Mr G. Turland

Proposed Residential Apartments 164 to 178 Mittagong Rd Bowral

Proposed Development Site

Flood Assessment Report

October 2016

FloodMit

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TABLE OF CONTENTS

Page

PREFACE

1 INTRODUCTION 3

2 REVIEW OF FLOOD BEHAVIOUR 5

- 2.1 SOURCE OF INFORMATION 5
- 2.2 EXTENT OF FLOODING AND DESIGN FLOOD LEVELS 6
- 2.3 DEPTH AND VELOCITY OF FLOODWATER 6
- 2.4 CLASSIFICATION OF FLOOD RISK 7
- 2.5 POTENTIAL CLIMATE CHANGE IMPACTS 7

3 DETAILS OF PROPOSED DEVELOPMENT 12

- 3.1 SITE SURVEY 12
- 3.2 COMPARISON OF SITE SURVEY WITH TUFLOW MODEL 12
- 3.3 PROPOSED DEVELOPMENT 12
- 3.4 POTENTIAL FLOOD IMPACTS 13

4 FLOOD IMPACT ASSESSMENT 18

- 4.1 METHOD OF ASSESSMENT 18
- 4.2 OPTION 1 – DEVELOPMENT WITH NO COMPENSATORY MEASURES 18
- 4.3 OPTION 2 – DEVELOPMENT WITH COMPENSATORY EXCAVATION 19
- 4.4 OPTION 3 – DEVELOPMENT WITH ADDITIONAL MEASURES 21

5 COMPLIANCE WITH COUNCILS FLOOD POLICIES 26

- 5.1 FLOOR LEVELS 26
- 5.2 BUILDING COMPONENTS 26
- 5.3 STRUCTURAL SOUNDNESS 27
- 5.4 FLOOD EFFECTS 27
- 5.5 CAR PARKING AND DRIVEWAY ACCESS 28
- 5.6 EVACUATION 29
- 5.7 MANAGEMENT AND DESIGN 29
- 5.8 FENCING 29

6 CONCLUSIONS 30

7 REFERENCES 31

TABLE OF CONTENTS (cont)

LIST OF TABLES

TABLE 1 – Design 100 year Flows in the Vicinity of the Site

LIST OF FIGURES

FIGURE 1 – Locality Sketch and Site Plan
FIGURE 2 – 100 Year Flood Extent and Design Flood Level Contours
FIGURE 3 – Depth of Flooding in 100 Year Flood including Flood Velocity Vectors
FIGURE 4 – Velocity x Depth Contours in 100 Year Flood
FIGURE 5 – Flood Risk Management Precincts
FIGURE 6 – Site Survey
FIGURE 7 – Difference between Site Survey and DEM in Tuflow Model
FIGURE 8 – Basement Floor Plan
FIGURE 9 – Ground Floor Plan
FIGURE 10 – Flood Impact Assessment – Option 1 No Compensatory Measures
FIGURE 11 – Flood Impact Assessment – Option 2 Compensatory Measures within Site
FIGURE 12 – Flood Impact Assessment – Option 3 Compensatory Measures beyond Site

LIST OF ILLUSTRATIONS

ILLUSTRATION 1 Option 2 – Compensatory Excavation within Site
ILLUSTRATION 2 Option 3 – Compensatory Excavation beyond Site

1 INTRODUCTION

FloodMit Pty Ltd was commissioned by Mr G. Turland to provide a flood assessment report to accompany an application for proposed residential apartments at 164-178 Mittagong Road, Bowral.

The proposal includes a three storey apartment complex with a total of 34 three bedroom apartments, 10 two bedroom apartments, and 2 one bedroom apartments. Basement car parking for 95 cars is also proposed.

A site plan is shown on **Figure 1**. The existing site comprises six residential allotments with frontage to either Mittagong Road or Victoria Street. The total site area is approximately 5,510m^2, and is zoned B4 Mixed Use under Wingecarribee LEP 2010. The site is mostly vacant land, with a number of previous homes now removed. One house remains at the corner of Mittagong Road and Victoria Street.

The northern boundary of the site is adjacent to Rivelut Park, and within 25m of Mittagong Creek. Mittagong Creek has a catchment area of 30km^2, which drains in a westerly direction through Bowral to the Wingecarribee River.

Mittagong Creek has a history of flooding. Significant floods have occurred in 1915, March 1975, August 1986, April 1988, October 1999 and June 2016. The *Bowral Floodplain Management Study and Plan* (Bewsher, 2009) identifies that the subject site is potentially affected by flooding. Flooding is therefore an important consideration to the proposed development of the site.

This report provides a flood assessment of the site, including:

i) a review of flood behaviour;

ii) description of the proposed development and compensatory flood mitigation measures;

iii) a flood impact assessment of the proposed development using the computer model developed as part of the floodplain management study; and

iv) an assessment of the proposal in terms of Council's flood risk management policies.

Figure 1
Locality Sketch and Site Plan
(Base map 2001 aerial photography)

2 REVIEW OF FLOOD BEHAVIOUR

2.1 SOURCE OF INFORMATION

The site is within the Mittagong Creek catchment. The catchment has a history of flooding problems, and a number of flood investigations have been undertaken. The most relevant is the *Bowral Floodplain Risk Management Study and Plan* (Bewsher, 2009).

The floodplain management study and plan provides a range of recommended measures to be implemented within the catchment to alleviate the flood risk where feasible. The study also includes a number of specific flood investigations that define the nature of flooding within the catchment. These include:

i) Flood Study Review (2004)

This was the review of an original council flood study prepared in 1990. A new two-dimensional hydraulic model (Tuflow) was developed to simulate flood behaviour throughout the catchment. The model was calibrated to the April 1988 and October 1989 floods. It was then used to simulate flood behaviour for a range of design floods including the 5, 10, 50 and 100 year ARI floods. A probable maximum flood (PMF) was also simulated.

ii) Flood Study Update (May 2005)

The flood study was updated in May 2005 to include the newly constructed Bowral Street Bridge. Blockage factors applied at culverts and bridges were also reviewed. The previously assumed 50% blockage allowance was reduced to 25% at the new Bowral Street Bridge, and for structures at Mittagong Road, Mount Road and Oxley Hill Road. The update notes that there were no significant changes to flood levels in the 100 year flood.

iii) Flood Study Addendum (2009).

Further sensitivity testing to assumed blockage factors and potential climate change variations were assessed during December 2008, and documented in 2009. The Tuflow model software was also updated (from Build 2003-07-BA to Build 2008-06-AD-ISP). The new software resulted in flood levels being reduced by between 0.1 to 0.25m in the 100 year flood, particularly on the upstream side of culverts and bridges. An unblocked scenario was also assessed and the 100 year flood profile taken as the maximum of the blocked and unblocked runs. The PMF was also re-run using the new software, but only for the blocked scenario. The addendum recommends that the December 2008 flood model results (for the 100 year and PMF floods) be adopted for applying council's flood risk management provisions in its DCP to properties within the Mittagong Creek floodplain.

Flood levels quoted in this report for the 100 year and PMF floods, including flood risk management precinct mapping, are derived from the 2009 addendum. Floods more frequent than the 100 year flood were not assessed as part of the 2009 addendum, and have been extracted from the May 2005 update.

All flood impact assessment modelling has been undertaken for the 100 year flood using the maximum of the blocked and unblocked scenarios, consistent with procedures adopted in the 2009 addendum.

2.2 EXTENT OF FLOODING AND DESIGN FLOOD LEVELS

The estimated extent of flooding in the 100 year flood in the vicinity of the subject site is shown on **Figure 2**. Also included are flood level contours at 0.1m intervals.

Figure 2 indicates that about 59% of the site would be inundated in the 100 year flood. Flood levels are shown to vary from RL 672.5 to RL 672.6m AHD. The southern portion of the property, fronting Victoria Street, is on higher ground and is not inundated in the 100 year flood.

Design flood levels for a range of floods that are applicable to the site have been extracted from the relevant Tuflow model grids, and are listed in **Table 1**. These results indicate relatively minor difference between frequent flood events (such as the 5 year flood) and major flood events (such as the 100 year flood). There is however a significant increase in flood levels in more extreme events, such as the probable maximum flood (PMF). The PMF is an estimate of the largest flood that could conceivably occur.

Table 1
Design Flood Levels (m AHD) at 164-178 Mittagong Road, Bowral

Design Flood	**Maximum within Subject Site (m AHD)**	**Source**
5 Year ARI Flood	672.2	Flood Study Update (Bewsher 2005)
10 Year ARI Flood	672.3	Flood Study Update (Bewsher 2005)
100 Year ARI Flood	672.5	Flood Study Addendum (Bewsher 2006)
PMF Flood	675.4	Flood Study Addendum (Bewsher 2006)

2.3 DEPTH AND VELOCITY OF FLOODWATER

Figure 3 illustrates the maximum depth experienced in the vicinity of the subject site in the 100 year flood.

The depth of flooding is greatest along the northern boundary of the site, adjacent to the public reserve. Flood depths in this vicinity range from 1.3 to 1.6m in the 100 year flood. Flood depths progressively reduce towards the south. The depth adjacent to the proposed building footprint (ie the northern limit of the basement parking) is typically 1.0m.

Flood velocity vectors are also illustrated on Figure 3. Velocities shown are for the 100 year flood and the "unblocked culvert" simulation, which provides the highest flood velocities at the subject site. Flood velocities are typically greater than 2.0m/s within the main creek, and reduce on the floodplain with distance from the creek bank. Flood velocities range from 0.4 to 0.7m/s along the northern site boundary, and are typically 0.3m/s along the proposed building footprint.

The product of velocity and depth is often used to provide a measure of the hazard that affects a property. A value of 0.4m^2/s is usually regarded as a limit for safety considerations. **Figure 4** illustrates the velocity depth product in the 100 year flood. The majority of the area located within the proposed building footprint has a relatively low velocity depth product of between 0.0 and 0.2m^2/s. This increases to about 0.3m^2/s at the northern limit of the proposed building footprint. The velocity depth product continues to rise towards the creek. The area within the public reserve increases to over 1.0m^2/s, which constitutes particularly hazardous conditions.

2.4 CLASSIFICATION OF FLOOD RISK

The Bowral Floodplain Management Study and Plan categorised the floodplain into four different flood risk management precincts. These include:

<u>High Flood Risk</u> – Land below the 100 year flood that is subject to a high hydraulic hazard or where there are significant evacuation difficulties. Most development is restricted from this area

<u>Medium Flood Risk</u> – Land below the 100 year flood that is not subject to a high hydraulic hazard and where there are no significant evacuation difficulties. Development is often permitted within this area subject to satisfying a number of flood risk management development controls

<u>Fringe Low Flood Risk</u> – Land that is less than 0.5m above the 100 year flood level. This area is within the 0.5m freeboard that is added to the 100 year flood when specifying minimum floor levels for residential type development

<u>Low Flood Risk</u> – Land that is above the 100 year food, but still potentially affect by floods up to the probable maximum flood (PMF). There are few flood risk management controls within this area.

The flood risk mapping in the vicinity of the subject site is shown on **Figure 5.**

The subject site contains all of the flood risk management precincts listed above. The proposed building footprint at ground level (ie the basement parking) has been adjusted so that it coincides closely with the boundary between the high flood risk and medium flood risk precincts. The upper levels of the development overhang the limit of the basement parking and the high flood risk precinct, however these floors are more than 0.5m above the 100 year flood level and provide no obstructions in the 100 year flood.

2.5 POTENTIAL CLIMATE CHANGE IMPACTS

Potential climate change can affect flood levels through either a change in design rainfall intensities or a change in mean sea level.

At Bowral, climate change could potentially affect flood behaviour by increasing the severity of flood producing storms or other weather systems. However, there is still considerable uncertainty regarding the magnitude of any impact of climate change on design rainfall intensities. The Bowral Floodplain Management Study and Plan (Bewsher 2009) recommended that any changes to flood planning levels be deferred until improved projections of changed rainfall intensities with climate change become available

Figure 2
100 Year Flood Extent and
Design 100 Year Flood Contours

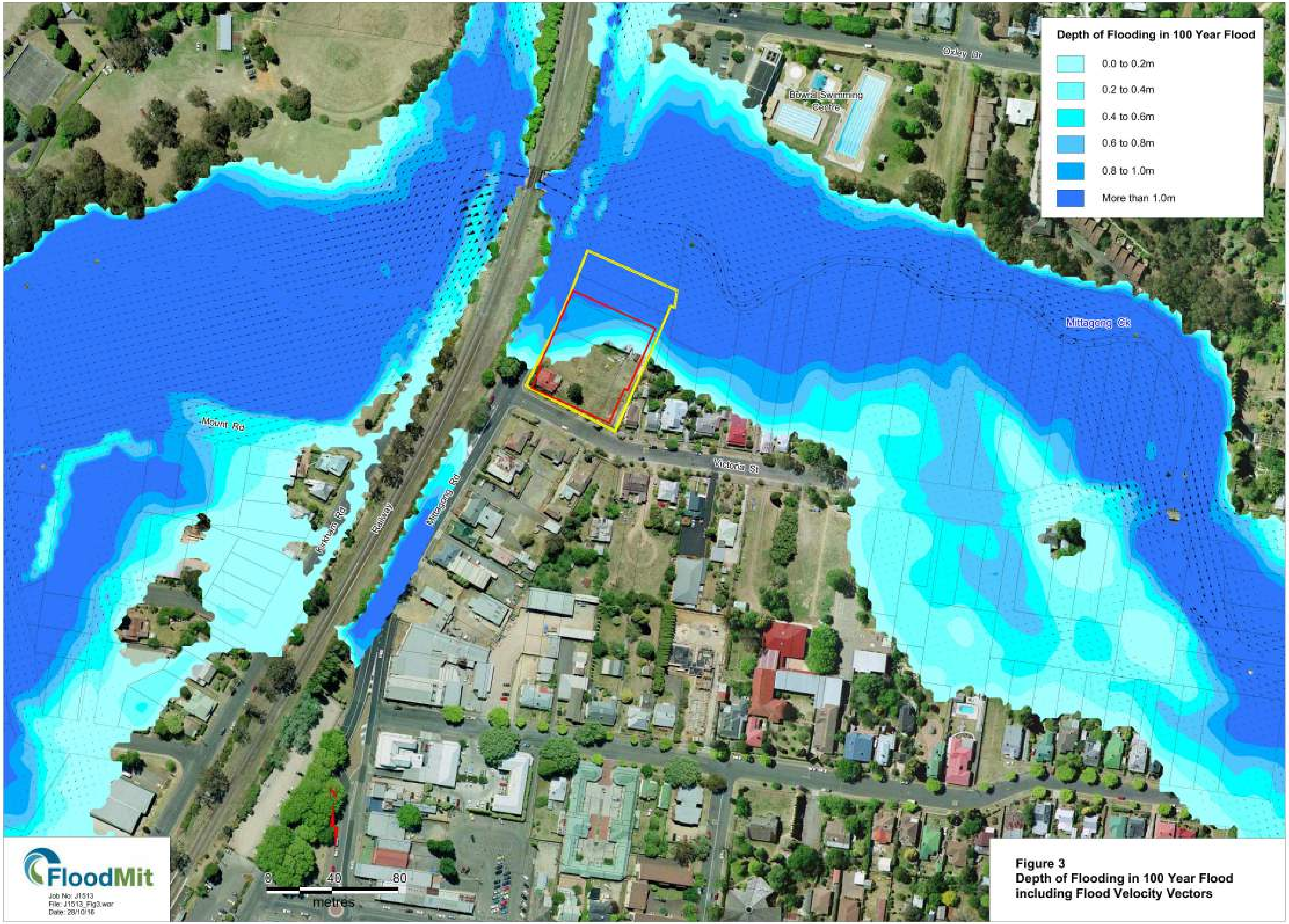

Figure 3
Depth of Flooding in 100 Year Flood including Flood Velocity Vectors

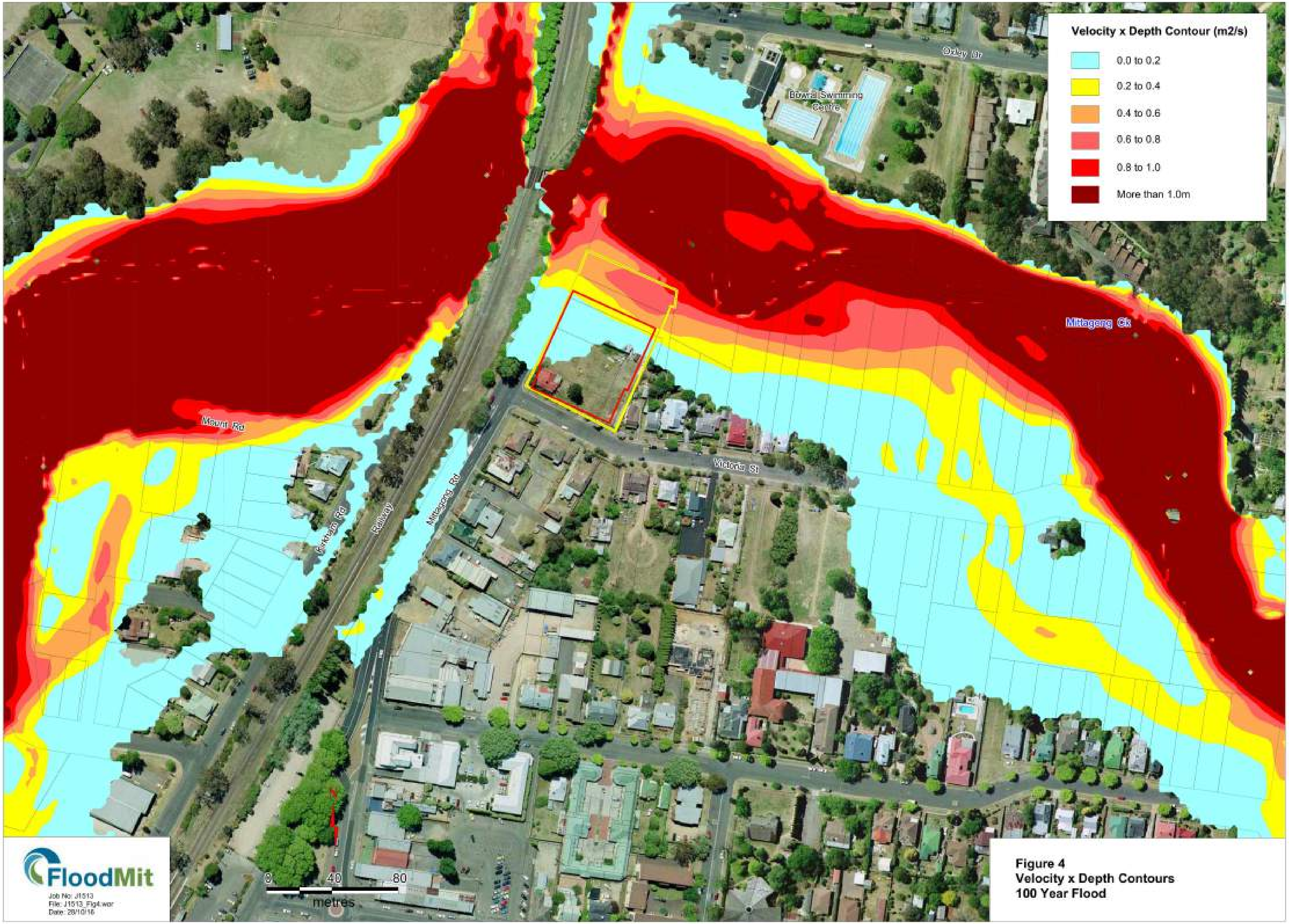

Figure 4
Velocity x Depth Contours
100 Year Flood

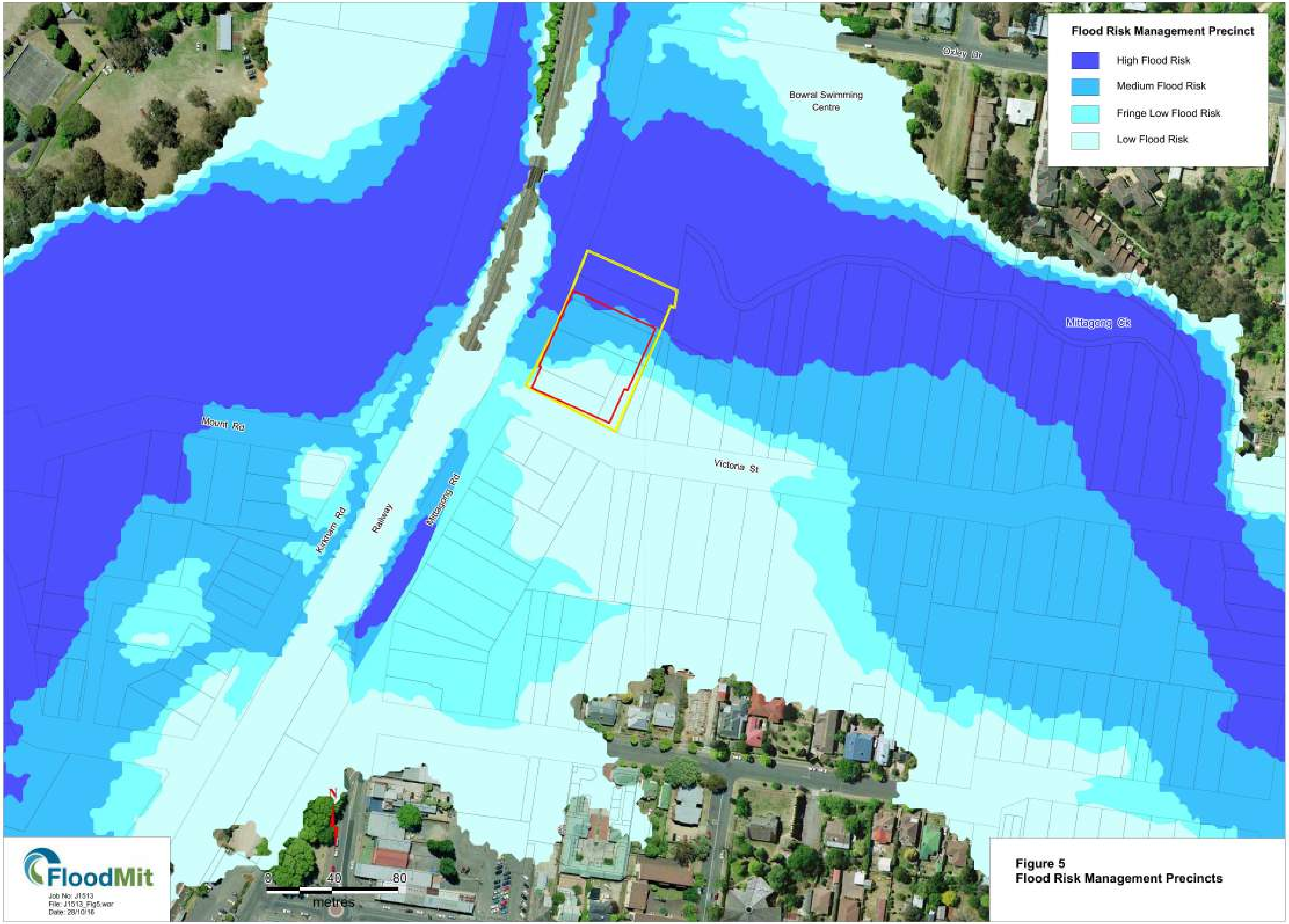

Figure 5
Flood Risk Management Precincts

3 DETAILS OF PROPOSED DEVELOPMENT

3.1 SITE SURVEY

A detailed survey of the subject site was undertaken by Campbell & Anderson in January 2002. The survey includes site features, ground levels, and contours at 0.5m intervals. The site survey is included at **Figure 6**.

Spot levels from the site survey have been compared with a digital elevation model (DEM) that forms the basis of the topography included in the Tuflow model. This comparison provides an indication of how accurately the flood model represents site conditions and the accuracy of the flood mapping in this area.

3.2 COMPARISON OF SITE SURVEY WITH TUFLOW MODEL

The TUFLOW flood model results, including the flood extent mapping, is based on the results of a DEM that was prepared from photogrammetric survey acquired by Council in approximately 2001.

A total of 120 points from the site survey were digitised, and the corresponding level from the Tuflow DEM extracted for comparison purpose. The difference in ground levels between the two survey sources is illustrated on **Figure 7**.

The mean difference for all points compared was determined to be -0.028m. That is, the site survey is on average 0.028m below the photogrammetric survey. Furthermore, 57% of all points compared have a difference that is less than 0.1m, and 93% of all points compared have a difference that is less than 0.2m. This is a particularly good agreement, and suggests that the photogrammetric survey is representative of actual site conditions.

The flood extents shown from the TUFLOW model are therefore expected to provide a good representation of the actual extent of flooding within the site.

3.3 PROPOSED DEVELOPMENT

The proposed development is shown on architectural plans prepared by MMA Architects. The most relevant include the Basement Floor Plan (Dwg DA03 07); and the Ground Floor Plan (Dwg DA04 05). These plans are attached as **Figure 8** and **Figure 9**.

The proposed development includes a three story residential apartment complex, comprising:

i) Basement car parking for 95 cars at RL 670.11m AHD. This is below the 100 year flood level (672.6m AHD) but is protected from inundation by the driveway from Victoria Street that slopes up from the pathway at RL 673.73 to a crest level of RL 674.03 before entering the basement. The crest level of the driveway entrance is 1.43m above the estimated 100 year flood level. Four lifts and stairwells are located near each of the basement corners.

   The basement parking area is the only part of the building that is located below the 100 year flood level, and is that part of the development that could potentially impact on flood behaviour in such an event. The basement footprint originally extended close to the northern boundary of the subject site, but has been moved back to be located outside the high flood risk boundary. This reduces the potential flood hazard to the structure, and helps to minimise any adverse flood impacts. The basement footprint has been digitised and shown on the various figures in this report as a red outline.

ii) 22 apartments on the ground floor level, with floor levels at RL 673.11m AHD. This is a minimum of 0.5m above the 100 year flood level. The ground floor level is not inundated in the 100 year flood, but could still be inundated in more extreme flood events.

Most of these apartments are located above the basement parking footprint. The four northern apartments extend partly over the open space area to the north of the basement. These floors are suspended on piers over the high flood risk area.

iii) 14 apartments on the first floor level, plus 6 ground floor apartments with upper levels, with floor level at RL 676.01m AHD. This level is above the PMF flood level of RL 675.4m AHD.

iv) 10 apartments on the second floor level, with floor levels at RL 678.91m AHD.

3.4 POTENTIAL FLOOD IMPACTS

The development is partially located within the 100 year flood extent, and could potentially have an impact on existing flood behaviour in such an event.

The footprint of the basement parking will result in a loss in flood storage and flow conveyance in the 100 year flood. The main impact is likely to be due to loss in flood storage, from the displacement of floodwater previously occupying the site of the basement. This part of the floodplain has relatively low flood velocities due to the shielding effect from the downstream railway embankment.

There could also be some impact from changes in flow conveyance, particularly towards the northern portion of the site where flood velocities increase. As the subject site consists of former residential properties, the Tuflow model assumes a relatively high roughness coefficient (n=0.10) within the site. This accounts for the presence of shrubs, trees, minor structures and the impact of boundary fences. All new boundary fences within the high flood risk precinct are proposed to be of a permeable, tubular steel type section. This is in accordance with Council's flood risk management requirements for high flood risk areas, and may results in some minor flow improvements. However, it has been conservatively assumed that the model roughness within the subject site is unchanged.

Potential flood impacts have been derived for the proposed development with and without compensatory flood management measures. The flood impact assessment has been undertaken using Council's Tuflow model, and is further reported in Section 4.

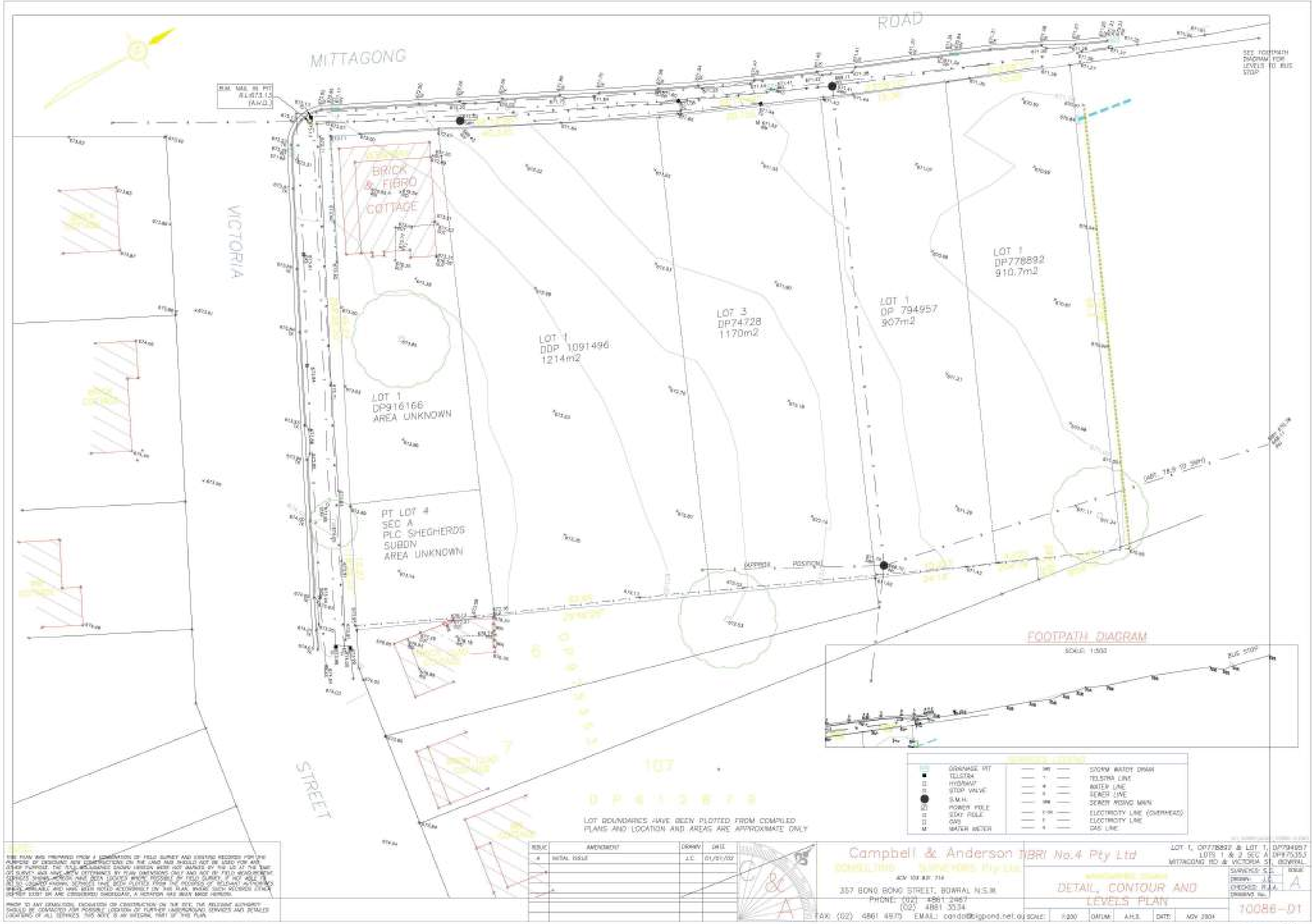

Figure 6
Site Survey

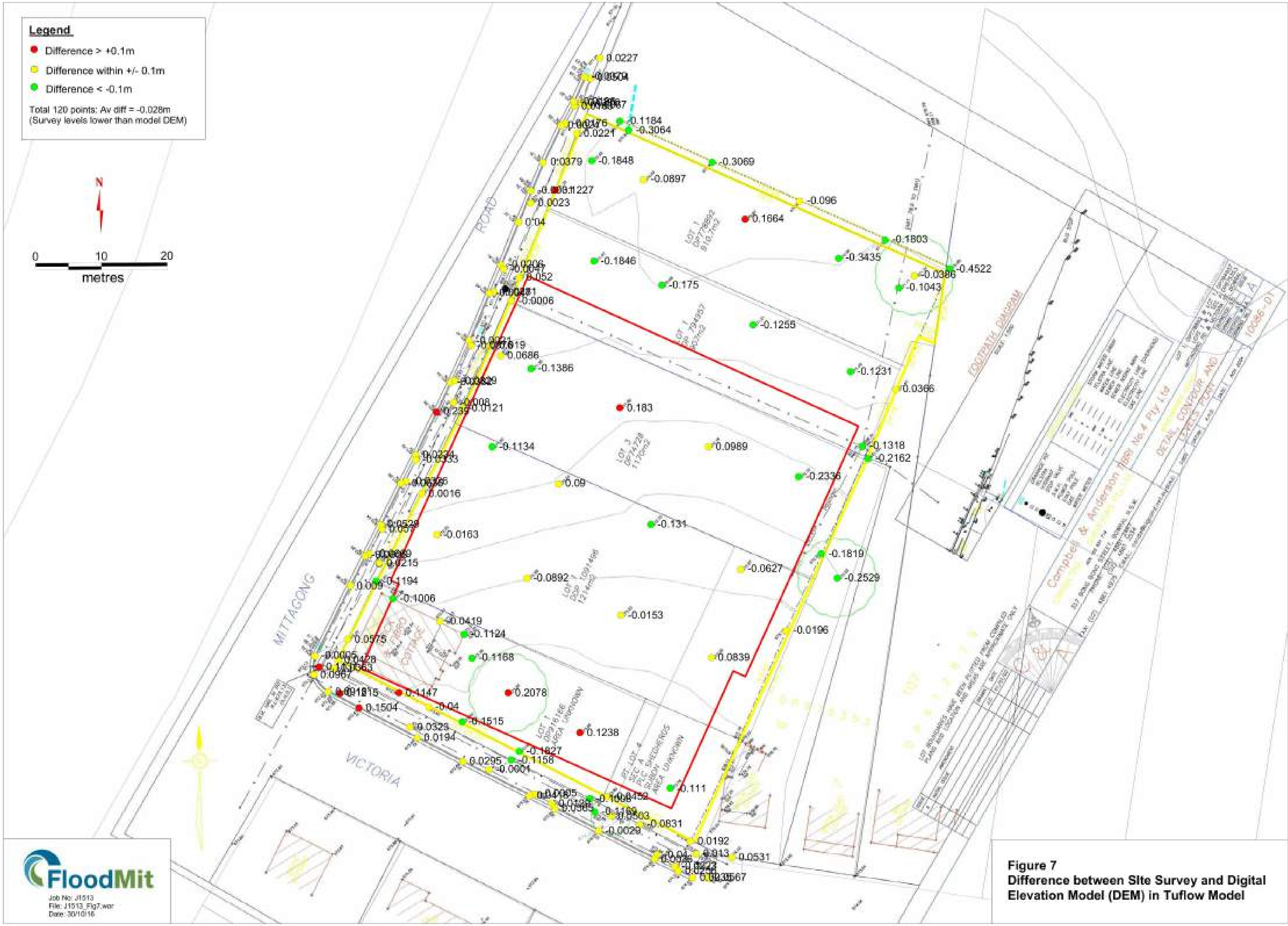

Figure 7
Difference between Site Survey and Digital Elevation Model (DEM) in Tuflow Model

Figure 8
Basement Floor Plan

1 BASEMENT FLOOR PLAN 1:200

GENERAL NOTES TO BUILDER / OR CONTRACTOR

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MR G. TURLAND CLIENT

164-178 MITTAGONG RD
BOWRAL, NSW PROJECT

BASEMENT FLOOR PLAN TITLE

DATE AS NOTED

PROJECT ARCHITECT

SCALE AS NOTED

PROJECT / DRAWING NUMBER AMENDMENT

542.01 DA03 07

Figure 9
Ground Floor Plan

AMENDMENTS

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GROUND FLOOR PLAN

542.01 DA04 05

4 FLOOD IMPACT ASSESSMENT

4.1 METHOD OF ASSESSMENT

The TUFLOW computer model that was originally developed by Bewsher Consulting for Wingecarribee Council as part of the *Bowral Floodplain Risk Management Study and Plan* (Bewsher, 2009) has been used to assess the impact of the proposed development on flood behaviour.

Three different options have been assessed.

Option 1 – The proposed development with no compensatory flood management measures

Option 2 – The proposed development including compensatory excavation from the northern potion of the subject site.

Option 3 – The proposed development including shallower compensatory excavation from the northern portion of the subject site and partly extending into the public reserve.

The assessment is based on the 100 year flood with critical storm duration of 9 hours. The model has been run for blocked and unblocked culvert/bridge scenarios and the maximum envelope of results adopted. Flood levels for each of the three options have been computed and compared against flood levels for existing conditions.

4.2 OPTION 1 – DEVELOPMENT WITH NO COMPENSATORY MEASURES

Option 1 assumes that the development is constructed with no compensatory flood management measures. The building footprint at ground level (basement parking area) displaces a volume of some 997m^3 in the 100 year flood and prevents any conveyance through this part of the floodplain.

The building footprint at ground level was included in the Tuflow model by raising the terrain surface in this part of the model above the 100 year flood. This prevents any ponding of floodwater within the building footprint and also any flow through this area. That part of the site to the north of the basement parking area was left unchanged.

A flood impact map has been prepared to illustrate the change in flood levels due to the proposed development. The flood impact map for the 100 year flood is shown on **Figure 10**.

Results indicate:

i) a maximum flood level increase of 25mm immediately upstream of the proposed development. The impact is relatively localised and diminishes relatively quickly in the upstream direction.

ii) The adjacent two properties to the subject site (4 and 6 Victoria St) experiences a flood level increase of between 10 and 20mm.

iii) The next two properties (8 and 10 Victoria St) experience a flood level increase of between 5 and 10mm.

iv) Further upstream the increase in flood level is less than 5mm.

v) Whilst some increase in flooding occurs upstream of the site, flood levels are reduced immediately downstream of the site. The flood level reduction is largely confined to Mittagong Road and is of the order of 5 to 10mm.

The increase in flooding is relatively small, but nevertheless is undesirable. Compensatory measures have therefore been investigated to mitigate these impacts

4.3 OPTION 2 – DEVELOPMENT WITH COMPENSATORY EXCAVATION

Compensatory excavation was included within the property to the north of the basement footprint to mitigate the increase in flooding experienced for Option 1. This part of the site was excavated to match the loss in flood storage from the basement parking area

Cross sections through the site, shown on **Illustration 1**, have been extracted from the terrain surface DEM at the following locations:

i) 7m from the upstream site boundary,

ii) the midpoint of the site; and

iii) 8m from the downstream site boundary.

The area between the basement footprint and the northern site boundary was then lowered to match the estimated loss in flood storage due to the development. This area has been lowered on average by approximately 0.8m, and results in an excavated volume of $990m^3$. The lowered area has been provided with a grade of 0.5% both longitudinally (towards Mittagong Road) and laterally (towards the creek).

The lowered area will effectively form an excavated basin area when the site is inundated. When floodwater subsides there will be a volume of $990m^3$ of floodwater contained within the excavated area. This part of the site currently experiences some ponding of floodwater, which is exacerbated by a masonry wall constructed parallel to the northern site boundary just within the public reserve. This area has historically been drained by an existing stormwater pipe (of approximately 375mm diameter) connecting the north-west corner of the site to Mittagong Creek. The drain still exists, but a floodgate to prevent backwater inundation is currently damaged. There is sufficient height to lower the inlet grate to accommodate the proposed lowering of the site, so that this pipeline (with repaired floodgate) can be utilised to drain the excavated area. It is estimated that it will take approximately 2 hours to drain the basin once flooding has subsided.

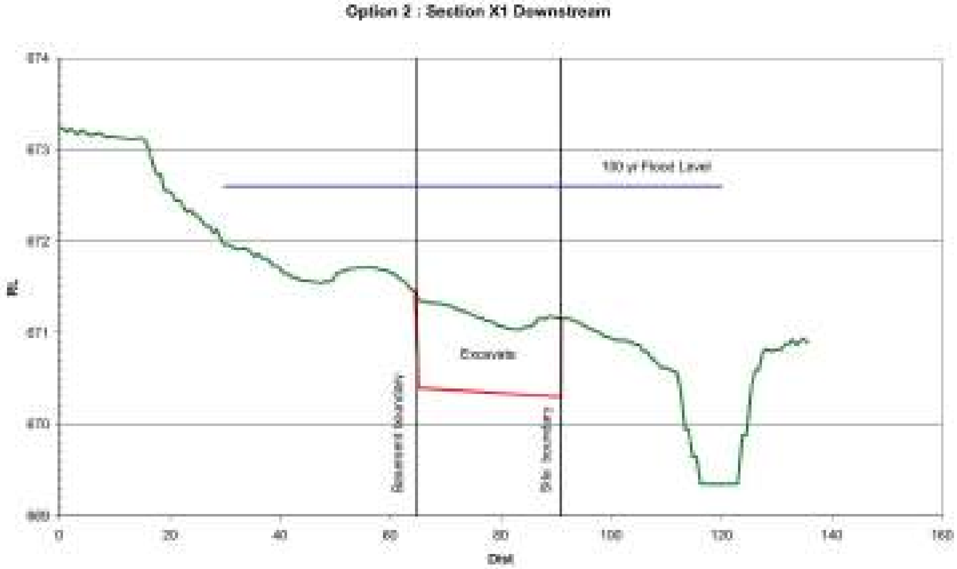
The proposed development, including compensatory excavation, was included in the Tuflow model to assess flood behaviour. A flood impact map has been prepared to illustrate the change in flood levels over existing conditions. The flood impact map for the 100 year flood is shown on **Figure 11**

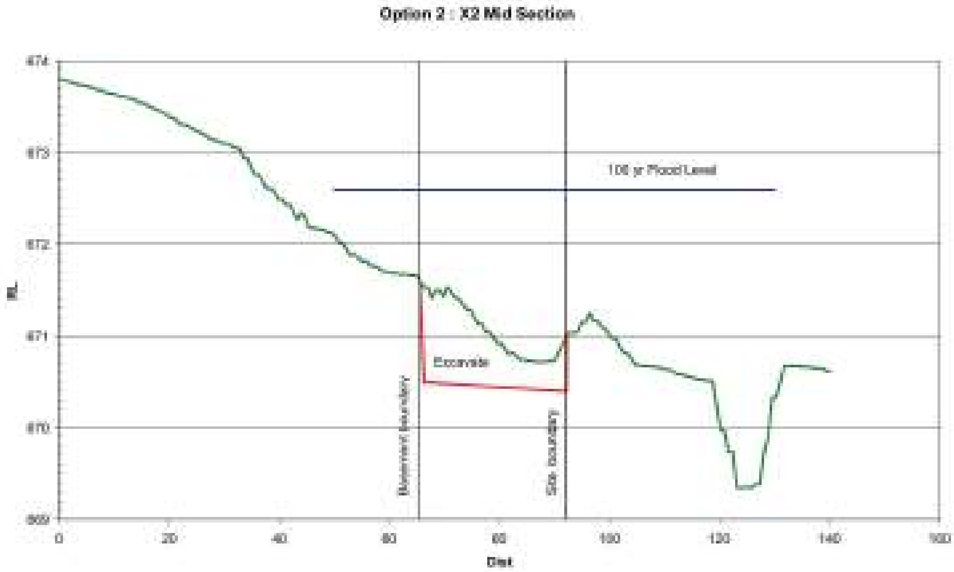
Results indicate:

i) The proposed excavation more than compensated for the loss in flood storage due to the development. Flood levels reduce by a maximum of 15mm immediately upstream of the site. This reduction is relatively localised and diminishes relatively quickly in the upstream direction

ii) Upstream properties (4 to 24 Victoria Street) experience a reduction in the 100 year flood level of between 5 to 10mm

iii) There is a slight increase of between 5 to 10mm within the subject site and extending onto Mittagong Road. The road is not trafficable during major floods, and this increase is not anticipated to be of any consequence.





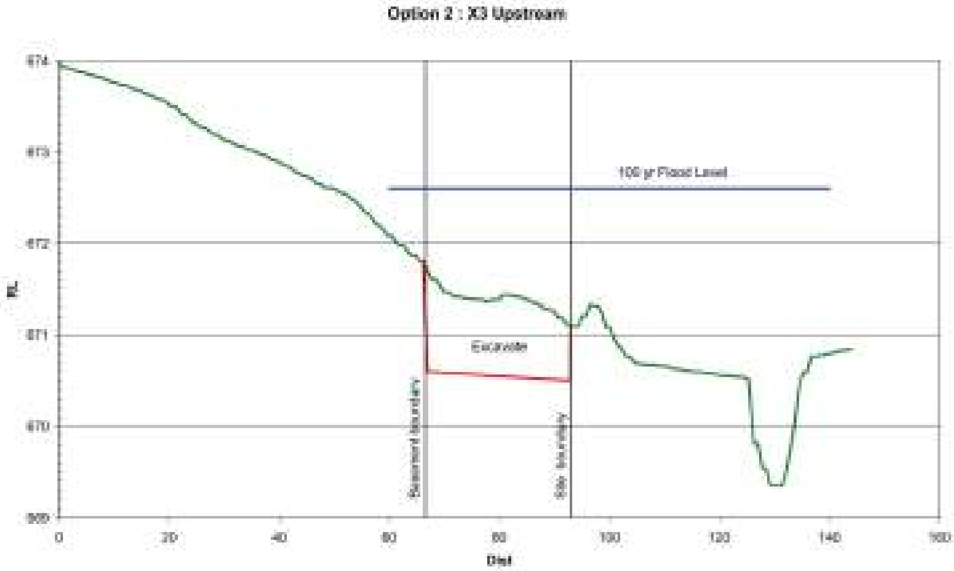


Illustration 1
Option 2 – Compensatory Excavation within Site

The proposed compensatory excavation is considered to more than compensate for the loss in flood storage due to the proposed development. Flood impacts are reduced upstream of the proposed development, whilst small increases downstream of the development are considered to be of minor consequence. All earthworks are confined within the subject site. There will be increased depth of flooding within the excavated area, and floodwater will pond within this area until it can drain back to the creek through the existing stormwater drain. It is estimated that it will take an additional 2 hours to drain once floodwater in the creek has subsided.

4.4 OPTION 3 – DEVELOPMENT WITH ADDITIONAL MEASURES

Option 3 aims to reduce the depth of excavation within the subject site by extending the excavation about 10m into the public reserve. This includes the removal of the masonry wall and mound in the public reserve, so that floodwater can drain naturally towards the creek.

Proposed cross sections through the site and public reserve are shown on **Illustration 2**.

The average depth of excavation through the subject site has been reduced to about 0.4m in depth and the removal of the masonry wall and mound in the public reserve now permits a steady grade of 0.8% towards the creek. The total volume of excavation is estimated at 540m^3, which is less than the loss in flood storage due to the development (997m^3). However, the improved conveyance over this part of the floodplain due to the removal of the masonry wall and mound is anticipated to compensate for the shortfall in flood storage. The existing drain to Mittagong Creek in the north-west corner of the site is now redundant, and could be removed.

The proposed development, including compensatory excavation, was included in the Tuflow model to assess flood behaviour. A flood impact map has been prepared to illustrate the change in flood levels over existing conditions. The flood impact map for the 100 year flood is shown on **Figure 12**.

Results indicate:

i) The proposed measures adequately compensate for the loss in flood storage due to the development, with any impacts reduced to less than 5mm everywhere.

ii) There are very slight reductions upstream of the site, of between 0 to 5mm in the 100 year flood. This benefit is minor and beyond the resolution of the mapping shown on Figure 12.

iii) Additional flood benefits may be realised if the excavation of the mound continued further upstream of the subject property.

These measures successfully compensate for the loss in flood storage due to the development. Whilst the benefits are not as much as in Option 2, there are several other advantages, including a reduced depth of excavation within the subject site, shallower inundation depths, and natural drainage of the overbank area to the creek without reliance of the stormwater pipe to drain this area. The disadvantage is that it relies on works to be undertaken beyond the subject site.

Either Option 2 or Option 3 is considered to provide a satisfactory solution to mitigate any adverse impacts as a result of the proposed development.

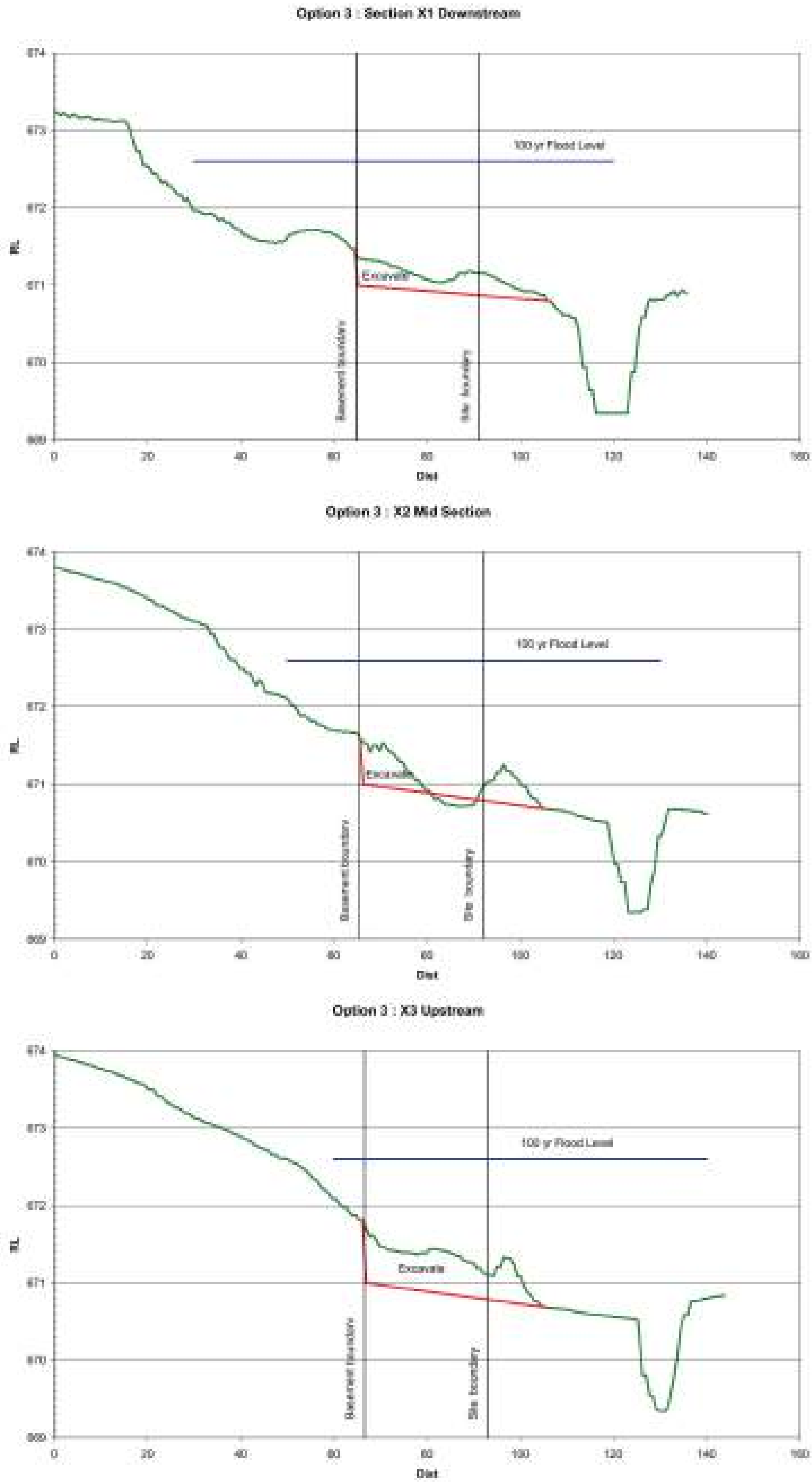


Illustration 2
Option 3 – Compensatory Excavation beyond Site

Figure 10
Flood Impact Assessment - Option 1
No Compensatory Measures

Figure 11
Flood Impact Assessment - Option 2
Compensatory Measures within Site

Figure 12
Flood Impact Assessment - Option 3
Compensatory Measures beyond Site

5 COMPLIANCE WITH COUNCILS FLOOD POLICIES

The Bowral Town Plan DCP 2015 outlines controls that apply to future development that is subject to potential flooding. These controls recognise the type of development proposed and the flood risk of the site where the development is to be located.

The proposed development is classified as 'residential development' and is located partly within the low flood risk, fringe flood risk, medium flood risk and high flood risk precincts. As the building footprint at ground level (ie the basement parking) is located outside the *High Flood Risk* precinct, the assessment of the proposal has been based on the next highest precinct applicable, namely the *Medium Flood Risk* precinct.

The compliance of the proposal with flood management controls that relate to residential development located within a Medium Flood Risk precinct are discussed below.

5.1 FLOOR LEVELS

Requirement 2
Habitable floor levels to be no lower than the 100 year flood level plus freeboard

The maximum 100 year flood level within the site is RL 672.6m AHD (refer Table 1). Council's normal freeboard allowance is 0.5m.

The lowest habitable floor level of ground floor apartments is 673.11m AHD

The floor level is more than 0.5m above the 100 year flood. This requirement is therefore satisfied

Requirement 6
Non-habitable floor levels to be equal to or greater than the 100 year flood level plus freeboard where possible, or otherwise no lower than the 5 year flood level plus freeboard unless justified by site specific assessment.

There are no non-habitable floor areas within the proposed development. Consequently this requirement is not applicable.

Requirement 7
A restriction is to be placed on the title of the land, pursuant to S. 88B of the Conveyancing Act where the lowest habitable floor area is elevated above finished ground level, confirming that the undercroft area is not to be enclosed, where Council considers this may potentially occur

This requirement is usually applied to single residential dwellings which are elevated above ground level because of the flood risk. Its objective is to prevent the owner, or subsequent owners, from enclosing the area and using it for habitable purposes.

A portion of the northern apartments is suspended over the top of the high flood risk area. However, this area is intended as common space and landscaping, and there is no likelihood that the area could be enclosed and used for habitation. This requirement is therefore considered to be not applicable to the proposed development.

5.2 BUILDING COMPONENTS

Requirement 1
All structures to have flood compatible components below the 100 year flood plus freeboard.

Given the type of development proposed, all building materials are anticipated to be flood compatible. This includes reinforced concrete footings, slabs, brick walls, etc. Whilst all building components are not known at this stage, it is considered that this requirement can be readily satisfied.

5.3 STRUCTURAL SOUNDNESS

Requirement 2
Applicant to demonstrate that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year flood plus freeboard, or a PMF if required to satisfy evacuation requirements. An engineer's report may be required.

Given the size of the development and number of units that are above the PMF flood level, it is anticipated that many residents will elect not to evacuate the building during major flood events, and will instead shelter within their apartment. Residents from ground floor apartments may similarly decide to shelter within upper levels of the building. Consequently it is imperative that the building is structurally sound in a PMF event.

Structural design of the building has not yet been undertaken. To assist in this regard, the building should be designed to withstand flood forces up to the PMF flood level (RL 675.4m AHD) and flood velocities of the order of 1.0m/s. Protection from scouring around the piers on the north side of the building will also require special attention.

Further satisfaction of this requirement will be required at the structural design phase.

5.4 FLOOD EFFECTS

Requirement 2
The flood impact of the development is to be considered to ensure that the development will not increase flood effects elsewhere, having regard to: (i) loss of flood storage; (ii) changes in flood levels and velocities caused by alterations to the flood conveyance; and (iii) the cumulative impact of multiple developments in the floodplain. An engineer's report may be required.

An assessment of potential flood impacts has been undertaken, which is reported in Section 4.

Development with no compensatory measures (Option 1) would result in small increases in upstream flood levels of up to 25mm in the 100 year flood. Given the number of flood affected properties and dwellings upstream of the proposed development (in Victoria Street), this impact is not considered to be acceptable.

Compensatory excavation has been proposed between the boundary of the basement parking area and the northern property boundary (Option 2). This mitigates the increase in flood levels identified above, and provides a small reduction in flood levels of up to 15mm in the 100 year flood.

Extension of the compensatory excavation into the adjacent public reserve was also considered (Option 3). This allows the depth of excavation to be reduced and allows for the overbank area to drain directly to the creek. There are no discernible impacts (within 5mm) from this option.

Either Option 2 or Option 3 provides a satisfactory solution to mitigate any adverse impacts on flooding as a result of the proposed development. It is understood that the applicant favours Option 2 as all earthworks are confined to the subject property.

It is considered that the proposed works will result in no adverse impacts on flood behaviour provided that measures identified in either Option 2 or Option 3 are implemented.

5.5 CAR PARKING AND DRIVEWAY ACCESS

Requirement 1

The minimum surface level of open car parking spaces or carports shall be as high as practical and not below: i) the 5 year flood level plus freeboard or ii) the level of the crest of the road where the site has access (which ever is the lower). In the case of garages, the minimum surface level shall be as high as practical, but no lower than the 5 year flood level plus freeboard.

The only parking areas proposed are within the basement parking area, for which Requirements 3 and 6 apply.

No other open car parking spaces, carports, or garages are proposed. Consequently this requirement is not applicable.

Requirement 3

Garages capable of accommodating more than 3 motor vehicles on land zoned for urban purposes, or enclosed car parking, must be protected from inundation by floods equal to or greater than the 100 year flood.

The basement parking area is required to be protected against inundation up to the 100 year flood (ie RL 672.6m AHD).

The entrance to the basement parking is the access ramp and lifts/stairwells from the ground floor development. The access ramp slopes up from the Victoria Street footpath (at RL 673.73m AHD) to a crest level of RL 674.03m AHD before sloping down into the basement. The crest of the access ramp provides a level of protection that is 1.43m above the 100 year flood. The lifts/stairwells from the ground floor level to the basement are at RL 673.11m AHD, which provides a level of protection that is 0.51m above the 100 year flood.

This requirement is satisfied

Requirement 5

Where the level of the driveway providing access between the road and the parking space is lower than 0.3m below the 100 year flood, the following conditions must be satisfied – the depth of inundation on the driveway during a 100 year flood shall not exceed: i) the depth at the road, or ii) the depth at the car parking space (Refer to Schedule 3). A lesser standard may be accepted for single detached dwelling houses where it can be demonstrated that risk to human life would not be compromised.

The access ramp to the basement parking could be considered as a driveway. The access ramp is protected from inundation above the 100 year flood.

This requirement is satisfied

Requirement 6

Enclosed car parking and car parking areas accommodating more than 3 vehicles (other than on rural zoned land) with a floor level below the 5 year flood level plus freeboard or more than 0.8m below the 100 year flood level, shall have adequate warning systems, signage and exits.

Basement parking is considered to be enclosed car parking. Adequate warning signs are therefore required to alert residents and visitors of the risk of inundation in extreme flood events. Lifts and stairwells have been provided in each corner of the basement to allow ready egress from the basement.

It is considered that this requirement can be readily satisfied

Requirement 7
Restraints or vehicle barriers to be provided to prevent floating vehicles leaving a site during a 100 year flood

The basement is not inundated in the 100 year flood, and there is no opportunity for vehicles to become buoyant and leave the site.

This requirement is not applicable.

5.6 EVACUATION

Requirement 2
Reliable access for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest habitable floor level to an area of refuge above the PMF flood level, or a minimum of 20% of the gross floor area of the dwelling to be above the PMF level. In the case of alterations and additions, to an existing development, this may require retro-fitting the existing structure if required to support a refuge above the PMF

Whilst the ground floor apartments are at least 0.5m above the 100 year flood level, they could nevertheless experience flooding in an extreme flood event. The first floor and second flood apartments are well above the PMF flood, and have no risk of flooding

In an extreme flood event, the most appropriate course of action would be for residents to remain within the building complex. Those residents on the ground floor could relocate to an upper level within the complex and wait for flooding to subside. Residents on the first and second floors have no need to leave their apartments

An area of refuge above the PMF is available within the building complex. This requirement is therefore satisfied

5.7 MANAGEMENT AND DESIGN

Requirement 1
If this application involves subdivision, the applicant to demonstrate that potential development as a consequence of the subdivision, can be undertaken in accordance with this DCP.

This requirement is not applicable.

5.8 FENCING

There are general prescriptive controls on new fencing. Fencing within a high flood risk precinct (ie north of the proposed basement parking area) must be security/permeable/open type safety fencing to ensure that it provides no impediment to the flow of floodwater.

It is considered that this requirement can be satisfied.

6 CONCLUSIONS

This flood assessment report has been prepared to accompany an application for proposed residential apartments at 164-178 Mittagong Road, Bowral

The site is within the Mittagong Creek catchment. The catchment has a history of flooding problems, and a number of flood investigations have been undertaken. The most relevant is the Bowral Floodplain Risk Management Study and Plan (Bewsher 2009). Information on flooding has been sourced from this report.

The estimated extent of flooding and 100 year flood level contours is shown on Figure 2. About 59% of the site would be inundated in such an event. The maximum 100 year flood level within the site is RL 672.6m AHD. The Probable Maximum Flood (PMF) is significantly higher, at RL 675.4m AHD and would inundate the entire site. The site has been categorised as partly within a high, medium, fringe low, and low flood risk precincts.

The footprint of building at ground level (ie the basement parking area) has been adjusted so that it is located outside the high flood risk precinct. This reduces development within the most hazardous area of the site and allows open space where compensatory flood management measures can be undertaken.

Potential flood impacts from the proposed development have been investigated using the Tuflow model developed as part of the floodplain management study. Three options have been assessed:

i) Proposed development with no compensatory measures;

ii) Proposed development including compensatory excavation to match the estimated loss in floodplain storage from the open space area between the basement parking and the northern boundary of the site;

iii) Proposed development including compensatory excavation extending about 10m beyond the northern property boundary, including the removal of a masonry wall and mound within the public reserve.

Either Option 2 or Option 3 provides a satisfactory flood solution that ensures that there will be no adverse impacts from the proposed development.

The proposal has been assessed against Council's flood risk management requirements that are specified in the Bowral Town Plan DCP 2015. It is considered that the proposal complies, or can comply with all requirements subject to the following recommendations.

i) That all building components below the 100 year flood level plus 0.5m freeboard (RL 673.1m AHD) are of flood compatible materials;

ii) The building is designed to withstand the forces of floodwater up to the PMF flood level (RL 675.4m AHD) with a flood velocity of the order of 1.0m/s. Appropriate scour protection around the base of column supports is also required;

iii) Measures identified in Option 2 or Option 3 are implemented;

iv) Adequate warning signs are installed within the basement parking area warning of the risk of sudden immersion in extreme flood events;

v) Any new fencing provided in the high flood risk area at the front of the property is constructed of a security/permeable/open type safety fencing to ensure that it provides no impediment to the flow of floodwater

7 REFERENCES

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