Draft Project Summary

Ingleside Precinct Water Cycle Management and Flooding Assessment

Prepared for NSW Department of Planning and Environment

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Cardno
Shaping the Future

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INGLESIDE WATER CYCLE MANAGEMENT AND FLOODING ASSESSMENT - SUMMARY

Introduction

NSW Department of Planning & Environment (DP&E) is proposing to re-zone the Ingleside Release Area (Ingleside Precinct) for residential purposes. This area is approximately 715 hectares and currently has a non-urban zoning. Cardno has been commissioned by DP&E to prepare a Water Cycle Management and Flooding Assessment (WCM&FA) for this Precinct. The WCM&FA will form part of the Precinct Planning Process to confirm development potential and to establish planning controls to enable development consistent with that potential.

The following summary has been prepared for the Community Reference Group on the development of the WCM&FA. It provides a summary of the initial investigations, and flooding and water quality impact assessments undertaken to date and proposed management measures.

Background

Catchment and Waterways

The Ingleside Precinct waterways is shown in Figure 1. The northern and western portions of the Precinct flow into McCarrs Creek, which discharges into Pittwater. McCarrs Creek is a natural waterway and has a catchment dominated by National Park and recreational grounds. Tributaries to McCarrs Creek located within the Precinct include Crystal Creek, which flows in a westerly direction by the northern boundary before joining Wirreandra Creek, and Cicada Glen Creek flowing through the centre of the Precinct in a northerly direction until it discharges into McCarrs Creek. Wirreandra Creek located on the western part of the Precinct flows north through Ku-ring-gai Chase National Park and further downstream into McCarrs Creek.

A number of tributaries of Mullet and Narrabeen Creeks are located on the eastern side of the Precinct. The eastern and southern portions of the Precinct flow into these waterways, which then flow into the environmentally sensitive and regionally significant Warriewood Wetlands, and ultimately into Narrabeen Lagoon.

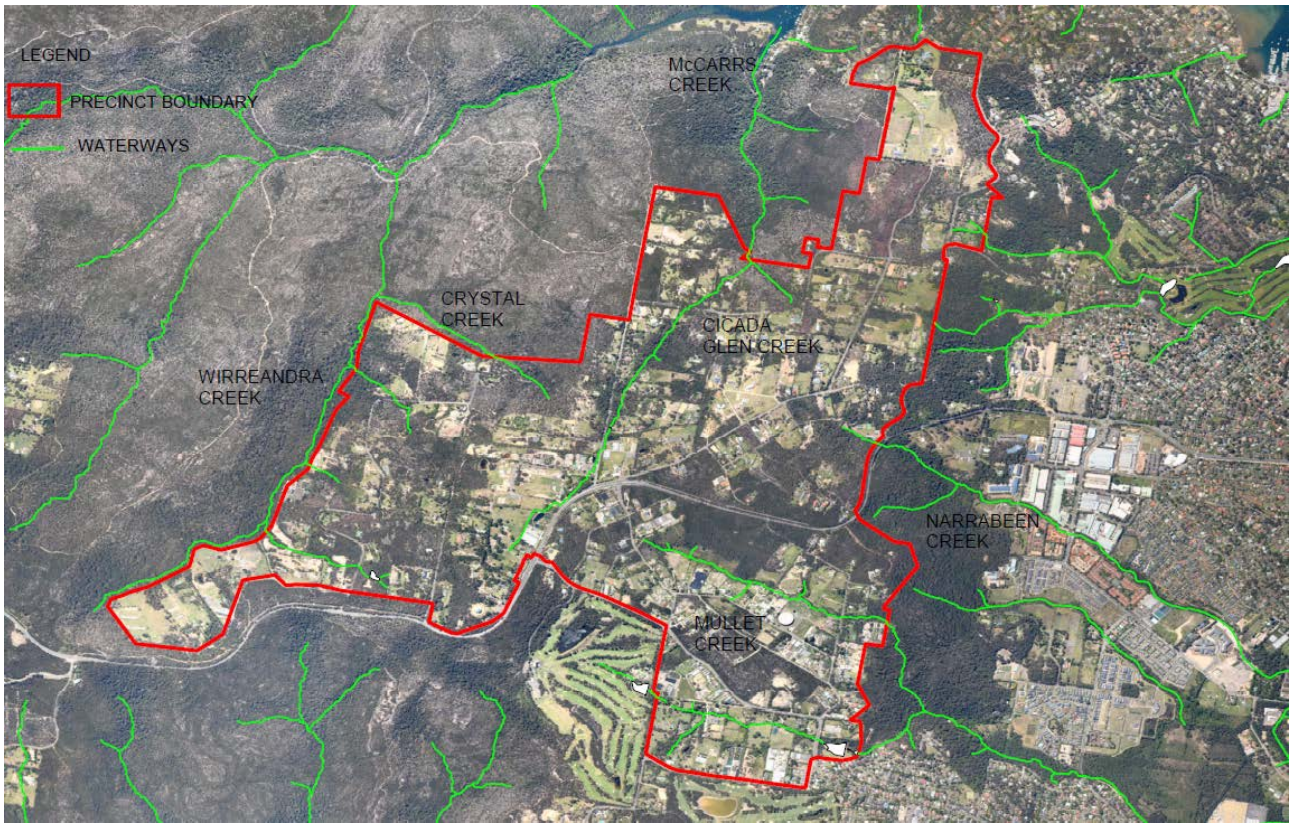
The receiving waterways are recognised for their environmental and recreational values that have been actively protected and rehabilitated by Pittwater Council. As such future urban development should include appropriate controls to ensure that the receiving waterway health is conserved.

Topography

Ingleside includes a range of topography due to its location on the Warriewood Escarpment. Above the escarpment the land gently undulates from the ridge line of Mona Vale Road into a number of waterways. These higher areas then begin to increase in slope before reaching the escarpment. In general the escarpment delineates the boundary of the Precinct because conservation areas and urban development exist thereafter. Urban settlements of Warriewood, Elanora and North Narrabeen are located to the east experiencing a steep transition of the

escarpment to the foothills before continuing at a lower grade to Warriewood Wetlands and Narrabeen Lagoon. To the north urban areas of Church Point and McCarrs Creek are situated on the Pittwater foreshore where the transition from the escarpment continues at a steep grade until meeting the foreshore. To the west the escarpment is not so prominent and land slopes down to Wirreandra Creek, then winding its way to the north meeting McCarrs Creeks and ultimately Pittwater. To the south the escarpment is located beyond the Precinct boundary within Garrigal National Park and slopes away to Elanora Heights and eventually to Narrabeen Lagoon.

Figure 1: Ingleside Precinct waterways



Initial investigations

Previous studies

As part of the initial assessment, the following studies were reviewed:

- Effects of urbanisation on water quality in creeks draining Hawkesbury Sandstone (Laxton, 2001)
- Warriewood Valley Water Management Specification (Lawson & Treloar, 2001)
- Mullet Creek Rehabilitation Plan (Hyder, 2008)
- Mullet Creek Environmental Flow Assessment (SKM, 2010)
- Mullet Creek Water Quality Monitoring Program and Design (Bio-Analysis, 2010)
- Ingleside Water Management Options (EDAW, 2008)
- Narrabeen Lagoon Flood Study (BMT-WBM, 2013)
- Pittwater Overland Flow Flood Study (Cardno, 2013)
- Mona Vale – Bayview Flood Study (DHI, 2002)
- Warriewood Valley Flood Study (Cardno Lawson Treloar, 2005)

Water Quality

Extensive water quality monitoring has been undertaken as part of the Warriewood Land Release Water Management Specification and external studies have been undertaken regarding the water quality of McCarrs Creek. Initial investigations of the water quality data suggests that low pH was recorded in natural catchments of McCarrs Creek as a result of runoff from dispersive Hawkesbury sandstone outcrops of the waterways.

Rezoning of the Precinct for more intense urban use would require specific water quality controls to maintain existing water quality that the best management practice controls recommend elsewhere. It is anticipated that such controls would require specific consideration in their design and would either maintain or improve existing water quality in a similar manner to the Warriewood Valley Water Management Specification, which controls development in Warriewood Valley. It should be noted that the type of urban development in the Precinct would ideally complement a water sensitive approach where land is set aside for water management.

Flooding

Ingleside is situated in the upper regions of numerous creek lines including Mullet, Narrabeen, Cicada Glen, Fern and Wirreandra. In addition the channel form is mostly confined by narrow valleys and sandstone bedrock. As such the flood behaviour is typical of steep upper reaches where flows are freely drained in a confined channel and have limited floodplain storage or backwater effects.

The attached Flood Extents Map indicates the mechanisms of flooding in the Precinct using extents extracted from the Pittwater Overland Flow Flood Study (Cardno 2013) and the Narrabeen Lagoon Flood Study (BMT WBM 2013). As part of the Overland Flow flood study Cardno undertook ground truthing and community consultation to gain a solid understanding of flood behaviour and to educate the community. One of the key issues identified was the importance of overland flow and its consideration for floodplain risk management. Pittwater Council has developed a Development Control Plan with specific requirements for the three flooding mechanisms in the attached figure. A range of flood planning level and freeboard requirements are identified. A summary of the flood study is outlined below

- The hydraulic modelling was done using a two-dimensional Sobek model, divided into seven models based on catchments within the LGA. Ingleside Precinct covers three of these models;
    - Model C – Mona Vale
    - Model D – Warriewood & North Narrabeen
    - Model E – Ingleside (more specifically the McCarrs Creek catchment)
- Hydrology was modelled using the rainfall on grid for the 2D network in the SOBEK model;
- No detailed survey of creek channels was undertaken for the waterways; and
- A consistent rainfall loss was applied to the entire LGA; initial loss of 5mm and 2.5mm continuing loss.

It is proposed to prepare a separate hydrology and hydraulic model for the Precinct using the recently completed flood studies as a base. A RAFTS model would firstly be prepared expanding on the recent model prepared for the Narrabeen Lagoon Flood Study, which only covers the areas draining to the east. In addition, an overall SOBEK model will be prepared by combining models C, D and E of the Pittwater Overland Flow Flood Study. It is necessary to use such an approach to allow for the establishment of tools that can rapidly assess the flood behaviour of the future development and estimate detention requirements.

Urban Development Implications

The initial investigations have highlighted some key issues relating to water quality and flooding. In order for the urban design to accommodate controls to mitigate the impacts on water quality and flooding, on a similar level to the requirements of Warriewood Valley, the following is recommended:

1. Do not allow filling or piping of waterways;
2. Encourage lot based control of water quality and quantity to increase community awareness of water management issues and reduce maintenance requirements for the public domain;
3. If controls are located in the public domain, encourage visual stormwater management controls on the surface that form part of the landscape and integrate with associated uses such as cycleways, passive and active recreation;
4. Apply limitations on the impervious percentage for a range of land uses and road reserves;
5. Encourage infiltration of stormwater if it is deemed acceptable by geotechnical consultants;
6. Apply limitations on the width of road reserves to increase space for stormwater management; and
7. Allow for innovative solutions to water management that could include the use of pervious pavements, green roofs, passive infiltration trenches (soakways) and stormwater harvesting.

Water Cycle Management and Flooding Assessment

The WCM&FA is being undertaken to prepare a WCM&FA strategy. The following objectives will form part of the strategy:

- Identify water management targets (water quality, water quantity, social and ecological requirements) for the future urban development in the Precinct;
- Prepare a water cycle assessment/water balance modelling;
- Consider ecological impacts including sustainable environmental flows to Warriewood Wetlands;
- Ensure no adverse impact to flows and flood behaviour in downstream areas;
- Prepare a water quality monitoring plan as a determinant of pre and post development impacts;
- Assess site constraints and opportunities including:
    - Potentially feasible water management strategies
    - Management of environmental flows in creeks
    - Stormwater re-use options
    - Source control measures
    - Water Sensitive Urban Design options
- Consolidate stormwater quality and quantity controls in order to control construction costs and reduce allocation of valuable land for water management purposes.
- Develop feasible options through consideration of:
    - Compliance with management objectives
    - Life cycle costs
    - Reliability
    - Operation and Maintenance
    - Land Take
    - Stakeholder Acceptance

<u>Flooding Assessment</u>

A computer-based RAFTS model has been used to determine the existing, pre-development stormwater discharges for the site and for the proposed development. In this way, it is possible to assess the potential impacts of the proposed development.

As expected, the modelling showed that the proposed development generally increased the stormwater flows. This is due to the changes in land use, with the transition from green space and forest that slowly absorb stormwater to a higher proportion of hard surfaces.

Flood detention basins have been proposed to attenuate the peak stormwater flows to existing levels in the Precinct. A flood detention basin is a depression created by excavation or creating a levee that detains stormwater run-off from an urban development area during the storm, and allows it to slowly drain out of the basin into the adjoining drainage system or waterway after the storm has passed.

Both on-line (i.e. on the existing watercourse) and off-line (located away from watercourses) basins (see Figure 2 and Figure 3 respectively) can provide peak stormwater flow control and ensure there are no adverse impacts on stormwater flows and flood behaviour within and downstream of the developed Precinct. The indicative location of the basins has been provided in the attached Flood and Water Cycle Management Plan. The indicative sizes of the basins are listed in Table 2.

Various possible locations were identified and evaluated for the basins. On-line basins are more efficient in terms of land-take and consolidate maintenance within the natural drainage corridor. The off-line basins were located based on site topography, location of conservation significant vegetation and modelled design flood extents.

Figure 2: Example of an online detention basin

Figure 3: Example of an offline detention basin

A SOBEK model has been established to assess the impact of urban development options to existing flood behaviour. Flood mapping for existing conditions has been completed and flood mapping for proposed urban development of the Precinct is currently underway.

Water Cycle Management

The computer-based Model for Urban Stormwater Improvement Conceptualization (MUSIC) was used for analysis for the stormwater management requirements for the Precinct. A stormwater treatment train approach incorporating different types of Water Sensitive Urban Design systems was evaluated. Grass swales and bioretention basins (raingardens) have been proposed to manage stormwater and improve the quality and quantity of stormwater discharging into the waterways.

Grass swales (see Figure 4) are a method of replicating a more natural water cycle, whereby nutrients, sediments and other pollutants with potential to cause water quality issues are captured or absorbed by the vegetation as the stormwater runoff flows through the swale.

Bioretention basins (see Figure 5) fulfil a similar function, filtering stormwater runoff through densely planted surface vegetation and an engineered filter media such as sand. Bioretention basins can have the added benefit of providing detention to alleviate flooding issues as well as treating stormwater runoff.

Figure 4: Example of a grass swale

Figure 5: Example of a bioretention basin

The MUSIC model has been used to calculate the appropriate size of the swales and bioterention basins, with the objective of achieving a neutral or beneficial effect on water quality and adopting the following best practice pollutant reduction targets as follows:

- 90% capture of gross pollutants;
- 85% reduction of total suspended solids;
- 65% reduction of total phosphorus; and
- 45% reduction of total nitrogen.

The modelling results showed that the adopted configuration of swales and bioretention basins reduced the stormwater runoff and removed significant amounts of pollutants generated (see Table 1). This treatment approach has the potential to mimic the pre-development condition, and provide improved outcomes.

Table 1: MUSIC water quality modelling result for a Precinct sub-catchment

Parameters	Existing Site	Proposed Development without Water Sensitive Urban Design	Proposed Development with Water Sensitive Urban Design
Flow (ML/year)	68.1	120.1	67
Total Suspended Solids (kg/year)	12,309	29,500	4,770
Total Phosphorus (kg/year)	33.73	78.6	22.6
Total Nitrogen (kg/year)	240.1	540	193
Gross Pollutants (kg/year)	1,351.5	2,780	0

The indicative sizes of the basins are listed in Table 2.

Table 2: Basin sizing

Basin Type	Number	Size range
Online	3	0.35 – 10 ha
Offline	7	0.15 – 1 ha
Water quality	19	0.2- 0.3ha

It is anticipated that all the offline basins will be located in open spaces. The locations are still under investigation. The intention is that these features will be visible to the public, resulting in increased awareness of water cycle management, whilst also being integrated with the surrounding landscape.

In addition, water balance modelling, assessment of pre-development and post-development environmental flows, investigation of water quality monitoring, and macroinvertebrate monitoring has commenced.

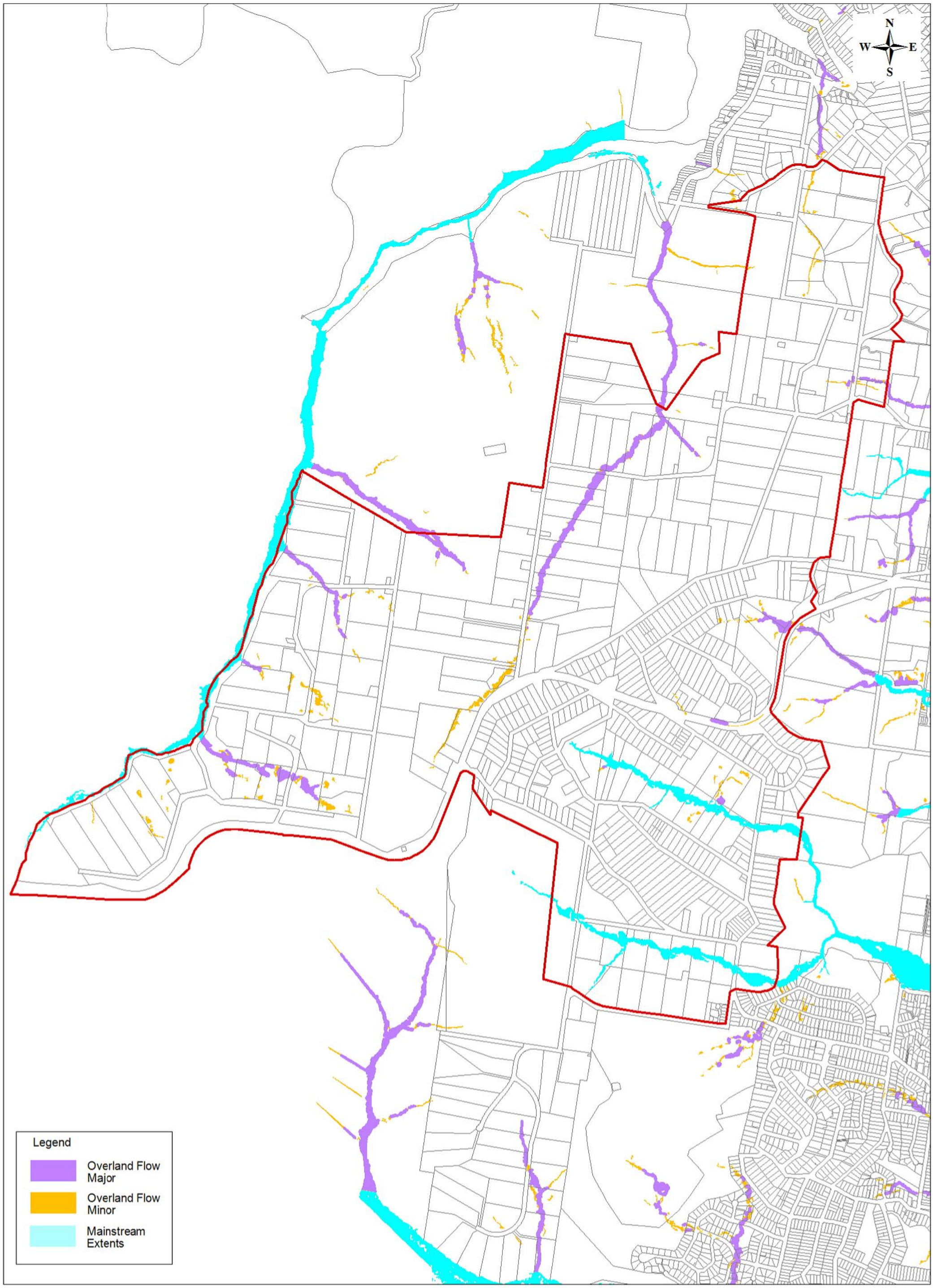
Conclusion

This document provides a summary of the flooding and water quality assessments undertaken to date. The assessments have identified potential impacts associated with future urban development. Suitable management measures (detention basins, swales and bioretention basins) have been proposed to mitigate these impacts.

Yours faithfully

Shefali Chakrabarty

Water Engineer



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PRELIMINARY

FIGURE
Existing Flood &
Overland Flow Affectation

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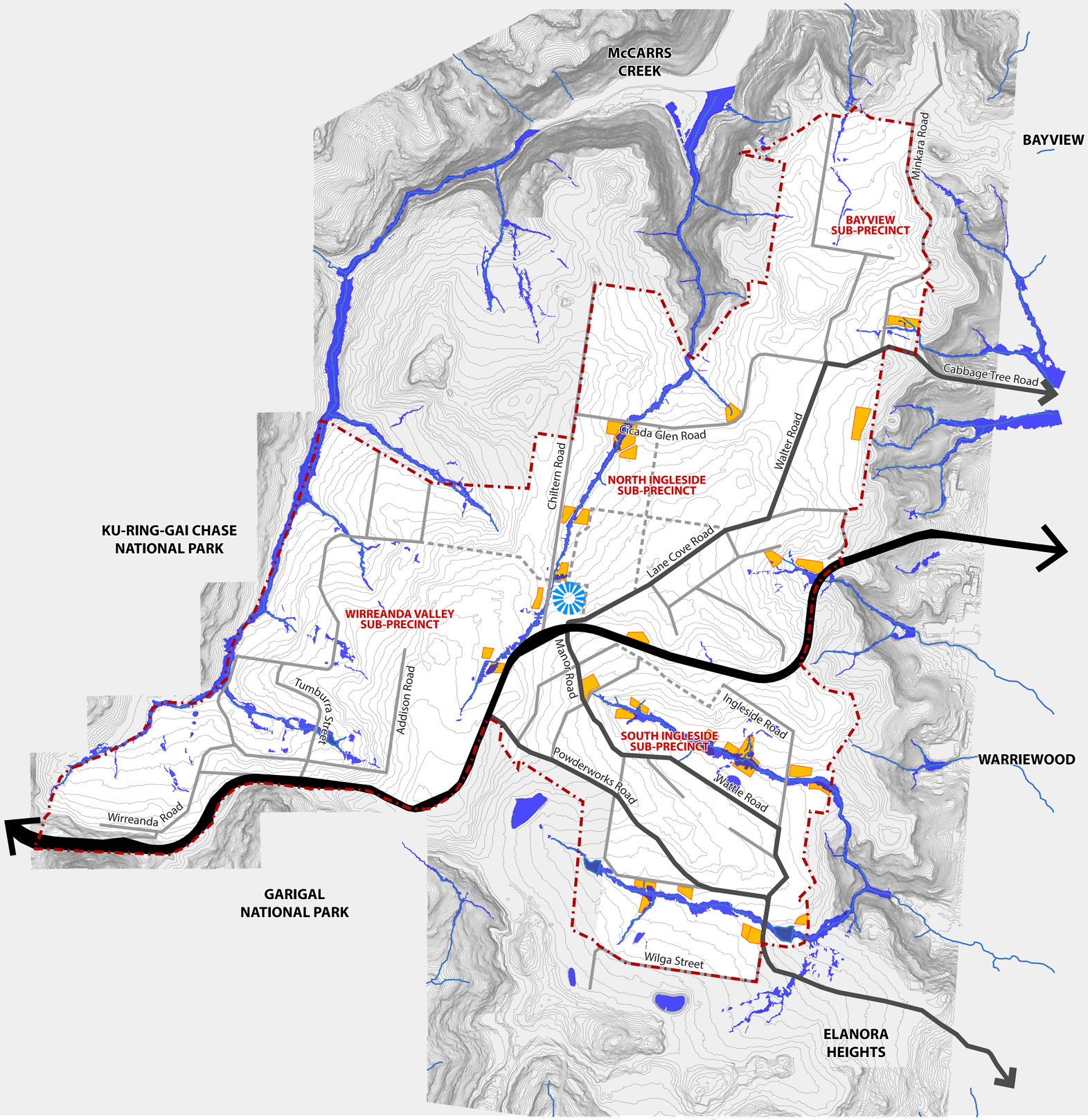
Ingleside WCM

INGLESIDE PRECINCT

FLOOD AND WATER CYCLE MANAGEMENT



FLOOD AND WATER CYCLE MANAGEMENT

KEY

- Precinct Boundary
- Mona Vale Road
- Detention Basin
- 100 Year Flood Extents
- 5m Contours
- Proposed Neighbourhood Centre

0 200m 400m 600m 800m 1km

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