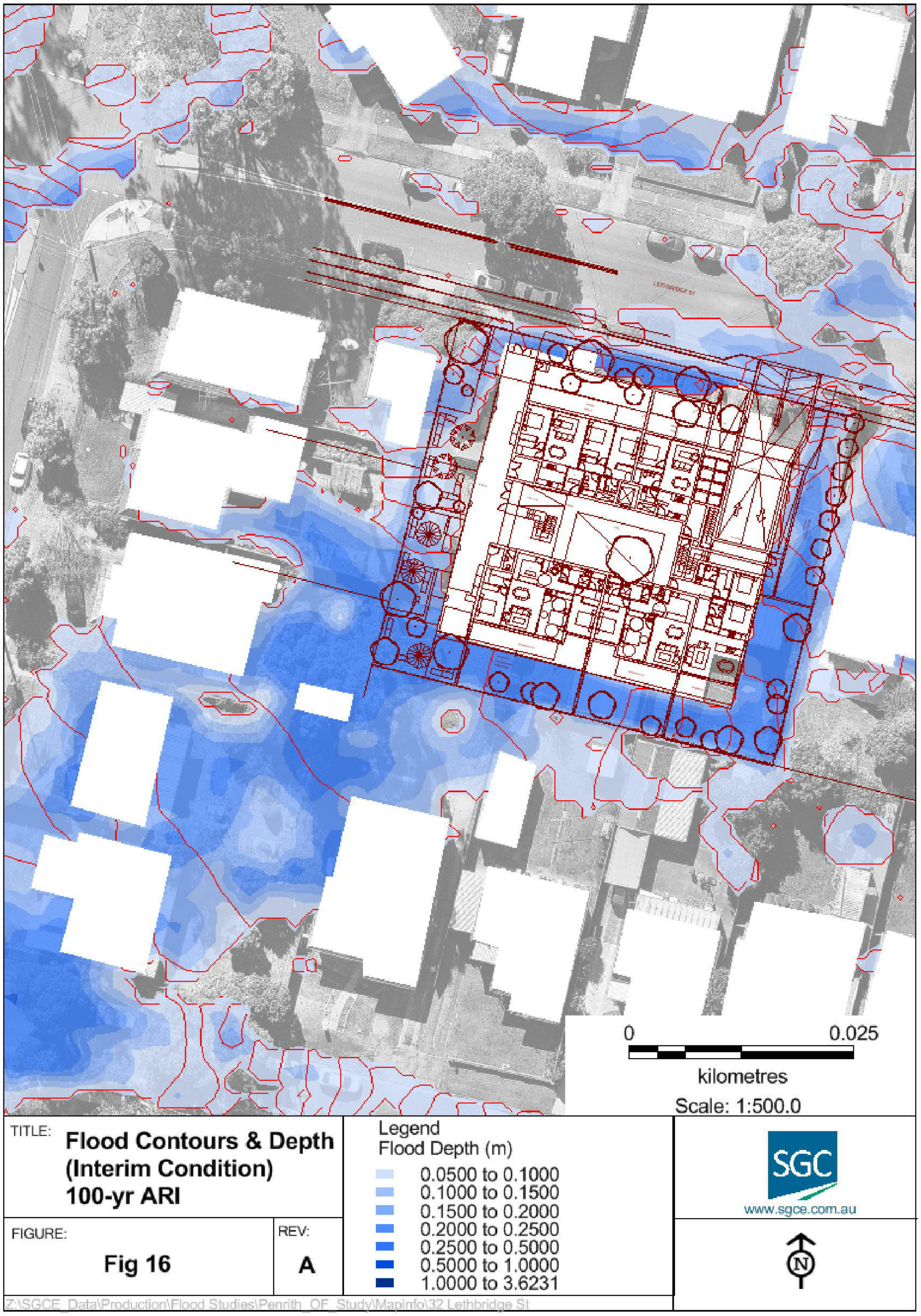

Figure 16 ***Flood Depth & Contours (100yr ARI) – Proposed Interim***

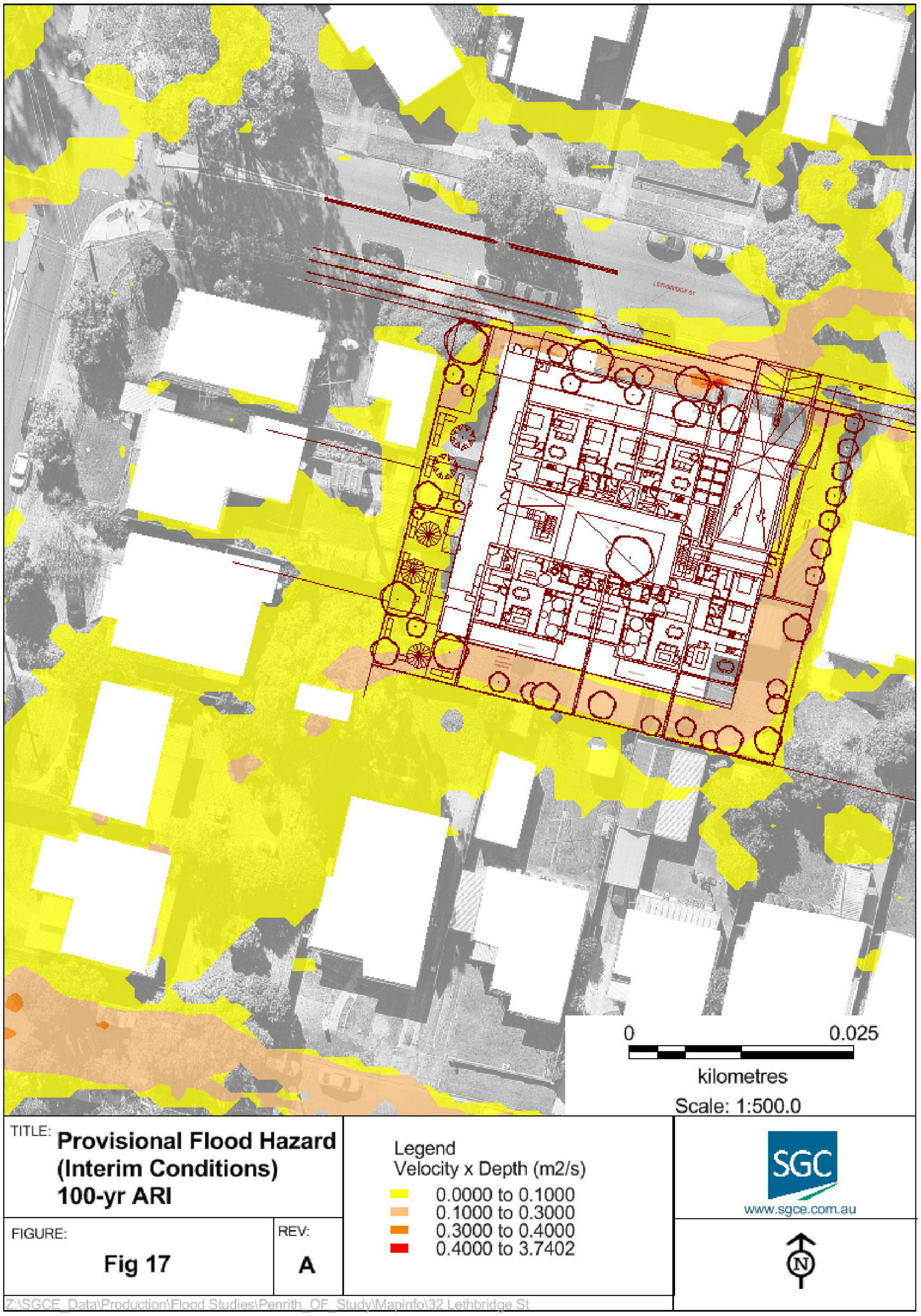

Figure 17 Provisional Flood Hazard (100yr ARI) – Proposed Interim

Figure 18 Flood Impact Map – 100yr ARI – Proposed Interim