APPENDIX 15

Flood Assessment Report (JWP, September 2016)









PANTHERS PRECINCT MASTER PLAN

Flood Assessment Report

6 September 2016

PANTHERS GROUP

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GLOSSARY

12D Model is a powerful terrain modelling, surveying and civil engineering software package used to develop the underlying surface for the 2D modelling.

Airborne Laser Survey (ALS) is a technique for obtaining a definition of the surface elevation (ground, buildings, power lines, trees, etc.) by pulsing a laser beam at the ground from an airborne vehicle (generally a plane) and measuring the time taken for the laser beam to return to a scanning device fixed to the plane. The time taken is a measure of the distance which, when ground truthed, is generally accurate to + 150mm.

Annual Exceedance Probability (AEP) is the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.

Average Recurrence Interval (ARI) means the average statistical interval (in years) between occurrences of floods, storms and flows of a particular magnitude.

Australian Rainfall and Runoff (AR&R) refers to the current edition of Australian Rainfall and Runoff published by the Institution of Engineers, Australia.

CatchmentSIM is a 3D-GIS application specifically tailored to hydrology based applications. CatchmentSIM is used to delineate a catchment, break it up into sub catchments, determine their areas and spatial topographic attributes and analyse each sub catchment's hydrologic characteristics to provide insight into the rainfall response of various catchments and the resultant assignment of hydrologic modelling parameters.

Council refers to Penrith City Council

Digital Terrain Model (DTM) is a spatially referenced three-dimensional (3D) representation of the ground surface represented as discrete point elevations where each cell in the grid represents an elevation above an established datum.

Floodplain Development Manual (FDM) and Guidelines (April 2005), the FDM is a document issued by DECCW that provides a strategic approach to floodplain management. The guidelines have been issued by the NSW DoP to clarify issues regarding the setting of Flood Planning Levels.

Hydrograph is a graph that shows how the stormwater discharge changes with time at any particular location.

Hydrology The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.

J. Wyndham Prince Pty Ltd (JWP) Consultant Civil Infrastructure Engineers and Project Managers undertaking these investigations

Peak Discharge is the maximum stormwater runoff that occurs during a flood event

Probable Maximum Flood (PMF) is the greatest depth of precipitation for a given duration meteorologically possible for 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." largest flood that could be

Triangular Irregular Network (TIN) is a technique used in the created DTM by developing a mass of interconnected triangles. For each triangle, the ground level is defined at each of the three vertices, thereby defining a plane surface over the area of the triangle

TUFLOW is a computer program that provides two-dimensional (2D) and one-dimensional (1D) solutions of the free surface flow equations to simulate flood and tidal wave propagation. It is specifically beneficial where the hydrodynamic behaviour, estuaries, rivers, floodplains and urban drainage environments have complex 2D flow patterns that would be awkward to represent using traditional 1D network models.

XP-RAFTS runoff routing model that uses the Laurenson non-linear runoff routing procedure to develop a subcatchment stormwater runoff hydrograph from either an actual event (recorded rainfall time series) or a design storm utilising Intensity-Frequency-Duration data together with dimensionless storm temporal patterns as well as standard AR&R 1987 dat.

1 EXECUTIVE SUMMARY

J. Wyndham Prince has undertaken a Flood Assessment to inform and support the proposed Master Plan for the Panthers Precinct and to support future development applications. The Flood Assessment has been prepared to conform with the statutory requirements and industry best practice for flood management in this catchment.

The Panthers Precinct is located within Penrith City Council local government area. The Precinct is approximately 51 ha in area (including the Council land to the west) bounded by existing residential and rural development to the west, vacant land and a retirement village to the north, Mulgoa Road to the east and Jamison Road to the south.

Regional flood modelling was previously undertaken by Worley Parsons for the Nepean River using the software package called RMA-2, which informed the flood assessment that formulated Appendix H of the Panthers Planning Proposal.

Several development scenarios for the Panthers Precinct were incorporated in the regional flood model (i.e. RMA2) to assess the impacts in the 0.5% AEP event. The outcomes of this modelling undertaken by Worley Parsons endorse the J. Wyndham Prince TUFLOW model results presented in this investigation and confirm that the TUFLOW model results are representative of those from the regional RMA-2 flood model.

As part of this current revision of the masterplan flood assessment report, the development masterplan and associated flood modelling has been updated to reflect a mixed use residential tower and retail development in the northern portion of the Precinct instead of the previously proposed Direct Factory Outlet. Additionally it has been identified that a zone electrical sub-station that was to be located in the floodplain in the north west portion of the Precinct is no longer likely to be delivered within the Panthers Precinct by Endeavour Energy.

The detailed flood assessment completed for the strategy has demonstrated that the proposed development will result in minor increases in flood levels within the Precinct, which can be safely accommodated within the future design. There are no material increases in flood levels outside the Precinct in the 1% AEP regional and local flood events. For the 0.5% AEP regional event, flood levels generally do not increase by more than 20 mm outside the Precinct, which is within the agreed accuracy of the TUFLOW model.

As part of the previous Appendix H of the Panthers Planning Proposal, a series of potential flood mitigation measures were identified in order to support the future development of the Precinct. These current investigations conclude that no flood mitigation works are considered to be necessary to support either the staged or the ultimate Master Plan development scenario for the Panthers Precinct.

2 INTRODUCTION

The Panthers Precinct is located within the Penrith City Council local government area and consists of approximately 51 ha of land bounded by existing residential and rural development to the west, vacant land to the north, Mulgoa Road to the east and Jamison Road to the south.

Peachtree Creek is the main water course within the Panthers Precinct. Peachtree Creek enters the Precinct along the southern boundary and travels in a northerly direction through the site. Two additional water courses impact the site. Jamison Creek enters at the south eastern corner of the site and travels in a westerly direction through a set of box culverts (known as the Bazooka culverts) toward Peachtree Creek. Showground Creek enters the site at the eastern boundary (just north of Ransley Place) and merges with Peachtree Creek north of the Panthers Precinct.

A Concept Plan was previously prepared to support rezoning of the land to facilitate a range of land uses within the Precinct, including retail, residential, seniors housing, community facilities and office premises. The rezoning for the earlier Master Plan was gazetted in June 2013 and the Development Control Plan for the Precinct was adopted by Penrith City Council in July 2013. The rezoning process was not supported by detailed local and regional flood modelling.

The current Masterplan, and this investigation in particular, addresses the detailed flood modelling on both a local and regional scale.

This report details the procedures used and presents the results of investigations undertaken by J. Wyndham Prince in developing a Flood Assessment to integrate with and inform the Master Plan, development applications and detailed design process for the Panthers Precinct.

The objective of this investigation is to identify the flood management issues to be considered in the future development of the Panthers Precinct including flood levels, flood impacts and to inform an appropriate evacuation strategy.

The investigation involved the following specific tasks:

- Liaison with Penrith City Council, Panthers Group and the Master Plan urban designer to determine their specific requirements for development of the Precinct.
- Receive and integrate the ultimate development landform, including roads, building pads and other stormwater infrastructure, to reflect the updated Master Plan and trunk drainage strategy for the site.
- Extract peak flow hydrographs at the Panthers upstream boundary locations from previous investigations for use in the site specific flood model.
- Undertake a hydrologic analysis to determine the peak 5%, 1% and 0.5% AEP local flow hydrographs within the Panthers site for use in the flood model.
- Development of a two dimensional TUFLOW hydraulic flood model for the Precinct and assessment of a range of storm events under existing conditions.
- Assess the impacts of the proposed ultimate development scenario within the site and adjacent properties.
- Determine the indicative size and configuration of infrastructure required to convey flows from upstream catchments through the site.
- Undertake an assessment of the staged development scenarios within the hydraulic model to determine the impact of the development on the flood regime and at what stage, if any, mitigation measures are required.
- Reconfirmation of an appropriate flood evacuation strategy for the Precinct.
- Preparation of flood maps.
- Preparation of a Flood Assessment Report to support the Master Plan for the Precinct, detailing the investigations, findings, calculations and design details.

3 PREVIOUS REPORTS AND INVESTIGATIONS

Four (4) previous investigations relating to flooding within the Panthers Precinct have been undertaken that have been used to inform this current investigation and are described below.

3.1 Peach Tree Creek Flood Study

Lyall and Macoun Consulting Engineers undertook the Peach Tree Creek Flood Study on behalf of the Public Works Department (PWD, 1994). The study involved investigation of flooding within the Peach Tree Creek floodplain for the 1% and 0.5% AEP events and included an assessment of the effects of various combinations of Nepean River flooding and local catchment runoff.

The flood levels determined in the study for the 1% AEP regional and 5% AEP local "Combined" event are still adopted by Penrith City Council as the flood planning levels for the Precinct.

3.2 Major Drainage Works on Peach Tree Creek at Panthers – Flood Investigation

Lyall and Associates completed this study in 2003 (LAA, 2003) to assess the impact of proposed earthworks within the Peach Tree Creek floodplain. The study determined 1% AEP regional and local flood levels as well as local 3 month and 100% AEP flood levels. It is understood that the proposed earthworks modelled in the study were never undertaken. However, the 3 month ARI flood levels determined in the study were used as an estimate to ensure that water quality basins proposed for the current Panthers development are located above these levels.

3.3 Nepean River Flood Assessment

Worley Parsons completed a flood assessment of the Nepean River on behalf of Penrith City Council in 2008 (WP, 2008). The assessment considered the 1%, 0.5%, 0.2% and 0.1% AEP events as well as the PMF. The investigation considered regional flows on the Nepean River only and did not consider local tributaries such as Peachtree Creek or Showground Creek. No report was available for the study, however Penrith City Council provided results of the assessment in WaterRide format.

Hydrographs for flows overtopping the Nepean River banks into the Peachtree Creek floodplain were provided by Worley Parsons for use in the current Panthers Precinct assessment.

3.4 Panthers Flood Impact Assessment

Worley Parsons undertook flood impact assessments (WP, 2009) of the Nepean River on behalf of Panthers for a number of possible development scenarios within the Panthers Precinct that were considered at planning proposal stage. The development scenarios were assessed for the 0.5 % AEP regional event only, as required by Penrith City Council. A development scenario was identified that resulted in minimal impact on surrounding properties and formed the basis of supporting documentation for the Panthers DCP 2010 and the Panthers Planning Proposal Appendix H.

4 THE EXISTING ENVIRONMENT

4.1 The Site

The Panthers Precinct is located within Penrith City Council's local government area in the suburb of Penrith. The Precinct consists of approximately 51 ha of land which is bounded by existing residential and rural development to the west, vacant land to the north, Mulgoa Road to the east and Jamison Road to the south.

The Precinct currently consists of a number of recreational facilities, such as two ski lakes and aqua golf, the Panthers Leagues Club, a hotel, administration buildings, an exhibition hall, a number of restaurants and fast food outlets and multiple car parking areas. The Precinct also consists of large areas of undeveloped land, primarily associated with the floodplains of a number of creeks which discharge through the site. The existing site plan is shown on Figure 4-1.

The majority of land within the Precinct is owned by the Panthers Group, with a portion of Peachtree Creek and surrounding land as well as lead in roads owned by Penrith City Council. The existing hotel adjoined to the main Panthers club building is also in separate ownership. The various land holdings are shown on Figure 4-2.

The Precinct land form within the area proposed for development is mostly very flat, with grades generally less than 3%. The site is virtually clear of all remnant vegetation except for a section within the Showground Creek corridor.

Three water courses or drainage channels discharge through the Panthers Precinct. The most significant of these is Peachtree Creek which enters the site at the southern boundary and flows in a northerly direction, bisecting the Precinct.

The two other water courses / drainage reserves enter the site at the eastern boundary and form tributaries to Peachtree Creek. Jamison Creek enters at the south eastern corner of the Panthers Precinct. Immediately upstream of Mulgoa Road, Jamison Creek is a concrete lined channel. At Mulgoa Road, the channel discharges to a set of box culverts, which enter and discharge into the Panthers site approximately 300 metres further west. The culverts have limited capacity, with surcharge flows in the 1% AEP event going in various directions overland.

Showground Creek enters the Panthers Precinct at the eastern boundary, at the location of the existing Paceway. Showground Creek is a concrete lined channel on either side of Mulgoa Road, linked by a set of box culverts. Showground Creek becomes a natural channel approximately 200 metres west of Mulgoa Road.

Details of the existing major drainage features in the Panthers Precinct, including water courses, drainage reserves, channels and culverts are shown on Figure 4-3.

Figure 4-4 provides details on the internal drainage network servicing the existing roads and carparks within the site, together with the trunk drainage culverts.

5 DEVELOPMENT

As part of the current master planning study, an updated Master Plan has been prepared identifying the various land uses and proposed development layout for the site. The land use for the site includes sporting, entertainment and recreational facilities, commercial, residential and office areas, a hotel, multi-story car parking, riparian corridors, drainage reserves and water management areas.

Due to the position of the development in relation to Peachtree Creek and the Nepean River, no stormwater detention basins are required by Penrith City Council for mitigation of peak flows. However, stormwater harvesting, reuse and water quality will be provided throughout the development to minimise the impact on the environment.

The proposed updated Master Plan for the Panthers Precinct is provided in Plate 5-1 below.



Plate 5-1 – Panthers Precinct Master Plan

5.1 Development Approved to Date

A number of Development Applications have recently been approved for the Panthers site. These include:

- The NRL Academy (completed in March 2016);
- The Western Sydney Community Sports Centre (WSCSC);
- The Multi-storey Carpark and Serviced Apartments (MSCSA); and
- The Nepean Manors (Seniors Living).

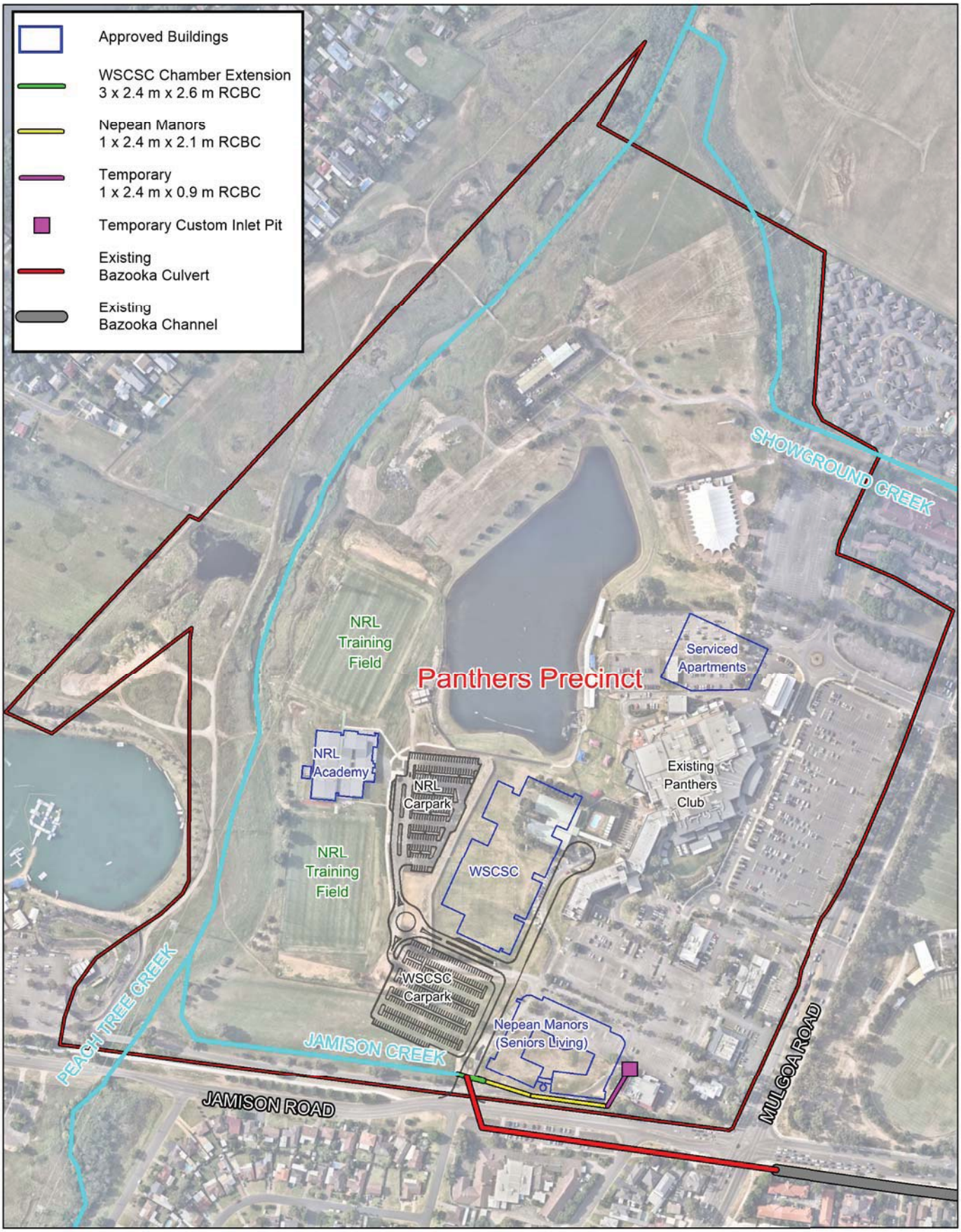
Details of the approved works are shown on the following plans:

- NRL Academy – J. Wyndham Prince Construction Certificate plans 9593/05CC00 - 9593/05CC12 (Rev B) and 9593/05A01 (Rev B).
- WSCSC – Diversi Development Application plans 008-C-9400 to 008-C-9416. See full list in Appendix B for revision numbers.
- MSCSA – Diversi Development Application plans 008-C-9300 to 008-C-9309. See full list in Appendix B for revision numbers.
- Nepean Manors – Diversi Development Application plans DA100 to DA109.

Plate 5-2 provides an overview of the location of these approved developments.

The Nepean Manors development proposes a temporary 2.4 m x 0.9 m RCBC and inlet pit to collect flows both from within the Panthers Precinct and over land flows that enter the site across Mulgoa Road. A single 2.4 m x 2.1 m RCBC is proposed to collect these flows and convey them to the existing Bazooka Culvert outlet chamber in the west.

Figure 5-1 provides details on the internal drainage network servicing the existing roads and carparks within the site, together with the approved drainage amendments.



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Title:
Panthers Precinct
Development Approved to Date

Plate 5-2

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5.2 Future Development

As part of the Panther Precinct masterplan, additional future development is proposed across the Precinct. The proposed development may include:

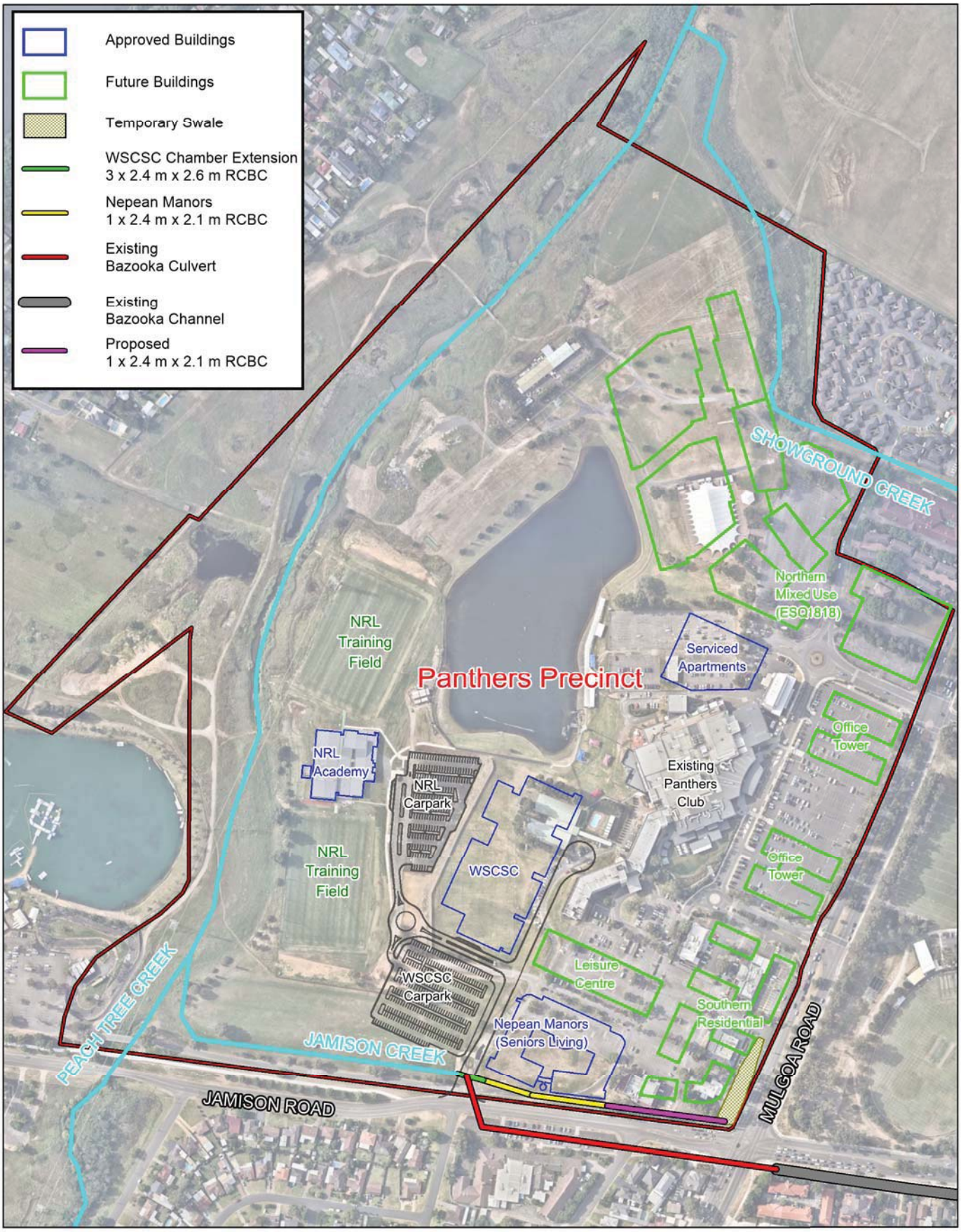
- Office towers;
- Southern residential development (Lot 5);
- ESQ1818 Mixed Use Development in the north;

Plate 5-3 provides an overview of the extent of these future developments.

The development of Lot 5 will require an extension of the Nepean Manors culvert and a temporary large swale adjacent to Mulgoa Road in order to capture and convey upstream 1% AEP flows through the site to the Bazooka channel outlet in the west. Once this system is operational, the temporary large pit inlet structure upstream of the Nepean Manors development can be de-commissioned.

A detailed report detailing the flood modelling to support the ESQ1818 development titled *"ESQ1818 Development Panthers Site – Flood Impact Assessment and Water Quality Management Report"* was prepared by J. Wyndham Prince in April 2016. This report was submitted as part of the Development Application package for that development. J. Wyndham Prince met with Penrith City Council to discuss the findings of the report in April 2016, and the outcome of the meeting was that this Panthers Precinct Master Plan flood assessment was to be updated to include the ESQ1818 development to ensure consistency for the Masterplan document as more refined development options are identified.

Figure 5-2 provides details on the future drainage amendments, together with existing internal drainage network servicing the existing roads and carparks within the site that are to be retained.



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Title:
Panthers Precinct
Future Development

Plate 5-3

N W E S

100 0 100 m

Scale 1: 5,000 @ A4

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6 DEVELOPMENT GUIDELINES, OPPORTUNITIES & CONSTRAINTS

The following guidelines were considered in developing the Flood Assessment for the Panthers Precinct.

6.1 Penrith City Council Development Control Plan 2014 – Section E13 Part B Panthers Penrith Precinct

Penrith City Council Development Control Plan Section E13 Part B Panthers Penrith Precinct (PCC, 2014) identifies the following objectives for consideration with regard to flooding and drainage:

- Manage development of the Panthers site with respect to its unique flooding characteristics;
- Develop the site in accordance with sound flood management principles;
- To achieve high quality outcomes for water quality and quantity; and
- To provide opportunities for WSUD initiatives.

Refer to Appendix C for discussion on how the above objectives and applicable controls have been addressed.

6.2 Penrith City Council Development Control Plan 2014

Penrith City Council Development Control Plan Part C3 Water Management (PCC, 2014) identifies the following objectives for consideration with regard to flooding:

- To ensure floodplain risk management minimises the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterway corridors;
- To maintain the existing flood regime and flow conveyance capacity and avoid significant adverse impacts on flood behaviour;
- To avoid significant adverse effects on the floodplain environment that would cause erosion, siltation, destruction of riparian vegetation or a reduction in the stability of the river bank/watercourse;
- To reduce the impact of flooding and flood liability on individual owners and occupiers;
- To limit the potential risk to life and property resulting from flood events;
- To contain the potential for flood losses in all new developed areas by the application of effective planning and development controls;
- To apply a “merit approach” to all development and building decisions, which takes account of social, economic and ecological factors as well as flooding considerations;
- To prevent the introduction of unsuitable land uses on land subject to flood planning provisions of the LEP; and
- To deal equitably and consistently (where possible) with applications for development on land affected by potential floods, in accordance with the principles contained in the Floodplain Development Manual, issued by the NSW Government.

6.3 Penrith City Council Local Environmental Plan 2010

Penrith City Council Local Environmental Plan 2010 (PCC, 2010) identifies the following objective with regards to Flood Planning (Clause 6.3):

- To minimise the flood risk associated with the use of the land.
- To limit uses to those compatible with flow conveyance function and flood hazard.
- To manage uses to be compatible with flood risks.
- To enable safe and effective evacuation of land.
- To ensure the existing flood regime and flow conveyance capacity is not compromised.
- To avoid detrimental effects on the environment that would cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or waterways.

Refer to Appendix C for discussion on how the above objectives and applicable controls have been addressed.

7 HYDROLOGY

7.1 Upstream Inflow Hydrographs

Peak inflow hydrographs for flows generated external to and entering the Panthers site were adopted from previous studies.

1% AEP and 0.5% AEP inflow and tailwater hydrographs for Peach Tree Creek were extracted from Worley Parsons' regional RMA-2 flood assessment of the Hawkesbury-Nepean Valley, and were provided to J. Wyndham Prince for use in the Panthers Precinct TUFLOW flood modelling.

The 0.5% AEP flows from the Nepean River (that overtop the Nepean River banks adjacent to the site) were also extracted from Worley Parsons' regional RMA-2 flood assessment of the Hawkesbury-Nepean Valley and provided to J. Wyndham Prince for use in the Panthers Precinct TUFLOW flood modelling.

5% AEP and 1% AEP inflow hydrographs for Jamison Creek and Showground Creek were extracted from the Peachtree Creek Flood Study (PWD, 1994). The timing of the hydrographs for Jamison and Showground Creeks was modified by Worley Parsons to ensure that the peak flows from Jamison and Showground Creeks coincide with the time to peak for the dominant Peachtree Creek flows. The likelihood of coincidence of a regional storm event occurring at the same time as a local event this is extremely low, however it provides a conservative assessment of flood impacts.

Visual representations of the inflow hydrographs are provided in Appendix D.

7.2 XP-RAFTS Modelling

The hydrologic analyses for the Panthers Precinct were undertaken using the rainfall - runoff flood routing model XP-RAFTS (Runoff and Flow Training Simulation with XP Graphical Interface) (Willing, 1996 & 1994). The hydrologic analyses for the Panthers Precinct were undertaken to generate local (i.e. within the bounds of the hydraulic model) peak hydrographs for input to the hydraulic model.

7.2.1 Sub-Catchments

Sub-catchment areas contributing to the local drainage system were established through detailed survey information provided by the Panthers Group for existing conditions. The catchment breakup within the site was then modified to reflect the various approved and proposed developments within the Panthers Precinct and the associated changes in percentage imperviousness.

For development approved to date and future development, catchment delineation was based on both known and assumed site grading using information provided on Development Application Civil works drawings for the approved to date works (refer Appendix B for list of drawings).

Catchment boundaries for the local areas within the Panthers Precinct are shown on Figures 7-1 and 7-2 for the existing and future scenarios respectively. The modelling of local catchments extends to the downstream boundary of the hydraulic model, being immediately upstream of the Great Western Highway.

7.3 Rainfall Data & XP-Rafts Parameters

7.3.1 Intensity-Frequency-Duration (I.F.D.)

Design rainfall intensity-frequency-duration (I.F.D.) data for the site were obtained using methods set out in Australian Rainfall and Runoff (A.R.R.) (1987). The 90 minute storm was adopted as the critical storm for the local sub-catchments within the Panthers Precinct for consistency with the Jamison Creek and Showground Creek inflows which also adopted the 90 minute storm duration as the critical storm (PWD, 1994). The rainfall intensity for the 90 minute storm is provided in Table 7-1.

Table 7-1 Penrith Rainfall Intensities

Storm Duration (min)	Rainfall Intensity (mm/hr)	
	5% AEP	1% AEP
90	39.98	52.62

7.3.2 XP-RAFTS Parameters

The PERN (n) values and losses adopted for the catchments in the XP-RAFTS modelling are listed in Table 7-2. The adopted parameters are consistent with those used previously for modelling within the Penrith LGA.

Table 7-2 Adopted XP-Rafts Parameters

Parameter	Catchment Condition	Adopted Value
Pern	Pervious	0.025
	Impervious	0.015
Losses		
Initial Loss	Pervious	10.0
Continuing Loss	Impervious	2.5
Initial Loss	Pervious	1.0
Continuing Loss	Impervious	0.0

7.4 Calibration

It is normal practice for flood routing models such as XP-RAFTS to be calibrated with historical rainfall and stream flow data for the catchment being investigated in order to produce the most reliable results. The model parameter values (in particular Bx) are adjusted so that the model adequately reproduces observed hydrographs. However, no stream flow records were available for the site and the default Bx value of 1.0 was adopted for the modelling.

7.5 Discharge Estimates

Discharge estimates and flow hydrographs for the local internal Panthers site catchments were derived for the 1% AEP 90 minute storm for the following scenarios:

- Existing case;
- Development approved to date; and
- Future development scenario.

Figures 7-1 and 7-2 in Appendix A provide details of the local peak flows from each sub-catchment for the Existing and Future Development Scenarios respectively.

7.6 Discussion of Modelling Results

The XP-RAFTS modelling has been undertaken primarily to generate peak flow hydrographs for input into the hydraulic model (refer to Section 8). It is noted that Penrith City Council does not require on-site detention for this location, and hence a pre/post assessment is not required.

8 FLOOD MODELLING

The flood modelling of the water courses, drainage channels and other stormwater infrastructure that run through the Panthers development has been undertaken using TUFLOW (Two-Dimensional Unsteady Flow). TUFLOW is a computational engine that provides two-dimensional (2D) and one-dimensional (1D) solutions of the free-surface flow equations to simulate flood and tidal wave propagation (TUFLOW, 2013). TUFLOW is specifically beneficial where the hydrodynamic behaviour in coastal waters, estuaries, rivers, floodplains and urban drainage environments have complex 2D flow patterns that would be difficult to represent using traditional 1D network models.

All flows within the creeks and over the floodplains were modelled as 2D flows. A 2D model provides a better estimation of the effects of momentum transfer between in-bank and overbank flows and the energy losses due to meanders or bends in creeks. Flows within the smaller drainage channels and underground stormwater network were modelled as 1D components. MapInfo, a GIS based software tool, was used for interrogating and plotting the results as well as creating the flood extents maps and the flood level difference maps.

Flood modelling for the existing and developed scenarios has been undertaken to determine the impact of the Panthers Precinct on the flood levels in the creeks and surrounding areas. At Council's request, Worley Parsons was engaged to conduct equivalent flood modelling assessments in the regional RMA-2 model to endorse the Precinct based TUFLOW modelling results (refer further discussion in Section 8.1).

8.1 Background

As discussed in Section 3, several previous flood studies have been undertaken that are relevant to the Panthers development. In 1994, the Department of Public Works undertook the Peach Tree Creek Flood Study (DPW, 1994). A quasi two dimensional model known as "FPLAIN" was prepared for this investigation, which considered a number of combinations of regional (Nepean River) and local flood events. The adopted "Combination" event for Peach Tree Creek was the 1% AEP regional with 5% AEP local. This "Combination" event is still currently adopted by Penrith City Council as setting flood planning levels for the Precinct.

In 2008, Worley Parsons (WP, 2008) undertook a regional flood assessment for the Nepean River on behalf of Penrith City Council. The study considered the 1%, 0.5%, 0.2% and 0.1% AEP flood events, as well as the Probable Maximum Flood (PMF). The broad scale investigation did not include applying local catchment inflows and flood mapping for tributaries such as Peach Tree Creek. The flood modelling was undertaken using a software package called RMA-2.

The RMA-2 model is a Nepean River regional model and is not appropriate to assess the local impacts that may occur within the Panthers Precinct. The "FPLAIN" model utilised in the Peach Tree Creek Food Study (PWD 1994) is no longer an industry accepted modelling approach. A TUFLOW model has therefore been prepared to assess the flood impacts within Peachtree Creek and the potential changes in flood regime within the proposed Panthers Precinct.

As part of the previous Panthers Precinct masterplan submitted to Penrith City Council back in 2014, J. Wyndham Prince prepared a TUFLOW model to support this process. This model was developed to determine localised flood impacts, as Council agreed that the broader RMA-2 regional flood model was impractical to test development scenarios for the Panthers Precinct.

At Council's request, Worley Parsons was engaged by Panthers Group to undertake an equivalent flood impact assessment of the proposed Master Plan in the regional RMA-2 model to endorse the results of the TUFLOW assessment detailed in J. Wyndham Prince's report. After a number of modelling refinements, Worley Parsons subsequently reviewed the updated TUFLOW results and provided an addendum report which is included in Appendix E. Whilst they noted some differences in inflow distribution, velocity and roughness, the results of the RMA-2 and updated TUFLOW modelling were compared, and it was concluded that:

> *'..they both predict equivalent flood impacts upstream, and thus the TUFLOW model can be confirmed as being suitable for assessing the impacts of various development options proposed as part of the Panthers Master Plan' (WP October 2014).*

A copy of Worley Parsons' endorsement letter is provided in Appendix D.

Subsequently this TUFLOW model was utilised to support Development Approval for the following developments:

- The NRL Academy;
- The Western Sydney Community Sports Centre (WSCSC);
- The Multi-storey Carpark and Serviced Apartments (MSCSA); and
- The Nepean Manors (Seniors Living).

These individual flood assessments have considered cumulative impacts of all developments to date (i.e. the TUFLOW model developed to support the Nepean Manors development includes the NRL Academy, the WSCSC, and the MSCSA development) with all flood impacts compared to existing conditions results (i.e. no recent development). This has ensured that the staged development of the Panthers Precinct provides an accumulative assessment of the flood impact within the bounds of the model.

8.2 Current TUFLOW Model

The TUFLOW model described in Section 8.1 has been adopted as the base model on which to undertake the updated Masterplan Assessment. The most notable change between this current Masterplan and the one presented in 2014 is that the northern portion of the precinct which was earmarked for a Direct Factory Outlet (DFO) will now be developed as a mixed use Tower Development known as a ESQ1818. The configuration of the ESQ1818 will change the impact on the Local Flood regime, and is documented as part of this report.

8.2.1 Flood Modelling Scenarios

Flood modelling has been completed for three (3) scenarios, being:

- Existing Conditions;
- Development Approved to Date; and
- Future Development (including Development Approved to Date and ESQ1818).

The flood report that supported the ESQ1818 completed by J. Wyndham Prince in 2016 provided a further development scenario where the "Approved to date + ESQ1818 development was considered. Details of these investigations are included in the future development option, and flood difference maps for this scenario are presented in Figure 8-24.

8.2.2 Flood Modelling Events

Flood modelling has been completed for four (4) events for existing, approved to date and future development cases. The four (4) events are as follows:

- Event 1 – 1% AEP regional event with no local tributary flows.
- Event 2 – 0.5% AEP regional event with no local tributary flows.
- Event 3 – 1% AEP regional event and 5% AEP local tributary flows ("Combination Event" as per Panthers DCP Appendix H).
- Event 4 – 5% AEP regional event and 1% AEP local tributary flows (used to size local infrastructure).

8.3 TUFLOW Model Set-Up and Modelling Assumptions

As with any flood modelling a number of assumptions are necessary to allow for the modelling process to proceed. The assumptions made within the TUFLOW model for the Panthers Precinct are summarised below.

8.3.1 Digital Terrain Model

The terrain used in the TUFLOW model consists of a series of individual survey files. A detailed survey of the Panthers Precinct and adjacent areas was undertaken by Freeburn surveyors. Areas outside the extent of the detailed survey were supplemented with ALS data taken in 2002 provided by Penrith City Council.

Detailed design surfaces are available for the the WSCSC carpark, and internal Panthers Link Road. The works as executed surface for the NRL Academy has been included in the model. These models have formed the basis of the assessment together with some further surface amendment within the hydraulic model to better reflect the staged development of the site.

The intersection of Mulgoa and Jamison Roads was reconstructed in 2011. The detailed survey and ALS data both include the levels prior to its reconstruction, which included a raised roundabout. To represent the new intersection levels, spot levels were extracted from RMS design plans and the new intersection surface was created within the TUFLOW model.

A grid size of 4 m was adopted in the TUFLOW model. This grid size was found to be a reasonable balance between computing time and flooding definition necessary to inform the assessment.

All large buildings within the Panthers Site have been modelled as full block outs (i.e the terrain within the building footprints has been artificially raised to RL100 m AHD).

8.3.2 Catchment Roughness

One of the advantages of using TUFLOW for the hydraulic assessment is that different land uses can be assigned different roughness factors. The roughness assumptions adopted in the modelling are summarised in Table 8-1.

Table 8-1 TUFLOW Material Roughness

Description	Mannings 'n'
Floodplain high grass, default for areas outside Peachtree Ck channel and overbanks (default)	0.035
Roads/Concrete Surfaces/Open Water Body	0.015
Light vegetation	0.06
Medium Vegetation	0.08
Building and houses	0.3
Residential areas	0.10
Bio-Retention Rain Garden	0.07
Sportsfields, managed lawns, etc	0.02

The Mannings "n" value of 0.06 within the Peachtree Creek channel and overbanks was adopted to be generally consistent with the value previously adopted in the Peachtree Creek Flood Study (DPW, 1994). It is noted that the Manning's value within these areas under current site conditions is expected to be less than 0.06, however it is a like-for-like assessment (i.e. the 0.06 Mannings' 'n' is adopted in both the existing, approved to date and future development scenarios).

Materials Mapping for Existing and Future Development conditions is provided on Figure 8-1 and Figure 8-2.

8.3.3 Boundary Conditions

The boundary conditions adopted in the TUFLOW model are shown on Figure 8-1 to 8-3 and described as follows:

- UPSTREAM –
    - The 1% AEP and 0.5% AEP regional flow hydrographs for Peach Tree Creek were provided by Worley Parsons from their Regional RMA-2 model for Events 1 and 2.
    - 0.5% AEP regional flow hydrographs for Nepean River side flows (i.e. flows that overtop the banks of the Nepean River) were also provided by Worley Parsons from their Regional RMA-2 model for Event 2.
    - 20% AEP and 1% AEP flow hydrographs for Peach Tree Creek, Jamison Creek and Showground Creek, interpolated from those included in the Peachtree Creek Flood Study (DPW, 1994), were modified by Worley Parsons to ensure that the peak flows coincide with the peak flows in Peach Tree Creek. These were applied as inputs at the upstream boundary of the model for Events 3 and 4.
- LOCAL INFLOWS – Local inflow hydrographs were included in the model at locations representing the additional sub-catchments between the upstream and downstream model

boundary extents. An XP-RAFTS model was developed for the local catchments, as described in Section 7.2. These flows were applied in Events 3 and 4.

- DOWNSTREAM – The area is affected by regional tailwater levels from the Hawkesbury/ Nepean River.
    - Regional tailwater level hydrographs for the 1% AEP and 0.5% AEP regional flow hydrographs for Peach Tree Creek were provided by Worley Parsons from their Regional RMA-2 model for Events 1, 2 and 3.
    - A constant 5% AEP (20 year ARI) tailwater level of 23.0 m AHD was adopted based on the Peach Tree Creek Flood Study (PWD 2004) for Event 4.

8.3.4 Additional Model Updates

The following additional updates to the TUFLOW model used in the previous revisions of the Master Plan assessment and as described in Section 8.1 have been made:

- The orientation of the TUFLOW loc line has been slightly rotated in comparison to *Panthers Precinct Master Plan – Flood Assessment Report (*JWP, 2014). This slight rotation allowed a greater number of TUFLOW cells to represent the actual flow conveyance within Peachtree Creek together with an improved alignment with the main features of the model (i.e. cells roughly parallel with Peachtree Creek rather than north-south orientation adopted in the previously modelling).
- The terrain at the location of the Peachtree Creek culverts under Jamison Road and the internal Panthers Ski Lake Road has been amended to remove the road surface as this infrastructure has now been modelled using a layered flow constrictions in TUFLOW.
- The future electricity sub-station that was to be located adjacent to Peachtree Creek in the northern portion of the site is no longer likely to be delivered in the Panthers Precinct by Endeavour Energy, and has therefore been excluded from the modelling.
- A localised sag in McNaughton Street has been included in the assessment in order to better reflect the likely local flood impacts due to backwater effects on the local drainage network from Peach Tree.

8.3.5 Blockage Factors

Due to the size of existing and proposed culverts, blockage factors have not been applied in the modelling.

8.3.6 Existing Conditions

There are a number of existing culvert and channel structures adjacent to and within the Panthers site that affect the flood behaviour through the site. These are described below and shown diagrammatically on Figure 4-3.

Surveyors Creek / Peachtree Creek

The majority of flows enter the site at the southern boundary via Surveyors Creek, which becomes Peachtree Creek within the site. Surveyors Creek crosses Jamison Road at the Precinct's southern boundary through a set of box culverts (Culvert 4 on Figure 4-3) and then a second set of box culverts (Culvert 3 on Figure 4-3) just downstream at the Ski Lake Road. Both sets of culverts have been included in the model as a 2D layered flow constructions to represent their drainage function. Details of the culverts are shown on Figure 4-3.

Jamison Creek

A concrete lined channel in various forms conveys flows in Jamison Creek upstream of the site. The channel connects to a set of box culverts at Mulgoa Road, which extend into the Panthers site and discharge toward Peachtree Creek a further 300 metres downstream of Mulgoa Road. The channel and culverts have been included as 1D elements within the model. Details of the culverts are shown on Figure 4-3.

Showground Creek

A concrete lined trapezoidal channel conveys flows in Showground Creek upstream of the site. The channel connects to a set of box culverts at Mulgoa Road and then back to a concrete lined channel within the site. The creek then transitions back to a more naturalised creek approximately 200 m downstream of Mulgoa Road. The channel (upstream of Mulgoa Road) and Culvert 1 (refer Figure 4-3) have been included as 1D elements within the model. Culvert 2 (refer Figure 4-3) adjacent to the retirement village has been modelled as a 2D layered flow construction to represent its drainage function.

Internal Stormwater Drainage

In order to better model the local drainage changes, the internal stormwater drainage network for the roads and carpark areas within the Panthers Precinct have now been included in the existing conditions model.

Figure 4-4 in Appendix A provides details of all drainage structures included in the existing conditions modelling.

Flood depth maps for the existing conditions scenario are presented in Figures 8-3 to 8-6, with a more detailed discussion on the results provided in 8.4.

8.3.7 Development Approved to Date

The TUFLOW model described in Section 8.1 was previously utilised to support Development Approval for the following developments (refer Plate 5-2 for building locations):

- The NRL Academy (completed in March 2016);
- The Western Sydney Community Sports Centre (WSCSC);
- The Multi-storey Carpark and Serviced Apartments (MSCSA); and
- The Nepean Manors (Seniors Living).

The existing conditions model described in Section 8.3.6 was updated to include the approved (and remaining existing) local drainage systems in the road and carpark networks in the southern portion of the Panthers Precinct, together with the previously modelled full block outs representing the proposed buildings.

The WSCSC civil works drawing 008-C-9409 (Rev B) details a proposed extension to the existing Bazooka Channel outlet under the Central Link Road (Jamison Road entry). This has been reflected in the TUFLOW modelling as part of the drainage system modelling.

A single 2.4 m x 2.1 m Reinforced Concrete Box Culvert (RCBC) together with a custom pit inlet structure upstream of the Nepean Manors as approved by Penrith City Council has been included in the model.

Figure 5-2 in Appendix A provides details of the proposed culvert and pit inlet structure to support the Nepean Manors development, together with the drainage structures included in the TUFLOW model.

The approved to date scenario was run for all four (4) events described in Section 8.2.2.

Flood difference mapping (i.e. approved to date – existing) is presented in Figure 8-23. A more detailed discussion on the results provided in Section 8.4.

8.3.8 Future Development Scenario

A future development scenario has been tested where all development approved to date (NRL Academy, MSCSA, WSCSC, Nepean Manors), together with the anticipated development within the remainder of the Panthers Precinct is included.

The following future developments have been included in the modelling (refer Plate 5-3 for building locations):

- Southern Residential development adjacent to the corner of Jamison and Mulgoa Roads;
- Leisure Centre between the approved Nepean Manors development and the existing club;
- Northern mixed use development (Future ESQ1818 development adjacent to the existing retirement village); and
- Office Towers fronting Mulgoa Road just north of the intersection with Panthers Place.

To convey flows around the future southern residential development on the corner on Mulgoa Road and Jamison Road, it is proposed that the single 2.4 m x 2.1 m culvert servicing the Nepean Manors development be extended to the south east corner of the Panthers Precinct. A large swale adjacent to Mulgoa Road is proposed to collect existing overland flows from Mulgoa Road in order to collect and convey them to this culvert and ultimately to Peachtree Creek.

Figure 5-2 in Appendix A provides details of the proposed culvert extension and swale to support the Southern Residential development, together with the drainage structures included in the TUFLOW model.

It is important to note that previously the masterplan for the Panthers Precinct included a large solid block-out reflecting a Direct Factory Outlet (DFO) building situated in the northern portion of the Precinct. The currently proposed mixed use ESQ1818 development is significantly different in built form to the DFO, and consists of a series of internal roads that provide flood conveyance during both the 1% and 0.5% AEP regional events.

Additionally, it has been identified that the electricity substation, which was to be positioned adjacent to Peachtree Creek within the north western portion of the Panthers Precinct, is no longer likely to be constructed in the Panthers Precinct by Endeavour Energy.

The following elements/assumptions relating to the ESQ1818 development have been adopted in the TUFLOW modelling:

- All entry ramps to basement carparks are above the regional 1% AEP flood level of 26.1 m AHD + 0.3 m freeboard.

- All podiums are reflected as solid blockouts to their respective design levels (i.e. varying from 26.5 m to 32.8 m AHD.
- All residential tower buildings above the podiums are reflected as solid block-outs up and out of the floodplain (i.e. an arbitrarily high value of RL 100 m AHD has been adopted).

The future development scenario was run for all four (4) events described in Section 8.2.2.

Flood depth maps for the future development scenario are presented in Figures 8-7 to 8-10. Flood difference map (i.e. future – existing) is presented in Figures 8-11 to 8-14, with discussion on the results provided in Section 8.4.

8.4 Discussion of Results

8.4.1 Flood Depth Mapping

Flood depth mapping has been completed for the existing conditions and future conditions scenarios for the four (4) events described in Section 8.2, and is provided on figures 8-3 to 8-10.

8.4.2 Flood Difference Mapping

Flood difference mapping (future conditions – existing conditions) is shown in Figures 8-11 to 8-14. Additional flood difference mapping for the Approved to Date (i.e. Approved to Date – Existing Conditions) and the ESQ1818 (Approved to Date + ESQ1818 Development – Existing Conditions) development scenarios is provided on Figures 8-23 and 8-24 respectively, which is discussed further in Section 8.5.

The figures show that development of the Panthers Precinct, with the proposed stormwater infrastructure, will result in negligible impacts for both the local and regional 1% AEP events within and external to the Panthers Precinct.

There are several isolated minor increases in flood levels external to the Panther's site (generally in areas that do not impact existing dwellings) during the regional 0.5% AEP event. It should be noted that this event considers regional flows only. The likelihood of a local storm event occurring in conjunction with or preceding this regional event is quite high, and hence it would be anticipated that the extent of flood impacted properties would be much broader than those mapped. Therefore, the change in flood levels presented would have negligible impact on local flood regime during this extreme event.

The assessment confirms that no flood mitigation works are considered necessary to support the future development Panthers Precinct.

8.4.3 Hydraulic Hazard Categories

Hazard can be considered to be a measure of the impact that floodwater may have on both people and/or property. Hazard mapping was undertaken for the existing conditions and future development conditions scenarios described in Section 8.2.

The floodplain has been divided into three (3) Hazard categories (consistent with the NSW Floodplain Development Manual (FDM, 2005) as follows.

- Low Hazard;
- Transitional Hazard; and
- High Hazard.

Hazard maps are useful to obtain an appreciation of the relative depth and velocity of floodwater within a locality and are a critical element in determining:

- The locations of critical public infrastructure such as hospitals and aged care facilities.
- The areas in the floodplain for which public safety is "at risk".

- Assist in the Flood Emergency response and Evacuation Management process.

The existing case flood hazard mapping for the four (4) events is shown on Figures 8-15 to 8-18. The future conditions development scenario flood hazard mapping for the four (4) events is shown on Figures 8-19 to 8-22.

8.5 Staged Development Assessment

A staged development assessment in TUFLOW for the Approved to Date and the ESQ1818 developments has been completed. Flood difference maps for these two (2) development scenarios are provided on Figures 8-23 and 8-24 respectively for the four (4) modelled events.

For the approved to date scenario, analysis of the flood difference maps indicates that there are no off-site flood level impacts in the four (4) modelled events within the agreed ±20 mm accuracy of the TUFLOW model.

For the ESQ1818 development scenario, analysis of the flood difference maps indicates that there are no off-site flood level impacts in the three (3) modelled events (i.e. 1% AEP Regional, 1% AEP Regional + 5% AEP Local and 1% AEP Local + 5 % AEP Local).

Similar to the Future Conditions flood difference mapping discussed in Section 8.4.2, there are several isolated minor increases in flood levels external to the Panther's site (generally in areas that do not impact existing dwellings) during the regional 0.5% AEP event. It should be noted that flood impactsin this event only considers regional flows. The likelihood of a local storm event occurring in conjunction with or preceding this regional event is quite high, and hence it would be anticipated that the extent of flood impacted properties would be much broader than those mapped. Therefore, the change in flood levels presented would have negligible impact on local flood regime during this extreme event.

The assessment confirms that no flood mitigation works are considered necessary to support the staged development of the Panthers Precinct.

9 FLOOD EVACUATION STRATEGY

The Panthers Precinct is subject to flooding from extreme local and regional flood events. The proposed roads within the Precinct will be graded with continuously rising grades from within the site (starting from the Western Sydney Community and Sports Centre) to Mulgoa Road, which is the designated regional flood evacuation route.

An initial assessment of the evacuation strategy was conducted as part of the rezoning process by Molino Stewart. This strategy was then updated at a later date to reflect a new Master Plan concept in 2013 – refer letter from Molino Stewart dated 11 October 2013. Molino Stewart also prepared a draft Flood Response Plan which forms part of the Infrastructure and Public Domain Master Plan for the Precinct.

Due to the current proposed change in land use for northern portion of the Panthers Precinct, a flood evacuation strategy was recently prepared to support the Development Application for the ESQ1818 development (EMCORPGROUP, 2016). A copy of this strategy is provided in Appendix F.

SUMMARY & CONCLUSION

The Flood Assessment for the Panthers Precinct has been prepared to inform and support the revised Master Plan for the Precinct and also to support future Development Applications for consideration by Penrith City Council. The strategy has been prepared to conform with the statutory requirements and relevant guidelines associated with flooding.

Peak flow hydrographs for flows entering the Panthers development have been provided by Worley Parsons for input to the TUFLOW flood model. Existing and future conditions hydrology models have also been prepared for the Panthers Precinct to determine local peak flow hydrographs for flows generated within the site for input to the flood model.

A separate flood impact assessment for the Panthers development undertaken by Worley Parsons in the regional RMA-2 model (using the same land form and model parameters adopted in the TUFLOW model) predicts very similar flood impacts to the TUFLOW modelling, and demonstrates that the TUFLOW model is suitable for assessing the impacts of various development options proposed as part of the Panthers Precinct Masterplan.

The detailed flood assessment completed for the Precinct has demonstrated that the ultimate Master Plan development will result in minor increases in flood levels within the precinct, which can be managed by appropriate design. There are no increases in flood levels outside the precinct in the 1% AEP regional and local flood events within the agreed ±20 mm accuracy of the TUFLOW model.

In the 0.5% AEP regional event, there are some relatively minor increases in flood level outside the Precinct in isolated locations. It should be noted that this event considers regional flows only. The likelihood of a local storm event occurring in conjunction with or preceding this regional event is quite high, and hence it would be anticipated that the extent of flood impacted properties would be much broader than those mapped. Therefore, the change in flood levels presented would have negligible impact on local flood regime during this extreme event.

A staged development assessment of both the development approved to date and the proposed ESQ1818 development in the north of the Panthers Precinct do not result in any flood level increases beyond those that may occur in the future development conditions 0.5% AEP event.

The assessment confirms that no flood mitigation works are considered necessary to support either staged or the ultimate Master Plan development of the Panthers Precinct.

This comprehensive assessment provides Council with sufficient detail in order to support the current Panthers Precinct Master Plan.

Yours faithfully

J. WYNDHAM PRINCE



DAVID CROMPTON

Manager – Stormwater & Environment

10 REFERENCES

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- Worley Parsons email correspondence 19 August 2014 (Nepean Hydrographs);

APPENDIX A – FIGURES



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LEGEND

Panthers Precinct Boundary

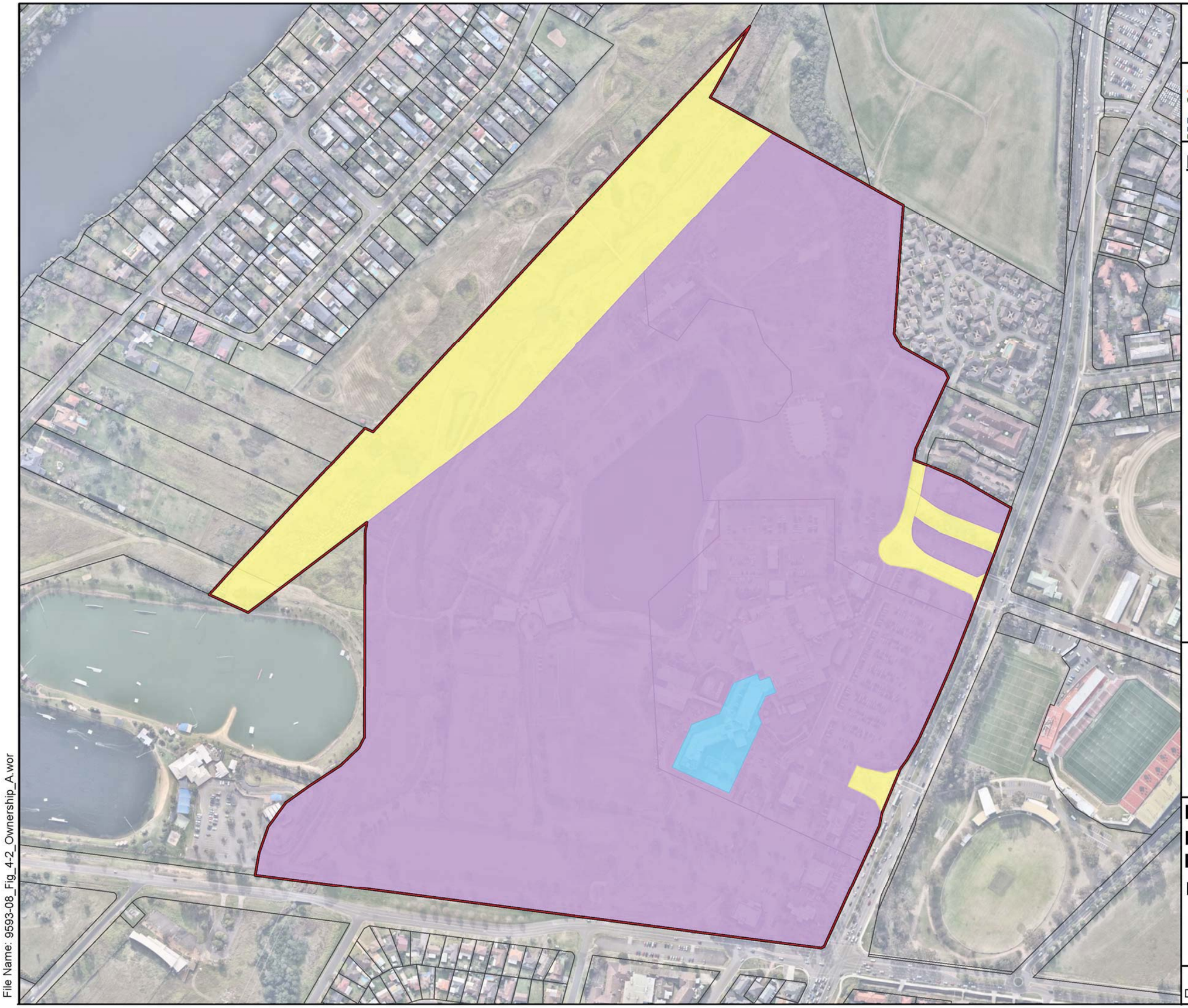
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Scale 1: 4,000 @ A3

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Figure 4-1
Panthers Precinct Master Plan
Existing Conditions Site Plan

Date : 05/07/2016 Issue : A



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LEGEND

- Panthers Precinct Boundary
- Panthers
- Penrith City Council
- Hotel

N
W E
S

Scale 1: 4,000 @ A3

100 0 100 m

Figure 4-2
Panthers Precinct Master Plan
Land Ownership Plan

Date : 30/06/2016 Issue : A

File Name: 9593-08_Fig_4-2_Ownership_A.wor

Culvert ID	Culvert Location	Culvert Configuration	Upstream Invert (m AHD)	Downstream Invert (m AHD)
1	Mulgoa Road (Showground Creek)	2 x 2.43(W) x 1.66(H) RCBC	25.195	24.54
2	Local Access Road (Showground Creek)	2 x 3.66(W) x 1.53(H) RCBC	23.86	23.68
3	Ski Lake Road (Peachtree Creek)	6 x 3.55(W) x 2.13(H) RCBC	21.66	21.62
4	Jamison Road (Peachtree Creek)	2 x 2.77(W) x 1.83(H) RCBC	22.055	21.64
		1 x 4.60(W) x 2.00(H) RCBC	21.80	21.64
		1 x 4.23(W) x 2.00(H) RCBC	21.80	21.64
5	Mulgoa Road (Jamison Creek)	2 x 2.90(W) x 1.60(H) RCBC	25.61	24.18

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LEGEND

- Panthers Precinct Boundary
- Natural / Grass Lined Channel / Watercours
- Culvert
- Concrete Lined Channel

N
W E
S

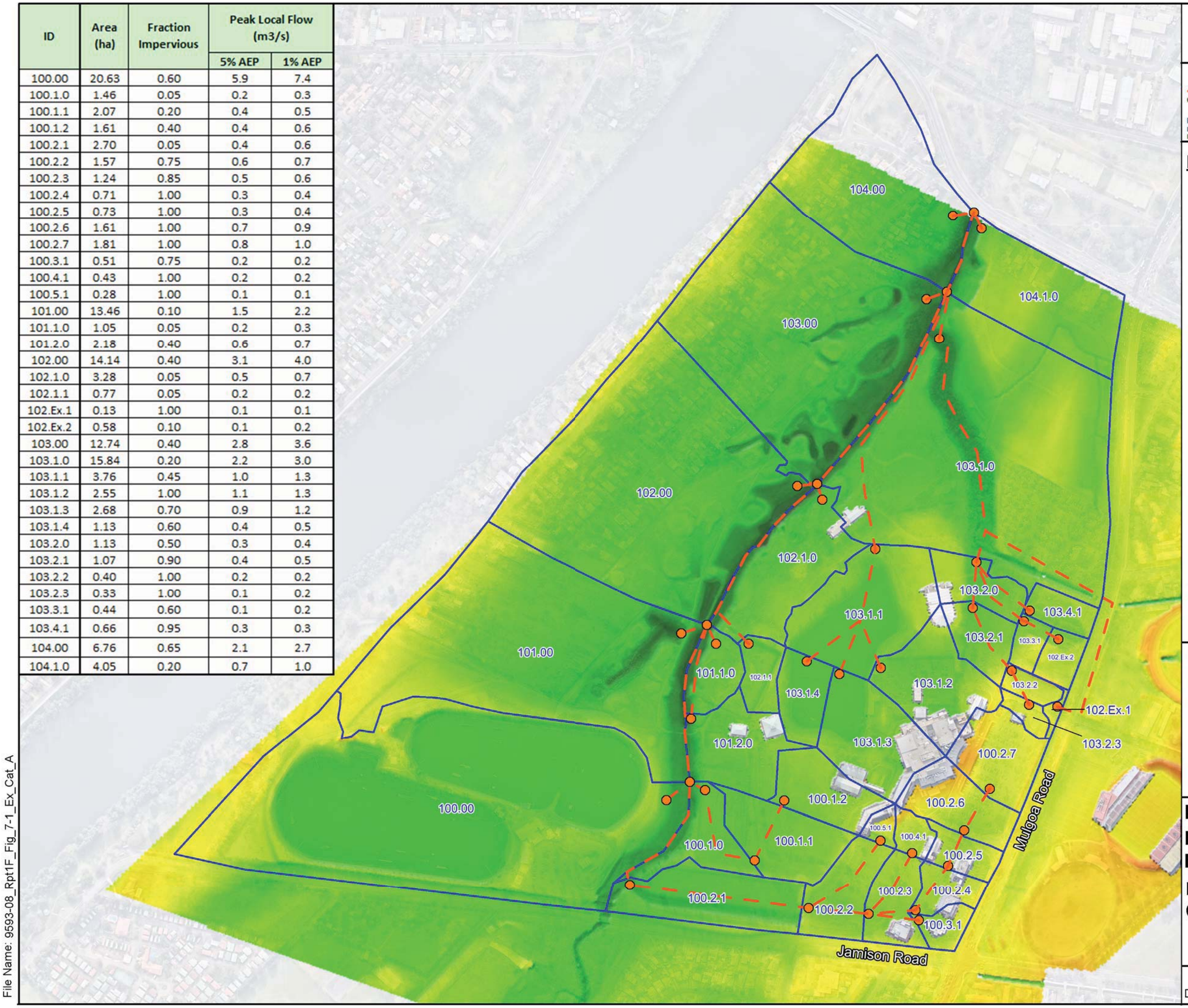
Scale 1: 4,000 @ A3

100 0 100 m

Figure 4-3
Panthers Precinct Master Plan
Existing Major Drainage Infrastructure Plan

Date : 30/06/2016 Issue : A

ID	Area (ha)	Fraction Impervious	Peak Local Flow (m3/s)	
			5% AEP	1% AEP
100.00	20.63	0.60	5.9	7.4
100.1.0	1.46	0.05	0.2	0.3
100.1.1	2.07	0.20	0.4	0.5
100.1.2	1.61	0.40	0.4	0.6
100.2.1	2.70	0.05	0.4	0.6
100.2.2	1.57	0.75	0.6	0.7
100.2.3	1.24	0.85	0.5	0.6
100.2.4	0.71	1.00	0.3	0.4
100.2.5	0.73	1.00	0.3	0.4
100.2.6	1.61	1.00	0.7	0.9
100.2.7	1.81	1.00	0.8	1.0
100.3.1	0.51	0.75	0.2	0.2
100.4.1	0.43	1.00	0.2	0.2
100.5.1	0.28	1.00	0.1	0.1
101.00	13.46	0.10	1.5	2.2
101.1.0	1.05	0.05	0.2	0.3
101.2.0	2.18	0.40	0.6	0.7
102.00	14.14	0.40	3.1	4.0
102.1.0	3.28	0.05	0.5	0.7
102.1.1	0.77	0.05	0.2	0.2
102.Ex.1	0.13	1.00	0.1	0.1
102.Ex.2	0.58	0.10	0.1	0.2
103.00	12.74	0.40	2.8	3.6
103.1.0	15.84	0.20	2.2	3.0
103.1.1	3.76	0.45	1.0	1.3
103.1.2	2.55	1.00	1.1	1.3
103.1.3	2.68	0.70	0.9	1.2
103.1.4	1.13	0.60	0.4	0.5
103.2.0	1.13	0.50	0.3	0.4
103.2.1	1.07	0.90	0.4	0.5
103.2.2	0.40	1.00	0.2	0.2
103.2.3	0.33	1.00	0.1	0.2
103.3.1	0.44	0.60	0.1	0.2
103.4.1	0.66	0.95	0.3	0.3
104.00	6.76	0.65	2.1	2.7
104.1.0	4.05	0.20	0.7	1.0



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LEGEND

- Catchment Boundary
- 100.1.0 Catchment ID
- XP-RAFTS Links
- XP-RAFTS Nodes

ELEVATION (m AHD)

35
30
25
20

N
W E
S

Scale 1: 6,000 @ A3

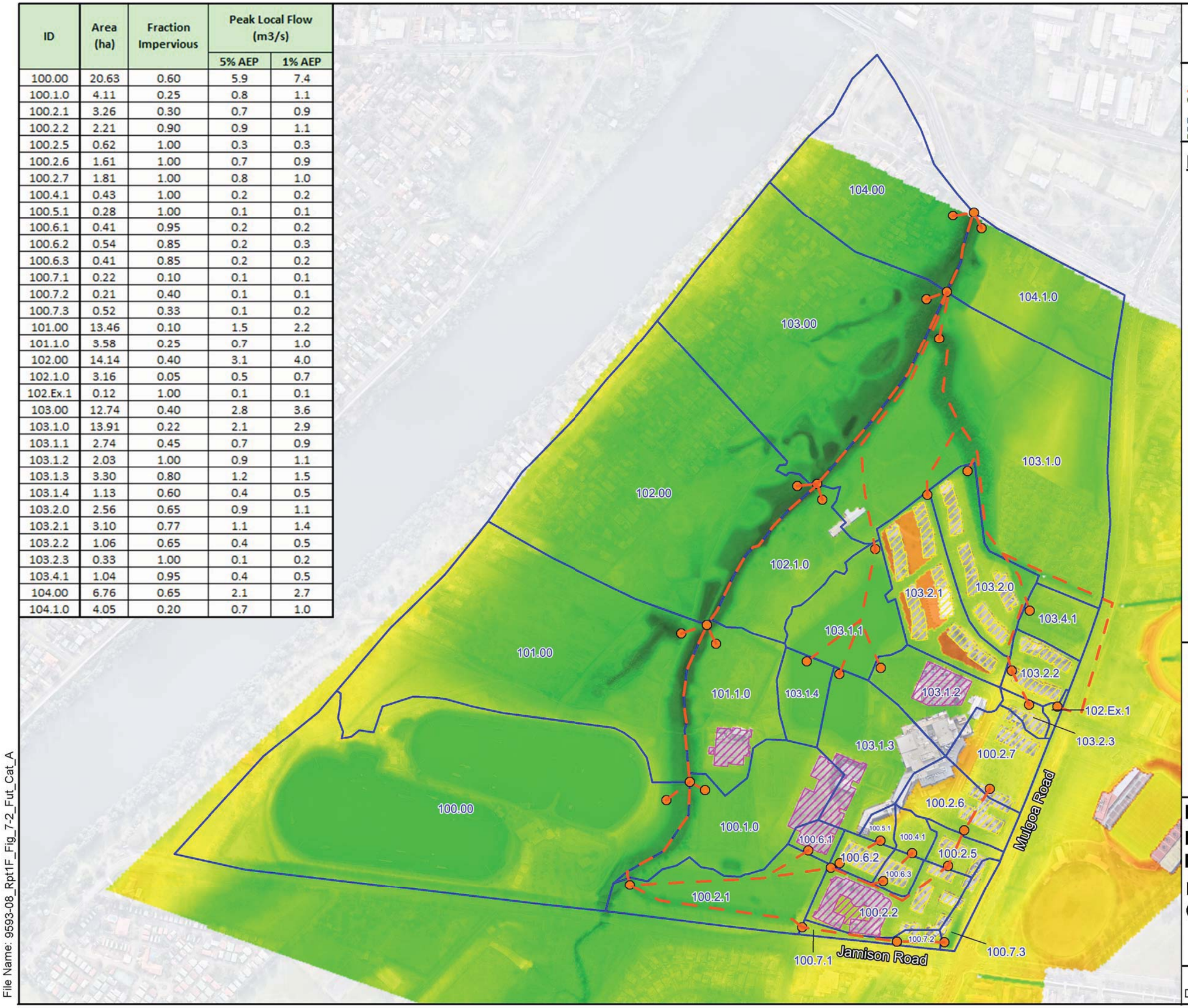
200 0 m

Figure 7-1
Panthers Precinct Master Plan
Existing Conditions Catchment Plan

Date : 27/06/2016 Issue : A

File Name: 9593-08_Rpt1F_Fig_7-1_Ex_Cat_A

ID	Area (ha)	Fraction Impervious	Peak Local Flow (m3/s)	
			5% AEP	1% AEP
100.00	20.63	0.60	5.9	7.4
100.1.0	4.11	0.25	0.8	1.1
100.2.1	3.26	0.30	0.7	0.9
100.2.2	2.21	0.90	0.9	1.1
100.2.5	0.62	1.00	0.3	0.3
100.2.6	1.61	1.00	0.7	0.9
100.2.7	1.81	1.00	0.8	1.0
100.4.1	0.43	1.00	0.2	0.2
100.5.1	0.28	1.00	0.1	0.1
100.6.1	0.41	0.95	0.2	0.2
100.6.2	0.54	0.85	0.2	0.3
100.6.3	0.41	0.85	0.2	0.2
100.7.1	0.22	0.10	0.1	0.1
100.7.2	0.21	0.40	0.1	0.1
100.7.3	0.52	0.33	0.1	0.2
101.00	13.46	0.10	1.5	2.2
101.1.0	3.58	0.25	0.7	1.0
102.00	14.14	0.40	3.1	4.0
102.1.0	3.16	0.05	0.5	0.7
102.Ex.1	0.12	1.00	0.1	0.1
103.00	12.74	0.40	2.8	3.6
103.1.0	13.91	0.22	2.1	2.9
103.1.1	2.74	0.45	0.7	0.9
103.1.2	2.03	1.00	0.9	1.1
103.1.3	3.30	0.80	1.2	1.5
103.1.4	1.13	0.60	0.4	0.5
103.2.0	2.56	0.65	0.9	1.1
103.2.1	3.10	0.77	1.1	1.4
103.2.2	1.06	0.65	0.4	0.5
103.2.3	0.33	1.00	0.1	0.2
103.4.1	1.04	0.95	0.4	0.5
104.00	6.76	0.65	2.1	2.7
104.1.0	4.05	0.20	0.7	1.0



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LEGEND

- Catchment Boundary
- 100.1.0 Catchment ID
- XP-RAFTS Links
- XP-RAFTS Nodes

ELEVATION (m AHD)

35
30
25
20

N
W E
S

Scale 1: 6,000 @ A3

200 0 m

Figure 7-2
Panthers Precinct Master Plan
Future Development Catchment Plan

Date : 27/06/2016 Issue : A

File Name: 9593-08_Rpt1F_Fig_7-2_Fut_Cat_A



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LEGEND

- TUFLOW Model Boundary
- Model Outflows
- Jamison PeachTree and Showground Creek Inflows
- Nepean River Side Flow

Materials (Mannings' 'n')

- Default Floodplain 0.035
- Roads 0.015
- Light Vegetation 0.06
- Medium Vegetation 0.08
- Buildings and Houses 0.30
- Concrete Surfaces 0.015
- Residential Areas 0.10
- Water Body 0.015

E1 = 1% AEP Regional Event
E2 = 0.5% AEP Regional Event
E3 = 20% AEP Local + 1% AEP Regional Event
E4 = 1% AEP Local + 20% AEP Regional Event

N
W E
S

Scale 1: 7,000 @ A3

200 0 m

Figure 8-1
Panthers Precinct Master Plan
TUFLOW Model Setup
Existing Cond. Materials, Boundaries & Peak Flows

Date : 01/07/2016 Issue : A

File Name: 9593-08_Fig_8-1_Ex_Mat_Flows_A.wor



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LEGEND

- TUFLOW Model Boundary
- Model Outflows
- Jamison PeachTree and Showground Creek Inflows
- Nepean River Side Flow

Materials (Mannings' 'n')

- Default Floodplain 0.035
- Roads 0.015
- Light Vegetation 0.06
- Medium Vegetation 0.08
- Buildings and Houses 0.30
- Concrete Surfaces 0.015
- Residential Areas 0.10
- Water Body 0.015
- Bio-Retention 0.07
- Training Field/ Managed Lawn 0.02

N
W E
S

Scale 1: 7,000 @ A3

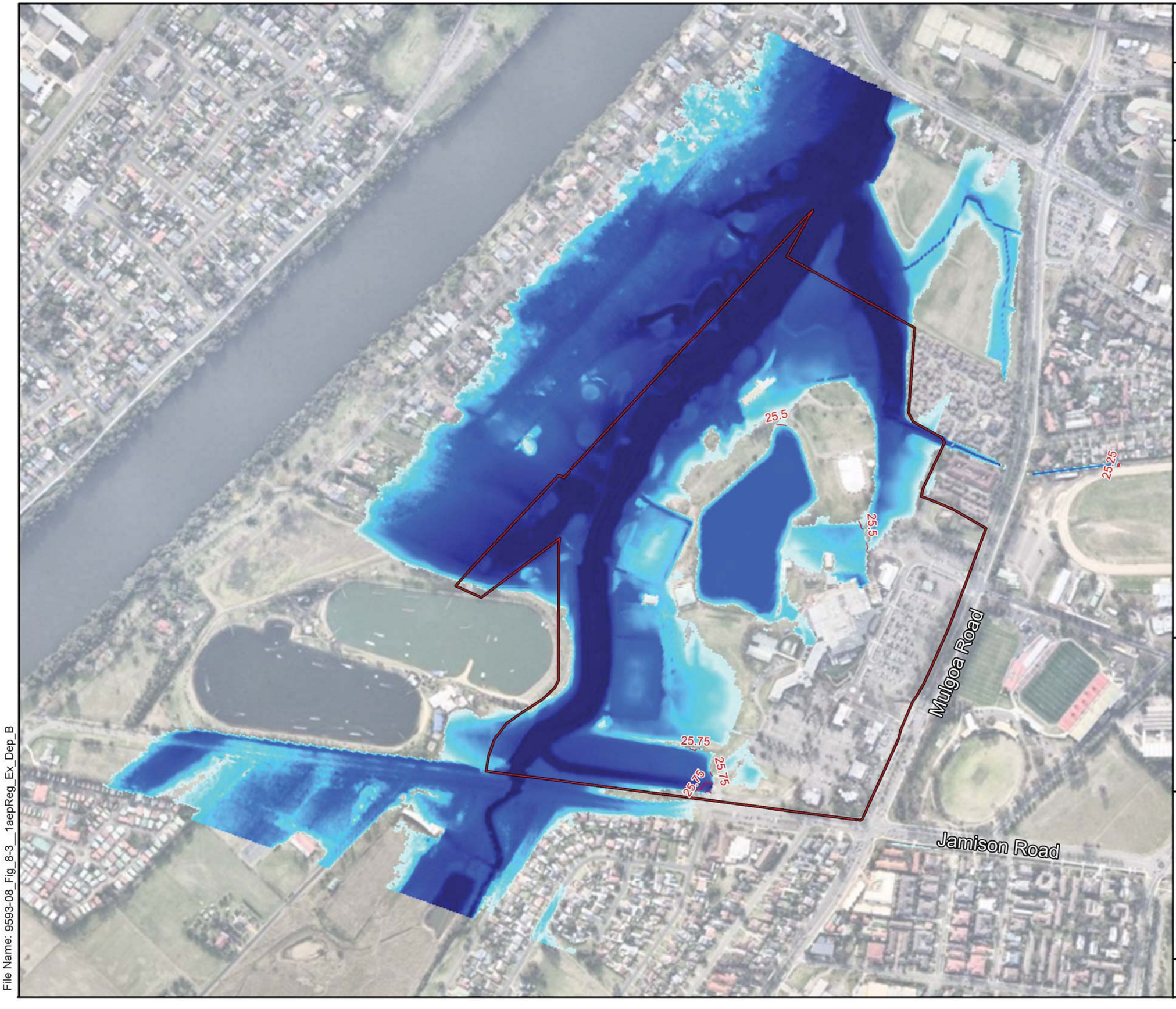
200 0 m

Figure 8-2
Panthers Precinct Master Plan

TUFLOW Model Setup
Future Cond. Materials, Boundaries & Peak Flows

Date : 01/07/2016 Issue : A

File Name: 9593-08_Rpt1F_Fig_8-2_Fut_Mat_Flows_A.wor



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LEGEND

Depth (m)

- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

27.00 Flood Level (m AHD)

Panthers Precinct Boundary

N
W E
S

Scale 1: 6,000 @ A3

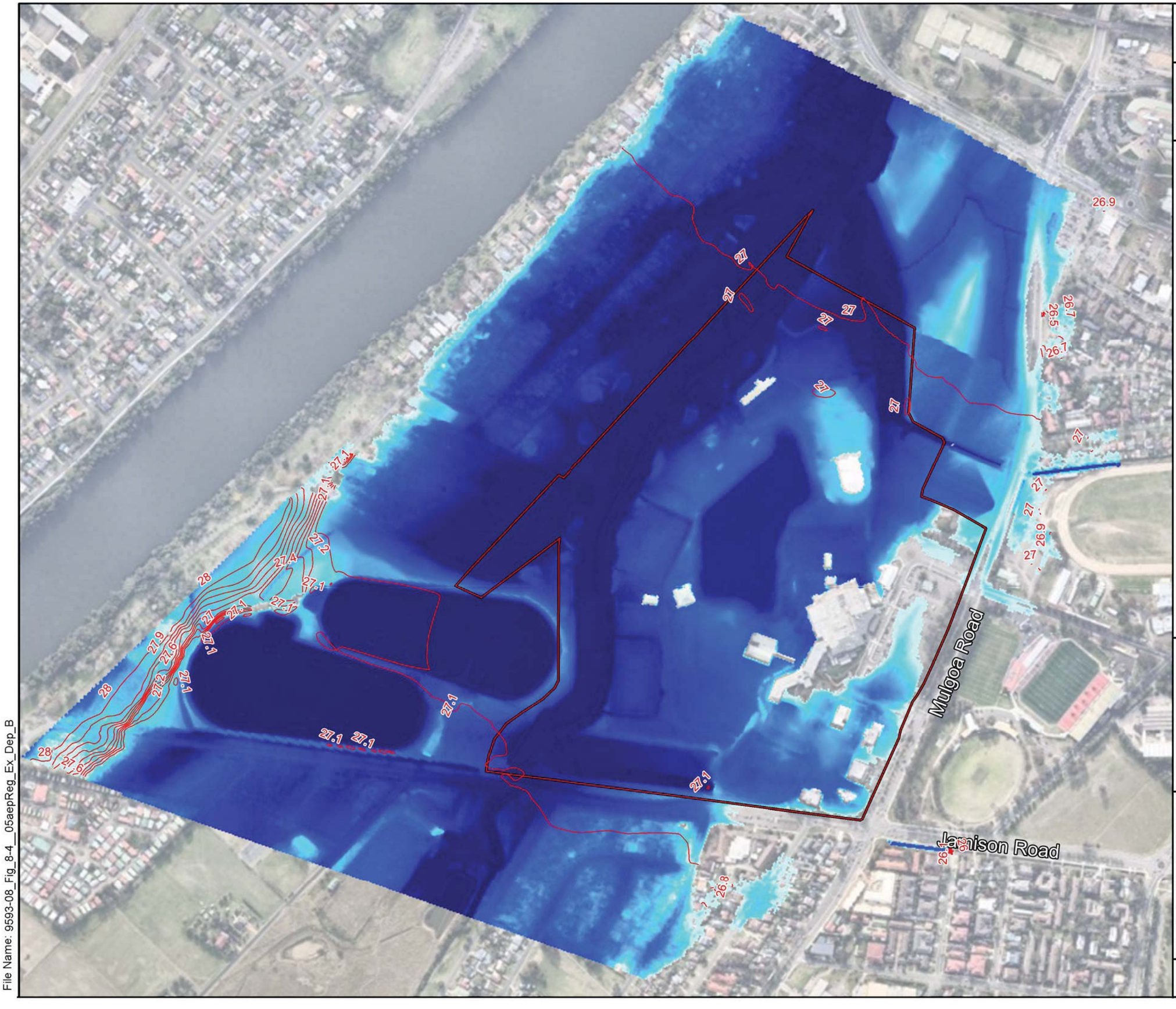
200 0 m

Figure 8-3
Panthers Precinct Master Plan
1% AEP Regional

Existing Conditions
Flood Depth and Level

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-3__1aepReg_Ex_Dep_B



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LEGEND

Depth (m)

- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

27.00 Flood Level (m AHD)

Panthers Precinct Boundary

N
W E
S

Scale 1: 6,000 @ A3

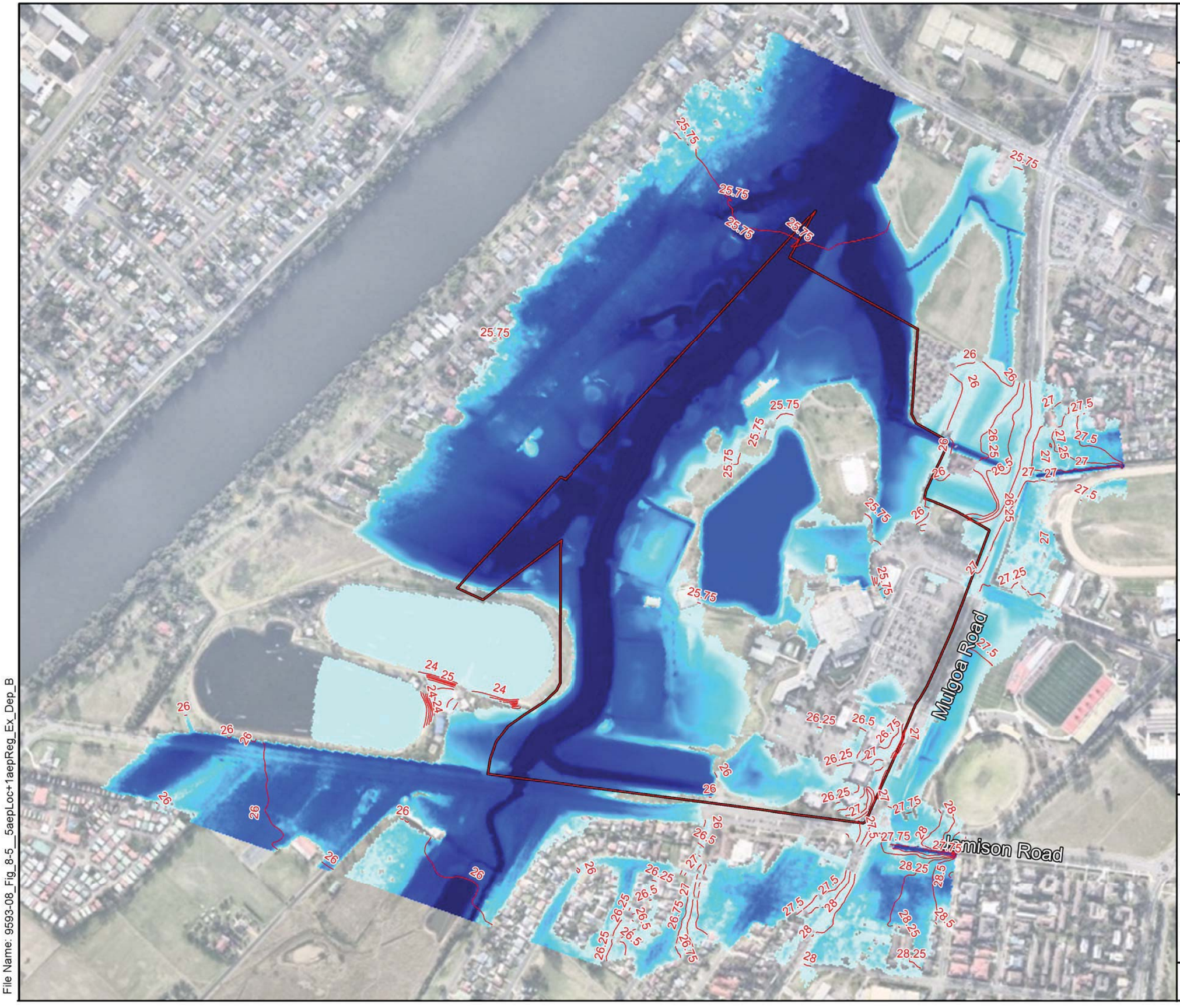
200 0 m

Figure 8-4
Panthers Precinct Master Plan
0.5% AEP Regional

Existing Conditions
Flood Depth and Level

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-4__05aepReg_Ex_Dep_B



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LEGEND

Depth (m)

- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

27.00 Flood Level (m AHD)

Panthers Precinct Boundary

N W E S

Scale 1: 6,000 @ A3

200 0 m

Figure 8-5
Panthers Precinct Master Plan
5% AEP Local + 1% AEP Regional Existing Conditions Flood Depth and Level

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-5__5aepLoc+1aepReg_Ex_Dep_B

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LEGEND

Depth (m)

- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

27.00 Flood Level (m AHD)

Panthers Precinct Boundary

N
W E
S

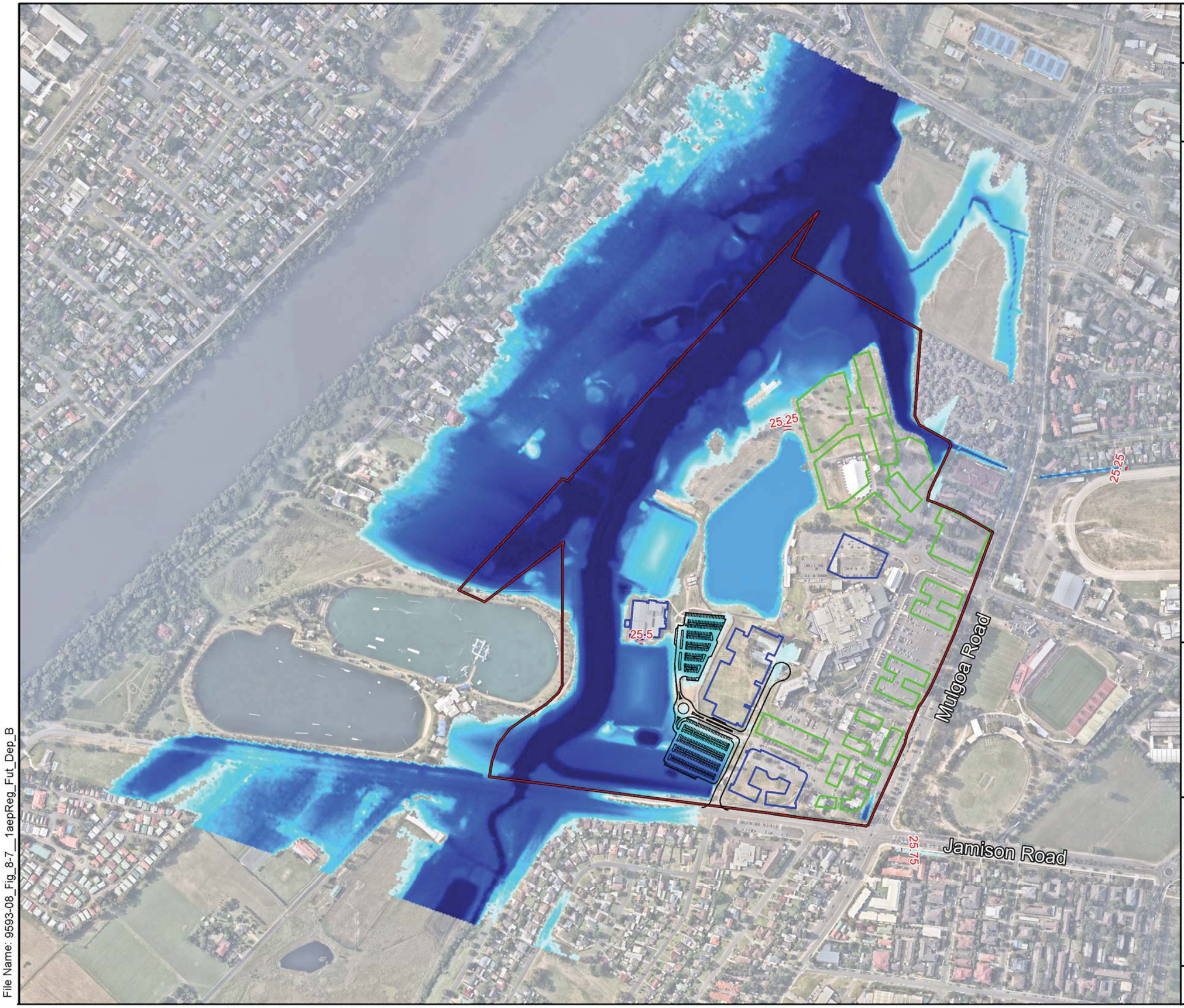
Scale 1: 6,000 @ A3

200 0 m

Figure 8-6
Panthers Precinct Master Plan
1% AEP Local +
5% AEP Regional
Existing Conditions
Flood Depth and Level

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-6__1aepLoc+5aepReg_Ex_Dep_B



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LEGEND

Depth (m)

- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

27.00 Flood Level (m AHD)

Panthers Precinct Boundary

N
W E
S

Scale 1: 6,000 @ A3

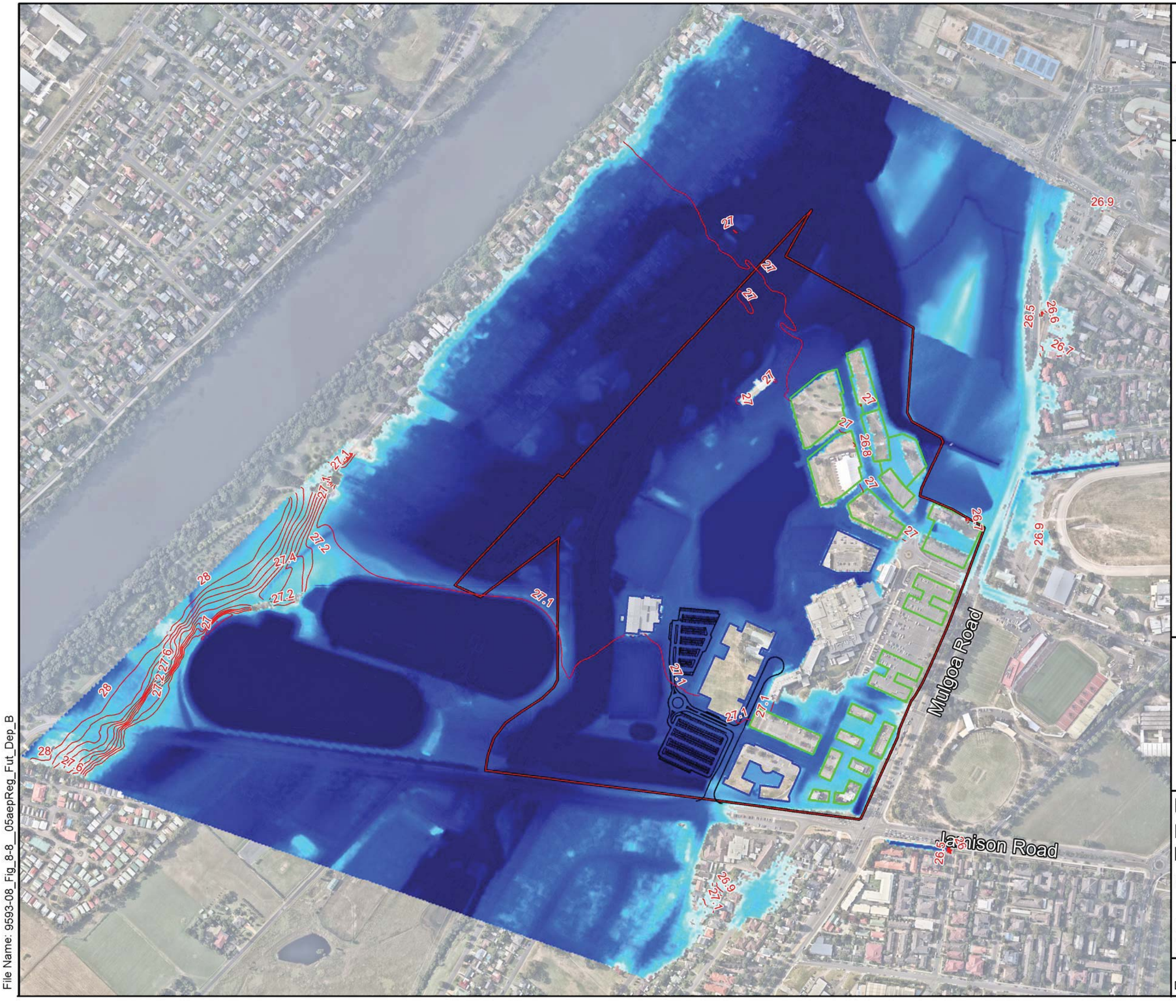
200 0 m

Figure 8-7
Panthers Precinct Master Plan
1% AEP Regional

Future Conditions
Flood Depth and Level

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-7__1aepReg_Fut_Dep_B



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LEGEND

Depth (m)

- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

27.00 Flood Level (m AHD)

Panthers Precinct Boundary

N W E S

Scale 1: 6,000 @ A3

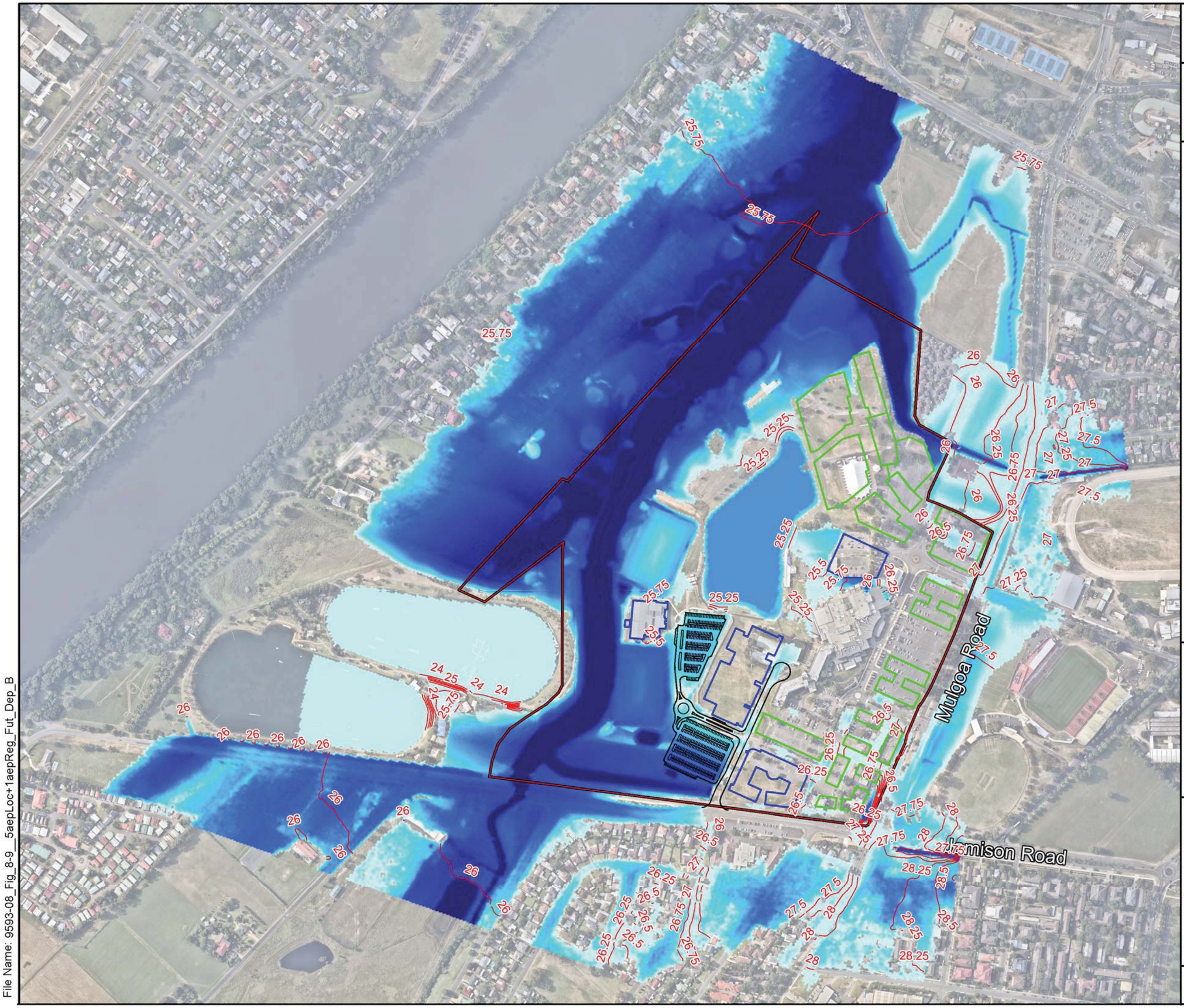
200 0 m

Figure 8-8
Panthers Precinct Master Plan
0.5% AEP Regional

Future Conditions
Flood Depth and Level

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-8__05aepReg_Fut_Dep_B



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LEGEND

Depth (m)

- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

27.00 Flood Level (m AHD)

Panthers Precinct Boundary

N
W E
S

Scale 1: 6,000 @ A3

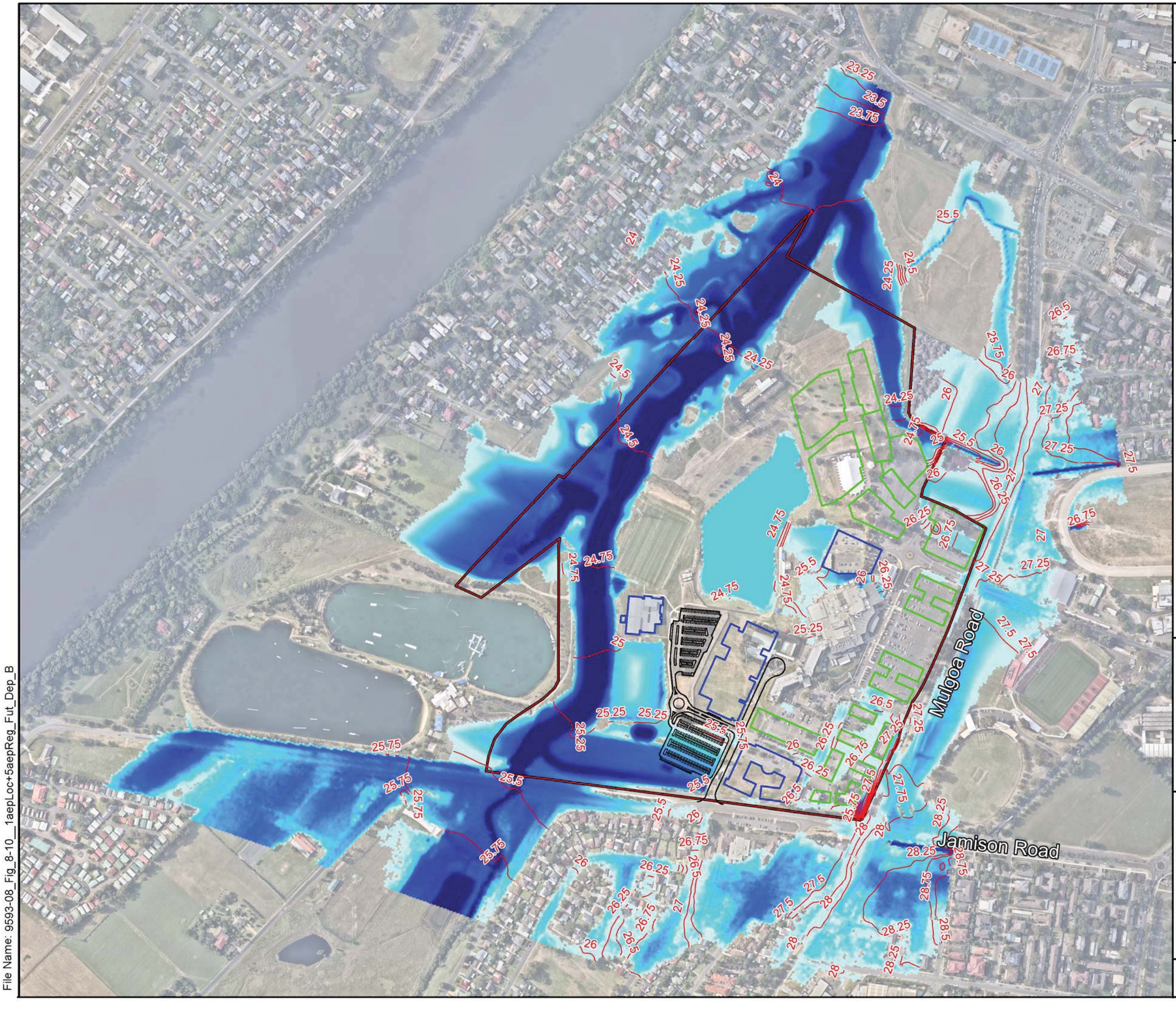
200 0 m

Figure 8-9
Panthers Precinct Master Plan

5% AEP Local +
1% AEP Regional
Future Conditions
Flood Depth and Level

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-9__5aepLoc+1aepReg_Fut_Dep_B



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LEGEND

Depth (m)

- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

27.00 Flood Level (m AHD)

Panthers Precinct Boundary

N W E S

Scale 1: 6,000 @ A3

200 0 m

Figure 8-10
Panthers Precinct Master Plan
1% AEP Local + 5% AEP Regional Future Conditions Flood Depth and Level

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-10__1aepLoc+5aepReg_Fut_Dep_B



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LEGEND

INCREASE IN FLOOD LEVELS (m)

- -0.2+
- -0.18
- -0.16
- -0.14
- -0.12
- -0.10
- -0.08
- -0.06
- -0.04
- -0.02
- -0.02 to 0.02
- 0.02
- 0.04
- 0.06
- 0.08
- 0.10
- 0.12
- 0.14
- 0.16
- 0.18
- 0.2+

AREA NOW FLOOD FREE IN MODELLED EVENT

AREA NOW FLOOD AFFECTED IN MODELLED EVENT

SPOT DIFFERENCES

- - xx mm Flood Level Reduction
- - xx mm Flood Level Increase
- Panthers Precinct Boundary

N
W E
S

Scale 1: 6,000 @ A3

200 0 m

Figure 8-11
Panthers Precinct Master Plan
1% AEP Regional Future Conditions - Existing Conditions Flood Difference Map

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-11__1aepReg_Fut-Ex_FDM_B



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LEGEND

INCREASE IN FLOOD LEVELS (m)

- -0.2+
- -0.18
- -0.16
- -0.14
- -0.12
- -0.10
- -0.08
- -0.06
- -0.04
- -0.02
- -0.02 to 0.02
- 0.02
- 0.04
- 0.06
- 0.08
- 0.10
- 0.12
- 0.14
- 0.16
- 0.18
- 0.2+
- **AREA NOW FLOOD FREE IN MODELLED EVENT**
- **AREA NOW FLOOD AFFECTED IN MODELLED EVENT**

SPOT DIFFERENCES

- - xx mm Flood Level Reduction
- - xx mm Flood Level Increase
- Panthers Precinct Boundary

N W E S

Scale 1: 6,000 @ A3

200 0 m

Figure 8-12
Panthers Precinct Master Plan
0.5% AEP Regional Future Conditions - Existing Conditions Flood Difference Map

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-12__05aepReg_Fut-Ex_FDM_B



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LEGEND

INCREASE IN FLOOD LEVELS (m)

- -0.2+
- -0.18
- -0.16
- -0.14
- -0.12
- -0.10
- -0.08
- -0.06
- -0.04
- -0.02
- -0.02 to 0.02
- 0.02
- 0.04
- 0.06
- 0.08
- 0.10
- 0.12
- 0.14
- 0.16
- 0.18
- 0.2+
- **AREA NOW FLOOD FREE IN MODELLED EVENT**
- **AREA NOW FLOOD AFFECTED IN MODELLED EVENT**

SPOT DIFFERENCES

- - xx mm Flood Level Reduction
- - xx mm Flood Level Increase
- Panthers Precinct Boundary

N W E S

Scale 1: 6,000 @ A3

200 0 m

Figure 8-13
Panthers Precinct Master Plan
5% AEP Loc+1% AEP Reg Future Conditions - Existing Conditions Flood Difference Map

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-13__5aepLoc+1aepReg_Fut-Ex_FDM_B



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LEGEND

INCREASE IN FLOOD LEVELS (m)

- -0.2+
- -0.18
- -0.16
- -0.14
- -0.12
- -0.10
- -0.08
- -0.06
- -0.04
- -0.02
- -0.02 to 0.02
- 0.02
- 0.04
- 0.06
- 0.08
- 0.10
- 0.12
- 0.14
- 0.16
- 0.18
- 0.2+
- **AREA NOW FLOOD FREE IN MODELLED EVENT**
- **AREA NOW FLOOD AFFECTED IN MODELLED EVENT**

SPOT DIFFERENCES

- - xx mm Flood Level Reduction
- - xx mm Flood Level Increase
- Panthers Precinct Boundary

N
W E
S

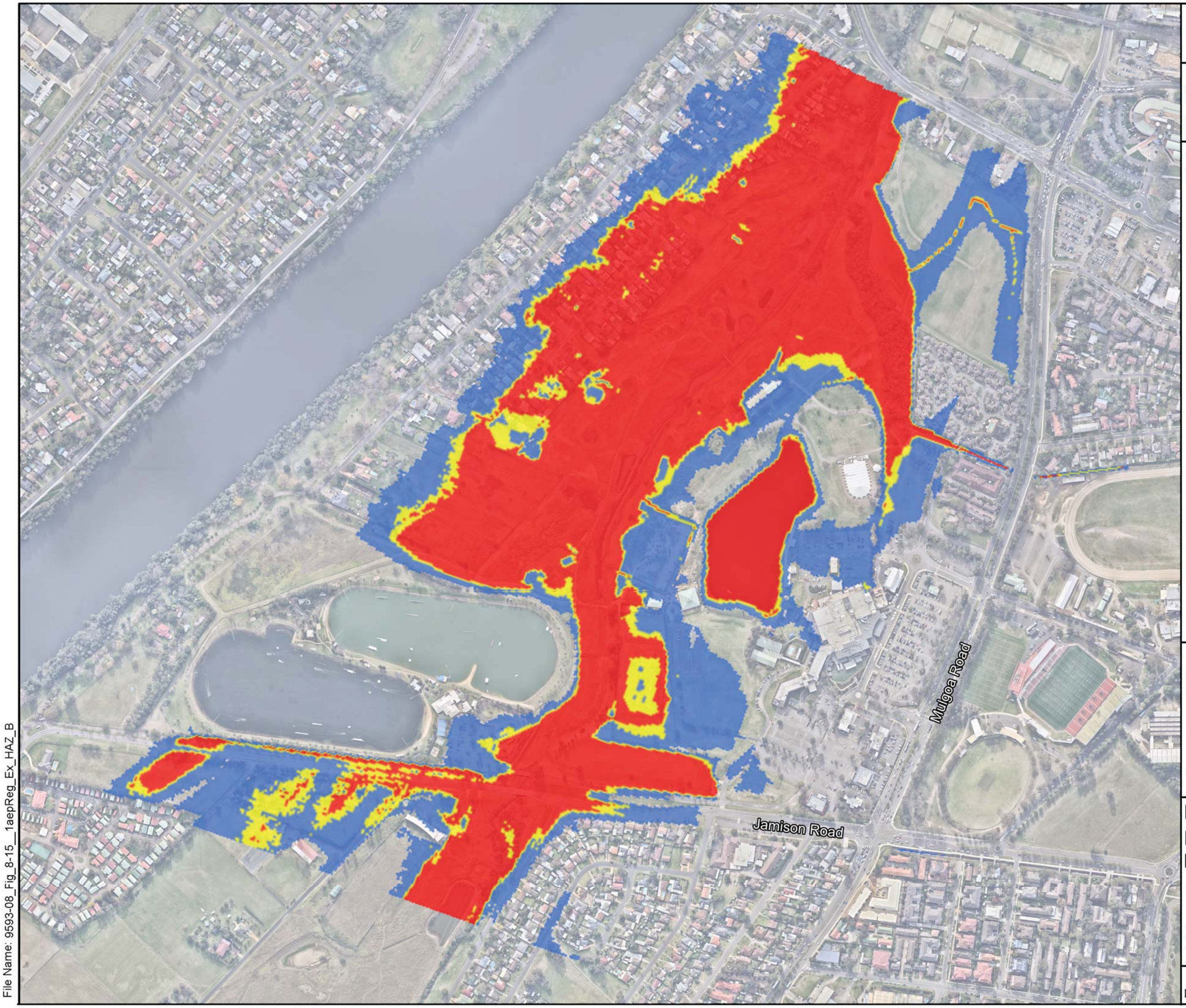
Scale 1: 6,000 @ A3

200 0 m

Figure 8-14
Panthers Precinct Master Plan
1% AEP Loc+5% AEP Reg Future Conditions - Existing Conditions Flood Difference Map

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-14__1aepLoc+5aepReg_Fut-Ex_FDM_B



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LEGEND

Hazard Categorisation

- LOW HAZARD
- TRANSITION HAZARD
- HIGH HAZARD

N
W E
S

Scale 1: 6,000 @ A3

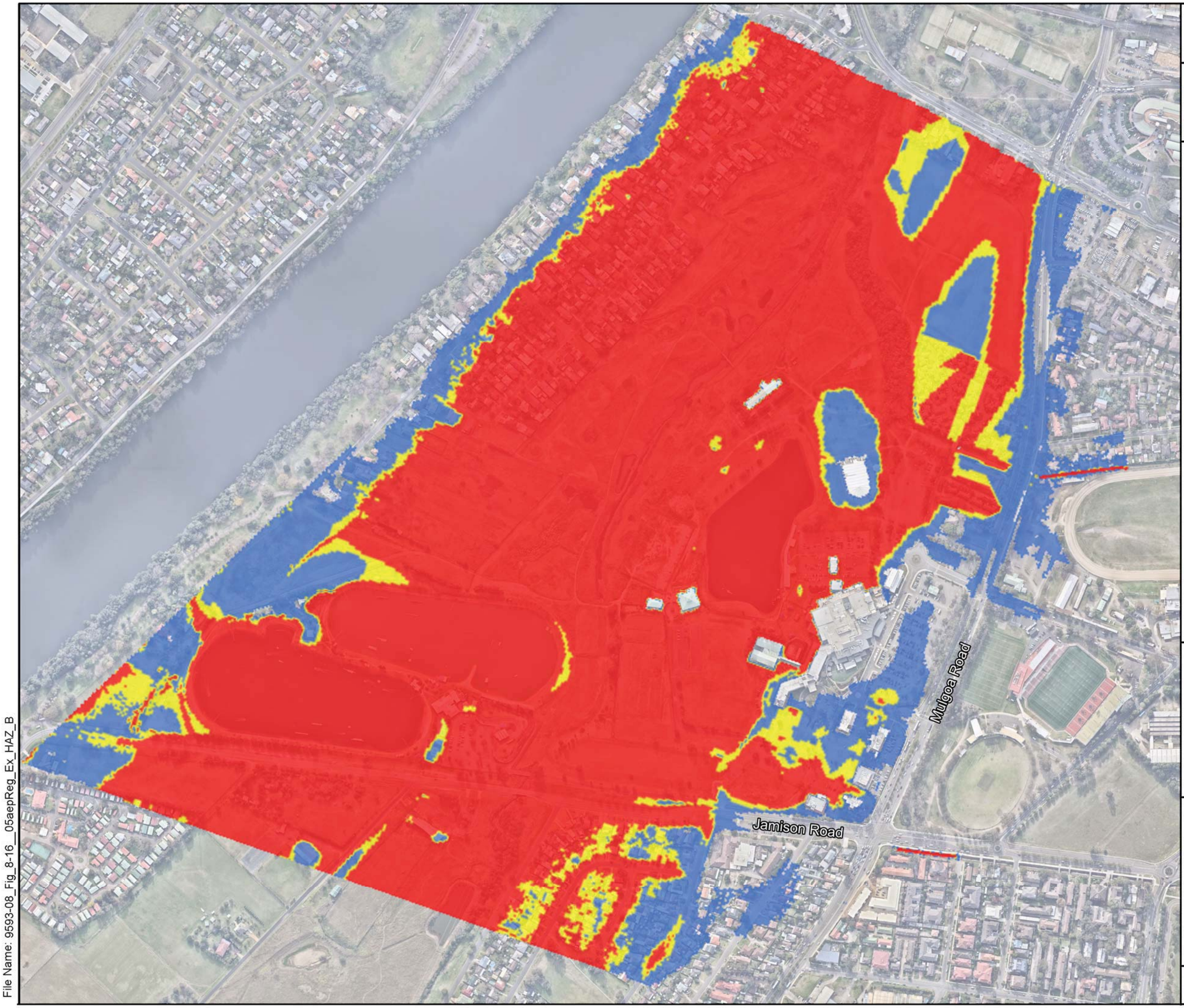
200 0 m

Figure 8-15
Panthers Precinct Master Plan
1% AEP Regional

Existing Conditions
Flood Hazard Categorisation

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-15__1aepReg_Ex_HAZ_B



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LEGEND

Hazard Categorisation

- LOW HAZARD
- TRANSITION HAZARD
- HIGH HAZARD

N
W E
S

Scale 1: 6,000 @ A3

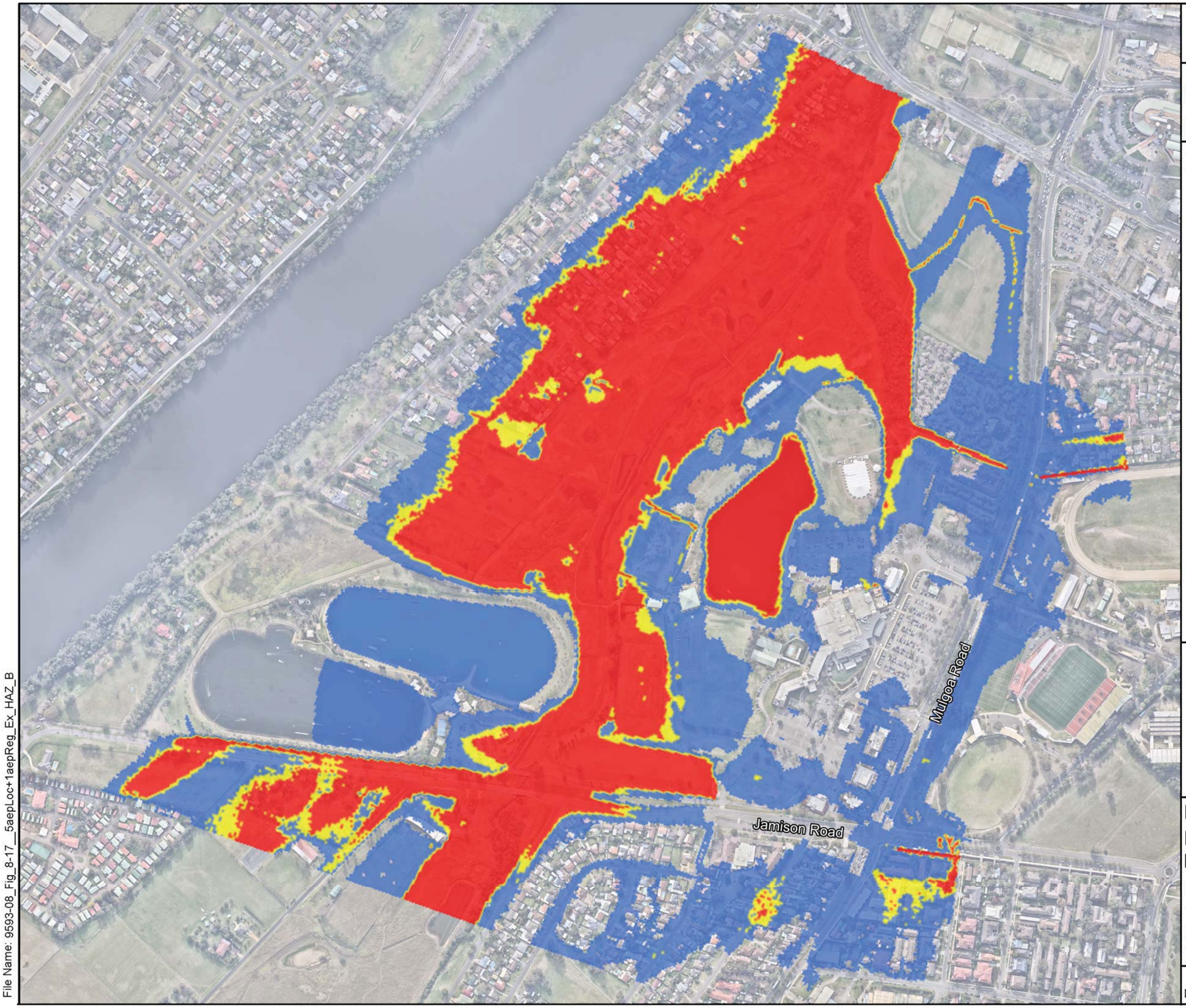
200 0 m

Figure 8-16
Panthers Precinct Master Plan
0.5% AEP Regional

Existing Conditions
Flood Hazard Categorisation

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-16__05aepReg_Ex_HAZ_B



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LEGEND

Hazard Categorisation

- LOW HAZARD
- TRANSITION HAZARD
- HIGH HAZARD

N
W E
S

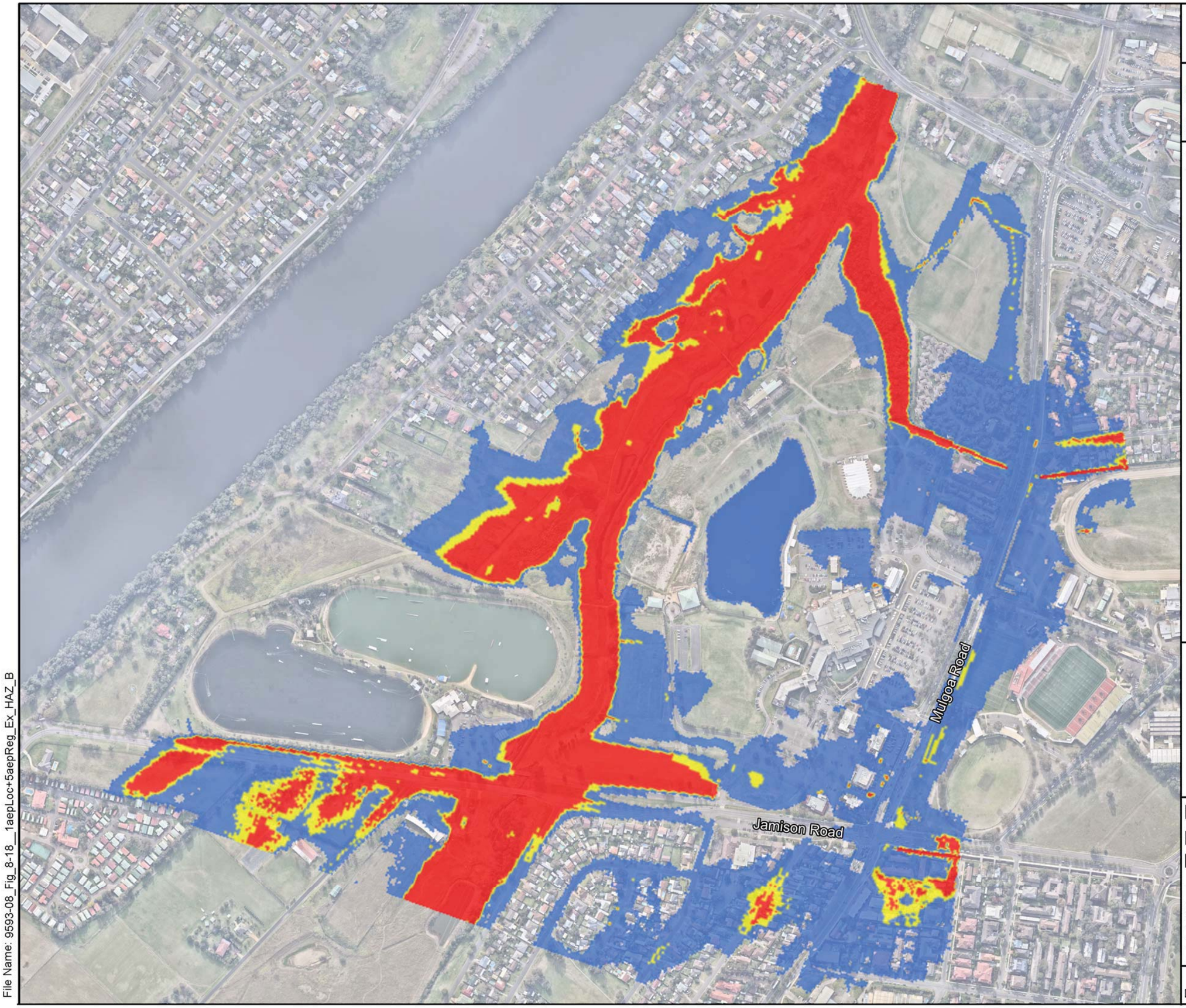
Scale 1: 6,000 @ A3

200 0 m

Figure 8-17
Panthers Precinct Master Plan
5% AEP Local + 1% AEP Regional Existing Conditions Flood Hazard Categorisation

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-17__5aepLoc+1aepReg_Ex_HAZ_B



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LEGEND

Hazard Categorisation

- LOW HAZARD
- TRANSITION HAZARD
- HIGH HAZARD

N
W E
S

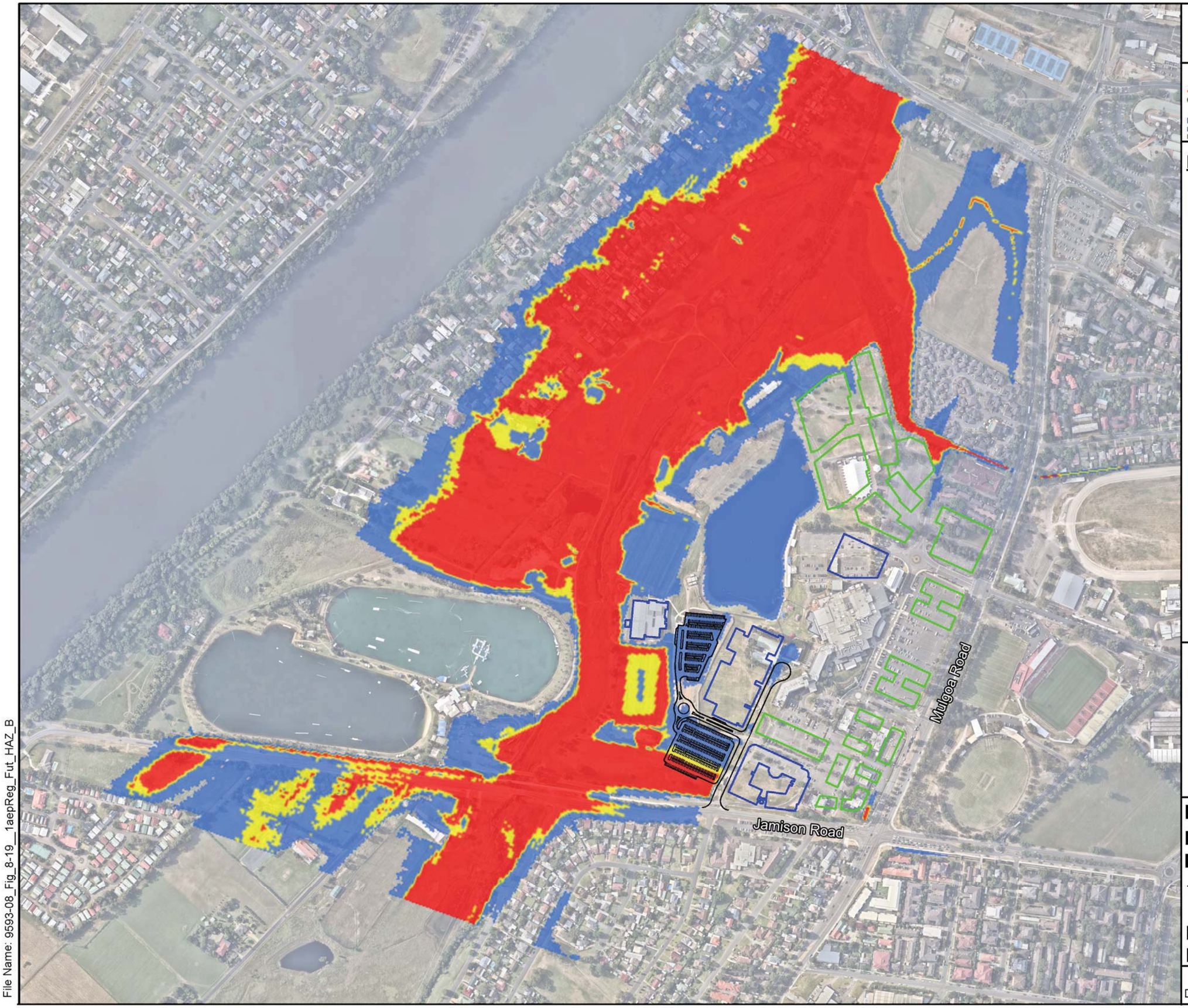
Scale 1: 6,000 @ A3

200 0 m

Figure 8-18
Panthers Precinct Master Plan
1% AEP Local + 5% AEP Regional Existing Conditions Flood Hazard Categorisation

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-18__1aepLoc+5aepReg_Ex_HAZ_B



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LEGEND

Hazard Categorisation

- LOW HAZARD
- TRANSITION HAZARD
- HIGH HAZARD

N
W E
S

Scale 1: 6,000 @ A3

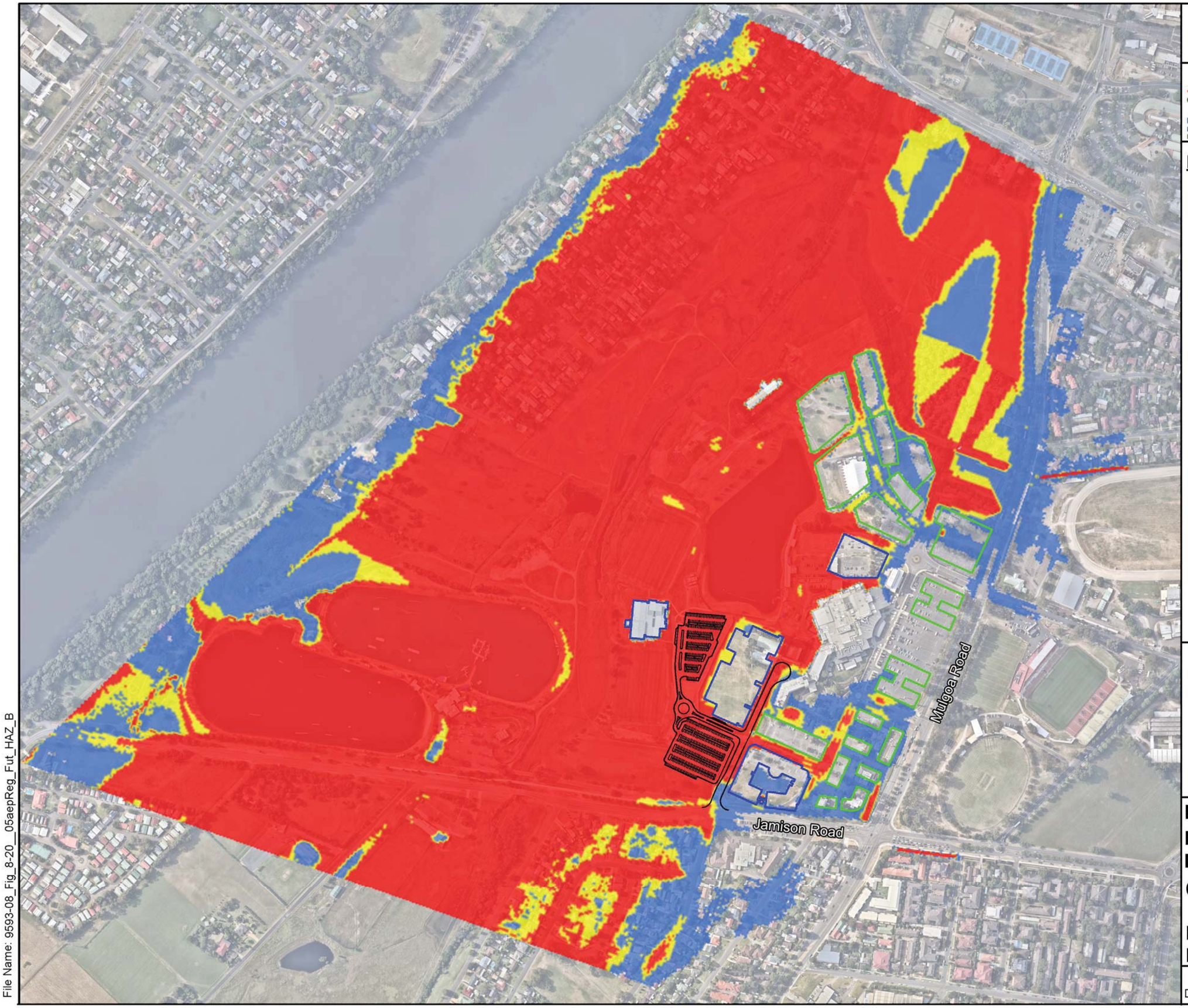
200 0 m

Figure 8-19
Panthers Precinct Master Plan
1% AEP Regional

Future Conditions
Flood Hazard Categorisation

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-19__1aepReg_Fut_HAZ_B



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LEGEND

Hazard Categorisation

- LOW HAZARD
- TRANSITION HAZARD
- HIGH HAZARD

N
W E
S

Scale 1: 6,000 @ A3

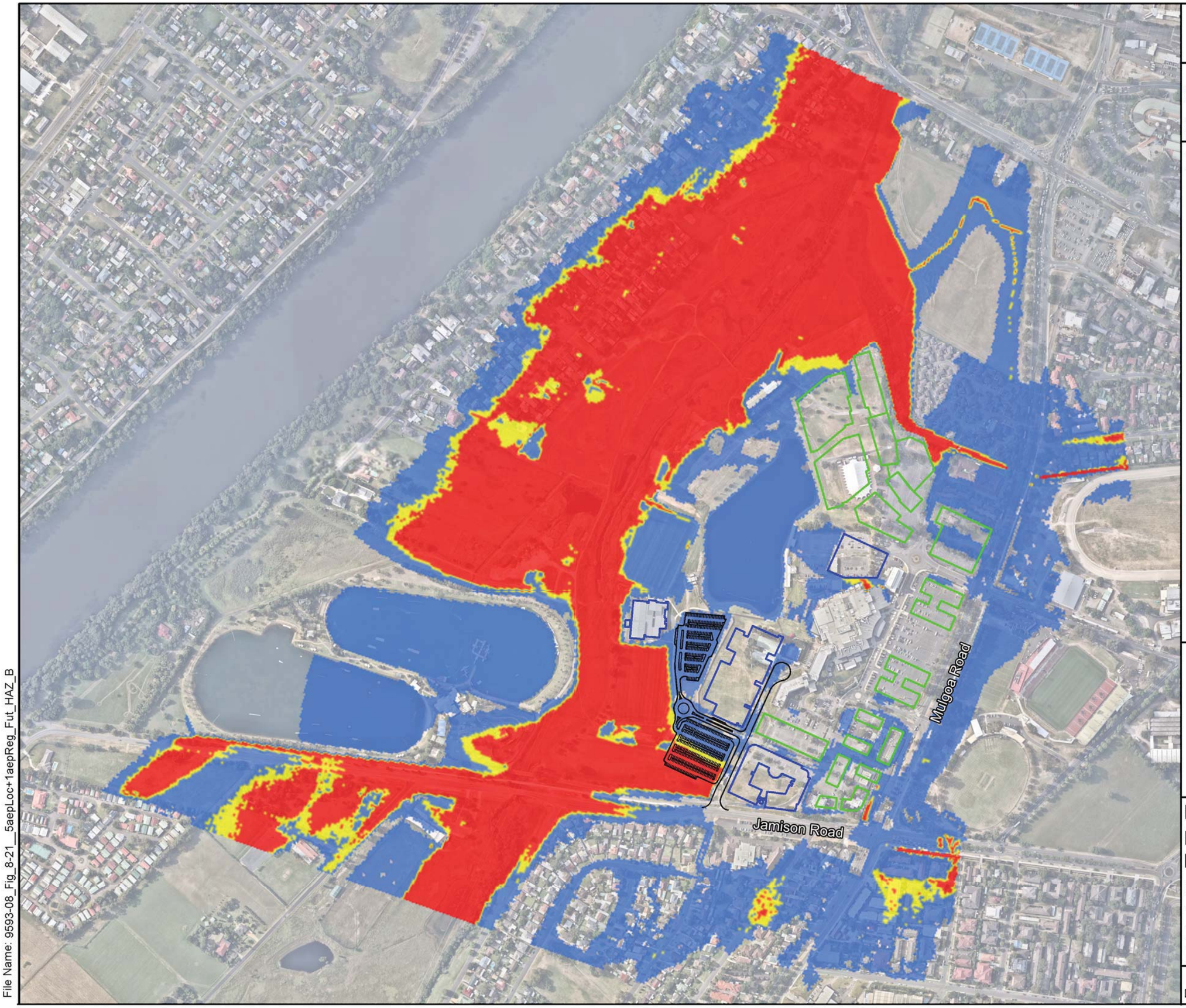
200 0 m

Figure 8-20
Panthers Precinct Master Plan
0.5% AEP Regional

Future Conditions
Flood Hazard Categorisation

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-20___05aepReg_Fut_HAZ_B



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LEGEND

Hazard Categorisation

- LOW HAZARD
- TRANSITION HAZARD
- HIGH HAZARD

N
W E
S

Scale 1: 6,000 @ A3

200 0 m

Figure 8-21
Panthers Precinct Master Plan
5% AEP Local + 1% AEP Regional Future Conditions Flood Hazard Categorisation

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-21__5aepLoc+1aepReg_Fut_HAZ_B



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LEGEND

Hazard Categorisation

- LOW HAZARD
- TRANSITION HAZARD
- HIGH HAZARD

N
W E
S

Scale 1: 6,000 @ A3

200 0 m

Figure 8-22
Panthers Precinct Master Plan
1% AEP Local + 5% AEP Regional Future Conditions Flood Hazard Categorisation

Date : 6/09/2016 Issue : B

File Name: 9593-08_Fig_8-22__1aepLoc+5aepReg_Fut_HAZ_B



1% AEP Regional



0.5% AEP Regional



5% AEP Local + 1% AEP Regional



1% AEP Local + 5% AEP Regional

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LEGEND

INCREASE IN FLOOD LEVELS (m)

- -0.2+
- -0.18
- -0.16
- -0.14
- -0.12
- -0.10
- -0.08
- -0.06
- -0.04
- -0.02
- -0.02 to 0.02
- 0.02
- 0.04
- 0.06
- 0.08
- 0.10
- 0.12
- 0.14
- 0.16
- 0.18
- 0.2+

AREA NOW FLOOD FREE IN MODELLED EVENT

AREA NOW FLOOD AFFECTED IN MODELLED EVENT

Panthers Precinct Boundary

N W E S

Scale 1: 12,000 @ A3

500 0 m

Figure 8-23
Panthers Precinct Master Plan

Approved to Date
- Existing Conditions
Flood Difference Map

Date : 06/09/2016 Issue : B

File Name: 9593-08_Fig_8-23_App-Ex_FDM_B



1% AEP Regional



0.5% AEP Regional



5% AEP Local + 1% AEP Regional



1% AEP Local + 5% AEP Regional

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F 02 4721 7638 E jwp@jwprince.com.au

LEGEND

INCREASE IN FLOOD LEVELS (m)

- -0.2+
- -0.18
- -0.16
- -0.14
- -0.12
- -0.10
- -0.08
- -0.06
- -0.04
- -0.02
- -0.02 to 0.02
- 0.02
- 0.04
- 0.06
- 0.08
- 0.10
- 0.12
- 0.14
- 0.16
- 0.18
- 0.2+

AREA NOW FLOOD FREE IN MODELLED EVENT

AREA NOW FLOOD AFFECTED IN MODELLED EVENT

Panthers Precinct Boundary

N W E S

Scale 1: 12,000 @ A3

500 0 m

Figure 8-24
Panthers Precinct Master Plan

ESQ1818
- Existing Conditions
Flood Difference Map

Date : 06/09/2016 Issue : B

File Name: 9593-08_Fig_8-24_ESQ1818-Ex_FDM_B

APPENDIX B – LIST OF APPROVED PLANS

A number of Development Applications have recently been approved for the Panthers site. These include:

The NRL Academy;

The Western Sydney Community Sports Centre (WSCSC);

The Multi-storey Carpark and Serviced Apartments (MSCSA); and

The Nepean Manors (Seniors Living).

Details of the approved works are shown on the following plans:

NRL Academy – J. Wyndham Prince Construction Certificate plans 9593/05CC00 - 9593/05CC12 (Rev B) and 9593/05A01 (Rev B).

WSCSC – Diversi Development Application plans:

008-C-9400 (Rev B)
008-C-9401 (Rev B)
008-C-9402 (Rev A)
008-C-9403 (Rev A)
008-C-9404 (Rev B)
008-C-9405 (Rev B)
008-C-9406 (Rev B)
008-C-9407 (Rev B)
008-C-9408 (Rev A)
008-C-9409 (Rev B)
008-C-9410 (Rev B)
008-C-9411 (Rev B)
008-C-9412 (Rev B)
008-C-9413 (Rev B)
008-C-9414 (Rev B)
008-C-9415 (Rev B)
008-C-9416 (Rev A)

MSCSA – Diversi Development Application plans:

008-C-9300 (Rev D)
008-C-9301 (Rev A)
008-C-9302 (Rev D)
008-C-9303 (Rev D)
008-C-9304 (Rev B)
008-C-9305 (Rev A)
008-C-9306 (Rev A)
008-C-9307 (Rev A)
008-C-9308 (Rev A)
008-C-9309 (Rev A)

Nepean Manors – Diversi Development Application plans:

DA100 (Rev B)

DA101 (Rev B)

DA102 (Rev B)

DA103 (Rev B)

DA104 (Rev A)

DA105 (Rev B)

DA106 (Rev B)

APPENDIX C – COMPLIANCE WITH CONTROL DOCUMENTS

CONTROL	JWP COMMENT
All applications are to address the relevant sub-sections of Penrith Development Control Plan 2014 Part C3 Water Management.	Refer to discussion below in Section 2.
A Stormwater Management Strategy (SMS) is to be prepared for the whole Precinct and be submitted with the first major development application and should identify and address: • Impacts of stormwater generated both on and off the site. • Stormwater easements and overland flow paths. • Opportunities to maximise the reuse of stormwater runoff. • Reductions in pollutants entering the water system.	This strategy (for flood related aspects) and as updated where appropriate for future development applications.
Any development west of the Central Link Road and within the flood flow conveyance corridor is to develop a strategy to ensure that the 0.5% AEP regional flood runner is maintained without causing adverse impact to adjoining lands in accordance with the principles of Scenario 4 modelling under Panthers Planning Proposal – Appendix H. The strategy will identify the timing, staging and detailing of necessary works to be undertaken.	Detailed flood modelling has been undertaken for a number of different local and regional flood scenarios, including the 0.5% AEP regional event. A detailed discussion of the flood modelling is included in Section 8 of this report. The proposed development layout varies from the Scenario 4 layout in Appendix H. The new layout has been modelled with the results showing only very minor increases in flood levels outside the Panthers Precinct in the 0.5% AEP event.
Development of a comprehensive flood evacuation and emergency response plan as part of the Infrastructure Master Plan.	An evacuation strategy was prepared for the Previous Masterplan by Molino Stewart in 2013. A flood evacuation strategy for the proposed ESQ1818 development in the northern portion of the Precinct is provided in Appendix F. Detailed flood response plans will need to be developed to support future development applications.

CONTROL	JWP COMMENT
Flood Liable Lands	
Submission Requirements	Section 8 of this report describes the detailed flood study undertaken, which addresses the submission requirements.
Flood Hazard Classifications	Flood hazard classifications for the proposed development are described in detail in Section 8 of this report.
Residential – New Development – Single Dwellings	Not applicable.
Residential – Minor Extensions	Not applicable.
Non-Habitable Extensions or Alterations, Outbuildings and Swimming Pools	Not applicable.
Industrial/Commercial – New Development:	All new development floor levels within the Panthers Precinct will be a minimum 0.5m above the 1:100 ARI "Combined" flood levels. Molino Stewart prepared an evacuation strategy for the previous Masterplan in 2013. A flood evacuation strategy for the proposed ESQ1818 development in the northern portion of the Precinct is provided in Appendix F. Detailed flood response plans will need to be developed to support future development applications.
Industrial/Commercial – Extensions and Infill Development	Not applicable.
Change of Use of Existing Building	Not applicable.
Rural Uses	Not applicable.
Subdivision	Not applicable.
Multi-Unit Housing	Proposed multi-unit housing within the Panthers Precinct will be located at or above the flood planning level.
Other land uses which may attract large numbers of people	All proposed floor levels within the Panthers Precinct will be located at or above the flood planning level.
Storage of Potential Pollutants above 1:100 ARI Flood	The proposed Panthers Precinct development does not include any proposed areas for storage of potential pollutants.

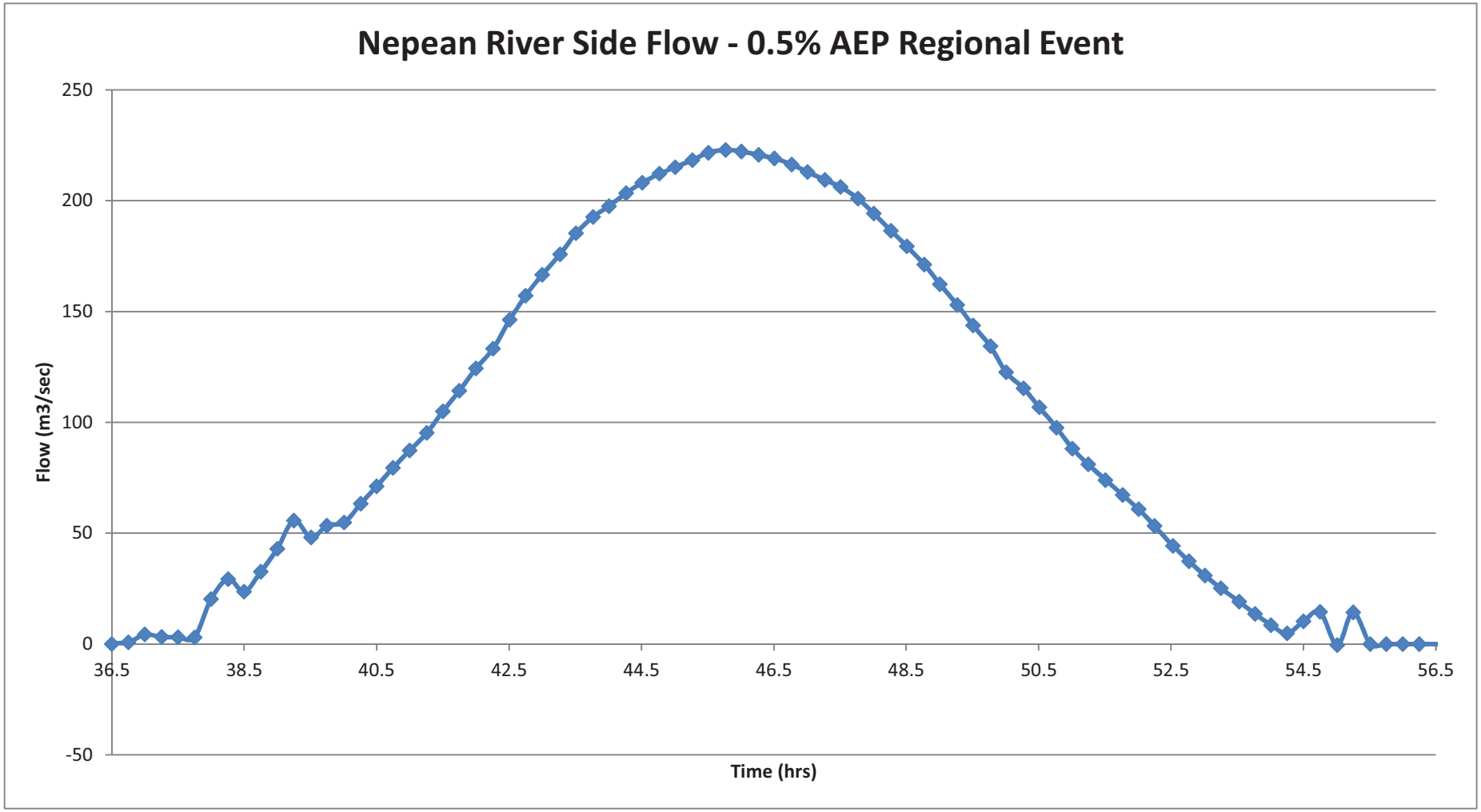
Overland Flow Flooding	The Panthers Precinct development includes provision to convey overland flows for events up to the 200 year ARI regional event, as described in detail in Section 8 of this report.
Filling of Land Below the Flood Planning Level	Some site regrading works are proposed as part of the Panthers Precinct development to ensure that floor levels will be located above the flood planning level. A comprehensive flood assessment, as described in Section 8 of this report, has been undertaken to determine the impact of the proposed site regrading and development work.
Rezoning of Land	Not applicable.
Stormwater Management and Drainage	
Drainage	A comprehensive flood assessment has been undertaken for the Panthers Precinct, as described in Section 8 of this report. The assessment includes modelling the existing major drainage infrastructure and flooding regime within the Precinct as well as the additional infrastructure that will be required to convey major overland flows and facilitate the proposed development. Detailed underground pit and pipe drainage design will be undertaken at the DA and detailed design stages of development.

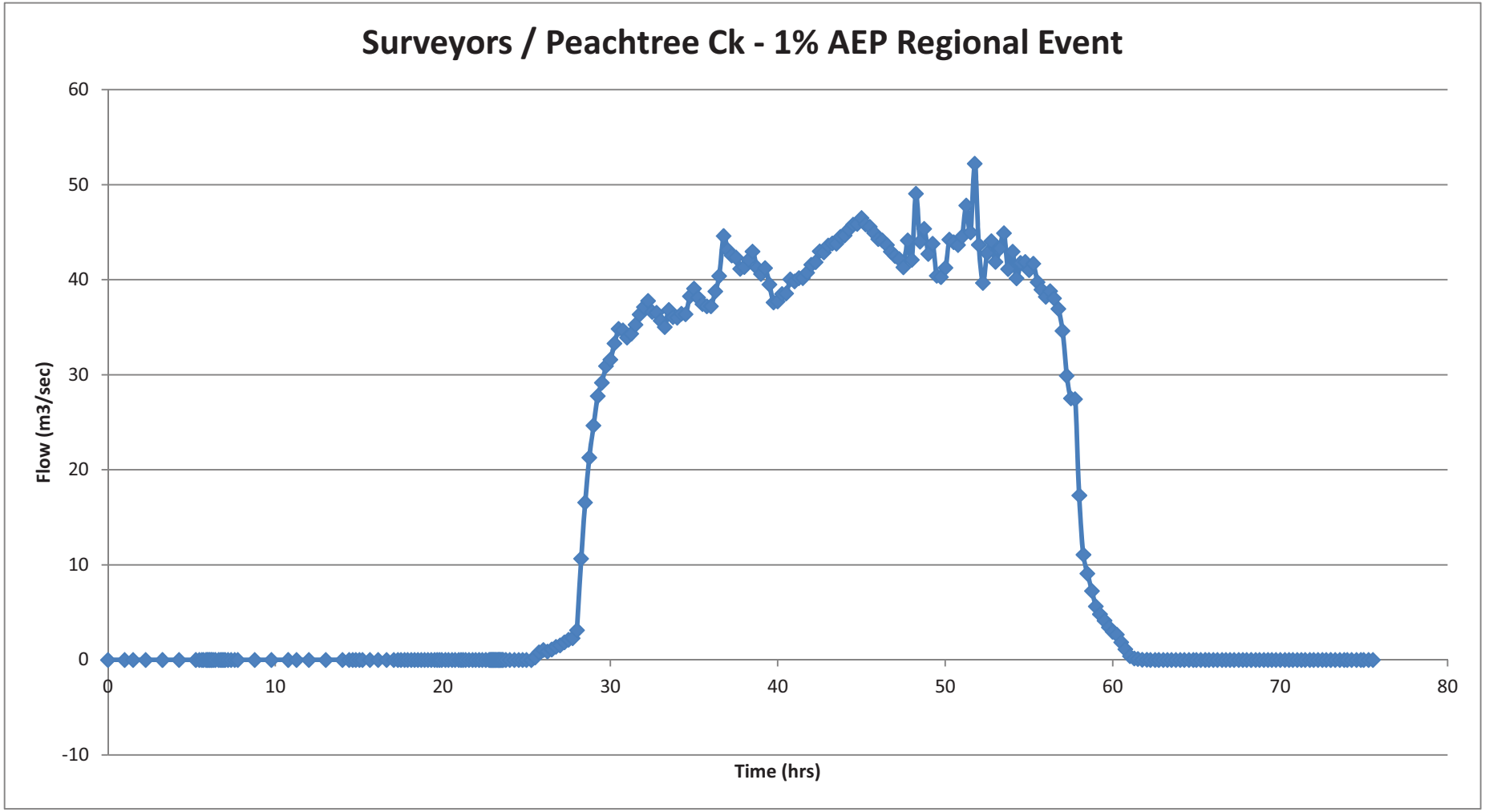
PENRITH CITY COUNCIL LOCAL ENVIRONMENTAL PLAN

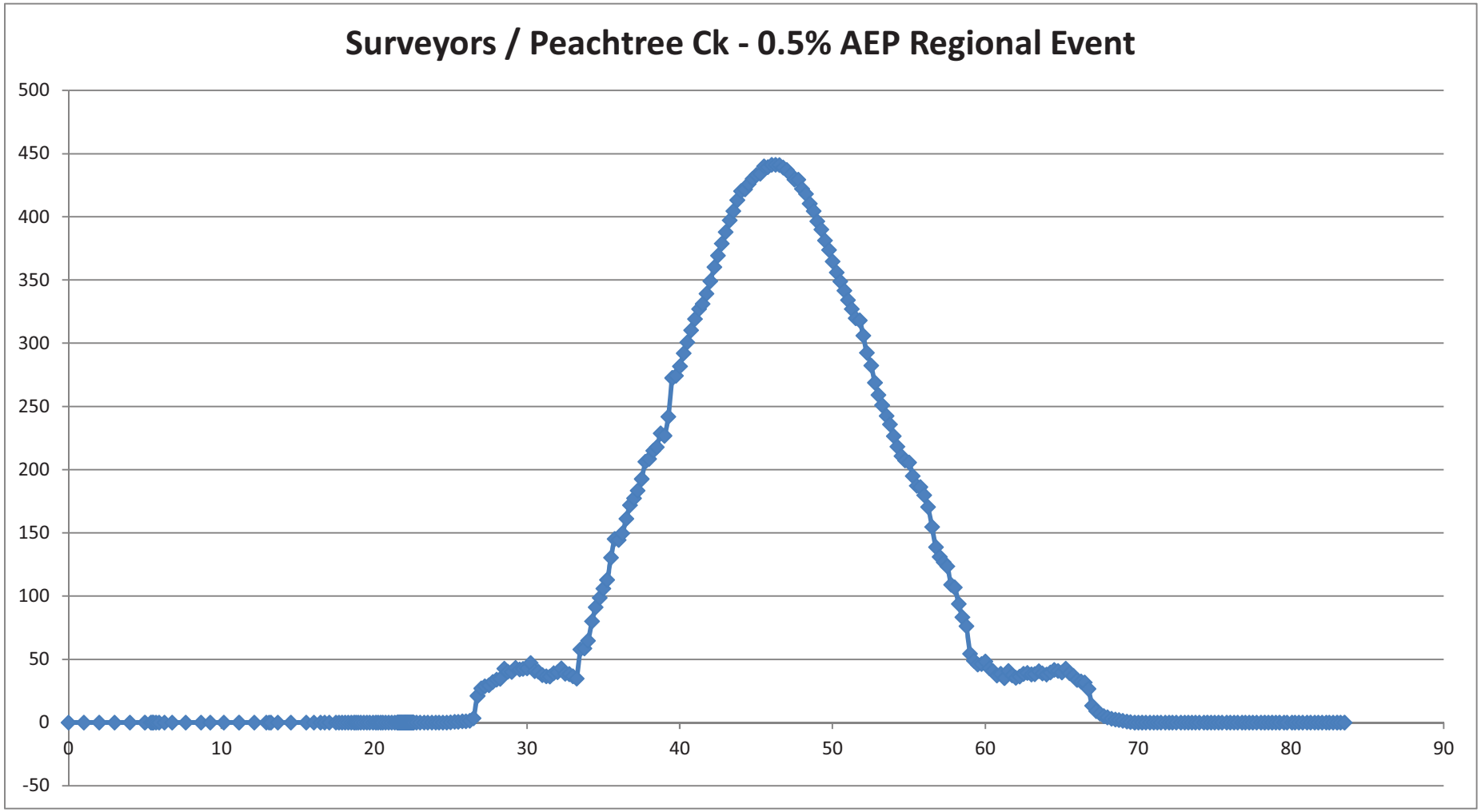
OBJECTIVE	**JWP COMMENT**
To minimise the flood risk associated with the use of the land.	A detailed flood assessment has been undertaken for the Panthers Precinct, as described in Section 8 of this report. All proposed buildings will have floor levels above the combined flood event flood level. Molino Stewart prepared an evacuation strategy for the Previous Masterplan in 2013. A flood evacuation strategy for the proposed ESQ1818 development in the northern portion of the Precinct is provided in Appendix F. Detailed flood response plans will need to be developed to support future development applications.
To limit uses to those compatible with flow conveyance function and flood hazard.	The Panthers development land uses are deemed to be compatible with flood conveyance and hazard. All proposed floor levels are to be located above the combined flood event flood level.

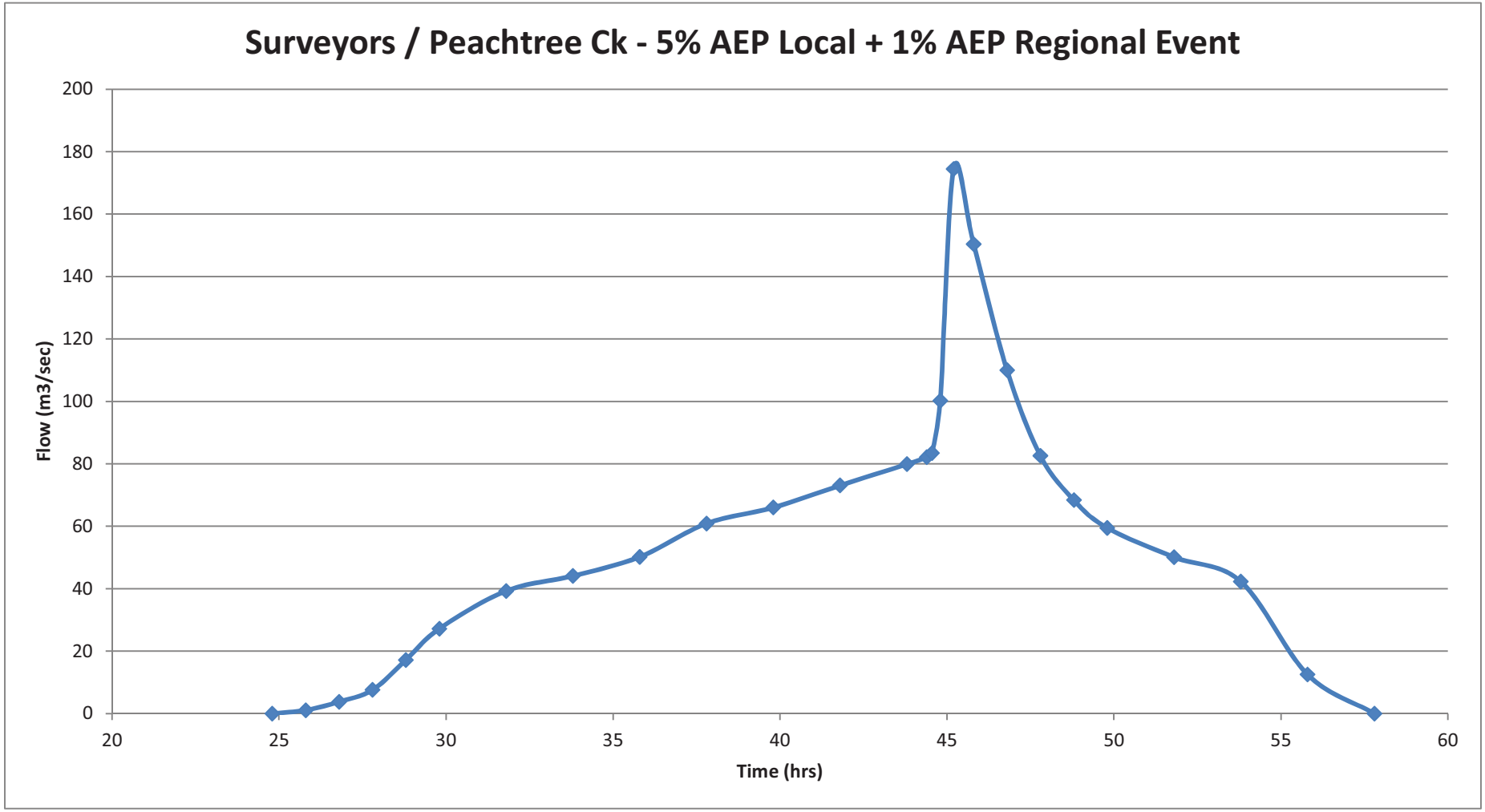
To manage uses to be compatible with flood risks.	The Panthers development land uses are deemed to be compatible with flood risk. All proposed floor levels are to be located above the combined flood event flood level An evacuation strategy was prepared for the Previous Masterplan by Molino Stewart in 2013. A flood evacuation strategy for the proposed ESQ1818 development in the northern portion of the Precinct is provided in Appendix F. Detailed flood response plans will need to be developed to support future development applications.
To enable safe and effective evacuation of land.	Molino Stewart prepared an evacuation strategy for the Previous Masterplan in 2013. A flood evacuation strategy for the proposed ESQ1818 development in the northern portion of the Precinct is provided in Appendix F. Detailed flood response plans will need to be developed to support future development applications.
To ensure the existing flood regime and flow conveyance capacity is not compromised.	A detailed flood assessment has been undertaken for the Panthers Precinct, as described in Section 8 of this report. Flood conveyance is maintained without significantly increasing flood levels for events up to at least the 200 year ARI regional event.
To avoid detrimental effects on the environment that would cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or waterways.	The proposed Panthers development will not significantly alter the existing flooding regime. In areas where the development may result in detrimental impacts, preventative measures are to be incorporated.

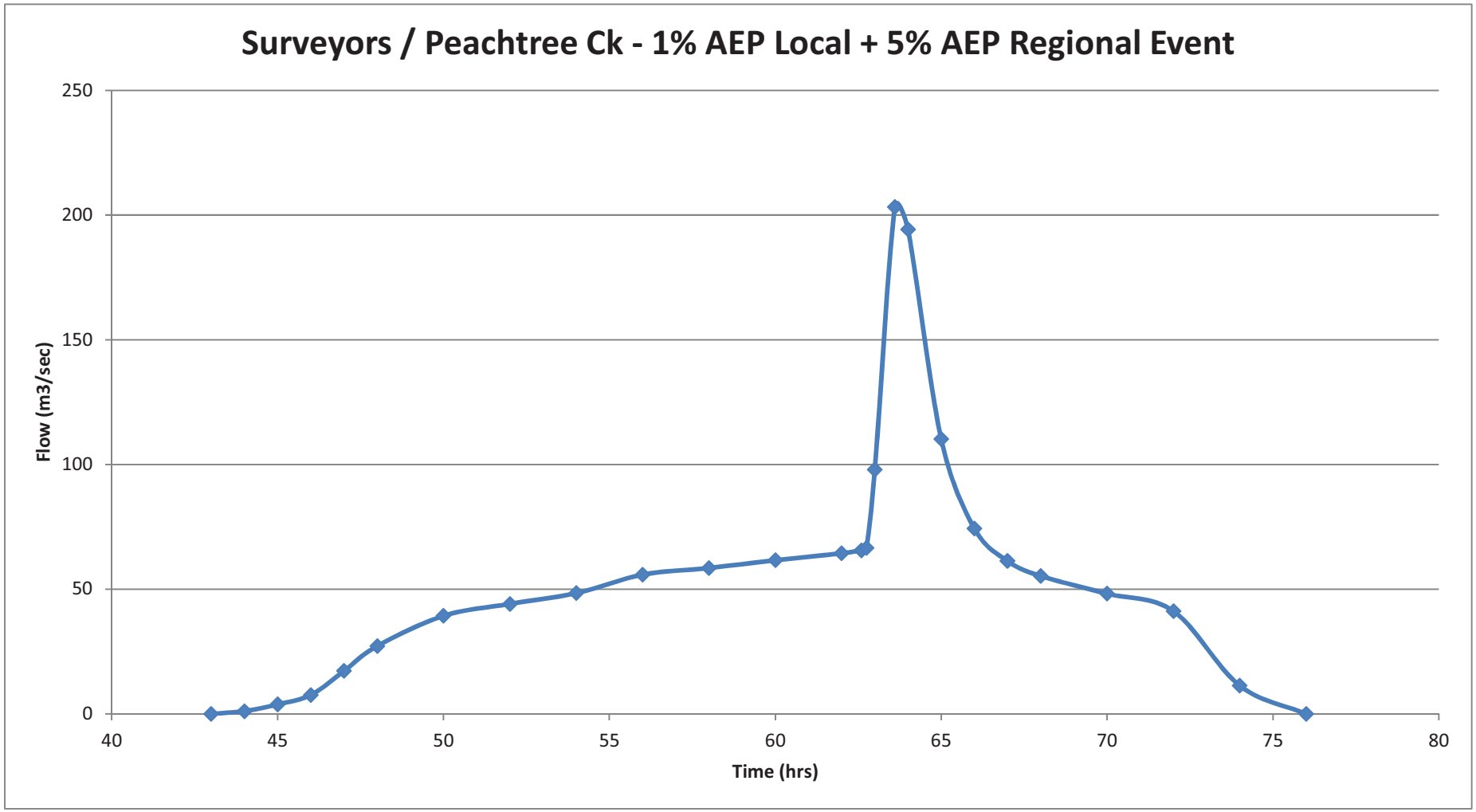
APPENDIX D – INFLOW HYDROGRAPHS

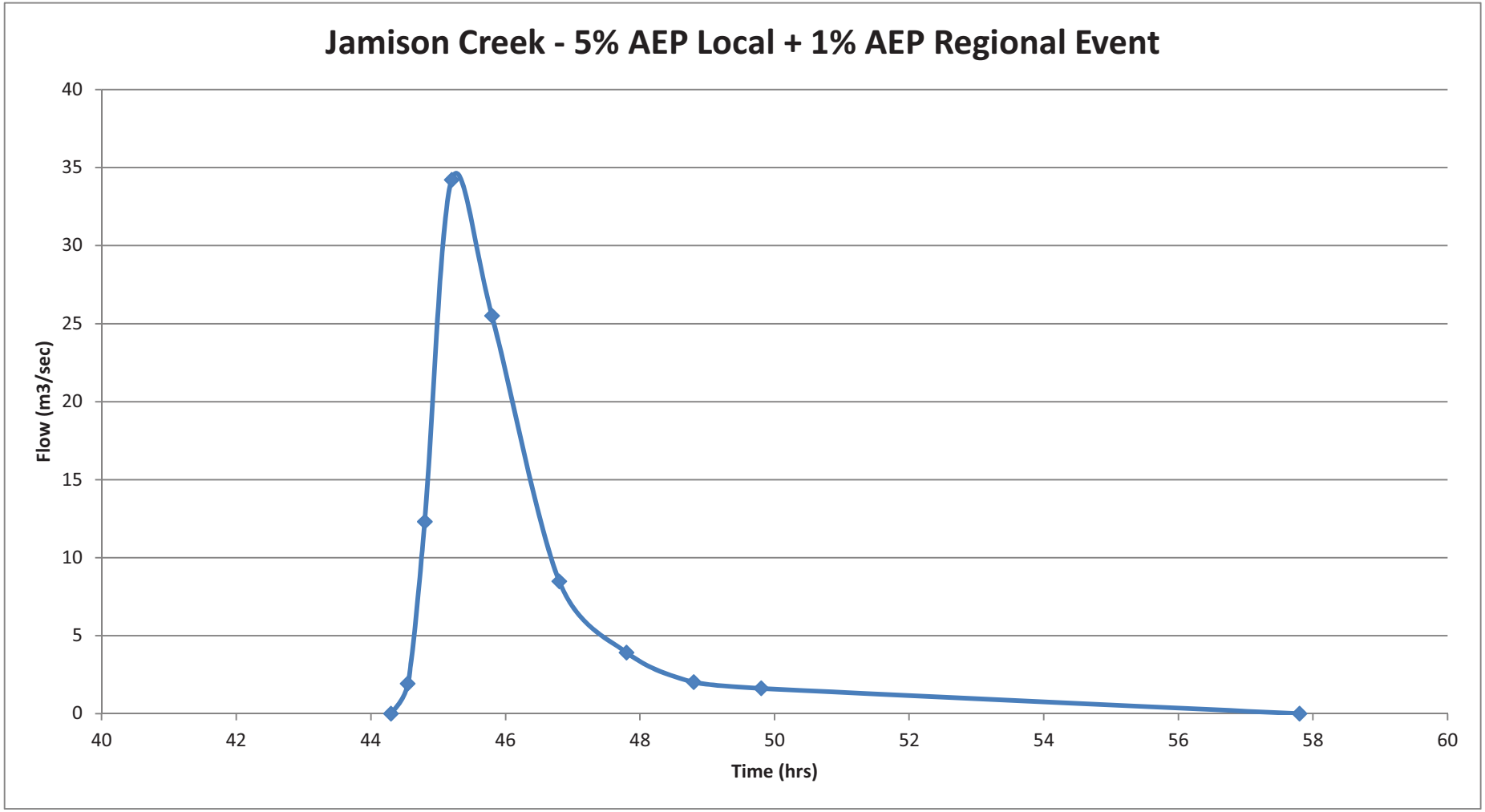

Nepean River Side Flow - 0.5% AEP Regional Event
250
200
150
100
50
0
-50
Flow (m3/sec)
36.5
38.5
40.5
42.5
44.5
46.5
48.5
50.5
52.5
54.5
56.5
Time (hrs)

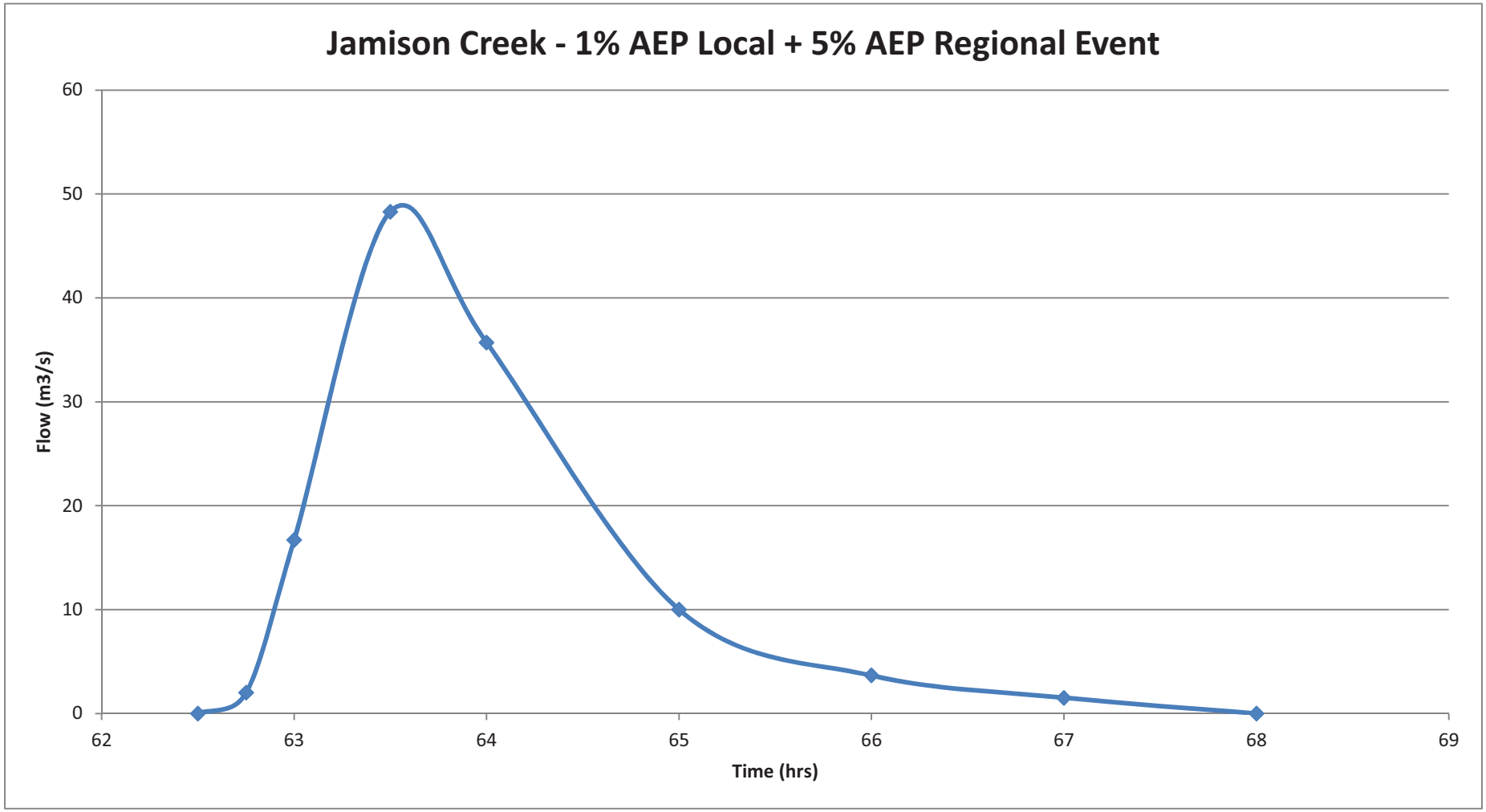

Surveyors / Peachtree Ck - 1% AEP Regional Event
Flow (m3/sec)
60
50
40
30
20
10
0
-10
0
10
20
30
40
50
60
70
80
Time (hrs)

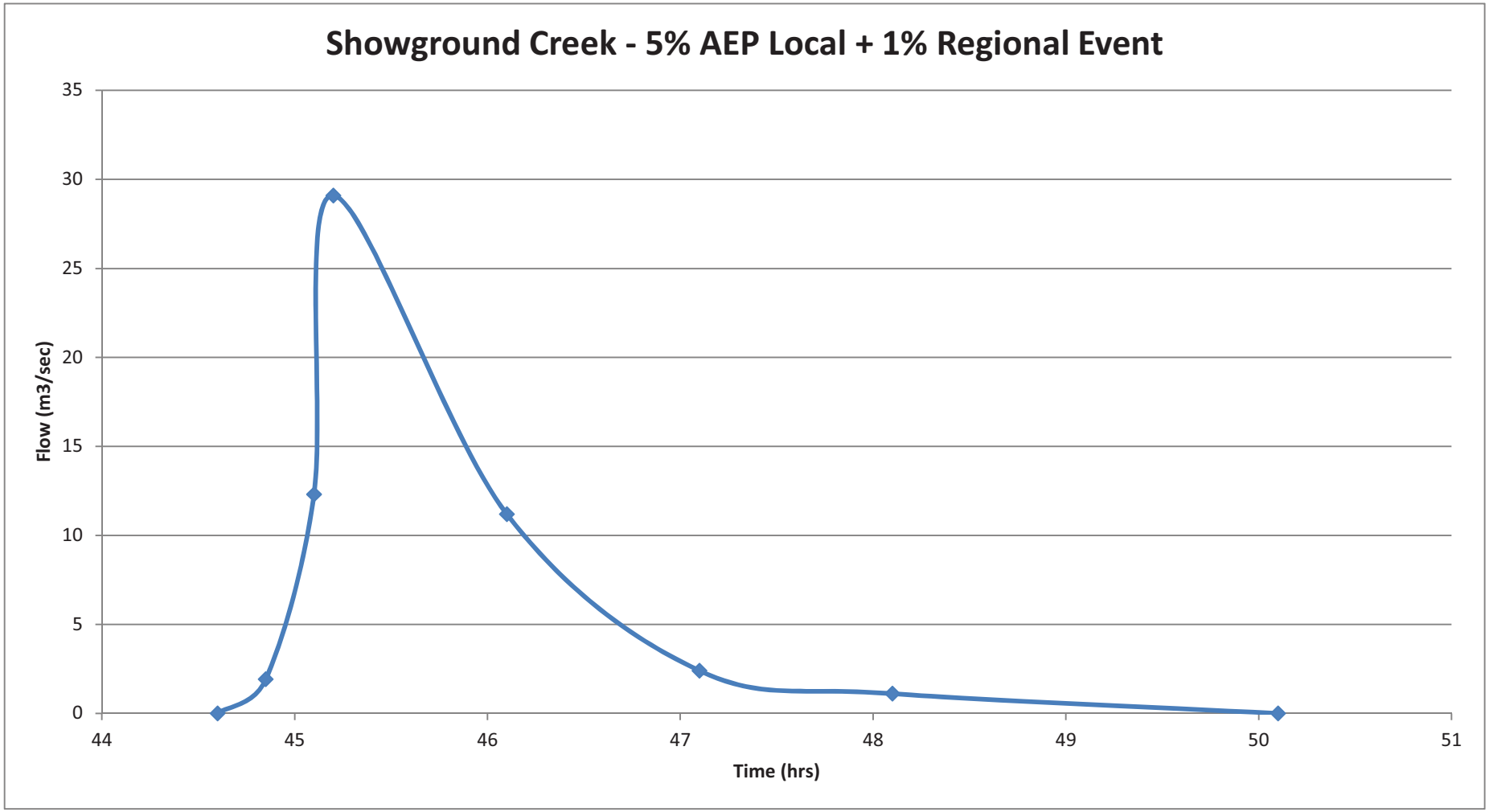

Surveyors / Peachtree Ck - 0.5% AEP Regional Event
500
450
400
350
300
250
200
150
100
50
0
-50
0
10
20
30
40
50
60
70
80
90

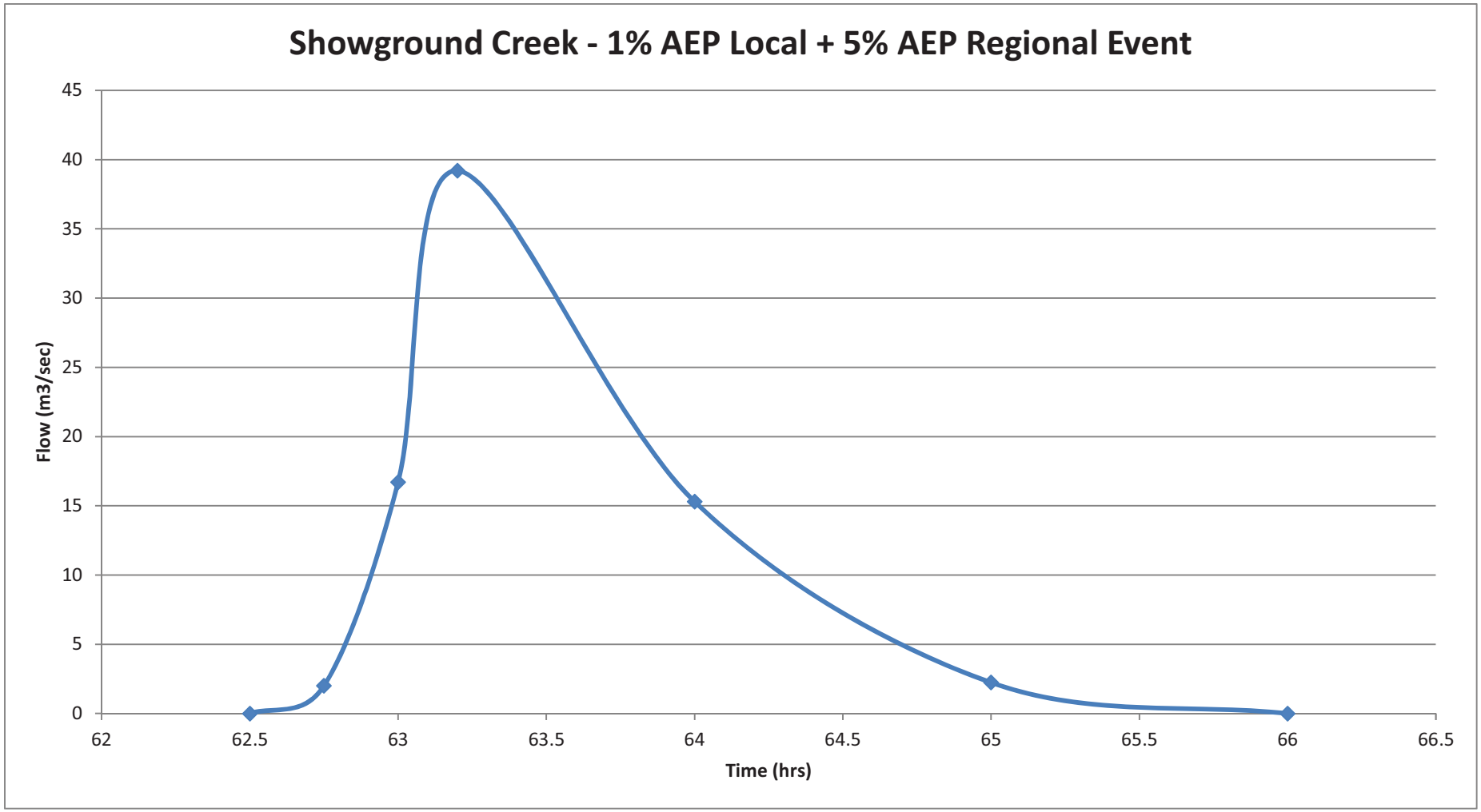

Surveyors / Peachtree Ck - 5% AEP Local + 1% AEP Regional Event
Flow (m3/sec)
200
180
160
140
120
100
80
60
40
20
0
20
25
30
35
40
45
50
55
60
Time (hrs)


Surveyors / Peachtree Ck - 1% AEP Local + 5% AEP Regional Event
250
200
150
100
50
0
Flow (m3/sec)
40
45
50
55
60
65
70
75
80
Time (hrs)


Jamison Creek - 5% AEP Local + 1% AEP Regional Event
Flow (m3/sec)
0
5
10
15
20
25
30
35
40
Time (hrs)
40
42
44
46
48
50
52
54
56
58
60


Jamison Creek - 1% AEP Local + 5% AEP Regional Event
60
50
40
30
20
10
0
Flow (m3/s)
62
63
64
65
66
67
68
69
Time (hrs)


Showground Creek - 5% AEP Local + 1% Regional Event
35
30
25
20
15
10
5
0
Flow (m3/sec)
44
45
46
47
48
49
50
51
Time (hrs)


Showground Creek - 1% AEP Local + 5% AEP Regional Event
Flow (m3/sec)
45
40
35
30
25
20
15
10
5
0
62
62.5
63
63.5
64
64.5
65
65.5
66
66.5
Time (hrs)

APPENDIX E – WORLEY PARSONS TUFLOW MODEL ENDORSEMENT

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resources & energy

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Facsimile: +61 2 8923 6877
www.worleyparsons.com
ABN 61 001 279 812

16 October 2014

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Penrith Rugby League Club Ltd
123 Mulgoa Road
Penrith, NSW 2750

ATT: Ben Bacon

RE: PENRITH PANTHERS MASTER PLAN (PPMP) – FLOOD IMPACT ASSESSMENT - ADDENDUM

Dear Ben,

We are pleased to provide this addendum to our previous letter report on the investigation into determining the flood impacts associated with the proposed Penrith Panthers development site.

The addendum has been prepared in response to some refinements to the TUFLOW model that were identified in the previous letter report. The changes related to more correctly representing boundary conditions for tailwater hydrographs and inflow hydrographs.

The purpose of this brief review is to confirm the suitability of the TUFLOW model in assessing options for the proposed Panthers Master Plan.

Review of Boundary Conditions

Water level hydrographs were extracted from the updated TUFLOW results in waterRIDE™ and reviewed. The shapes of the 100yr and 200yr ARI hydrographs match the data that was provided to JWP on August 19, 2014. However there is a small difference of 2cm in the peak 100yr level with the TUFLOW model being lower. The 200yr results have equivalent peak tailwater levels.

The very flat water gradients through Peachtree Creek would likely see any small change in tailwater levels reflected across the floodplain surface within the TUFLOW model extents, and given that options assessment will be based on relative changes, this issue should not have any influence on outcomes.

Considering the accuracy of extracting flows from 2D model results, the correct magnitudes for the peak flows at the upstream and western lateral boundary (*200yr only*) agree with the data provided in August. However it is noted that the upstream boundary flows are concentrated within Peachtree Creek, rather than being distributed across the floodplain boundary. This leads to increased velocities within the TUFLOW model.

Review and Comparison of Results

200yr ARI Design Flood

The 200yr ARI design flood results from the RMA and TUFLOW models have been compared using a common profile along Peachtree Creek, **Figure 1** and the following points can be noted:

- Firstly, a comparison between the original (*previous*) TUFLOW results and the recently updated results for the proposed case, clearly shows the effect of the adjusted tailwater conditions. The tailwater was lowered by 0.24m and this difference is reflected throughout the profile within a centimetre or two (*average of 0.2403m*).

- Secondly, the two TUFLOW Original profiles (*existing and proposed*), show the influence of the proposed development with a slight increase in the water surface gradient leading to the 3cm difference outlined in the previous letter. This difference is likewise reflected in the two RMA profiles (*existing and proposed*), with an equivalent increase in water level at Jamison Road.

- Finally, a comparison between the TUFLOW Updated model and the RMA model results for the proposed case shows the equivalent tailwater level with a steeper backwater gradient leading to higher absolute flood levels at Jamison Road. Since the flow magnitudes are equivalent for both models, the increased backwater slope can only be explained through velocity, roughness and terrain differences.

  The majority of the landscape along the main flow corridor through the creek is grass and has been represented with a Manning's 'n' roughness of 0.030 and 0.035 in the RMA model. The TUFLOW model has a higher roughness of 0.06 which would explain the steeper gradient.

  The terrain for both models is based on Council's LiDAR data, however the TUFLOW model has a finer mesh capable of capturing more detail. A review of 6 cross-sections normal to the flow (*200yr ARI*), from Jamison Road downstream to just past the sub-station, **Table 1**, shows the increased conveyance area in the TUFLOW model moderated by some variation in the terrain. The reduced terrain capacity at the downstream end and in the middle reach for the TUFLOW model may be influencing the increased backwater gradient.

  As indicated in the boundary condition discussion above, the TUFLOW model has increased velocities resulting from the confined distribution of upstream boundary inflows. A velocity profile along the creek, **Figure 2**, clearly shows the significant increase in velocity in the TUFLOW model down to the vicinity of the ski lake, and then a smaller increase along the remainder of the profile down to the Great Western Highway. Since water surface slope is proportional to the square of velocity, these increased velocities in the TUFLOW model may explain or partly explain the backwater differences, along with the differences in roughness.

Table 1- Comparison of TUFLOW conveyance and terrain capacity with RMA

Cross-section	Chainage	Conveyance Area (TUFLOW – RMA)	Area Above Bed (TUFLOW - RMA)
Across Jamison Road	160m	+8%	0%
Downstream of ski lakes	430m	+12%	+4%
Middle of Panthers lake	690m	+3%	-8%
Downstream end of Panthers lake	840m	+2%	-6%
Downstream of Sub-station	1140m	+6%	-1%
Downstream end of TUFLOW model	1430m	-3%	-13%

100yr ARI Combined Design Flood

The 100yr ARI design flood results from the RMA and TUFLOW models have also been compared using a common profile along Peachtree Creek, **Figure 3** and the following points can be noted:

- Firstly, a comparison between the original (*previous*) TUFLOW results and the recently updated results for the proposed case, clearly shows the effect of the adjusted tailwater conditions. The tailwater was lowered by 0.09m and this difference is reflected throughout the profile within a centimetre (*average of 0.092m*).

- Secondly, a comparison between the TUFLOW Updated model and the RMA model results for the proposed case shows the equivalent tailwater level with a steeper backwater gradient upstream of the NRL Academy, leading to higher absolute flood levels at Jamison Road. Similar to the 200yr results, the increased backwater slope can only be explained through velocity, roughness and terrain differences.

  The 100yr velocity comparison, **Figure 4**, also shows some increased velocities in the TUFLOW results upstream of the NRL Academy, although not as dramatic as the 200yr differences where the total flow is much greater. The ratio of water surface slopes is proportional to the square of the ratio of the roughness values, and the increased slope of the TUFLOW results upstream of the NRL Academy can readily be explained by the difference in roughnesses.

- Finally, notwithstanding the increased absolute levels upstream of the NRL Academy in the TUFLOW model, the increases resulting from the proposed development are equivalent for both models and vary between 0 and 2 cm, **Figure 3**

TUFLOW Confirmation

The updated TUFLOW model with the corrected boundary conditions provides a closer agreement with the RMA model. Further corrections to the distribution of inflows across the upstream TUFLOW model boundary together with adjustments to roughness values would alleviate any issues related to the velocity differences and may see even closer agreement. The refined mesh of the TUFLOW model may well be related to some of the backwater slope differences and thus be providing a more realistic outcome for the local area covered by the TUFLOW model.

Notwithstanding these differences between the two models, they both predict equivalent impacts upstream, and thus the TUFLOW model can be confirmed as being suitable for assessing the impacts of the various options being proposed as part of the Panthers Master Plan.

We trust that this report addresses your requirements

Yours faithfully
WorleyParsons

David McConnell
Principal Consultant

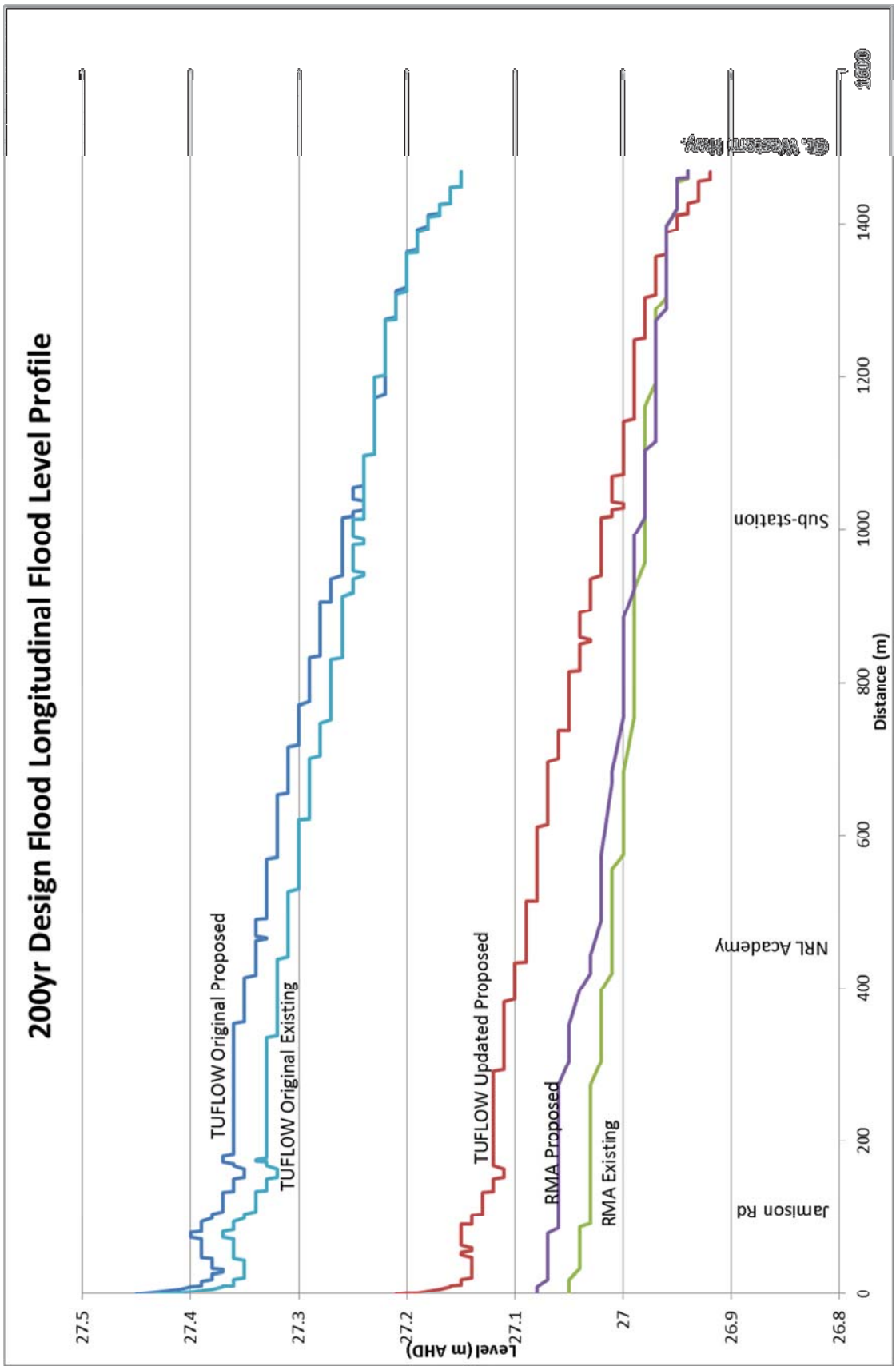


Figure 1: 200yr ARI flood profiles along Peachtree Creek

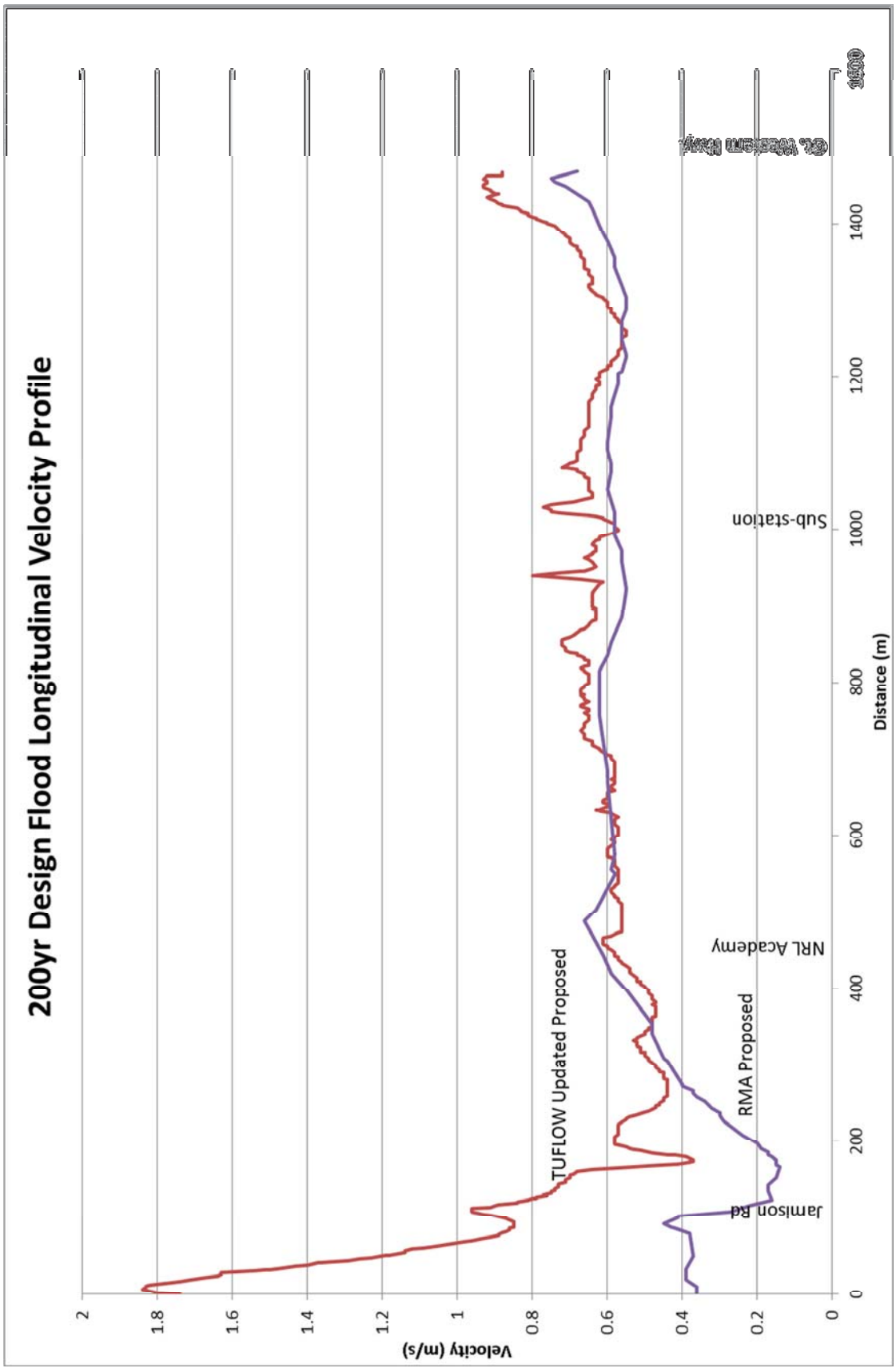


Figure 2 - 200yr ARI velocity profiles along Peachtree Creek

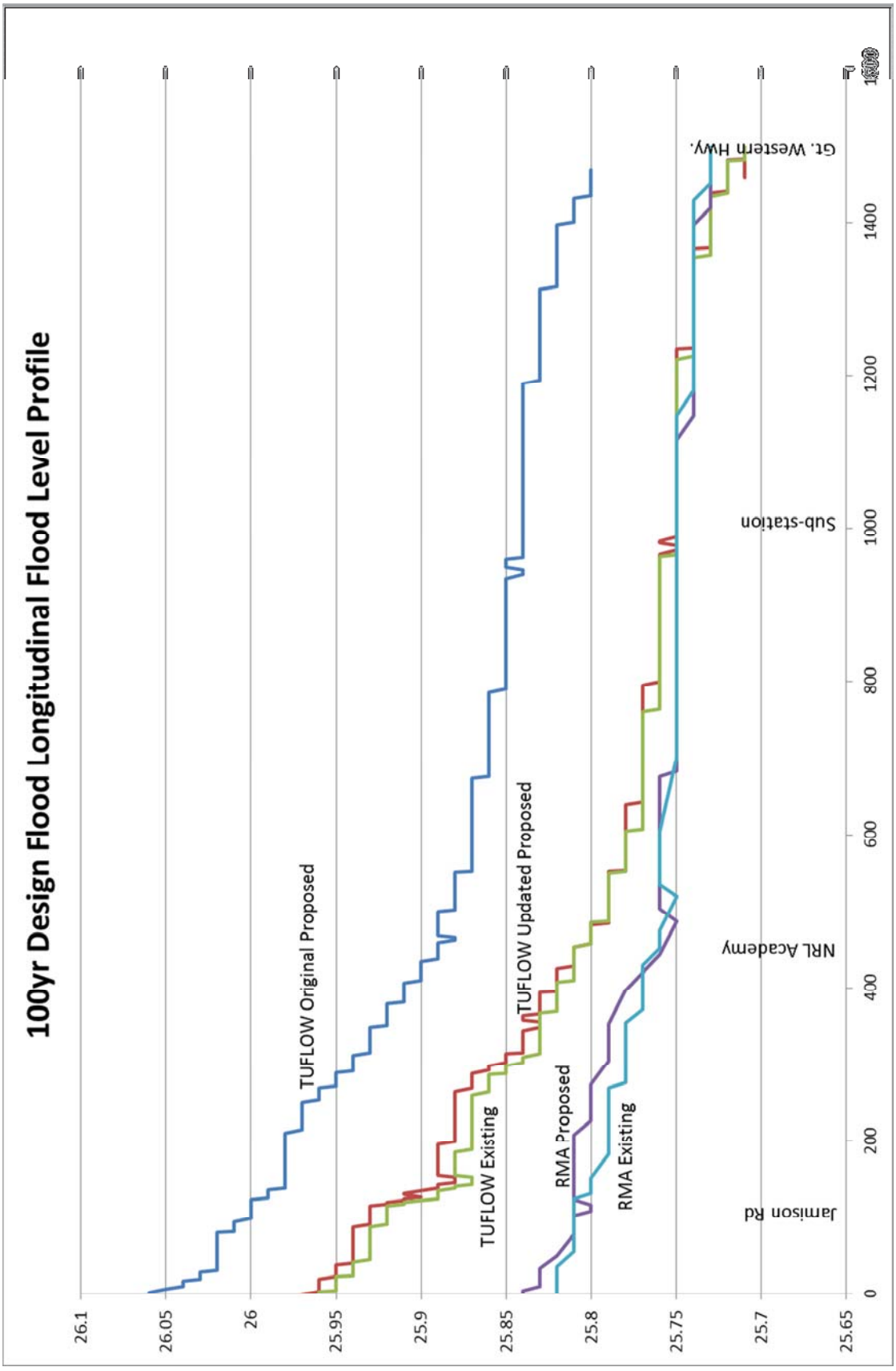


Figure 3 - 100yr ARI flood profiles along Peachtree Creek

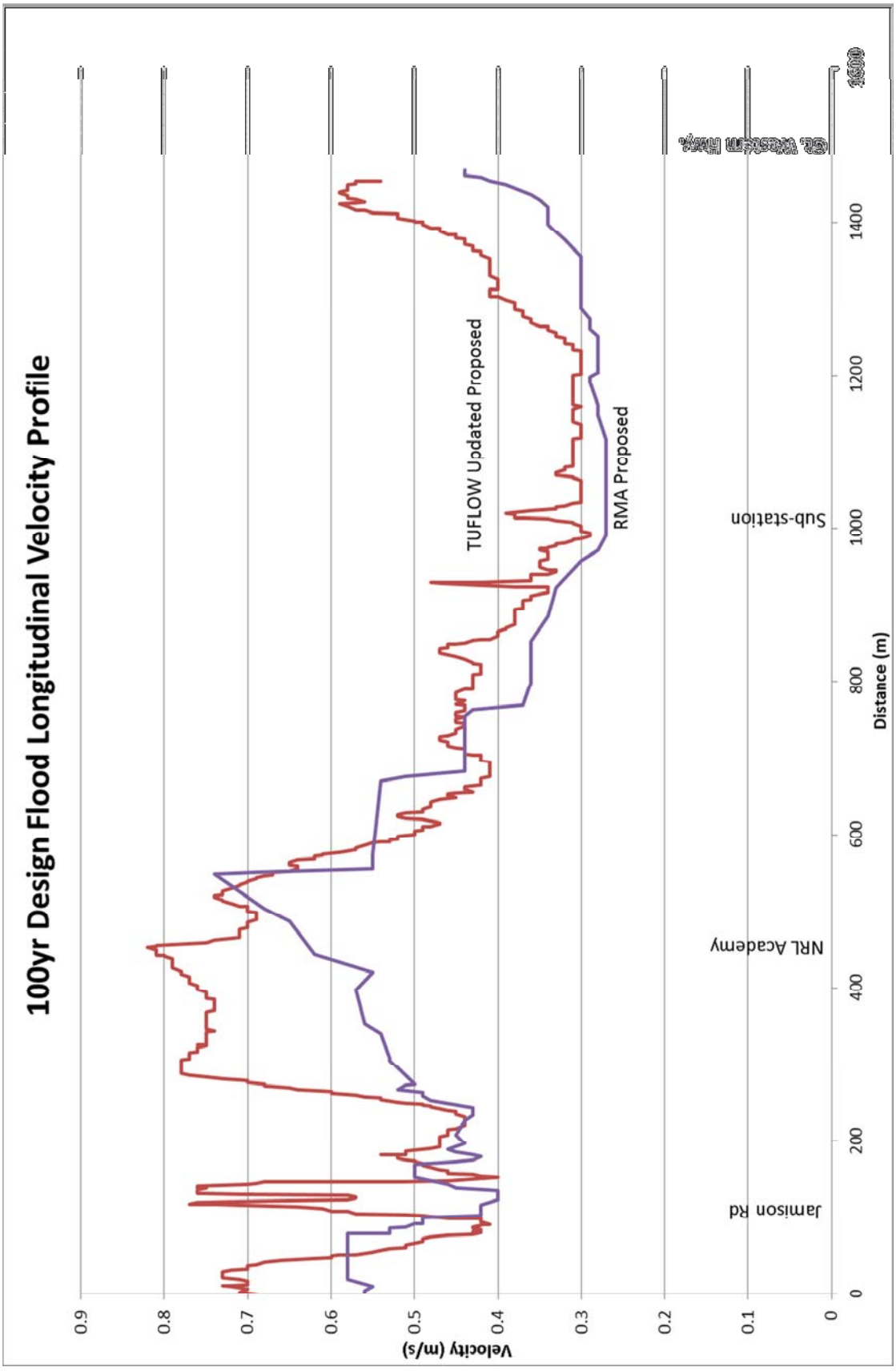


Figure 4 - 100yr ARI velocity profiles along Peachtree Creek

APPENDIX F – ESQ1818 FLOOD EVACUATION STRATEGY

EMCORPGROUP

RISK | RESPONSE | TRAINING | TECHNOLOGY

Client: ESQ1818 Panthers Pty Ltd

Service: Flood Evacuation Plan

Site: Penrith Residential Precinct



09-02-16

ESQ1818 Panthers Pty Ltd
Joe Bevacqua
Development Manager

Dear Joe

Emcorp was engaged by ESQ1818 Panthers Pty Ltd to develop a flood evacuation plan (FEP) for the mixed use development, ESQ1818. The plan covers the full range of operating procedures in response to a large flood that may require a full evacuation of the building contractors and later, the residents, of the precinct. The report also references the Hawkesbury-Nepean Valley Flood Management Review Stage One – Summary Report, developed by the NSW Dept. of Primary Industry in March 2014.

ESQ1818

The FEP supports the Flood Response Plan developed by the Panthers Group for the Panthers Precinct by environment and natural hazards consultancy Monino Stewart Pty Ltd in June 2014. The FEP expands upon the FRP and identifies the procedures for your building contractors during the build phase and then residents after handover that may require full evacuation. The report focuses upon estimated numbers and their related modes of transport for building contractors and then residents, the routes and estimated vehicle numbers, distances and time frames.

Company Overview

Emcorp has provided risk management consulting services to commercial industry since 2003. It is a vetted risk management partner of QBE insurance for the Asia Pacific Region. The author of this document, Brett Stevens, possess a background in policing, industrial fire rescue, the military, medical and emergency management. Supporting development was Richard Stevens, who possesses a background in policing and specialist government fire rescue and hazardous materials areas, in addition to emergency management.

Yours sincerely,



Brett Stevens
Director Operations

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e: bstevens@emcorp-group.com
p: PO Box 748, Bondi Junction NSW Australia 2022
a: Sydney Office: Suite 2201, Level 22, Tower 2
Operate in all States & Asia Pacific Locations

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AUTHORISATION

The following Plan has been authorised by the following:

APPROVED: …….

Mr. Joe Beacqua
Development Manager
2-8 Brookhollow Avenue
Baulkham Hills NSW 2153

Date: ……..

DISCLAIMER

This document may only be used for the purpose for which it was commissioned and in accordance with the contract

The scope of services was defined in consultation with ESQ1818 Panthers Pty Ltd, by time and budgetary constraints agreed to be the client and Emcorp, and the availability of reports and other data on the subject area. Changes to available information, legislation and schedules are made on an ongoing basis and readers should obtain up to date information.

Emcorp accepts no liability or responsibility for or in respect of any use of or reliance upon this report and its supporting material by any third party. Information provided is not intended to be a substitute for legal advice in relation to any matter. Unauthorised use of this report in any form is prohibited.

Introduction

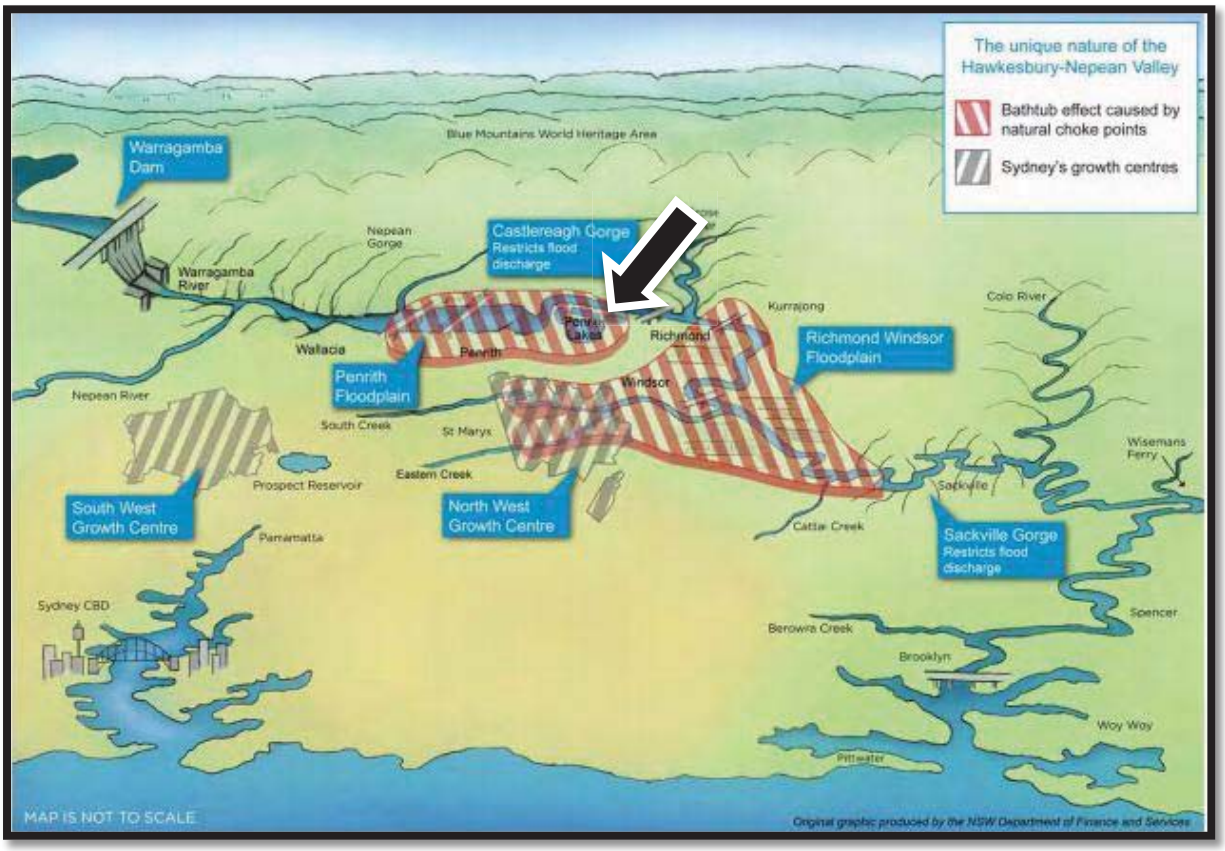
- Due to the commercial building development of Nepean river Penrith flood plan by various entities the Penrith City Council requires developers to provide a flood evacuation plan for the build phase and ongoing occupation phases of the project.

- This is in addition to other government agency plans, such as the NSW HEALTHPLAN, which requires all public hospitals and health care facilities to develop and maintain disaster plans for major incidents. This includes planning for the evacuation of the facility and / or management of an internal emergency, i.e.: flood, bush fire, power outage.

- As such, and in accordance to both Council and NSW Health requirements, Emcorp has developed and trained organisations that are both current and future occupants of areas adjacent to the proposed ESQ1818 Pty Ltd project and within the flood plain. It should be noted that these two companies, SummitCare and Tulich Project Management, are aged care companies that required complex evacuation procedures due to the high incidence of ambulatory residents.

- As a result, this plan will establish a review of the risk of flood to the area as advised by the Department of Primary and Industry and the preparation of an evacuation process for the building contractors followed by the residents upon handover.

- The plan acknowledges the areas under threat, the first is the 1 in 100-year flood zone and the 1 in 200-year flood zone. Estimated warning times designated by experts cover a 7-hour period for evacuees to be warned and conduct an evacuation of the designated areas.



Above: the two main flood plans in the Hawkesbury-Nepean Valley

Background

- This Flood Management Plan (FEP) has been developed in consultation with the ESQ1818 Senior Management Team. This FEP outlines step-by-step procedures that include the planned transition of building contractors to residents requiring evacuation from this area in the event of an imminent flood warning.

- For the purpose of this plan, the decision to evacuate offsite for any local emergency will be made by the appropriate external emergency services agency, dependent on the type of incident.

- Further information on emergency management can be found on the Emergency Management Australia website – http://www.ema.gov.au/. Additionally, the Hawkesbury-Nepean Valley Flood Management Review Stage One – Summary Report, developed by the NSW Dept. of Primary Industry in March 2014 outlines the mass evacuation processes and systems.

- All members of the Senior Management Team take responsibility to ensure they are well versed in the procedures to put each phase of the plan into action and acknowledge that staff, contractors and residents require consideration.

Scope

- This FEP covers all operational roles and responsibilities in the event of a major flood. The plan will be activated and implemented immediately an official notification is received or made.

Review of Procedures

- These procedures will be tested and reviewed internally on an annual basis and with other members of the designated Emergency Planning Committee or following an evacuation event, whichever occurs earlier.

Emcorp Experience

- Emcorp has developed emergency and mass evacuation procedures for both flood and bushfire. Our development team possess real time experience in dealing with a range of emergency related incidents, that in some cases have required mass evacuations.

- In the case of SummitCare, Emcorp assisted the crises management team move two hundred aged care residents were evacuated from the blue mountains in 2014 due to the threat of bushfires.

- In 2011, Emcorp trained Toowoomba QIC shopping centre staff and local emergency services in flood disaster response and recovery prior to the floods. That same year it provided specialist personal to Brisbane businesses attempting to recover from the floods due to contaminated food stuffs and the release of H2S gas within the lower areas of buildings.

- Since 2010, Emcorp has trained the Starwood chain of hotels throughout the Asia Pacific in the area of incident command and control. This scenario based training has included cyclones and major flooding issues.

- Since 2003, Emcorp has provided procedural development and conducted real time crisis management exercises for commercial and construction entities. These have often been linked to real time site evacuation drills and incorporated responses by the emergency services as a test and evaluation of capability, procedures and communications.



Above: Brisbane river flood 2011

A: ESQ1818 – Long Overview



B: ESQ1818 – Close Overview



NEPEAN RIVER FLOOD HISTORY

The Nepean River has experienced a major flood at least once every decade since records began in 1799. In the largest flood of record -- which occurred in June 1867 -- flood waters reached approximately 12 metres higher than the deck of the present-day Windsor Bridge. The 1 in 100-year flood level used by Penrith Council is 26.1m AHD (Australian Height Datum) at Victoria Bridge, Nepean River Penrith. Penrith City Council Flood Management Plan estimates that a 1 in 100-year would reach the first stage precinct west of Retreat Drive and the 1 in 200-year flood east of Retreat Drive.

FLOODING RATES & TIMINGS

The rate at which this water rises will vary depending on how big the flood is and how quickly the rain is falling. The NSW SES plans its vehicular evacuation of the Hawkesbury Nepean Valley around an average rate of rise of about **0.5m per hour** and pedestrian evacuation around a rate of rise of about **1.5m per hour**.

Floods could rise more slowly than but it is appropriate to plan around these rapid rates of rise as they are quite possible. A time frame of **7 hours** for the evacuation to be completed as been determined by local authorities but in the event of an immediate event residents can evacuate in place to upper levels of the 4 story building.

It should also be noted that when the site is flooded from the Nepean River via Peach Tree Creek, the peak at the site will occur sometime after the flood has peaked at Victoria Bridge because of the time it takes the flood peak to travel downstream from the bridge and then back up Peach Tree Creek.

PENRITH CITY COUNCIL EMERGENCY CONTACT

Mr. Laurie Cafarella Community Protection Coordinator
Phone: 02 4732 7618
Mobile: 0417 060 815
Email: lcafarella@penrithcity.nsw.gov.au
For all flooding and emergency related incidents call Penrith City Council: 02 4732 7777

A: Below: approximate 1 in 100-year flood affecting ESQ1818



B: Below – approximate 1 in 200-year flood affecting ESQ1818



PENRITH RESIDENTIAL PRINCINCT ROAD SYSTEM



- ESQ1818
- Retreat Drive
- Ransley Drive
- Mulgoa Road
- Jamison Road
- Henry St

Roundabout overview

Traffic exiting Retreat Drive, a dual north/south single lane carriageway turns east into Ransley Drive, a dual west/east double lane street. Traffic can continue or turn north or south on to Mulgoa Road, a dual double lane main arterial road.



Street level images

- **Retreat Drive**



- **Roundabout**

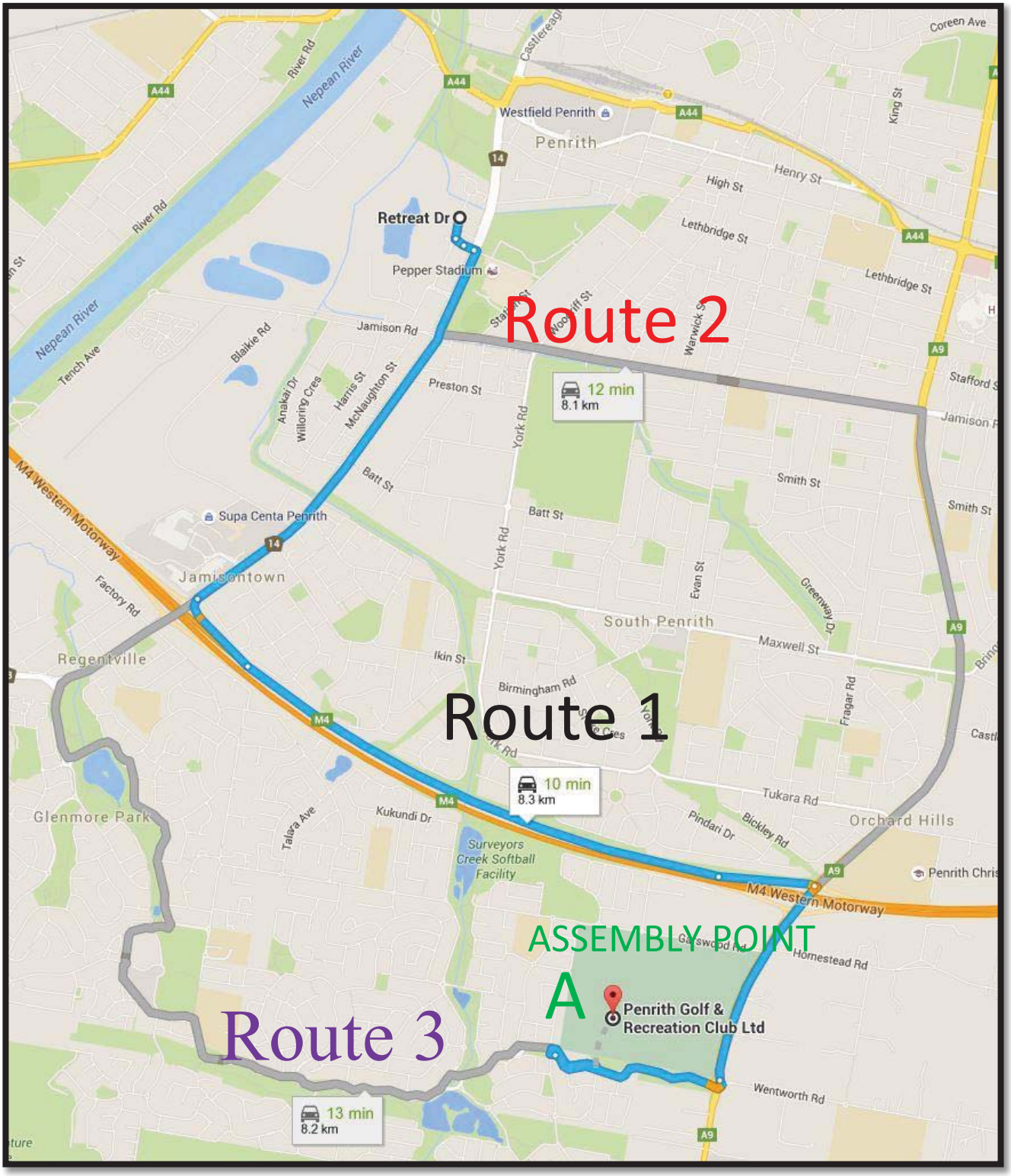


- **Ransley St leading to Mulgoa road intersection**



EVACUATION ROUTES FROM PRP

Retreat Drive to Penrith Golf Club approx. **8 km. 10-minute** by motor vehicle
Note: there are three routes that can be taken to the assembly area
All three are about the same distance and time frame by vehicle



SENIOR MANAGEMENT CONTACT SHEET

These staff should be contacted immediately in case of emergency

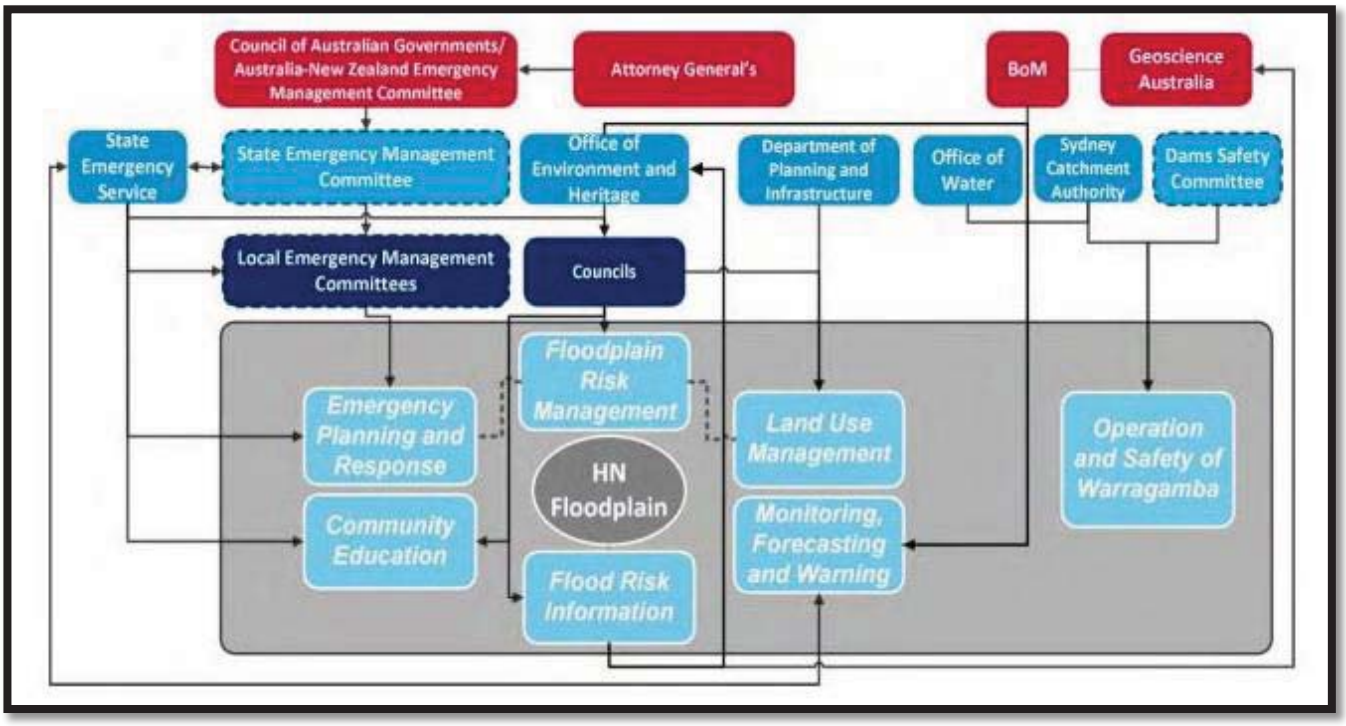
POSITION	NAME	CONTACT NUMBERS OFFICE	MOBILE
Gabe Pty Ltd. Project Manager			
Gabe Pty Ltd. Evacuation Leader			
Gabe Pty Ltd. Evacuation Coordinator			
Penrith Precinct Site Chief Warden			
Penrith Precinct Deputy Chief Warden			

LOCAL EMERGENCY & UTILITY SERVICES

CALL 000 IF YOU NEED FIRE, AMBULANCE OR POLICE SERVICES IN AN EMERGENCY

Penrith State Emergency Service for emergency help in floods or storms	132 500
Penrith Fire Brigade - Fire Calls: Ring 000	4721 5575
Electricity – Integral Energy	132 090
Sewage/Water – Sydney Water	132 090
Penrith City Council Flood contact	132 090

Current flood risk management arrangements in the Hawkesbury-Nepean Valley



Ref: Department of Primary Industries report. Figure 4

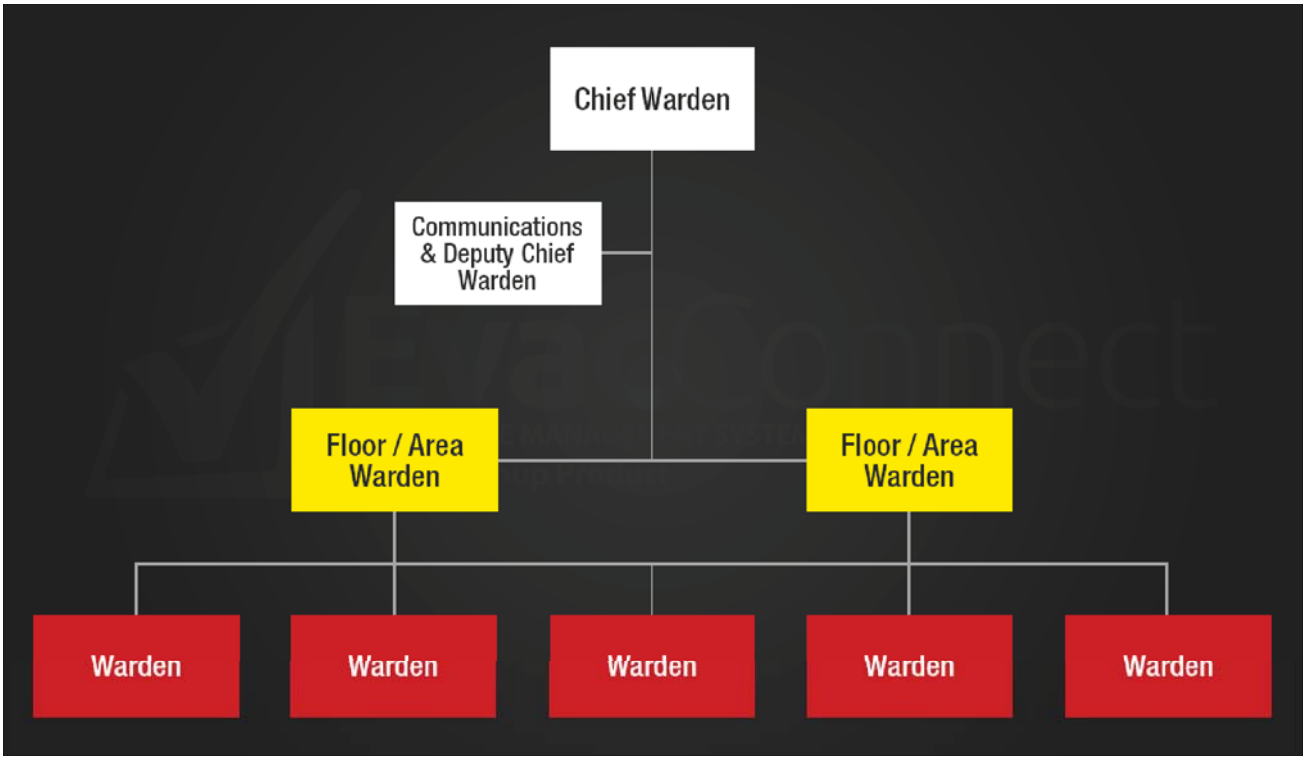
STANDARD OPERATIONS PROCEDURES – CONSTRUCTION PHASE

Emergency Planning Committee

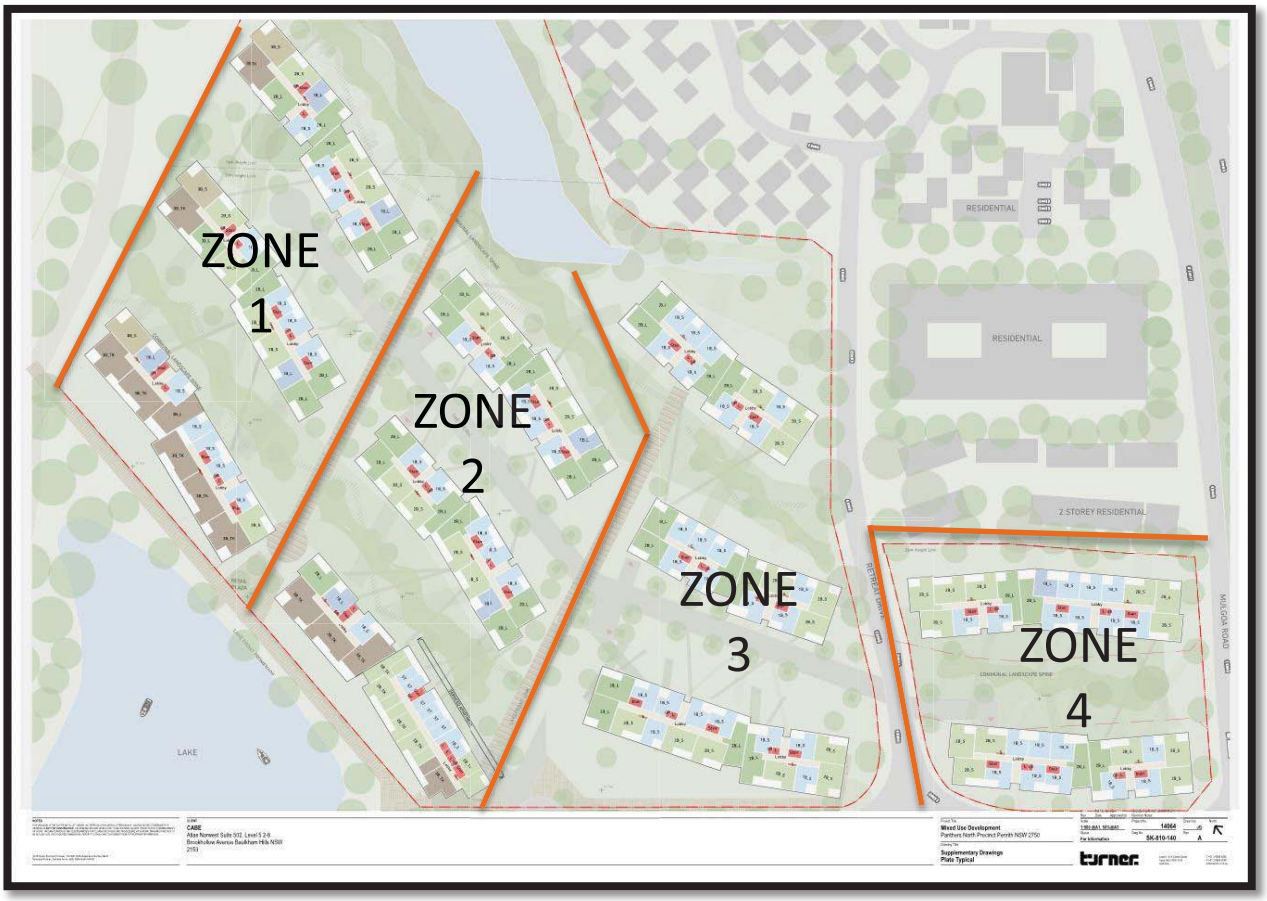
- ESQ1818 Panthers Pty Ltd will establish an Emergency Planning. The EPC will meet at the commencement of the building phase and annually or as required, thereafter.
- The EPC will establish an evacuation team
    - Evacuation Leader – ESQ1818 manager
    - Evacuation Coordinator – ESQ1818 manager
- The EPC will also establish a site Emergency Control Organisation (ECO)
- EPC to identify mobility impaired persons working on site
- EPC to ensure a PEEP form (Personal Emergency Evacuation Plan) is completed
    - Emcorp to provide templated form
- The ECO will be made up of local site ESQ1818 staff and contractors as required
- Standard emergency procedures will be provided
- The ECO will reflect the structure below
- Communication methods and numbers will be confirmed upon deployment
- Training in AS3745-2010 will be conducted to ensure that the system is in place
- A test evacuation will be conducted shortly after the commencement of works
- Upon observation or notification from the authorities, the ECO shall coordinate the evacuation of all site staff and contractors to the designated assembly point.
- Area wardens will ensure that their various designated zones are cleared
- This is reported to the Chief Warden
- The ECO Chief Warden, shall liaise with the emergency services and confirm to both ESQ1818 head office and the emergency services upon the precinct being cleared.

Emergency Control Organisation

Established with onsite staff and contractors



Area Warden Zones – Construction Phase



Local Assembly Point is in the 1-200-year zone. – Construction Phase



FLOOD MANAGEMENT – EXTERNAL– Construction Phase

Key Considerations

- Flooding or potential flooding of the residential precinct or part of the precinct with water from an external source such as flash flooding of Prospect Creek, pipeline failure or dam failure.
- These following procedures should be used as a guide and may not be suitable for all circumstances.
- Some procedures may need to be undertaken simultaneously.
- Before taking any action, identify the hazards, assess the risk and consider the consequences.

Trigger

- Prolonged rainfall, downpour, dam, weir or levy failure, water main failure etc.

Warnings

1. Beware wet and slippery floors. Waters may be energised with electrical current.
2. Water may be contaminated with chemical and biological hazards.
3. Do not enter floodwaters because you cannot see what is beneath the water.
4. Flood depths and speed can be deceptive and floodwaters may contain hazardous materials (e.g. raw sewage, chemicals) as well as spiders and snakes.

Normality may be restored when:

- Flood waters recede, disaster recovery measures and repairs are completed and the precinct is reoccupied.



Before and During the Flood – Checklist– Construction Phase

- ☐ See Discovering an Emergency.
- ☐ Tune radio to local media.
- ☐ Tell staff of the likelihood of a flood and of the need to stay in the building if flooding occurs.
- ☐ Tell staff that are away from the premises to shelter in a safe location away from the affected area and not to return until flood waters recede.
- ☐ Raise stock, records, equipment, chemicals, waste e.g. by stacking them on benches and tables well above floor level.
- ☐ Shelter in the highest part of the building if possible.
- ☐ Remind staff of WHS procedures and added risks of manual handling and working in darkness.
- ☐ If you are asked to evacuate, leave before floodwaters arrive and shelter at an appropriate place on higher ground away from creeks and drains.
- ☐ Never drive, ride or walk through floodwater.
- ☐ If you are asked to evacuate shut off electricity, gas and water supplies and secure building.
- ☐ Do not leave the facility until floodwaters have receded.
- ☐ Do not use lifts or escalators during a flood.



After the Flood - Checklist– Construction Phase

- ☐ Salvaged material and documents should be relocated to a well-drained, ventilated, sheltered area where they will not cause further damage.
- ☐ Undertake an WHS risk assessment before entering the flood damaged part of the premises, inc;
  - -Structural safety of buildings.
  - -Safety of electricity and gas supplies and equipment.
  - -Slips, trips and falls particularly with mud and water.
  - -Venomous spiders and snakes.
  - -Sharp debris.
  - -Manual handling and lifting.
- ☐ Clean up in accordance with WHS procedures e.g. wear protective clothing including enclosed, waterproof, non-slip footwear and waterproof, puncture-resistant gloves.
- ☐ Ensure occupants wash properly after cleaning flood damage.
- ☐ Clean and dry as much stock, plant, equipment, fittings and furniture as is salvageable.
- ☐ Remove debris and clean, repair and disinfect premises.
- ☐ Restore critical records, cash and computer files.
- ☐ Implement any reciprocal help agreements.



FLOODING (Internal) – Construction Phase

Key Considerations

- A large quantity of water outside its normal containment with the potential to cause damage, such as internal pipes, water mains or drainage systems on or near the property.
- These procedures should be used as a guide and may not be suitable for all circumstances.
- Some procedures may need to be undertaken simultaneously.
- Before taking any action, identify the hazards, assess the risk and consider the consequences.

Trigger

- Severe weather, structural failure, plumbing failure, services failure, plant failure.

Warning

1. Beware wet and slippery floors.
2. Pools of water may be energised with electrical current.
3. The quantity of water may exceed the buildings load bearing capacity and cause structural failure. Water may be contaminated with chemical and biological hazards.

Normality may be restored when

- The cause of flooding has been isolated, recovery operations have concluded and there is no risk to occupant safety.

Can this procedure be challenged?

- Limited aspects may be challenged through desktop exercises and simulations.



During the Internal Flood – Checklist – construction phase

- ☐ See Discovering an Emergency.
- ☐ If there is significant or uncontrolled flooding or any electrical hazard call Fire Rescue.
- ☐ If affected, do not use lifts or escalators.
- ☐ If possible use local control valves to isolate source of flooding.
- ☐ If necessary use main control valve to isolate source of flooding.
- ☐ Check for flooding on and water draining to lower levels.
- ☐ Isolate power to affected area.
- ☐ Provide gloves and other necessary PPE for persons exposed to flooding.
- ☐ Raise stock, records, equipment, chemicals, waste e.g. by stacking them on benches and tables.
- ☐ Use squeegees, towels and other absorbents to contain and direct flow to drains, exits and the facility's exterior.
- ☐ Use mops, buckets and other absorbents to remove floodwater.
- ☐ Salvaged material and documents should be relocated to a well-drained, ventilated, sheltered area where they will not cause further damage.



Evacuation Roles & Responsibilities – Construction Phase



Appointing an Evacuation Team

Gabe Pty Ltd should designate members of your team to take on key roles and responsibilities for a safe, orderly and coordinated evacuation. The roles are:

- Evacuation Leader - Designated Gabe staff member
- Evacuation Coordinator – Designated Gabe staff member
- Chief Warden
- Deputy Chief Warden
- Area Wardens

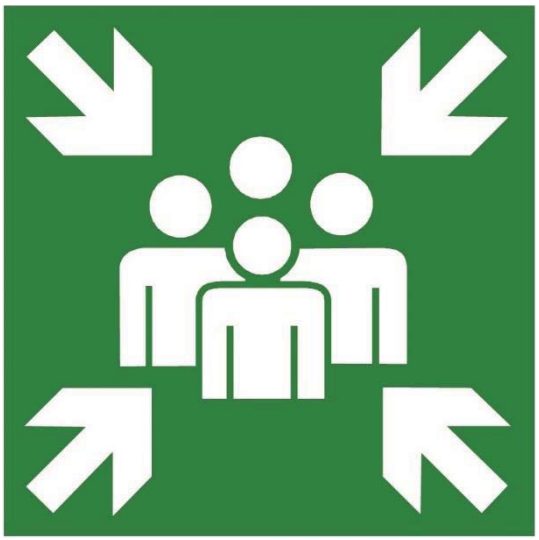
Evacuation Leader

- Alert emergency services to the emergency, request their assistance and provide them with information re the emergency and the planned response.
- Alert the ECO of the emergency and actions being taken.
- Oversee the internal evacuation process until Emergency Services personnel arrive.
- Identify the muster / evacuation point and ensure all staff are aware of its location.
- Liaise with Emergency Services when they arrive on site.
- Follow instructions from the lead agency / emergency service.
- Provide staff/contractor information pertinent to evacuation safety of staff/contractors, e.g.:
  - Number of staff/contractors involved.

Evacuation Coordinator

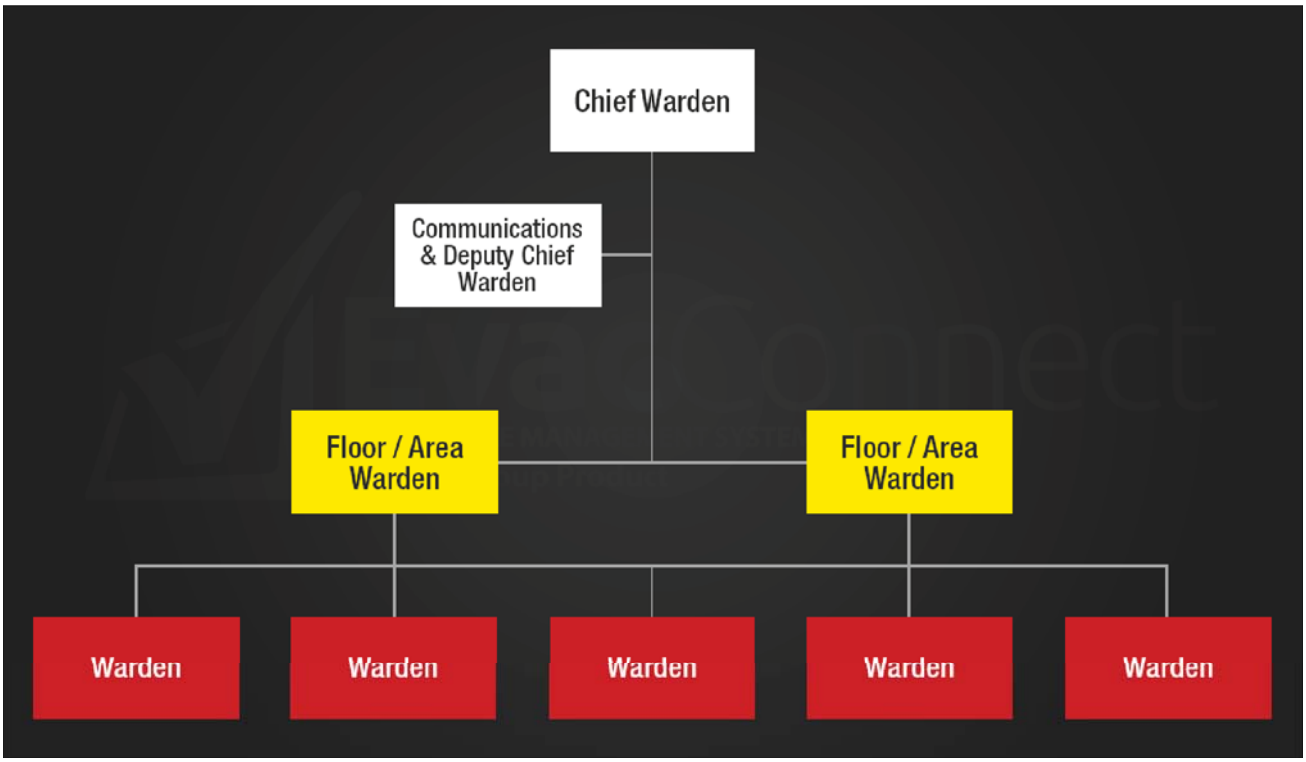
- Allocate staff roles to assist with:
  - Evacuating of staff/contractors.
  - Control of movements.
  - Ensure contact numbers for 'all' site contractor supervisors are up to date

- Treat any minor injuries / first aid and medical needs. Some first aid equipment is available in the emergency case.



Chief Warden & Area Wardens

- Ensure that internal evacuation processes are followed.
- Ensure all areas are evacuated
- Account for all staff/contractors
- Ensure all power to site is turned off
- Ensure that the Evacuation Leader and Coordinators area aware of any immediate medical needs
- Continue with the evacuation process until told otherwise by Evacuation Coordinator/Emergency Services Personnel.
- Ensure no one enters a previously evacuated area unless authorised by Emergency Services personnel.
- All staff to follow duties and requests designated to them by the Evacuation Coordinator.



SITE - GABE STAFF & BUILDING CONTRACTORS MOBILITY

The following is a suggested breakdown of the staff & contractor mobility type. Any mobility impaired staff must be identified and entered on to a PEEP (Personal Emergency Evacuation Plan).

- Walk unaided 100
- Walk assisted 0
- Wheelchair non restrained 0





100 **0** **0**

Note: All staff and contractors are expected to have access to a work or personal motor vehicles

Total: 100 on-site staff/contractors



- 100 - contractors
- 2 – passengers per vehicle
- 50 - vehicles required for a single trip
- 4.5 m - Average car length
- 9 m – two length gap between slow travelling vehicles
- 13.5 m - single road lane length required for vehicle traveling at 20 km
- 700 m - approximate length of slow moving traffic column on single lane road
- 20 minutes – estimated time for last vehicle to 1 km
- 30 minutes – estimated time for last vehicle to arrive at the Penrith Golf Club

FLOOD MANAGEMENT – EXTERNAL– Resident Occupation Phase

Key Considerations

- Flooding or potential flooding of the residential precinct or part of the precinct with water from an external source such as flash flooding of Prospect Creek, pipeline failure or dam failure.
- These following procedures should be used as a guide and may not be suitable for all circumstances.
- Some procedures may need to be undertaken simultaneously.
- Before taking any action, identify the hazards, assess the risk and consider the consequences.

Trigger

- Prolonged rainfall, downpour, dam, weir or levy failure, water main failure etc.

Warnings

5. Beware wet and slippery floors. Waters may be energised with electrical current.
6. Water may be contaminated with chemical and biological hazards.
7. Do not enter floodwaters because you cannot see what is beneath the water.
8. Flood depths and speed can be deceptive and floodwaters may contain hazardous materials (e.g. raw sewage, chemicals) as well as spiders and snakes.

Normality may be restored when:

- Flood waters recede, disaster recovery measures and repairs are completed and the precinct is reoccupied.



Evacuation Roles & Responsibilities – Resident Phase



Gabe Pty Ltd

- Gabe Pty Ltd can only play an advisory role to residents during the occupation phase.
- There will be no onsite Gabe managers once handover is completed
- As part of the handover process, Gabe management will advise the residents of the flood risk
- This will include a set of 'recommended' procedures (see following page)
- Gabe recommend or provide additional information, such as the Department of Primary Industries Flood Management Review dated March 2014 which outlines the risk and emergency management of a flood event

Evacuation Leader

- The NSW Police is the primary agency for a mass evacuation





FLOOD EVACUATION PROCEDURES - RESIDENT

Dear resident

The ESQ1818 is in a zone designated to be at risk of flooding from the Nepean River. This is a 1 to 100-year event to 1 in 200-year event. Authorities have estimated that notice for such a flood incident will have approximately **seven (7) hours warning from the emergency services to evacuate** the area. The police will be the primary authority during a mass evacuation event. Although the risk of flooding is minimal it is recommended that you follow these procedures.

1. During periods of heavy rain listen to the news programs for updates on the situation. This will assist in ensuring your awareness of the situation and better preparation for any possible evacuation order

2. Upon notification that the area is to be evacuated, load all residents and valuables into a motor vehicle and evacuate to a pre-determined area. It is only suggested that that be the Penrith Golf and Recreation Club on Homestead Road, Penrith.

3. Contact police either on-site, or via 000, if you require assistance or know of any neighbour that requires any assistance.

4. Confirm all of your designated group attains the designated assembly (offsite meeting) location and inform police if you have any person (or pets) missing from your group.

5. Emergency services 'usual' conduct a final door knock to ensure all persons have evacuated the area.

RESIDENT MOBILITY

The following is a suggested breakdown of the resident mobility type. These figures may fluctuate but are deemed representative

- Walk unaided 330
- Walk assisted 10
- Wheelchair non restrained 10





320 **20** **10**

Note: 90% of the residents are estimated to have their own motor vehicles with parking spaces provided at each site

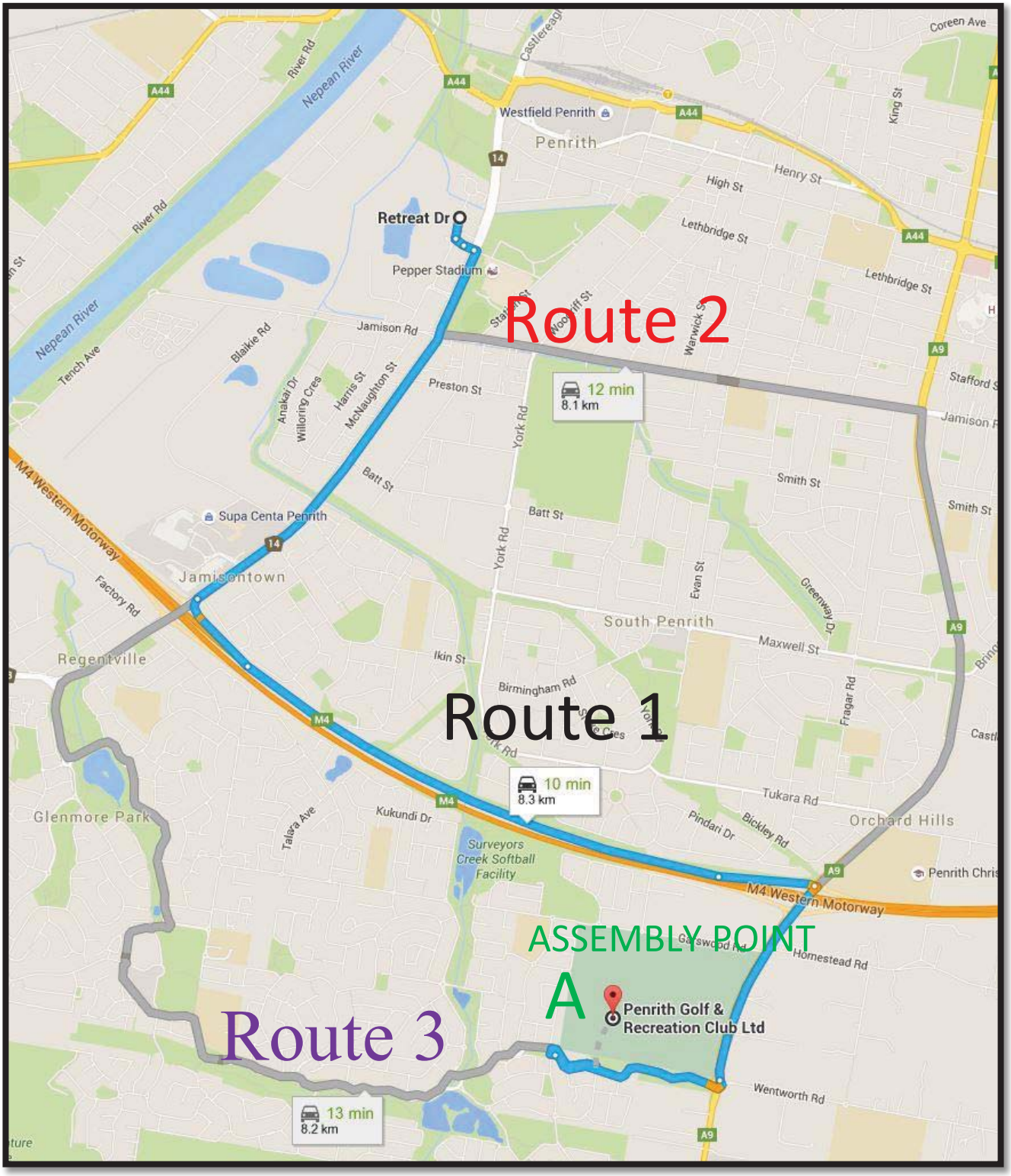
Total: 350 residents



- 350 - residents
- 2.5 – passengers per vehicle
- 140 - vehicles required for a single trip
- 4.5 m - Average car length
- 9 m – two length gap between slow travelling vehicles
- 13.5 m - single road lane length required for vehicle traveling at 20 km
- 2 km - approximate length of slow moving traffic column on single lane road
- 30 minutes – estimated time for last vehicle to travel 1 km distance from at risk flood zone
- 40 minutes – for all vehicles ability to achieve the designated assembly point at Penrith Golf Club

Evacuation route FROM ESQ1818 to assembly area at Penrith Golf Club

Retreat Drive to Penrith Golf Club approx. **8 km. 10-minute** by motor vehicle
Note: there are three routes that can be taken to the assembly area
All three are about the same distance and time frame by vehicle



Reference pages 11, 12, 13 for site road system information

Conclusion

This Flood Evacuation Plan has been developed for the construction and resident occupant phases. The FEP provides an overview of the flood risk with a system designed to evacuate the area as required. With this preparation and training, ESQ1818 Pty Ltd, will be able to correctly respond and manage a range of flood type incidents.