

17 Flooding and drainage

This chapter describes the potential flooding and drainage impacts associated with the project. The chapter has been informed by flooding and drainage assessments provided in **Appendix Q** (Technical working paper: Surface water and flooding).

The Secretary of the NSW Department of Planning and Environment (DP&E) has issued environmental assessment requirements for the project; these are referred to as Secretary's Environmental Assessment Requirements (SEARs). **Table 17-1** sets out these requirements and the associated desired performance outcomes that relate to flooding and water (hydrology), and identifies where they have been addressed in this environmental impact statement (EIS).

Table 17-1 SEARs – flooding and water (hydrology)

Desired performance outcome	SEARs	Where addressed in the EIS
12. Flooding The project minimises adverse impacts on existing flooding characteristics. Construction and operation of the project avoids or minimises the risk of, and adverse impacts from, infrastructure flooding, flooding hazards, or dam failure.	1. The Proponent must assess and (model where required) the impacts on flood behaviour during construction and operation for a full range of flood events up to the probable maximum flood (taking into account sea level rise and storm intensity due to climate change) including:	An assessment of flood behaviour during construction and operation is provided in section 17.3 and section 17.4 respectively. A description of how tunnel entries and cut-and-cover sections of the tunnels would be protected from flooding during construction is provided in section 17.3 and section 17.5 . As assessment of the potential impacts of future climate change on flood behaviour is provided in section 17.4.3 .
	(a) how the tunnel entries and cut-and-cover sections of the tunnels would be protected from flooding during construction works;	
	(b) any detrimental increases in the potential flood affectation of the project infrastructure and other properties, assets and infrastructure;	Consideration of potential flood affectation is provided in section 17.3.1 , section 17.3.2 and section 17.4 .
	(c) consistency (or inconsistency) with applicable Council floodplain risk management plans;	Consistency with applicable floodplain risk management plans is provided in section 17.3 and 17.4 .
	(d) compatibility with the flood hazard of the land;	Compatibility with the flood hazards is discussed in section 17.3.1 and section 17.4.1 .
	(e) compatibility with the hydraulic functions of flow conveyance in flood ways and storage areas of the land;	Compatibility with flood ways and storage areas is discussed in section 17.3.1 .

Desired performance outcome	SEARs	Where addressed in the EIS
	(f) whether there will be adverse effect to beneficial inundation of the floodplain environment, on, or adjacent to or downstream of the site;	Beneficial inundation is discussed in section 17.1.3 . The potential for adverse effects during construction and operation are provided in section 17.3 and section 17.4 respectively.
	(g) downstream velocity and scour potential;	Downstream velocities and scour potential are considered in section 17.3.2 and section 17.4.5 . Also refer to Chapter 15 (Soil and water quality).
	(h) impacts the development may have upon existing community emergency management arrangements for flooding. These matters must be discussed with the State Emergency Services and Council;	Emergency management arrangements for flooding are considered in section 17.4.2 , including a commitment to discuss with the State Emergency Services and Council during the detailed design stage.
	(i) any impacts the development may have on the social and economic costs to the community as consequence of flooding;	Likelihood of social and economic impacts is provided in section 17.4.4 .
	(j) whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses;	Refer to Chapter 15 (Soil and water quality) and Chapter 18 (Biodiversity).
	(k) any mitigation measures required to offset potential flood risks attributable to the project;	Mitigation and management measures are provided in section 17.5 .
	2. The assessment should take into consideration any flood studies undertaken by local government councils, as available.	Relevant flood studies used are provided in section 17.1.1 and section 17.1.3 and Appendix Q (Technical working paper: Surface water and flooding).

Desired performance outcome	SEARs	Where addressed in the EIS
<p>10. Water - Hydrology</p> <p>Long term impacts on surface water and groundwater hydrology (including drawdown, flow rates and volumes) are minimised.</p> <p>The environmental values of nearby, connected and affected water sources, groundwater and dependent ecological systems including estuarine and marine water (if applicable) are maintained (where values are achieved) or improved and maintained (where values are not achieved).</p> <p>Sustainable use of water resources.</p>	<p>1. The Proponent must describe (and map) the existing hydrological regime for any surface and groundwater resource (including reliance by users and for ecological purposes) likely to be impacted by the project, including stream orders, as per the FBA.</p>	<p>Refer to section 17.2.3 for the existing hydrological regime for surface water resource.</p> <p>Refer to Chapter 15 (Soil and water quality) for information on the hydrological regime.</p> <p>Refer to Chapter 19 (Groundwater) for groundwater resource.</p> <p>Refer to Chapter 18 (Biodiversity) for further consideration of the Framework for Biodiversity Assessment (FBA).</p>
	<p>2. The Proponent must prepare a detailed water balance for ground and surface water including the proposed intake and discharge locations, volume, frequency and duration for both the construction and operational phases of the project.</p>	<p>A water balance for surface water for construction and operation is summarised in section 17.3 and section 17.4 respectively and in detail in Appendix Q (Technical working paper: Surface water and flooding).</p> <p>Refer to Chapter 19 (Groundwater) and Appendix T (Technical working paper: Groundwater) for groundwater inflow predictions.</p>
	<p>3. The Proponent must assess (and model if appropriate) the impact of the construction and operation of the project and any ancillary facilities (both built elements and discharges) on surface and groundwater hydrology in accordance with the current guidelines, including:</p>	<p>An assessment of potential surface hydrological impacts during construction and operation is provided in section 17.3 and section 17.4 respectively.</p> <p>Groundwater hydrology is assessed in Chapter 19 (Groundwater).</p>

Desired performance outcome	SEARs	Where addressed in the EIS
	(a) natural processes within rivers, wetlands, estuaries, marine waters and floodplains that affect the health of the fluvial, riparian, estuarine or marine system and landscape health (such as modified discharge volumes, durations and velocities), aquatic connectivity and access to habitat for spawning and refuge;	<p>Refer to section 17.3 and section 17.4 for discharge impacts on hydrology and natural processes.</p> <p>Refer to Chapter 15 (Soil and water quality) for geomorphological and scour impacts.</p> <p>Refer to Chapter 18 (Biodiversity) for potential impacts on aquatic connectivity and access to habitat.</p>
	(b) impacts from any permanent and temporary interruption of groundwater flow, including the extent of drawdown, barriers to flows, implications for groundwater dependent surface flows, ecosystems and species, groundwater users and the potential for settlement;	Refer to Chapter 19 (Groundwater) for impacts on groundwater and Chapter 18 (Biodiversity) for impacts on groundwater dependant ecosystems and species.
	(c) changes to environmental water availability and flows, both regulated/licensed and unregulated/rules-based sources;	Changes to environmental water availability and flows are discussed in section 17.3.1 , section 17.3.2 and section 17.4.5 and in Appendix Q (Technical working paper: Surface water and flooding).
	(d) direct or indirect increases in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses;	Refer to Chapter 15 (Soil and water quality) and Chapter 18 (Biodiversity).
	(e) minimising the effects of proposed stormwater and wastewater management during construction and operation on natural hydrological attributes (such as volumes, flow rates, management methods and re-use options) and on the conveyance capacity of existing stormwater systems where discharges are proposed through such systems; and	<p>Proposed management measures are provided in section 17.5.</p> <p>Discussion on conveyance capacity is provided in section 17.3 and section 17.4.</p>

Desired performance outcome	SEARs	Where addressed in the EIS
	(f) water take (direct or passive) from all surface and groundwater sources with estimates of annual volumes during construction and operation.	Water balance and discharge volumes for surface water are provided in section 17.4.5 and in detail in Appendix Q (Technical working paper: Surface water and flooding). Refer to Chapter 19 (Groundwater) and Appendix T (Technical working paper: Groundwater) for groundwater balance and volumes.
	4. The Proponent must identify any requirements for baseline monitoring of hydrological attributes.	No monitoring of hydrological attributes in surface water bodies was considered to be required for the project given that no surface water extraction from urban waterways would be undertaken and considering the nature of the receiving waterways. Refer to Chapter 19 (Groundwater) for groundwater attributes.
	5. The assessment must include details of proposed surface and groundwater monitoring.	For proposed surface water monitoring refer to Chapter 15 (Soil and water quality). For proposed groundwater monitoring refer to Chapter 19 (Groundwater).
	6. The proposed tunnels should be designed to prevent drainage of alluvium in the palaeochannels.	Refer to Chapter 19 (Groundwater).

17.1 Assessment methodology

17.1.1 Relevant legislation, policies and guidelines

Relevant legislation

The *Water Act 1912* (NSW) and the *Water Management Act 2000* (NSW) (WM Act) are the two key pieces of legislation for the management of water in NSW and contain provisions for the licensing of water access and use. The *Water Act 1912* (NSW) is being progressively phased out and replaced by the WM Act, but its provisions remain in force in respect of areas of NSW where water sharing plans under the WM Act have not yet been made.

The objects of the WM Act are to provide for the sustainable and integrated management of the state's water sources for the benefit of both present and future generations. The WM Act implicitly recognises the need to allocate and provide water for the environmental health of our rivers and

groundwater systems, while also providing licence holders with more secure access to water and greater opportunities to trade water through the separation of water licences from land. The WM Act manages the state's water resources through water sharing plans. The water sharing plans are used to set out the rules for the sharing of water in a particular water source between water users and the environment and rules for the trading of water in a particular water source.

The project is located within an area covered by the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources* (DPI-Water 2011). This Plan includes rules for protecting the environment, water extraction, managing licence holders' water accounts, and water trading within the plan area.

The Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 is also relevant to this flooding and drainage assessment. Waterway zones have been specifically tailored to suit the differing environmental characteristics and land uses of the harbour. This has resulted in a stronger zoning system that provides greater clarity and certainty for applicants and consent authorities in development considerations and applications. Definitions of the different zones are provided in the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005.

Relevant policy and guidelines

The assessment of potential flooding impacts of the project on existing flood regimes has been conducted in accordance with the requirements of the *Floodplain Development Manual* (NSW Department of Infrastructure, Planning and Natural Resources, now the NSW Office of Environment and Heritage (OEH) 2005), which incorporates the NSW Government's Flood Prone Land Policy. The key objectives of this policy are to identify potential hazards and risks, reduce the impact of flooding and flood liability on owners and occupiers of flood prone property, and to reduce public and private losses resulting from floods. This policy also recognises the benefits of the use, occupation and development of flood prone land.

Other relevant government policies and guidelines were also considered as part of the assessment of the project's potential flooding and drainage impacts. These are outlined in **Appendix Q** (Technical working paper: Surface water and flooding) and in **Chapter 15** (Soil and water quality).

The floodplain planning provisions of the local environmental plans and development control plans applicable to the Inner West (formerly Ashfield, Leichhardt and Marrickville) and the City of Sydney local government areas (LGAs) were considered as part of this assessment. The assessment undertaken in **Appendix Q** (Technical working paper: Surface water and flooding) is generally consistent with the various flood studies undertaken by the Inner West and City of Sydney LGAs.

17.1.2 Study area

The study area for the flooding and drainage assessment includes the project's surface construction and operational footprints, as well as areas where potential surface water and flooding impacts could occur as a result of the construction or operation of the project. **Figure 17-1** shows the study area for the flooding and drainage assessment.

Twelve construction ancillary facilities are described and assessed in this EIS. To assist in informing the development of a construction methodology that would manage constructability constraints and the need for construction to occur in a safe and efficient manner, while minimising impacts on local communities, the environment, and users of the surrounding road and other transport networks, two possible combinations of construction ancillary facilities at Haberfield and Ashfield have been assessed in this EIS. The construction ancillary facilities that comprise these options have been grouped together in this EIS and are denoted by the suffix a (for Option A) or b (for Option B).

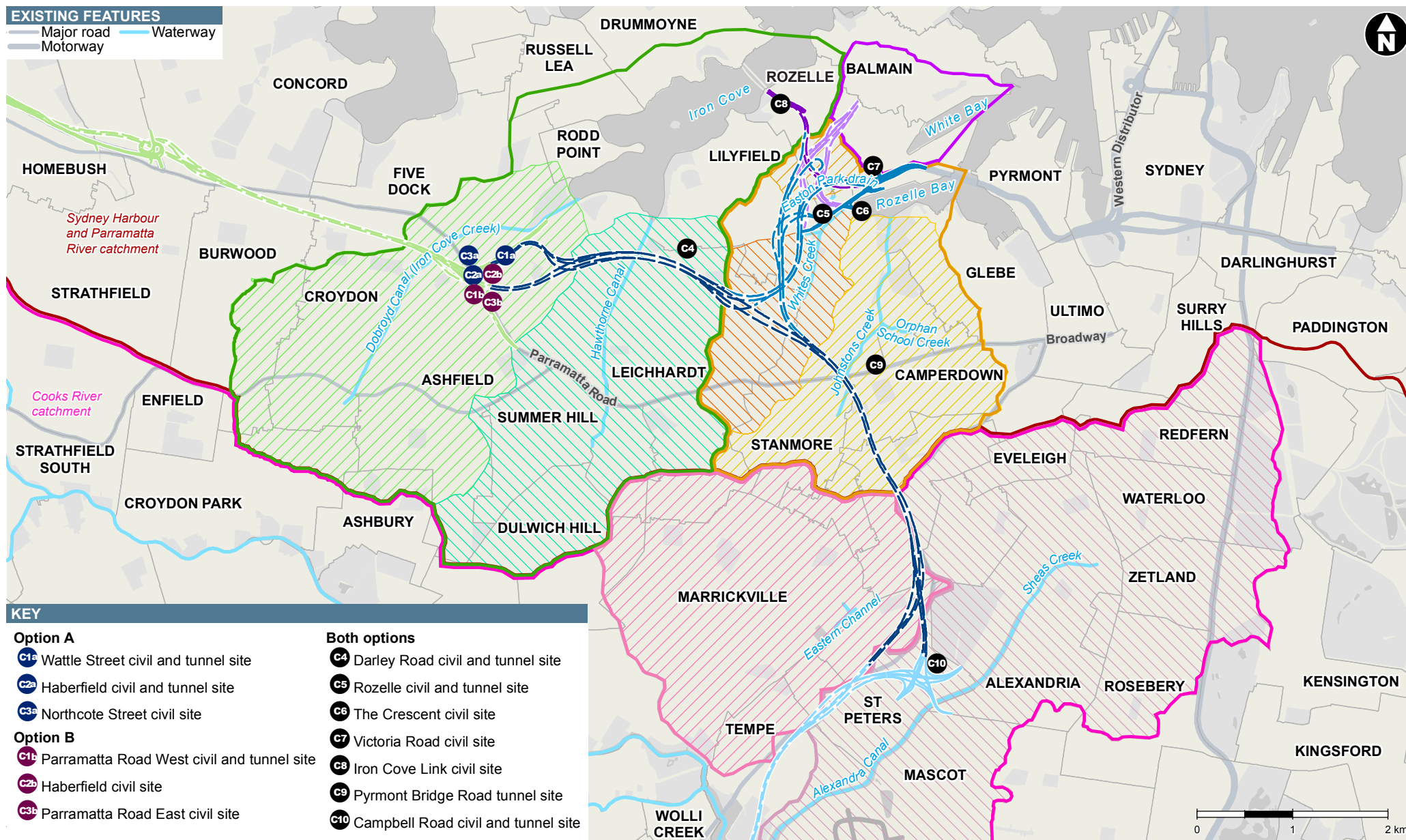


Figure 17-1 Flooding and drainage assessment study area

17.1.3 Method of assessment

The approach taken to assessing the potential flooding and drainage impacts associated with the project included:

- A desktop review and analysis of existing information to characterise the existing environment, identify surface water receptors, existing flood behaviours and drainage infrastructure, and identify potential issues
- A field assessment to confirm and supplement the findings of the desktop analysis and refine understanding of potential issues
- Assessment of potential construction and operational impacts (including cumulative impacts) related to flooding, drainage, and surface water, including hydrologic and hydraulic flood modelling where required
- Identification of appropriate measures to mitigate potential impacts.

Desktop analysis

A desktop analysis was carried out to determine the existing surface water environment within the study area and qualitatively assess potential impacts. The desktop analysis included consideration of:

- Readily available data and information from previous studies on surface water within the study area. This included previous flooding and surface water studies that have been used to inform the M4 East EIS and New M5 EIS
- Other technical working papers included in this EIS, including those relating to groundwater, contamination and biodiversity.

The studies and models that were reviewed as part of this assessment are listed in **Appendix Q** (Technical working paper: Surface water and flooding). The key studies included:

- Whites Creek Catchment Management Study (Sydney Water 1990)
- Johnstons Creek SWC55 Capacity Assessment (Sydney Water 1995)
- Hawthorne Canal Flood Study, Final Draft (Ashfield and Marrickville Councils 2013a, WMAwater)
- Dobroyd Canal Flood Study, Final Draft (Ashfield and Burwood Councils 2013b, WMAwater)
- Johnstons Creek Catchment Flood Study (City of Sydney Council 2015, WMAwater)
- Leichhardt Flood Study (Leichhardt Council 2014a, Cardno)
- Alexandra Canal Catchment Flood Study (City of Sydney Council 2014b, Cardno).

Information on the existing environmental conditions within the study area was collected from the following sources:

- The Inner West Council and the City of Sydney Council
- NSW Government agencies: NSW Roads and Maritime Services (Roads and Maritime), Sydney Motorway Corporation (SMC), UrbanGrowth NSW, Sydney Water and Transport for NSW.

Field assessment

Field assessments were undertaken to visually assess the locations of the proposed surface elements and understand the potential flood risk associated with the project. Field assessments were conducted over three separate occasions in 2016.

Impact assessment

The assessment of surface water quality impacts during project construction and operation is provided in **Chapter 15** (Soil and water quality). A staged approach was undertaken to determine the level of assessment required for flooding. This enabled the assessments to be tailored to individual sites and targeted towards the locations considered to be at greatest risk of flooding.

The level of assessment required was determined by considering:

- Existing flood risk information
- Flood risk to the project, including tunnel portals and construction ancillary facilities
- Potential flooding impacts on surrounding areas as a result of the project, including other properties, assets and infrastructure.

Adopting this approach enabled consideration of areas that could potentially be subject to a high flood risk during the design of the interchanges and construction sites. This included identifying opportunities to:

- Provide easements from areas identified at risk of flooding to maintain existing flow paths, where feasible
- Locate land uses across the site based on vulnerability to flooding. For example, locating car parks in areas of a site considered at high risk of flooding and placing tunnel ramps away from areas of flooding.

The process for establishing flood risk and the level of assessment required is provided in **Figure 17-2**. Surface features within the study area associated with the project (interchanges and construction sites) were assessed through this process. On this basis, it was identified that quantitative assessments would be required for the Rozelle interchange, Iron Cove Link and Darley Road sites.

The SEARs for the project refer to 'adverse effect on beneficial inundation'. Beneficial inundation is considered to be more applicable to natural wetland habitats or a rural agricultural environment. Therefore, in the context of this EIS and considering that the project is located in a highly urbanised environment, the flood assessment has considered adverse effects on general flooding behaviour on, or adjacent to, the site.

Quantitative assessment

For locations where a quantitative assessment was required, the following approach was undertaken:

- Development of new hydrologic and hydraulic flood models
- Running of the flood models to identify flood behaviour under present day (pre-project) conditions for the 10 year, 100 year average recurrence interval (ARI) events, as well as the probable maximum flood (PMF)
- Assessment of the potential impact the project would have on flooding characteristics during and post-construction
- Assessment of the impact a partial blockage of major hydraulic structures would have on flood behaviour under post-construction conditions
- Assessment of the impact that future climate change would have on flood behaviour under post-construction conditions.

The 10 year ARI, 100 year ARI and PMF design events were chosen for the quantitative assessment as they represent a range of different flood events from more frequent (ie 10 year ARI) to extreme event (ie PMF). The flood behaviour across the three events was found to be very similar. Therefore, the assessment of other design events is likely to result in similar outcomes. Further detail on the methodology adopted for locations that required a quantitative assessment is provided in Annexure C of **Appendix Q** (Technical working paper: Surface water and flooding). The potential impacts on the project from flooding caused by climate change are addressed in **Chapter 24** (Climate change risk and adaptation).

Process for establishing flood risk and the level of assessment required

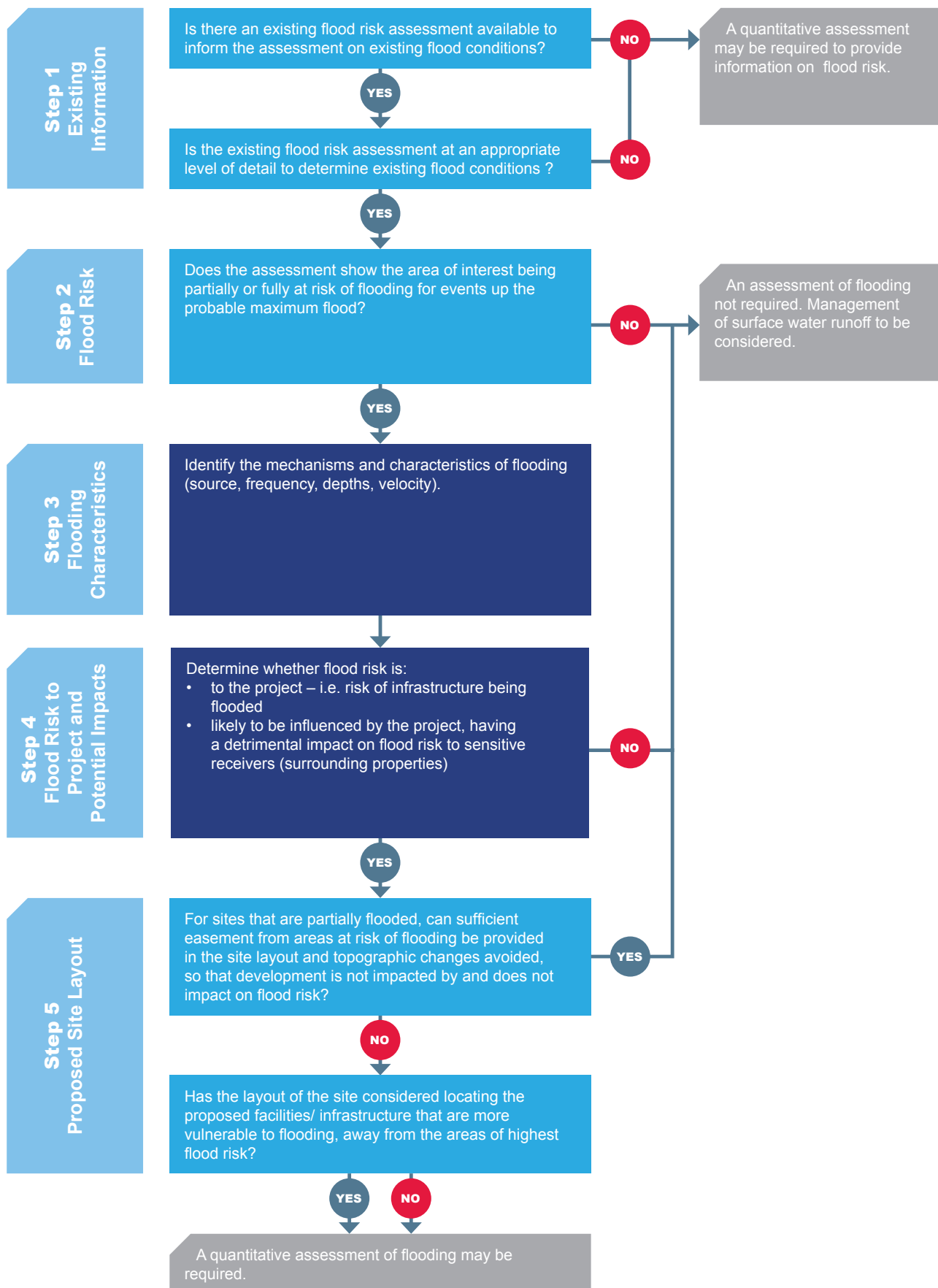


Figure 17-2 Process for establishing flood risk

Hydrologic standards

The standards adopted in the assessment of transverse drainage and flood mitigation measures were established in accordance with the *Floodplain Development Manual* (OEH 2005) and current Roads and Maritime standards. The hydrologic standards adopted are based on matching the level of protection to the risk and consequence of flooding. The standards adopted for the project infrastructure and the impacts on existing developments are summarised in **Table 17-2**.

Table 17-2 Hydrologic standards

Project infrastructure	Standard
Tunnel portals and ancillary facilities (ventilation facility, water treatment plants, substations)	Located above the PMF level or the 100 year ARI flood level plus 0.5 metres freeboard (whichever is greater).
Emergency response facilities (motorway control centre, fire water tank, pump buildings)	Located above the PMF level or the 100 year ARI flood level plus 0.5 metres freeboard (whichever is greater).
Modifications to existing road network	Modifications to existing roads at their point of connection to the project are to be configured such that the existing level of flood immunity is maintained. Temporary modifications to existing roads during the construction staging would maintain the existing level of flood immunity where feasible, taking the duration of the construction stages into consideration.
Impacts on existing development	Standard
Operational	<p>The 100 year ARI flood standard is to be adopted in the assessment of measures required to mitigate any adverse flooding impacts attributable to the project.</p> <p>Changes in flood behaviour under PMF conditions would be assessed to identify impacts on critical infrastructure and significant changes in flood hazard resulting from the project.</p>
Construction	<p>Construction-related flood risks and impacts need to be evaluated in the context of the construction period to set requirements that are commensurate to the period of time that the risk exposure occurs.</p> <p>To this end, the assessment identifies the risks and potential impacts associated with construction activities at the site so that informed decisions can be made on the flood criteria to be set as part of the flood risk management plan for the construction of the project.</p>

17.2 Existing environment

A general description of the geomorphology and water quality of the existing catchment and watercourse environments is provided in **Chapter 15** (Soil and water quality). This section outlines:

- Catchments and watercourses within the study area
- Existing drainage infrastructure and surface water management infrastructure of the study area
- The existing flood behaviour of the study area.

17.2.1 Catchments and watercourses

Descriptions of catchments and key waterways within the Sydney Harbour and Parramatta River catchment that have the potential to be impacted by the project are provided in **Chapter 15** (Soil and water quality). Mapping of the existing hydrological regimes is provided in **Appendix Q** (Technical working paper: Surface water and flooding).

The predominant waterways within the Sydney Harbour and Parramatta River catchment that would be traversed or affected by the project include Dobroyd Canal (Iron Cove Creek), Hawthorne Canal, Whites Creek, Johnstons Creek and Easton Park drain. Dobroyd Canal (Iron Cove Creek) and Hawthorne Canal discharge into Iron Cove, while Whites Creek, Johnstons Creek and Easton Park drain discharge into Rozelle Bay.

Figure 17-1 shows the waterways and associated catchments within the study area that are intersected by or downstream of the project.

Dobroyd Canal (Iron Cove Creek)

Dobroyd Canal, also known as Iron Cove Creek, drains parts of the inner west suburbs of Ashfield, Burwood, Haberfield, Croydon, Drummoyn and Canterbury and discharges into Iron Cove (Cardno Lawson Treloar 2008). The canal is tidal to upstream of Parramatta Road.

The canal, which is owned and managed by Sydney Water for trunk line drainage, is shown in **Figure 17-3** and comprises an open concrete-lined channel between Iron Cove and the intersection of Carshalton and Norton streets with underground branches extending upstream. This waterway runs parallel to the Wattle Street interchange and the tunnel portal of the project. Riparian areas are grassed or planted native and exotic vegetation. Construction ancillary facilities (identified in **Figure 17-1**) that are located within the Dobroyd Canal (Iron Cove Creek) catchment include:

- Wattle Street civil and tunnel site (C1a)
- Haberfield civil and tunnel site (C2a)/Haberfield civil site (C2b)
- Northcote Street civil site (C3a)
- Parramatta Road West civil and tunnel site (C1b) and Parramatta Road East civil site (C3b).

The Wattle Street interchange would drain to Dobroyd Canal (Iron Cove Creek) during operation of the WestConnex program of works.



Figure 17-3 Dobroyd Canal (Iron Cove Creek) at Timbrell Park

Hawthorne Canal

Hawthorne Canal starts in Lewisham and flows into Iron Cove at Dobroyd Point. The channel, which is owned and managed by Sydney Water for trunk line drainage, is shown in **Figure 17-4** and is generally constructed from unreinforced concrete with the base of the channel comprising paved brick for a section upstream of Parramatta Road (Sydney Water 2014).

The main channel is tidal to upstream of Parramatta Road and the channel width varies from about two metres in upper areas to about 22 metres at its confluence with Iron Cove (WMAWater 2013a). The project's tunnel alignment crosses beneath Hawthorne Canal adjacent to Hawthorne Parade, about 300 metres upstream of Iron Cove. The proposed operational water treatment plant at Darley Road, Leichhardt, would discharge to Hawthorne Canal. The Darley Road civil and tunnel site (C4) is located within the catchment.



Figure 17-4 Hawthorne Canal at Blackmore Park

Whites Creek

Whites Creek is a brick and concrete-lined channel, which is owned and managed by Sydney Water for trunk line drainage that flows through the suburbs of Leichhardt and Marrickville, discharging into Rozelle Bay. The channel is shown in **Figure 17-5** and varies between circular and covered sections in the upper reach, and open channel sections in the lower reach.

The lower reach of Whites Creek is located to the south of the proposed Rozelle interchange and associated road upgrades. Proposed works in this area include the redevelopment of City West Link and The Crescent intersection, and the construction of new culverts into Rozelle Bay. There would also be an upgrade and widening of the existing bridge structure that crosses Whites Creek at The Crescent. The Crescent civil site (C6) is located around the junction of Whites Creek and Rozelle Bay.

Sydney Water is investigating potential opportunities for naturalisation within a section of Whites Creek at Annandale. A concept design has been developed for the Whites Creek naturalisation project, which includes the replacement of deteriorating concrete banks and low flow channel with a combination of rocks, native plants and sandstone blocks or concrete.

The Sydney Water naturalisation works at Whites Creek would be located adjacent to Railway Parade and Hutchinson Lane at Annandale, to the south of the proposed Rozelle interchange. Construction timeframes for these naturalisations works are not currently known. Channel naturalisation works extending from Rozelle Bay to the re-aligned The Crescent would be carried out as part of the project to integrate with Sydney Water's naturalisation works.



Figure 17-5 Whites Creek at Brennan Street

Johnstons Creek

The Johnstons Creek catchment is situated within the suburbs of Glebe, Annandale, Petersham and Newtown, immediately west of the Sydney central business district (CBD). The channel, which is owned and managed by Sydney Water for trunk line drainage, consists of a wide open concrete section at the Rozelle Bay end and brick walls further upstream.

The project's mainline tunnel alignment is proposed to traverse beneath Johnstons Creek adjacent to Bridge Street, Stanmore, south of Parramatta Road. The Pyrmont Bridge Road tunnel site (C9) is located within the Johnstons Creek catchment.

Sydney Water is investigating potential opportunities for naturalising a section of Johnstons Creek at Annandale. The potential works on Johnstons Creek proposed by Sydney Water extend from Rozelle Bay to around 20 metres south of The Crescent. The construction schedule for the works is currently unknown.

Easton Park drain

Easton Park drain conveys runoff from the suburb of Rozelle and runs between Denison Street adjacent to Easton Park and Rozelle Bay. The drain originates from a series of stormwater networks that discharge into a brick-lined, open channel south of Lilyfield Road. The open channel section passing through the industrial area between Lilyfield Road and the Rozelle Rail Yards is about 175 metres long and shown in **Figure 17-6**. The open channel then discharges into a culvert that runs underneath the Rozelle Rail Yards and into Rozelle Bay, to the east of the intersection of City West

Link and The Crescent. Observations of the outfall into Rozelle Bay suggest that discharges from the culvert are influenced by tidal fluctuations in Rozelle Bay.

Easton Park drain passes through the proposed Rozelle interchange, and also the Rozelle civil and tunnel site (C5), from Lilyfield Road in the north to Rozelle Bay in the south. It is proposed to divert Easton Park drain into a new channel to convey flows through Rozelle Rail Yards, with the former Easton Park drain decommissioned. An upsized culvert would be provided to discharge flows into Rozelle Bay.



Figure 17-6 Easton Park drain adjacent to Lilyfield Road

Rozelle Bay

The Rozelle Bay catchment (see **Figure 17-7**) is highly urbanised and comprises an area of about 857 hectares. Rozelle Bay is located between the suburbs of Glebe, Annandale, Lilyfield and flow inputs include Whites Creek, Johnstons Creek and Easton Park drain. The foreshore is actively used for recreational fishing and boating by NSW patrol vessels and maritime industries including the Sydney Heritage Fleet located on the western shore of Rozelle Bay. Rozelle Bay is classified as W1 Maritime Waters under the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005. The edges of the bay are either fully developed, with some retaining walls and relatively narrow, or mainly grassed riparian areas.

Rozelle Bay would be a receiving waterbody for discharge from the operational water treatment plant at Rozelle and runoff from the proposed Rozelle interchange and associated road upgrades. A new outlet would be constructed within Rozelle Bay to receive the stormwater flows from the Rozelle interchange. The Rozelle civil and tunnel site (C5) and The Crescent civil site (C6) are located within the Rozelle Bay catchment. The Victoria Road civil site (C7) is located on the boundary of Rozelle Bay and White Bay catchments.

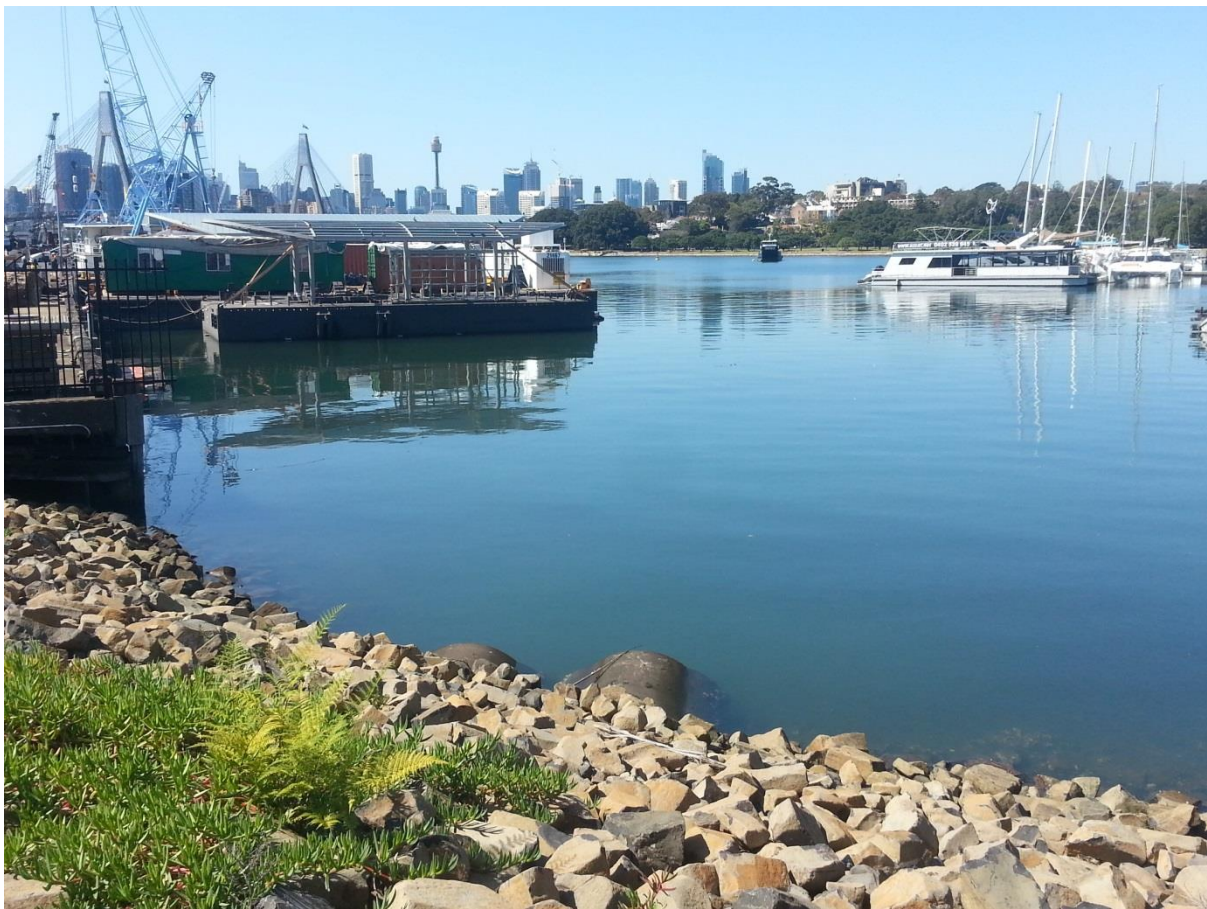


Figure 17-7 Rozelle Bay foreshore

White Bay

The White Bay catchment is surrounded by the suburbs of Balmain and Rozelle with White Bay wharf and White Bay Cruise Terminal to the north and Glebe Island to the south. White Bay is classified as W1 Maritime Waters in the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005.

The Victoria Road civil site (C7) is located on the boundary of the White Bay and Rozelle Bay catchments. A portion of the proposed Victoria Road upgrade between Hornsby Street and Robert Street would drain to White Bay. Drainage along this section of road would be reinstated as part of the road upgrade with connection to the existing drainage network on Victoria Road. The location and size of the drainage works would be confirmed during detailed design, assessed as necessary and managed in accordance with the measures outlined in **Appendix F** (Utilities Management Strategy).

Iron Cove

Iron Cove is a bay within the Parramatta River estuary. **Figure 17-8** shows an image of Iron Cove immediately downstream of Iron Cove Bridge. Dobroyd Canal (Iron Cove Creek) and Hawthorne Canal both discharge into Iron Cove.

A portion of the proposed road upgrades (ie the widening of a section of Victoria Road) associated with the Iron Cove Link would drain into Iron Cove, using existing outlets or via a new direct drainage outlet should the existing outlets not be suitable. The proposed Iron Cove Link civil site (C8) and bioretention basin and car park improvement works within King George Park, adjacent to Manning Street at Rozelle, would be located within the Iron Cove catchment.



Figure 17-8 Iron Cove immediately downstream of Iron Cove Bridge

Alexandra Canal

The Alexandra Canal catchment (including Sheas Creek) includes the suburbs of Alexandria, Rosebery, Erskineville, Beaconsfield, Zetland, Waterloo, Redfern, Newtown, Eveleigh, Surry Hills and Moore Park. The catchment is heavily altered, predominantly covered by commercial, industrial and residential development, with a small amount of parkland such as Sydney Park and Moore Park (see **Figure 17-9**).

Alexandra Canal flows into the Cooks River near the north-western corner of Sydney Airport. As it was originally built for navigation by boat for transportation purposes, it is much larger than technically required to convey stormwater from the catchment.

The project's proposed underground connection to the St Peters interchange and ventilation facility, as well as the Campbell Road civil and tunnel site (C10), would be within the Alexandra Canal catchment.



Figure 17-9 Alexandra Canal downstream of Canal Road

Eastern Channel

The mainline tunnel alignment runs through part of the catchment of the Eastern Channel that is located near Murray Street, Marrickville to its confluence with the Cooks River adjacent to Tempe Station. However, no surface works or discharges, surface operational facilities or surface carriageways are proposed within the catchment. As such the project is not expected to impact the channel. No further assessment of the Eastern Channel in relation to flooding and drainage impacts has been undertaken.

17.2.2 Drainage

Due to the extensive urban nature of the study area, there is a dense network of drainage infrastructure conveying stormwater flows for small storm events. These drainage features are illustrated and discussed in detail in **Appendix Q** (Technical working paper: Surface water and flooding).

This network manages stormwater flows predominantly from the roads and impervious areas of the catchments before discharging into the local waterways and canals, including Dobroyd Canal (Iron Cove Creek), Hawthorne Canal, Easton Park drain, Whites Creek, Johnstons Creek and Alexandra Canal. During larger storm events when the capacity of the existing drainage system is exceeded, runoff flows overland to these waterways and canals.

The former Rozelle Rail Yards site is an area that has little known formal drainage other than:

- The Easton Park drain and associated drains in the north of the site
- An open channel running west to east along the base of the rock-wall to the south of Lilyfield Road, between Denison Street and Cecily Street. The channel discharges into a culvert underneath 92–94 Lilyfield Road. It is likely that this drain discharges into the Easton Park drain
- A small number of pits and pipes found throughout the site.

The existing drainage infrastructure on the former Rozelle Rail Yards site is likely to be of relatively poor condition as a consequence of its age and a lack of maintenance since the site ceased to be an active rail facility in the late 1990's. The Easton Park drain is the only known discharge point from the northern section of the site.

From the limited drainage information available for the Rozelle Rail Yards, it is expected that rainfall and runoff from the site would generally drain through a combination of infiltration, evaporation and the local drainage network (condition unknown). Observations made on-site following rainfall, indicate

that water pools across the site including at the stormwater pits adjacent to (east of) the existing workshop in the southwest corner.

There are some Sydney Water and Council road drainage assets near the former Rozelle Rail Yards, some of which connect into the Easton Park drain. The catchment to the northwest of the proposed Rozelle interchange is connected to Whites Creek via a brick-arch culvert that passes underneath the CBD and South East Light Rail site and the Inner West Light Rail line. This provides a sub-surface connection between Whites Creek and a catchment north of Lilyfield Road.

At Iron Cove, there is an Inner West Council stormwater drainage system serving the existing road network to the southeast and east of the proposed Iron Cove Link. The drainage network on Victoria Road is reported to generally consist of pipes 300 millimetres to 450 millimetres in diameter.

To the south of the proposed Darley Road tunnel and civil site (C4), an Inner West Council stormwater drainage system serves the road network. The drainage network on Darley Road is reported to consist of pipes 2,400 millimetres in diameter receiving surface water inputs from drainage to the east and to the south.

The age or quality of some of these existing stormwater drainage assets may reflect the age of the buildings and houses in the area. Therefore, some of the assets are potentially nearing, at, or beyond the end of their design life. The stormwater network is owned by Sydney Water and the Local Government authorities (Inner West and City of Sydney councils).

A number of drainage networks would need to be crossed by the proposed road alignment, particularly in areas where the proposed road works are at or near the surface ie the western and southern ends of the project, interchanges, cut-and-cover sections and tunnel portals.

17.2.3 Hydrology and flooding

Flood risk in the study area has increased since the onset of urbanisation, as a consequence of:

- Development occurring prior to the installation of road drainage systems in the 1900s
- Development occurring in overland flow paths or in localised topographic depressions and encroaching into floodplains, which reduces storage capacity
- Culverting and channelisation of watercourses which increases the speed of water travelling through the system
- Increases in impermeable land, resulting in increased runoff during rainfall events.

This means that the watercourse flow rates and water levels respond more quickly to rainfall events, due to reduced storage and infiltration capability within the catchments. Areas affected by flooding (local and regional) are discussed below.

Council flood studies have been prepared for the major catchments that the project would cross. The main one is the Leichhardt Flood Study (Cardno 2014a), undertaken in 2015. The new Inner West Council is currently considering that flood study in their preparation of a Floodplain Risk Management Study and Plan for the new Council. In the absence of a floodplain risk management plan, the assessment of flood behaviour (existing and future) has therefore been based on the Leichhardt Flood Study.

Existing flood behaviour

Wattle Street interchange

The Wattle Street interchange (part of the M4 East project) is in the catchment of Dobroyd Canal (Iron Cove Creek). Due to the interface of this project with the M4 East project and timing for completion of these projects, the 'existing' flood conditions at the Wattle Street interchange has been taken to be the post-construction situation for the M4 East project. This is because the flood conditions at this location would change after completion of the M4 East project, and new flood mitigation measures would be in place to protect the M4-M5 Link project upon completion. Cumulative assessment of flood impacts is provided in **Chapter 26** (Cumulative impacts).

The western section of the interchange is not affected by creek flooding, only by localised stormwater runoff. Mitigation measures, such as local piped drainage systems, an on-site detention basin, and an overland flow path would be delivered by the M4 East project to capture local runoff upstream and connect into the new interchange drainage system. Excess flows in events greater than the 100 year ARI up to the PMF would be diverted around the western tunnel portal towards Parramatta Road.

The eastern end of the interchange is affected by flooding from Dobroyd Canal (Iron Cove Creek). The road crest for the eastern tunnel portal has been located above the PMF level to prevent flooding of the tunnel portals. The tunnel ventilation facility at the Wattle Street interchange (Parramatta Road ventilation facility) is also protected from flooding in events up to the PMF.

For the Wattle Street interchange, the mitigation measures provided by the M4 East project mean that the risk of flooding to the M4-M5 Link project at this location from a PMF is considered to be low. As the M4-M5 Link would not change the design surface layout or levels of the interchange, the impact of the project is considered to be negligible and no additional mitigation measures are necessary at this location. Therefore, a quantitative assessment of impacts at this location is not required.

St Peters interchange

The St Peters interchange (delivered as part of the New M5 project) is in the catchment of Alexandra Canal. Because the New M5 would be primarily delivered before the M4-M5 Link project, the 'existing' flood conditions at the St Peters interchange are represented by the post-construction situation for the New M5 project.

The St Peters interchange is generally not affected by flooding from Alexandra Canal and only the area around the intersection of Campbell Road and Burrows Road is flood affected in events up to the 100 year ARI. Critical infrastructure, such as the motorway operations complexes are generally located above the PMF level, including the tunnel ventilation facility at the interchange.

The design of the New M5 project is providing enabling works for the M4-M5 Link project construction site within the St Peters interchange, including provision of flood mitigation measures. As a result, the risk of flooding to the M4-M5 Link project from a PMF is considered to be low and no additional mitigation measures are necessary for the project at this location. A quantitative assessment of impacts at this location is therefore not required.

Rozelle interchange

The Rozelle interchange would be located within and adjacent to the Rozelle Rail Yards in the catchment of Rozelle Bay and Whites Creek. The Rozelle Rail Yards is comprised of reclaimed land located within a disused rail cutting. The site spans a topographic low with levels ranging from about two metres to seven metres Australian Height Datum (AHD). The site is bound by excavated, near-vertical rock walls up to eight metres high along the northern boundary and a fill-embankment in the southwest section adjacent to City West Link.

Two watercourses are located within this section of the study area: Easton Park drain and Whites Creek. The Easton Park drain drains a heavily urbanised catchment of around 55 hectares to the north of the Rozelle Rail Yards and discharges to Rozelle Bay through a combination of stormwater pipes, lined open channel and culverted reaches. Once it has passed under Lilyfield Road the drain is an open concrete lined section for about 170 metres through the Industrial Estate on Lilyfield Road. It then flows into a culvert passing under the Rozelle Rail Yards before discharging to Rozelle Bay just east of the intersection of City West Link and The Crescent. Observations of the outfall suggest that discharges from the culvert are influenced by tidal fluctuations at Rozelle Bay.

Whites Creek is located to the south of both the Rozelle Rail Yards and City West Link. The watercourse drains a dense urban catchment area of around 262 hectares originating about 1.9 kilometres southwest of the Rozelle Rail Yards. The upstream section of the creek is conveyed within a culverted system, owned by Sydney Water, flowing in a north-easterly direction before discharging into an open channel at Annandale. Downstream near the proposed Rozelle interchange, Whites Creek is a brick and concrete lined open channel about nine metres wide. It is spanned by several road and rail crossings near the Rozelle Rail Yards and discharges into Rozelle Bay immediately east of The Crescent and is also tidally influenced.

Although there is no known direct surface water connection between the Rozelle Rail Yards site and Whites Creek, there are potential indirect surface pathways, including:

- The adjacent Inner West Light Rail line passes underneath City West Link and may present a pathway for surface water to exchange between the Rozelle Rail Yards site and a drain that discharges into Whites Creek
- In extreme rainfall events, surface water potentially flowing across City West Link and into the lower reaches of Whites Creek near The Crescent or vice versa.

Rozelle Bay is about 65 metres south of the Rozelle Rail Yards. The Bay is tidal and receives urban runoff from the suburbs of Rozelle, Lilyfield, Annandale, Glebe and Forest Lodge. On average the Bay experiences two tidal cycles a day with a mean high water springs level of 0.69 metres AHD and mean low water spring level of -0.64 metres AHD reported for Port Jackson.

The Leichhardt Flood Study suggests that a significant area of the Rozelle Rail Yards site would be inundated with floodwater in the five year ARI event, with localised depths of over 0.5 metres on Lilyfield Road near Easton Park. A larger area would be inundated during the 100 year ARI event with depths of up to one metre on Lilyfield Road adjacent to Easton Park.

Flooding along Whites Creek is fairly well confined to the main channel, but there are breakout areas mainly along the southeast bank, affecting properties along Railway Parade in particular. Both The Crescent and City West Link have 100 year ARI flood immunity from creek flooding under existing conditions in the vicinity of the study area. Some ponding occurs on these roads due to localised pavement runoff.

The flood extent and depth maps suggest that the Rozelle Rail Yards site acts as a storage area for floodwater. The site of the proposed Rozelle interchange is classed as a flood control lot in the Leichhardt Development Control Plan (Leichhardt Council 2013).

As the site is below the flood planning level and is flood prone land (potentially impacted by the PMF), it is considered to be at high risk of flooding. A quantitative assessment of flood risk was therefore undertaken for the Rozelle interchange.

The results of the flood modelling of existing conditions shows that the Rozelle Rail Yards site is subject to surface water inputs through both piped drainage discharges and overland flow, from a number of external catchments to the north and west. More details on the flood model development are provided in **Appendix Q** (Technical working paper: Surface water and flooding).

As the Rozelle Rail Yards site is within a topographic low, it receives runoff from relatively steep, contributing catchments to the north and west. This, combined with the limited capacity of the local drainage network, means that the site functions as a floodway for overland flow and provides a significant area for floodwater storage. Floodways are areas of the floodplain where a significant discharge of water occurs during floods. They are areas that, even if only partially blocked, would cause a significant redistribution of floodwaters or a significant increase in flood levels.

The main surface outlet from the Rozelle Rail Yards is at a low point on City West Link, where excess floodwater spills over the road and discharges into Rozelle Bay. However, overtopping of City West Link currently occurs in relatively large, infrequent flood events greater than the 100 year ARI.

The existing flood conditions for the 10 and 100 year ARI design events and PMF are shown in **Figure 17-10** to **Figure 17-12**. The figures highlight that the Rozelle Rail Yards site currently provides a large area of surface water storage during these events. During the PMF event, depths across the site reach over 1.5 metres at the low point near the intersection with The Crescent. Areas of higher ground along City West Link at the southern boundary of the site and along Lilyfield Road to the northeast are outside of the PMF flood extent.

Flow velocities across the site during flood events are generally low. For example, in the 100 year ARI event, peak flow velocities are less than 0.5 metres per second across the most of the site, and typically less than 0.2 metres per second. Zones of faster moving floodwaters up to around two metres per second occur in the vicinity of the existing workshop in the southwest corner of the site.

Flood hazards according to the *Floodplain Development Manual* (NSW Government 2005) are shown in **Figure 17-13** for the 100 year ARI. Easton Park drain and Whites Creek, as well as its overbank areas including sections of Railway Parade, are considered high flood hazard zones. This is consistent with the Leichhardt Flood Study. The Rozelle Rail Yards site is generally a low flood hazard area, except for a small area near Victoria Road.

The Rozelle Rail Yards site is generally not subject to flooding from Whites Creek as the Inner West Light Rail line and City West Link provide physical barriers to flow. However, during the PMF, Whites Creek overtops the structure at The Crescent and flows in an easterly direction along City West Link, merging the floodwaters from the Rozelle Rail Yards and Whites Creek.

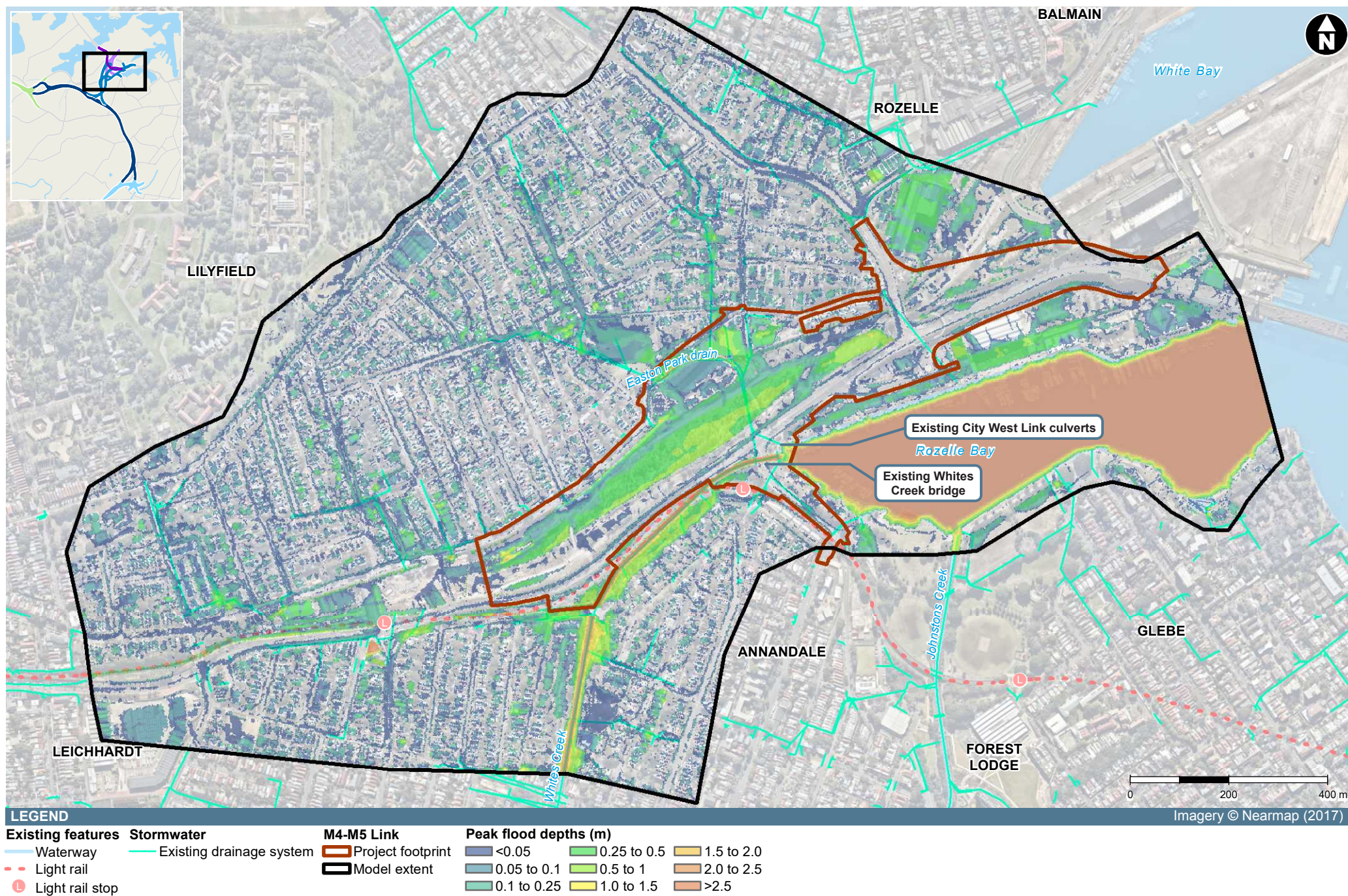


Figure 17-10 Present day flood behaviour – Rozelle interchange - peak flood depths (10 year ARI)

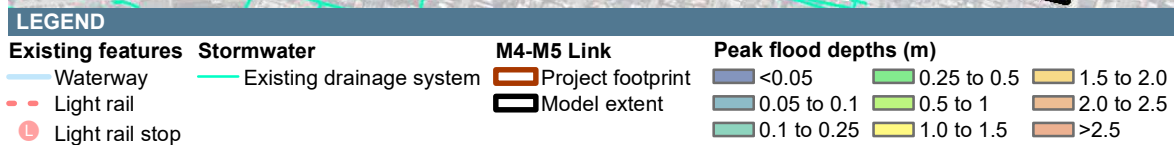
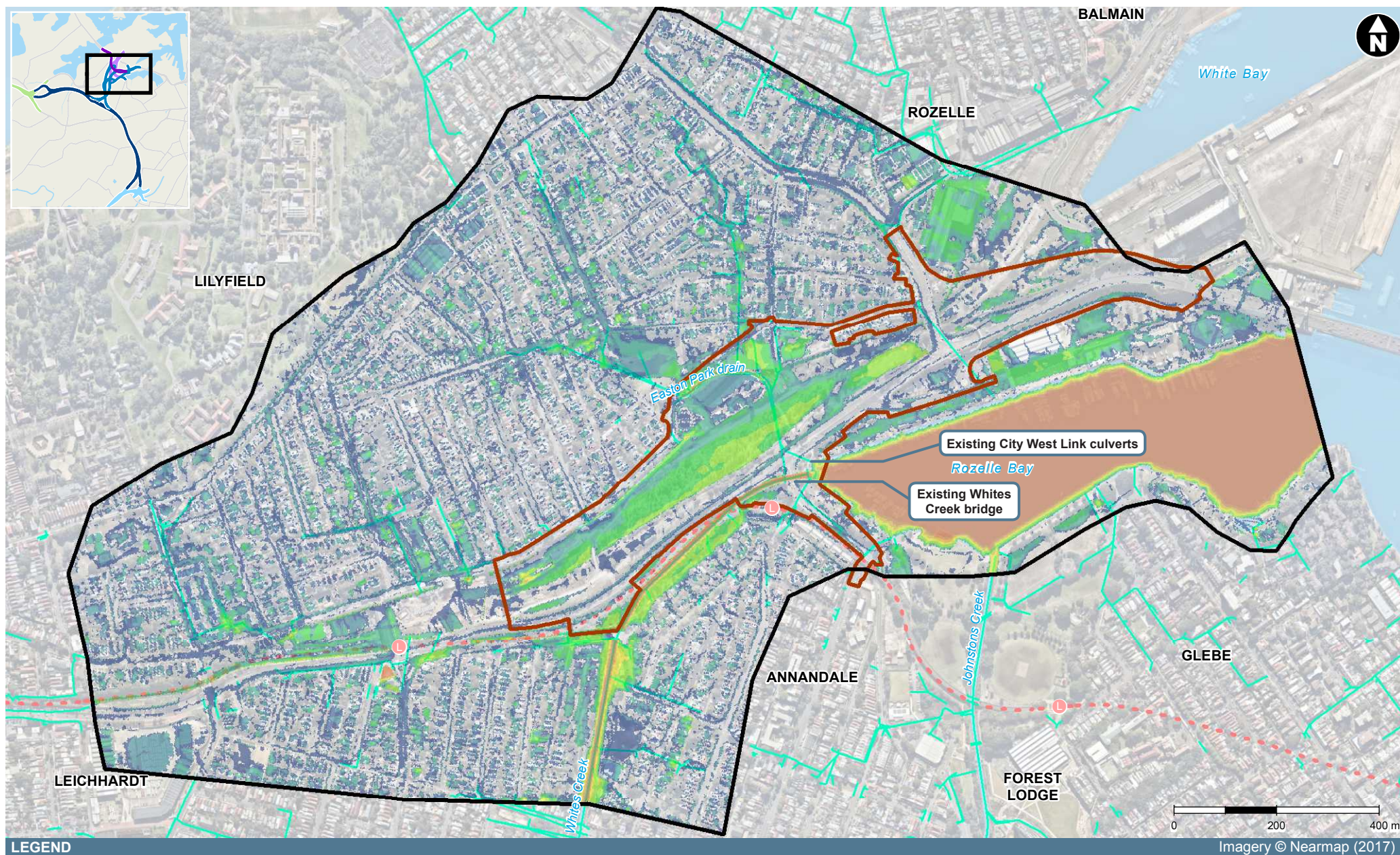


Figure 17-11 Present day flood behaviour – Rozelle interchange - peak flood depths (100 year ARI)

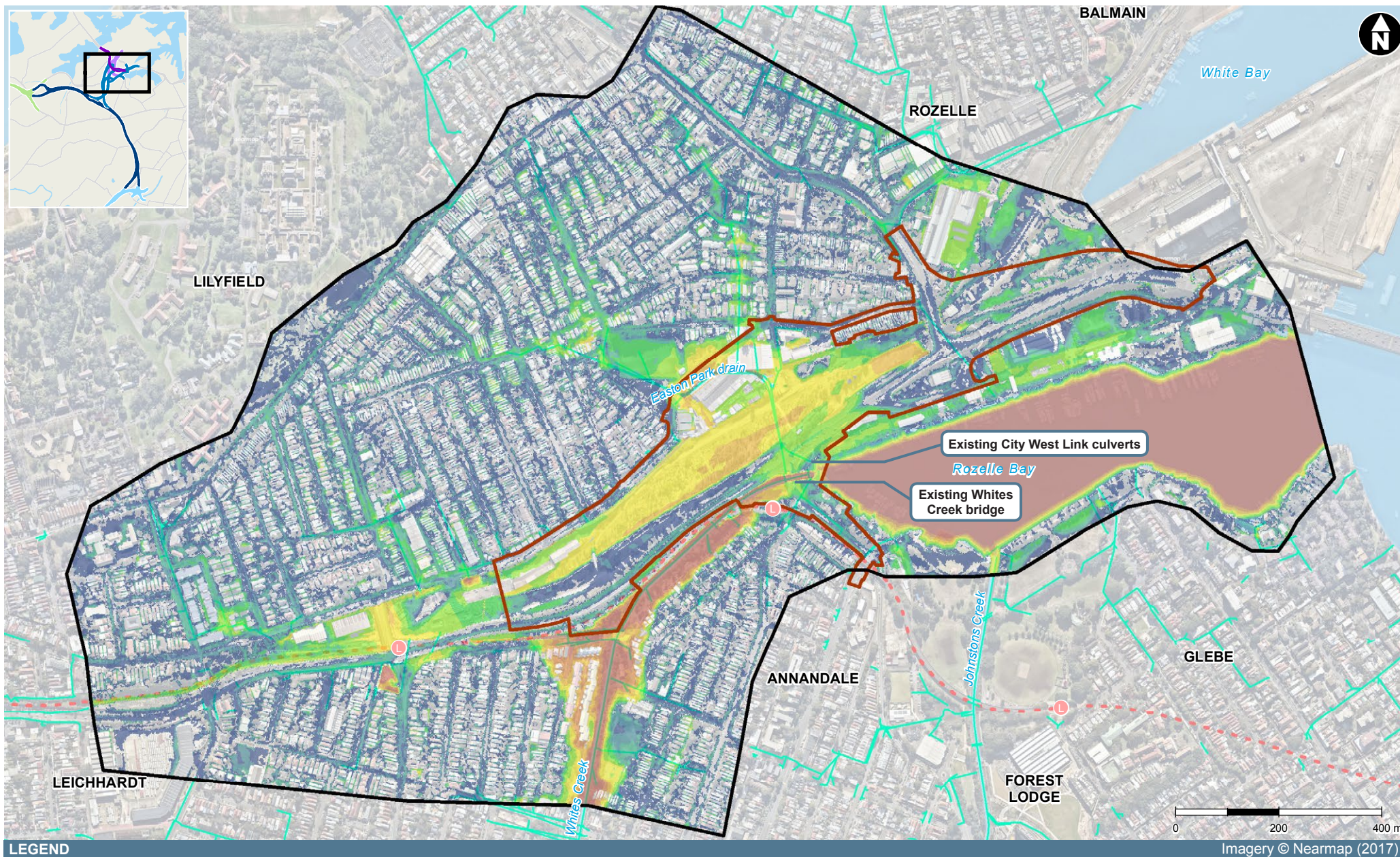


Figure 17-12 Present day flood behaviour – Rozelle interchange - peak flood depths (PMF)

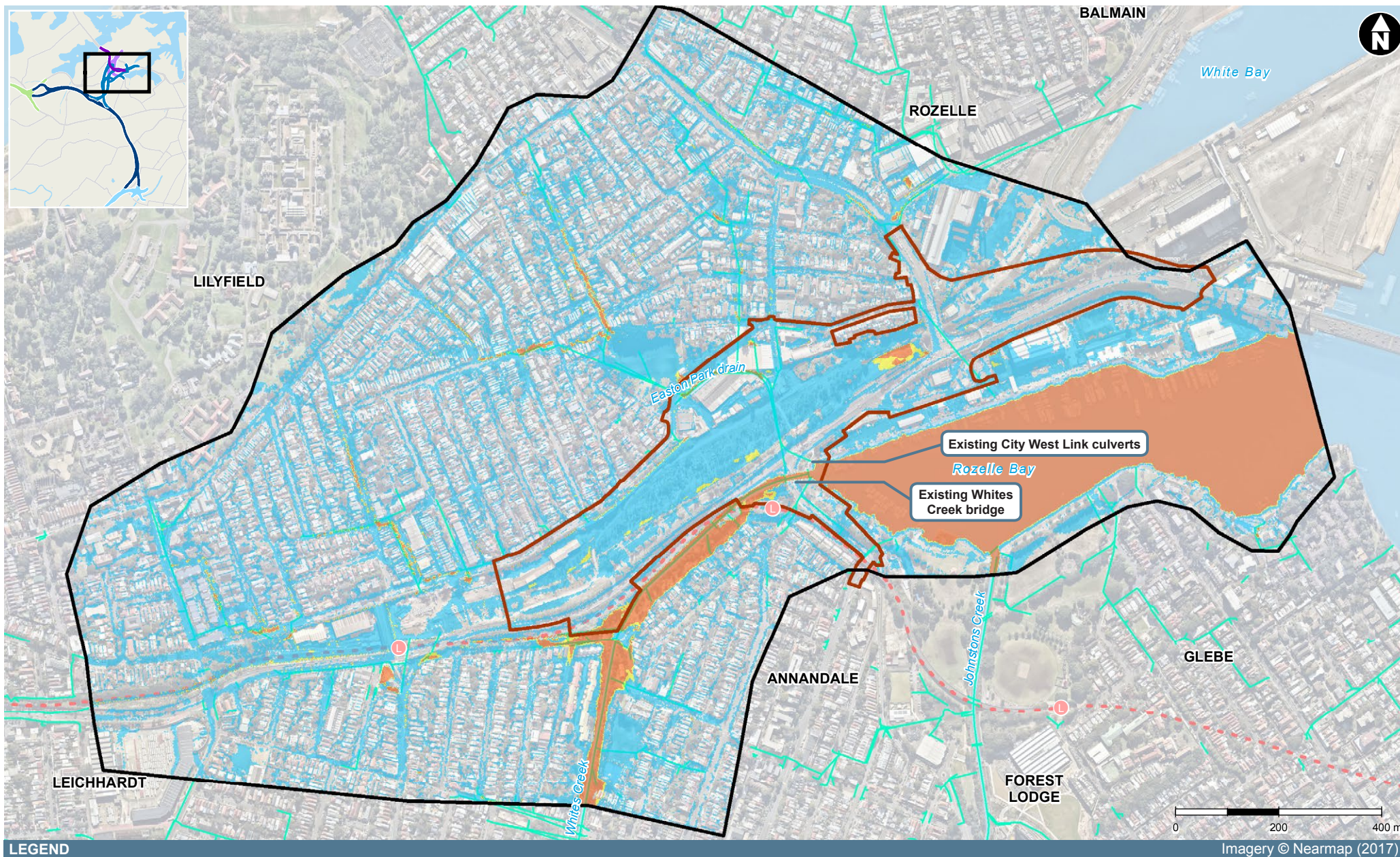


Figure 17-13 Present day flood behaviour – Rozelle interchange - provisional flood hazard (100 year ARI)

Iron Cove Link

The proposed Iron Cove Link would connect to Victoria Road within the Iron Cove catchment. The area slopes from the southeast (about 24 metres AHD) to the northwest (about 16 metres AHD) towards Iron Cove Bridge. The closest waterway in proximity to Iron Cove Link is Iron Cove, located to the northwest of the proposed Rozelle interchange.

The existing flood conditions for the 10 and 100 year ARI design events and PMF are shown in **Figure 17-14** to **Figure 17-16**. Maximum water depths of less than 0.25 metres are found on Victoria Road near the proposed Iron Cove Link, with the deeper water generally found on the northern carriageway. During the PMF event, depths across the site reach 0.3 metres near the intersection with Terry Street.

Flow velocities across the site during flood events reach up to 2.0 and 2.5 metres per second for the 10 year and 100 year ARI events respectively. This is due to the topographic levels along Victoria Road dropping towards Iron Cove Bridge. Flood hazards for the 100 year ARI are shown in **Figure 17-17**.

The hazards associated with main overland flow paths are predominantly medium hazard. However, there are localised areas of high hazard on the northern carriageway of Victoria Road. This is consistent with the Leichhardt Flood Study.

An assessment of flood risk posed to the Iron Cove Link was undertaken by comparing the location of the portals to the PMF flood extents presented in the Leichhardt Flood Study report and model results. This location is subject to runoff generated in the small catchment to the north and east and conveyed along the roads, mainly Victoria Road and Crystal Street. The site is not identified as a flood control lot in the Leichhardt Development Control Plan 2013.

The flood mapping suggests that the Iron Cove Link portals may be at risk of inundation from overland flow paths on Victoria Road during the PMF event. The water flows in a north-westerly direction along Victoria Road towards Iron Cove Bridge. The median traffic barrier along Victoria Road provides an obstruction to overland flows and deflects floodwaters towards Iron Cove Bridge.

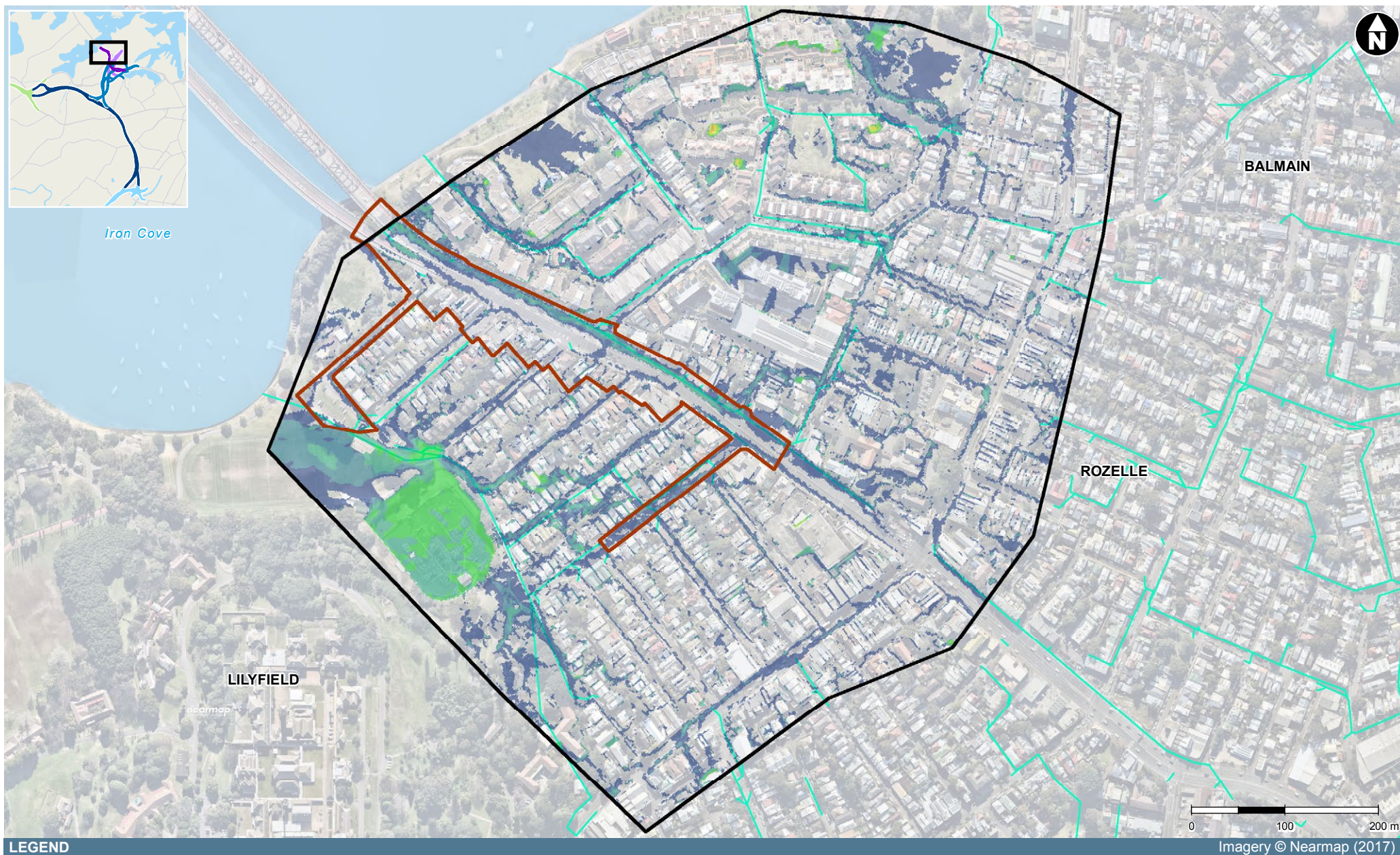


Figure 17-14 Present day flood behaviour – Iron Cove Link - peak flood depths (10 year ARI)

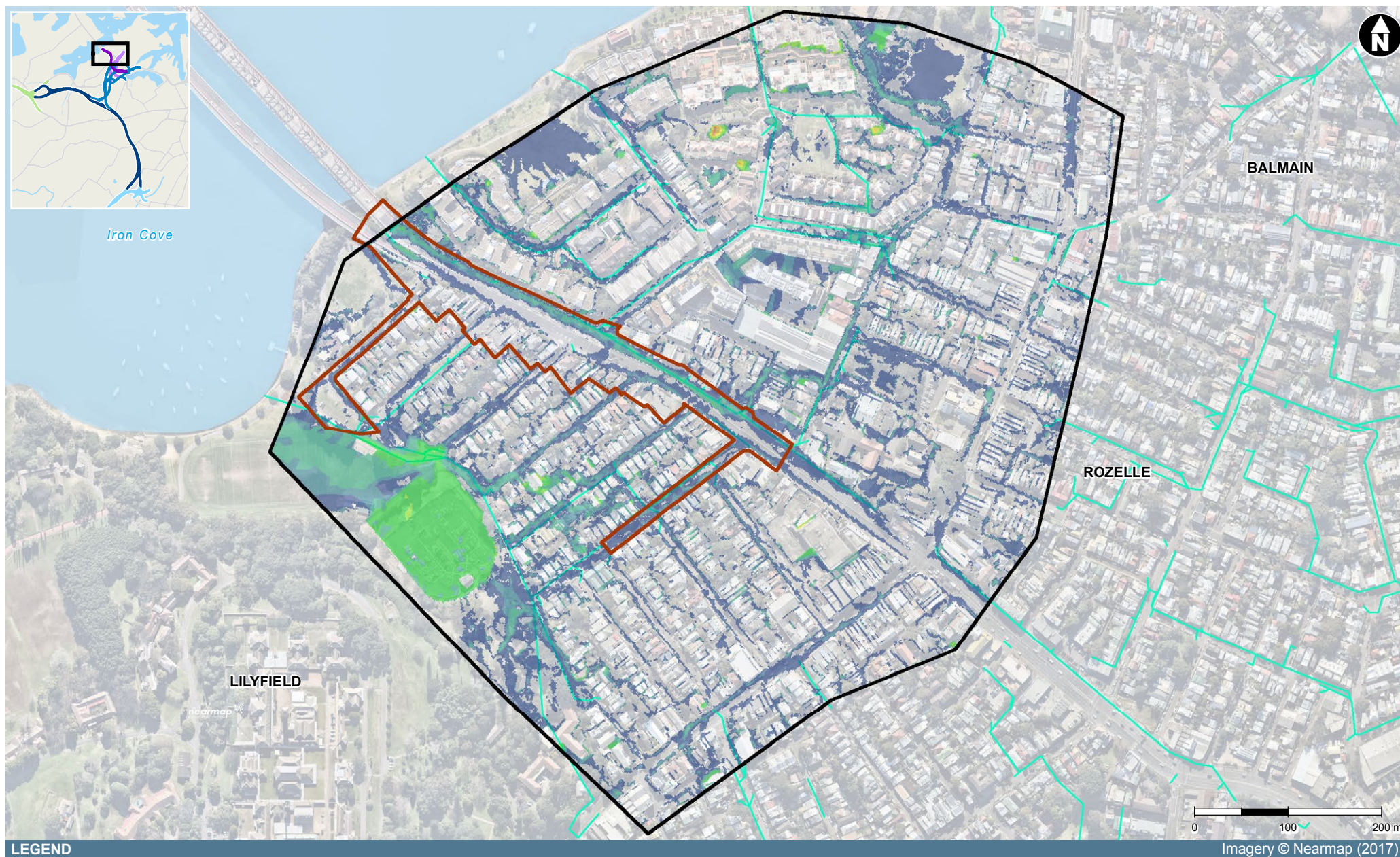


Figure 17-15 Present day flood behaviour – Iron Cove Link - peak flood depths (100 year ARI)

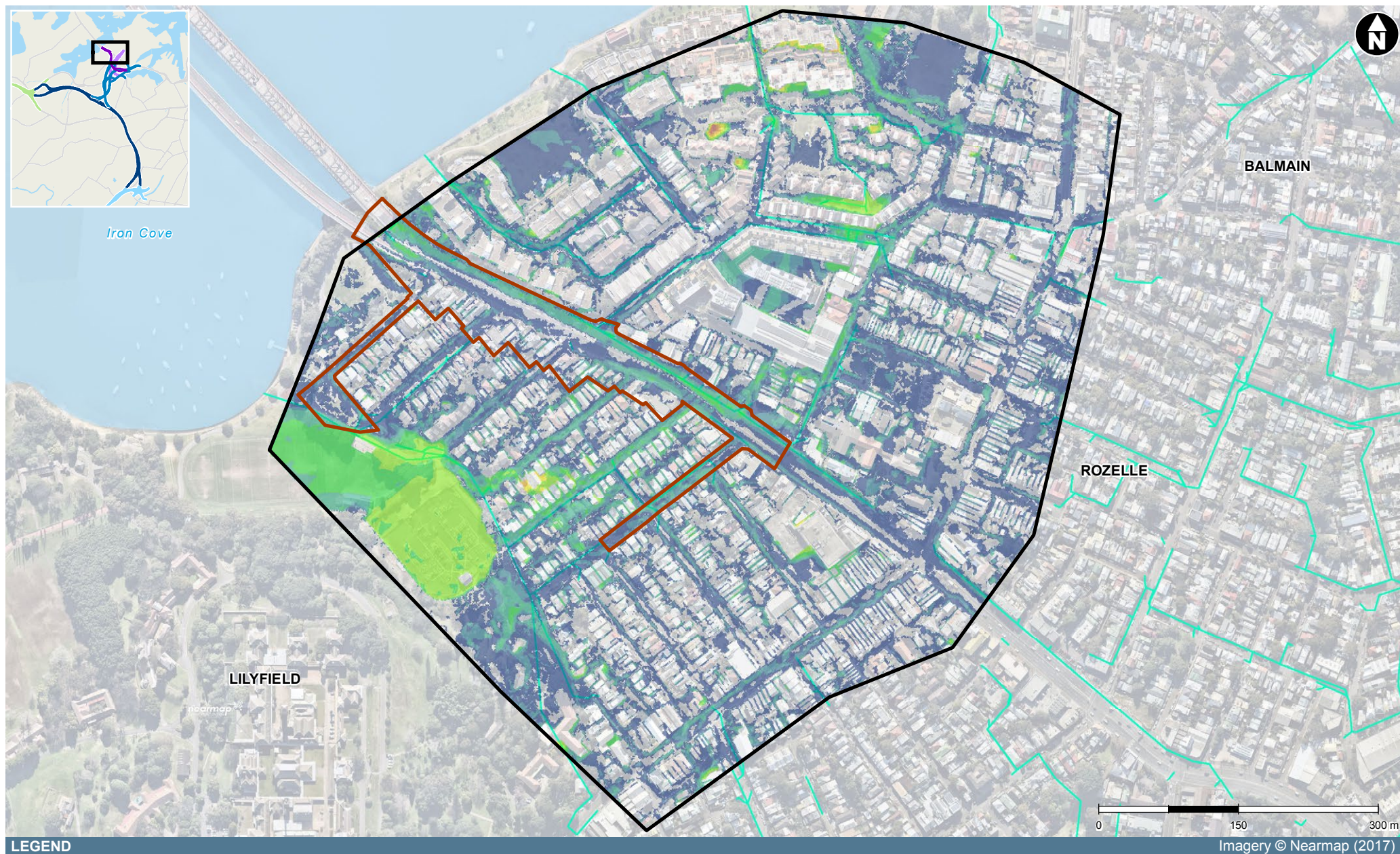


Figure 17-16 Present day flood behaviour – Iron Cove Link - peak flood depths (PMF)

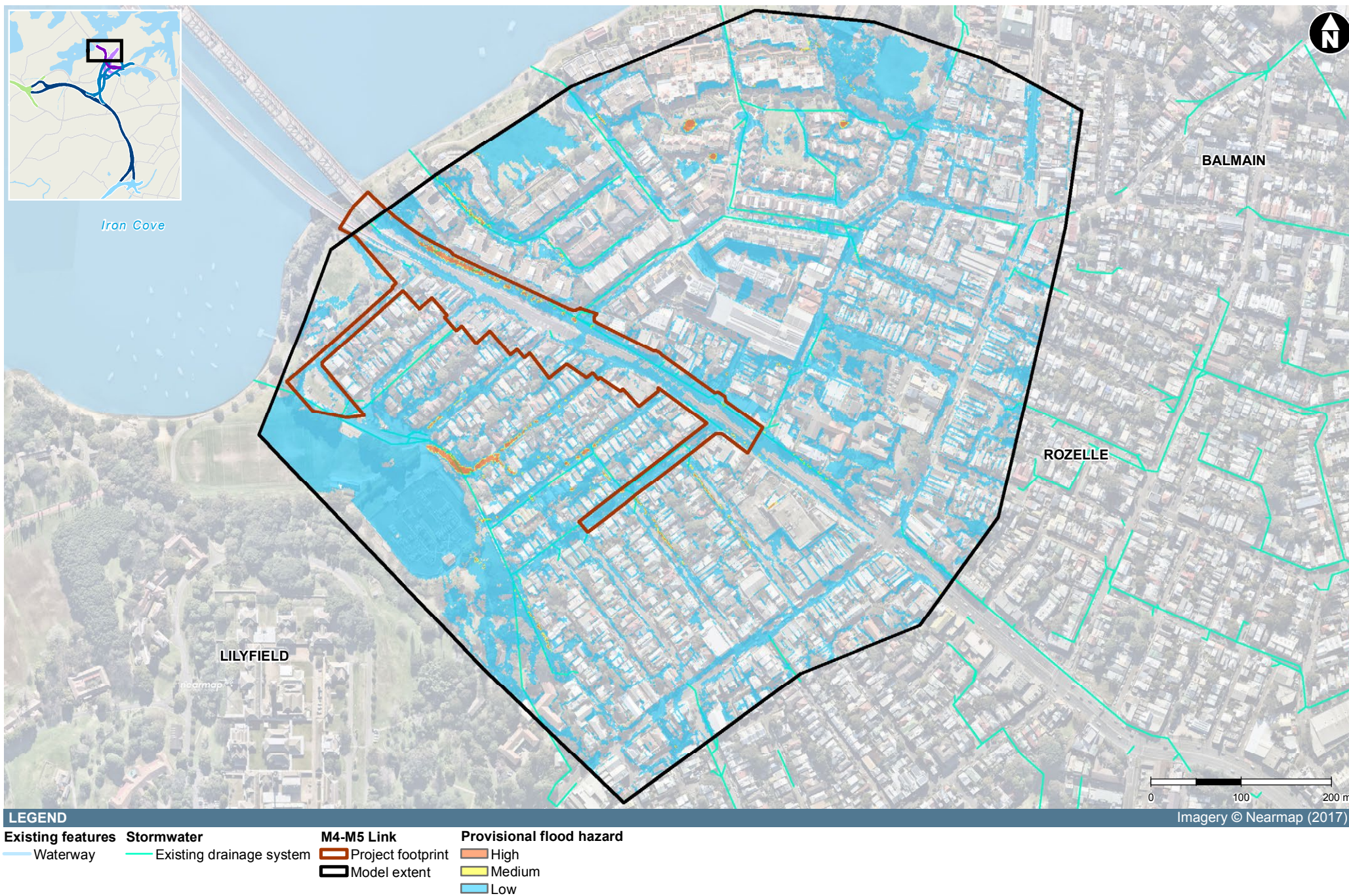


Figure 17-17 Present day flood behaviour – Iron Cove Link - provisional flood hazard (100 year ARI)

Darley Road

The Darley Road civil and tunnel site (C4), where the operational water treatment plant for the project may be located, is situated south of City West Link in the catchment of Hawthorne Canal. The site is situated in an area that has been assessed by two flood studies, the Hawthorne Canal Flood Study (WMAWater 2013a) commissioned by Ashfield and Marrickville Councils, and the Leichhardt Flood Study.

The site slopes east to west with ground levels dropping from about 12 metres AHD to four metres AHD. The eastern side of the Darley Road site sits higher than the Inner West Light Rail line to the north, with levels dropping by about eight metres in its western extent and sitting lower than the rail line.

The Hawthorne Canal Flood Study shows that the Darley Road site is on the fringe of the 100 year ARI flood extent. However, most of the site may be inundated in a PMF, particularly the western half of the site, with depths of up to 0.5 metres within the site and up to one metre around the intersection of Darley Road and Charles Street. The Leichhardt Flood Study identified that part of the Darley Road civil and tunnel site (C4) may be subject to flooding during the PMF to similar depths. The site is identified as a flood control lot in the Leichhardt Development Control Plan 2013.

The site itself has a limited catchment area and the presence of low walls on the eastern side of the site reduces the potential for runoff to enter from higher ground near City West Link, deflecting it onto Darley Road and around to the south of the site.

During the PMF event, the northeast section of the site is subject to flooding as a consequence of water spilling onto the site from the Leichhardt North light rail stop platform area. The western section, which is the lowest part of the site, is inundated by floodwater during the PMF event as a consequence of water spilling from the Inner West Light Rail line, as well as from water that collects at the topographic low point near the junction of Darley Road and Charles Street.

Localised inundation depths of less than 0.2 metres are expected for the 10 year ARI event. Maximum depths on the western section of the site are about 0.8 metres for the PMF event (**Figure 17-18** to **Figure 17-20**).

The velocity of water through the site is generally less than 0.1 metres per second except on the steeper areas where water flows from Darley Road onto the site. Velocities on Darley Road are estimated to be up to 1.5 metres per second along the kerb line. Flood hazards near the site are generally low, but medium to high hazards are estimated along the north-eastern boundary with the Inner West Light Rail line (see **Figure 17-21**).

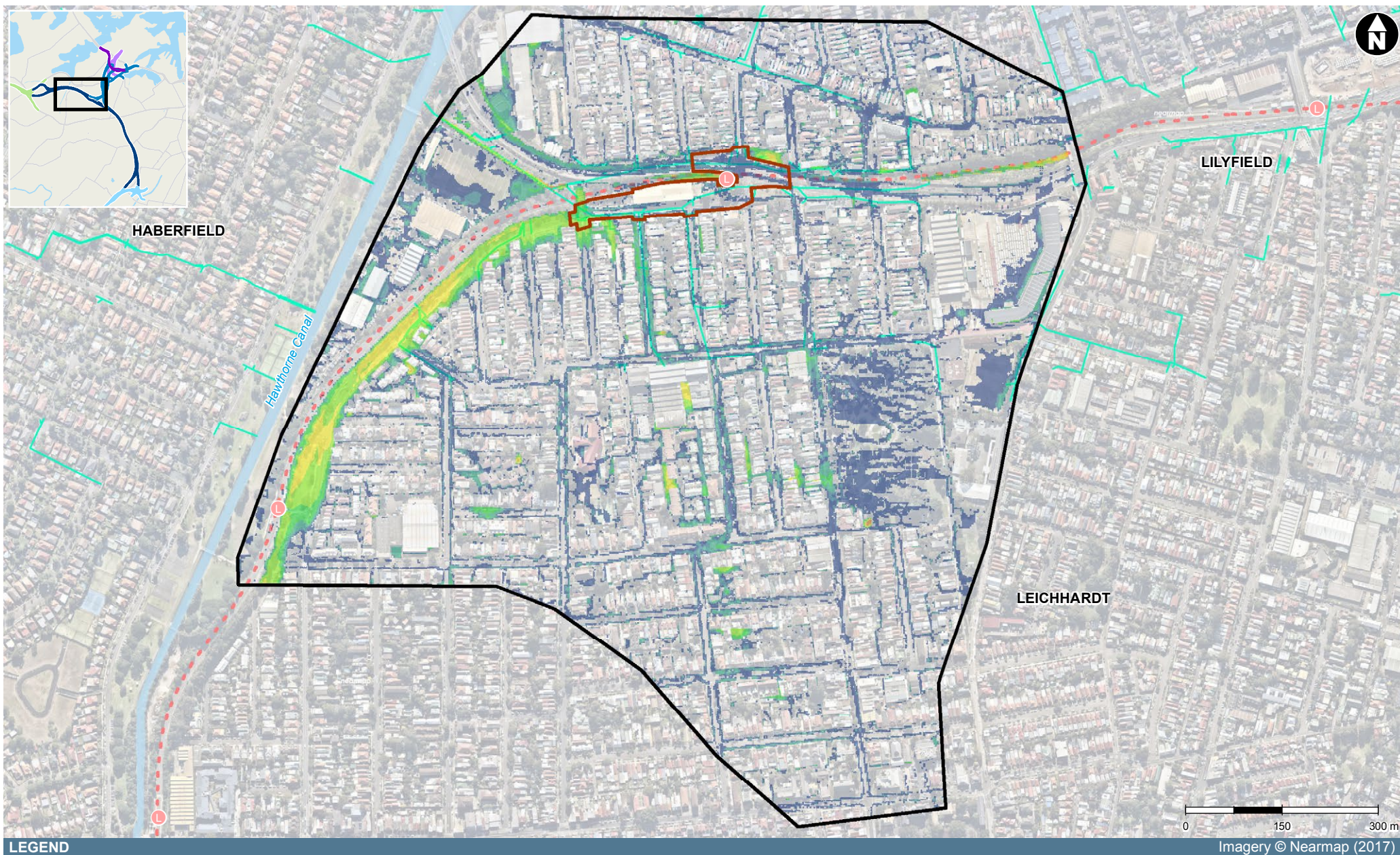


Figure 17-18 Present day flood behaviour – Darley Road - peak flood depths (10 year ARI)



Figure 17-19 Present day flood behaviour – Darley Road - peak flood depths (100 year ARI)

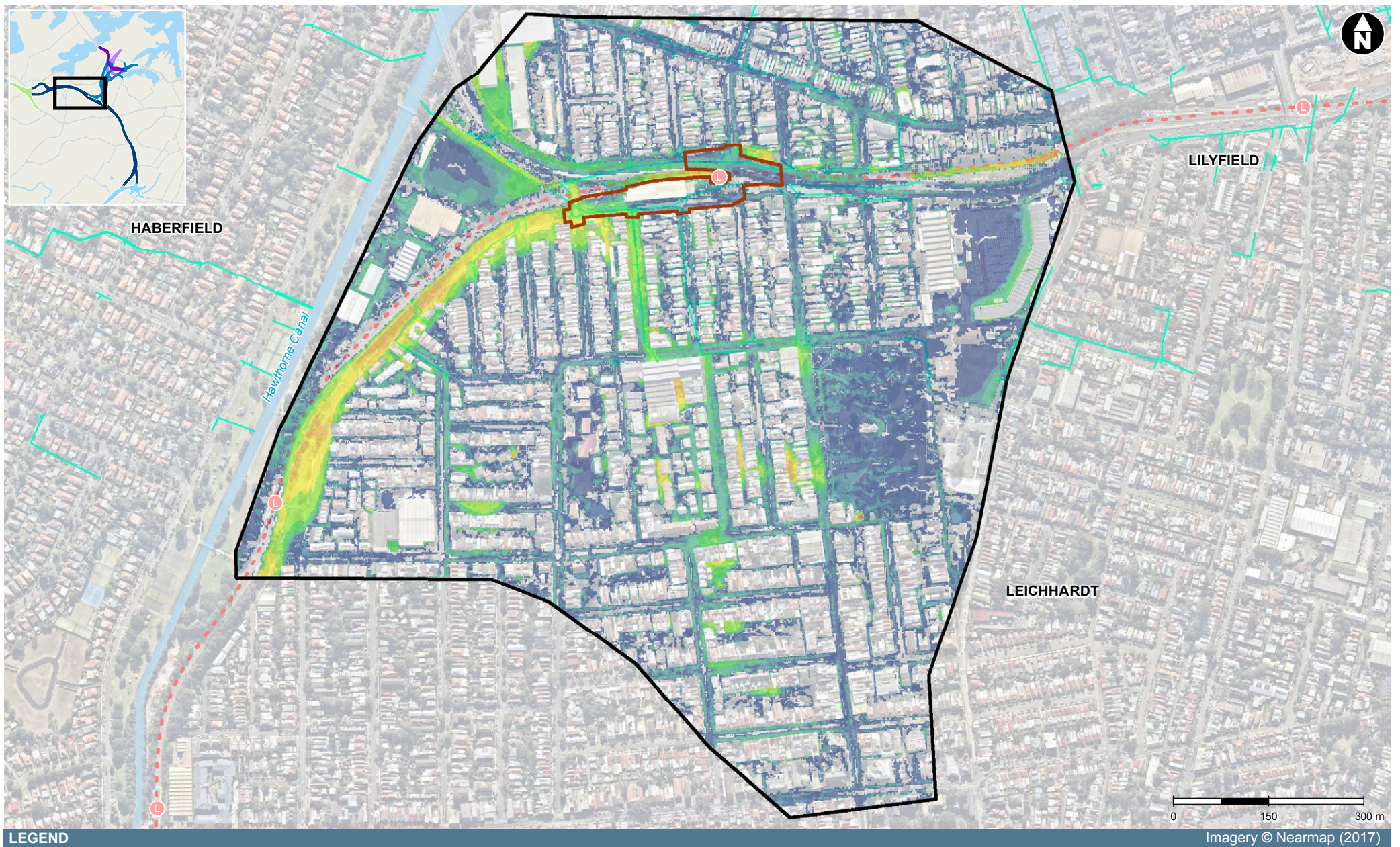


Figure 17-20 Present day flood behaviour – Darley Road - peak flood depths (PMF)

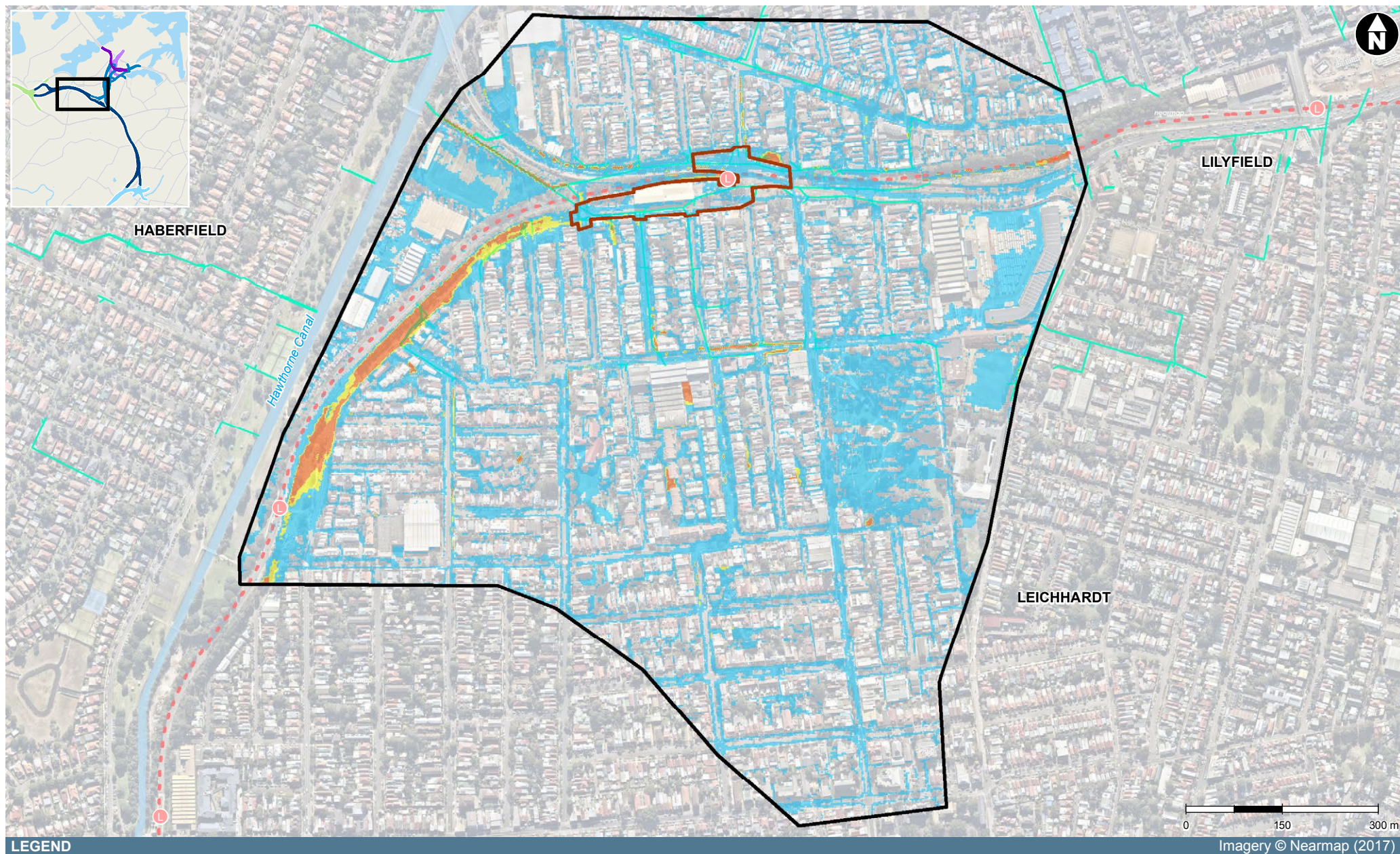


Figure 17-21 Present day flood behaviour – Darley Road - provisional flood hazard (100 year ARI)

Pymont Bridge Road

The Pymont Bridge Road tunnel site (C9) is located near the top of the Johnstons Creek catchment. There is only a small catchment draining to the site, but the dense existing built environment means that a substantial amount of runoff is channelled along Bignell Lane, with water ponding at the low point along this lane. The local drainage system connects to the road drainage system on Pymont Bridge Road before draining towards Johnstons Creek.

The Leichhardt Flood Study identified flood depths generally between 0.1 metres and 0.2 metres along Bignell Lane and up to one metre at the low point towards the western end of Bignell Lane in the 100 year ARI event. Given the small catchment size, the relatively high flood depths are a result of the confined overland flow path.

During construction, the existing buildings on the site are proposed to be demolished and replaced with facilities, which would cover a smaller area. This would allow for less concentrated overland flows paths, greater opportunity for infiltration and would also reduce the potential to displace water and impact surrounding properties. With appropriate site drainage to manage runoff at the Pymont Bridge Road tunnel site (C9), the risk of flooding to the site from overland flow is considered to be low. Measures would include a combination of temporary piped drainage, open drains and swales, overland flow paths and sedimentation and erosion control measures.

Existing flood behaviour summary

A summary of the existing flood conditions at the surface features during the operational phase of the project is presented in **Table 17-3**. This is based on a review of existing flood risk assessments and identifies if further quantitative assessment is required to assess flood risk and impacts of the project.

Table 17-3 M4-M5 Link operational surface features and existing flood risk

Project surface feature	Catchment	Existing flood risk assessment	Existing flood risk review	Further assessment required?
Wattle Street interchange	Dobroyd Canal (Iron Cove Creek)	M4 East EIS (Roads and Maritime 2015a); M4 East Final Design (CSJ 2016a, b)	The project portals (tunnel entries) and cut and cover sections of the M4-M5 Link have been constructed as part of the M4 East project. M4 East has designed raised road crests at the entry to the tunnels above the PMF level. The M4 East ventilation facility at Walker Avenue (Parramatta Road ventilation facility) has been designed to be flood protected in design storm events up to the PMF by providing bunds and walls around the site and local drainage systems to direct stormwater runoff away from critical buildings. The project would not change the M4 East design surface layout or levels, therefore it is considered that the: <ul style="list-style-type: none"> • Risk of flooding to the project tunnel structure in a PMF event is low • The project would not have an impact on flood risk to surrounding properties at this location. Therefore, no further mitigation measures are required beyond those	No

Project surface feature	Catchment	Existing flood risk assessment	Existing flood risk review	Further assessment required?
			provided by the M4 East project.	
Rozelle interchange	Easton Park drain Rozelle Bay, Whites Creek	Leichhardt Flood Study (Cardno 2014a)	<p>The Rozelle Rail Yards site is subject to extensive flooding in the five year ARI event.</p> <p>Limited information is available on flood depths at the Rozelle Rail Yards and the potential risk to the project (inundation of portals).</p> <p>The project has the potential to displace water and impact on flood risk to surrounding properties at this location.</p> <p>A replacement bridge structure is proposed over Whites Creek at The Crescent.</p> <p>Critical project infrastructure such as the Rozelle motorway operations complexes (MOC2 and MOC3) and tunnel ventilation facility are proposed at the Rozelle Rail Yards site.</p>	Yes
Iron Cove Link	Iron Cove	Leichhardt Flood Study (Cardno 2014a)	<p>An overland flow path is present on Victoria Road for the five year ARI event.</p> <p>Floodwater depths of up to 0.3 metres for the PMF.</p> <p>Peak flow velocities between two and three metres per second for PMF.</p> <p>Potential risk to project (inundation of portals and flooding of the Iron Cove Link motorway operations complex (MOC4)).</p> <p>Potential for project to displace water and impact on flood risk to surrounding properties at this location.</p>	Yes
St Peters interchange	Alexandra Canal	<p>M5 EIS (Roads and Maritime 2015b)</p> <p>New M5, Substantial Detailed Design report, Rev D (AJJV 2016a)</p>	<p>The tunnel stubs for the project and St Peters interchange are being constructed as part of the New M5 project.</p> <p>Mitigation measures for the New M5 project include a bund around the perimeter of the interchange and upgrades to the local drainage network around the interchange.</p> <p>The New M5 tunnel ventilation facility (St Peters ventilation facility) has been designed to be above the PMF event.</p> <p>The project portals would be at low risk of flooding as they are protected from the PMF by the measures provided by</p>	No

Project surface feature	Catchment	Existing flood risk assessment	Existing flood risk review	Further assessment required?
			<p>the New M5 project.</p> <p>The tunnel ventilation facility for the M4-M5 Link project would be above the tunnel portal and would therefore also be flood protected up to the PMF event.</p> <p>The project would not change surface levels or layout outside of the perimeter flood bund and therefore would not have a detrimental impact on flood risk to surrounding properties at this location. No further mitigation is required at this location.</p>	
Darley Road	Hawthorne Canal	<p>Hawthorne Canal Flood Study (WMAwater 2013a)</p> <p>Leichhardt Flood Study (Cardno 2014a)</p>	<p>Localised ponded water on the north-eastern side of the site for 20 year ARI event.</p> <p>Flood water depths up to 0.8 metres during the PMF event.</p> <p>Potential risk to project (inundation of portals and Darley Road motorway operations complex (MOC1)).</p> <p>Potential to displace water and impact on flood risk to surrounding properties.</p>	Yes

17.3 Assessment of potential construction impacts

Construction works have the potential to change flood behaviour and impact on the surrounding environment. In addition, flooding has the potential to impact on areas within and near construction sites for the project (ie potential inundation of project sites).

An assessment of the flood risks to the project and the surrounding environment, along with development of appropriate mitigation measures, has been carried out in accordance with the *Floodplain Development Manual* (OEH 2005), the requirements of the previous WestConnex program of works environmental approvals and industry guidelines.

Construction of the project would involve a range of activities at sites of both permanent and temporary occupancy. The construction activities associated with the project that could result in impacts if not mitigated include:

- Enabling and temporary works, including construction power, water supply, ancillary site establishment, demolition works, property adjustments and public transport modifications (if required)
- Construction of the road tunnels, interchanges, intersections and roadside infrastructure
- Haulage of spoil generated during tunnelling and excavation activities
- Fitout of the road tunnels and support infrastructure, including ventilation and emergency response systems
- Construction and fitout of the motorway operations complexes and other ancillary operations buildings
- Realignment, modification or replacement of surface roads, bridges and underpasses

- Implementation of environmental management and pollution control facilities for the project.

An assessment of construction impacts associated with water extraction, flooding and drainage is provided in the following sections.

17.3.1 Flooding and drainage

This section considers flood behaviour resulting in potential detrimental increases in the potential flood affectation of the project infrastructure and other properties, assets and infrastructure. Flooding during construction of the project could potentially impact areas within and near the construction sites. Flood related impacts during construction could include:

- Inundation of excavated tunnels
- Damage to facilities, infrastructure, equipment, stockpiles and downstream sensitive areas caused by inundation from floodwaters
- Increased risk of flooding of adjacent areas due to temporary loss of floodplain storage (due to displacement of water) or impacts on the conveyance of floodwaters.

Tunnel portals would be located at the Wattle Street interchange, the Rozelle interchange, along Victoria Road near the eastern abutment of Iron Cove Bridge (associated with the Iron Cove Link) and at the St Peters interchange. Tunnel portals at the Wattle Street interchange and the St Peters interchange are being built by the M4 East and New M5 projects respectively.

Tunnel portals would be constructed using cut-and-cover techniques (refer to **Chapter 6** (Construction work) for a description of this construction technique). Tunnelling would also occur via temporary access tunnels that would connect the Parramatta Road West civil and tunnel site (C1b), the Darley Road civil and tunnel site (C4), the Pyrmont Bridge Road tunnel site (C9) and the Campbell Road civil and tunnel site (C10) with the mainline tunnels.

Ingress of floodwater into the tunnel shafts or cut and cover excavations during construction would pose a risk to personal safety for those working in the tunnel. Where these facilities occur within the floodplain, such as at Darley Road at Leichhardt and Rozelle, protection measures such as bunding or floodwater barriers would be provided to ensure floodwaters do not enter shafts or portals.

Other flood impacts during construction, such as flooding of site facilities or stockpiles and erosion of cleared areas, are expected to be minor and would be adequately managed through the management and mitigation measures identified in **section 17.5**.

These would include adjusting the construction ancillary facility designs and planning sites to recognise the identified flood conditions and minimise the potential for off-site flood impacts. The indicative layouts of the construction ancillary facilities have been developed to provide setback from high risk flooding areas (ie high flood hazard areas and overland flow paths) to minimise impacts on existing flow paths, where feasible. All formwork, access tracks and other temporary works would be located outside of the existing Whites Creek channel.

While there is the potential for temporary structures (used to support permanent structures, materials, plant, equipment or people) to reduce the available waterway area beneath the replacement bridge, the longer spans of the bridge would be designed to mitigate potential impact on flood behaviour. It is also likely that the replacement bridge would comprise pre-cast members, meaning that the waterway would not be obstructed by any additional temporary structures associated with an alternative cast *in situ* type approach. This approach would also result in a comparatively shorter timeframe for installation of the bridge.

The likelihood of flooding and a summary of the potential impacts of construction sites (as shown in **Figure 17-1**) and associated construction activities on flood risk are provided in **Table 17-4**. These are based on preliminary construction plans and indicative layouts, which would be refined in the future as the detailed design and site construction planning is further developed.

Table 17-4 Construction ancillary facilities and flooding

Construction ancillary facility	Facilities	Existing flood risk (source, mechanisms)	Potential impacts
C1a Wattle Street civil and tunnel site (part of M4 East project footprint)	<ul style="list-style-type: none"> • Dive structure into the mainline tunnel • Buildings • Parking • Laydown area 	<ul style="list-style-type: none"> • Dobroyd Canal (Iron Cove Creek) catchment • Western side of the site inundated by PMF overland flow path • M4 East project has mitigated flood risk from overland flow, channelling PMF flow towards Parramatta Road junction and away from the dive structure. • M4 East EIS (2015a), M4 East Detailed Design (CSJ 2016a,b) 	None anticipated – area flooded in the PMF only used for vehicle access. No topographic changes proposed therefore negligible impacts on flood risk.
C2a Haberfield civil and tunnel site (part of M4 East project footprint)	<ul style="list-style-type: none"> • Mechanical and electrical fitout of existing M4 East Ventilation facility (Parramatta Road Ventilation facility) • Office, storage and laydown area • Sub-station • Parking • Stockpiling underground 	<ul style="list-style-type: none"> • Dobroyd Canal (Iron Cove Creek) catchment • Outside of PMF flood extent for mainstream flooding and overland flow path • M4 East EIS (2015a), M4 East Detailed Design (CSJ 2016a,b) 	None anticipated – area outside of PMF flood extent.
C3a Northcote Street civil site (part of M4 East project footprint)	<ul style="list-style-type: none"> • Parking • Laydown area 	<ul style="list-style-type: none"> • Dobroyd Canal (Iron Cove Creek) catchment • Outside of PMF flood extent for mainstream flooding and overland flow path • M4 East EIS (2015a), M4 East Detailed Design (CSJ 2016a,b) 	None anticipated – area outside of PMF flood extent.
C1b Parramatta Road West civil and tunnel site	<ul style="list-style-type: none"> • Acoustic shed • Laydown area • Temporary dive structure into the mainline tunnel 	<ul style="list-style-type: none"> • Dobroyd Canal (Iron Cove Creek) catchment • Outside of 100 year ARI flood extent for mainstream flooding • Overland flow paths along Parramatta Road, Bland Street and Alt Street 	None anticipated – area just on the fringe of PMF flood extent. No overland flow paths through the site. No topographic changes proposed for Parramatta Road, Bland Street and Alt Street, therefore overland flow paths would be maintained.

Construction ancillary facility	Facilities	Existing flood risk (source, mechanisms)	Potential impacts
C2b Haberfield civil site (part of M4 East project footprint)	<ul style="list-style-type: none"> • Parking • Office, storage and laydown area • Ventilation facility (Parramatta Road Ventilation facility) 	<ul style="list-style-type: none"> • Dobroyd Canal (Iron Cove Creek) catchment • Outside of PMF flood extent for mainstream flooding and overland flow paths • M4 East EIS (2015a), M4 East Detailed Design (CSJ 2016a,b) 	None anticipated – area outside of PMF flood extent.
C3b Parramatta Road East civil site	<ul style="list-style-type: none"> • Parking 	<ul style="list-style-type: none"> • Dobroyd Canal (Iron Cove Creek) catchment • Outside of PMF flood extent for mainstream flooding 	None anticipated – area outside of PMF flood extent.
C4 Darley Road civil and tunnel site	<ul style="list-style-type: none"> • Temporary access tunnel for construction • Buildings and laydown area • Parking • Acoustic shed and spoil handling area • Temporary sub-station 	<ul style="list-style-type: none"> • Hawthorne Canal catchment • Localised shallow flooding from 10 year ARI and 100 year ARI flow path from light rail line • Majority of the site may be inundated in a PMF with depths up to 0.5m at the western end of the site • Hawthorne Canal Flood Study (WMA Water 2013a), Leichhardt Flood Study (Cardno 2014a), AECOM flood modelling (2016) 	Potential displacement of water by bunding of tunnel ramps to prevent floodwater ingress, as well as presence of temporary noise walls, buildings/hoarding, acoustic shed, stockpiles and other structures.
C5 Rozelle civil and tunnel site	<ul style="list-style-type: none"> • Dive structure into the mainline tunnel • Buildings and laydown area • Parking • Acoustic shed and spoil handling areas • Temporary sedimentation pond and water treatment plant • Ventilation facility • Temporary drainage structures 	<ul style="list-style-type: none"> • Easton Park drain catchment • Mainstream flooding and overland flow paths • Located within 10 year, 100 year ARI and PMF flood extent • AECOM flood modelling (2016) 	Potential displacement of water by bunding of ramps to prevent floodwater ingress, as well as presence of temporary noise walls, buildings/hoardings, buildings, stockpiles and other structures.

Construction ancillary facility	Facilities	Existing flood risk (source, mechanisms)	Potential impacts
C6 The Crescent civil site	<ul style="list-style-type: none"> Construction of Whites Creek bridge Widening and improvement works to Whites Creek Construction of culverts from Rozelle Rail Yards Buildings and laydown area Parking 	<ul style="list-style-type: none"> Whites Creek catchment On the edge of Rozelle Bay Located outside 100 year ARI flood extent but within PMF flood extent AECOM flood modelling (2016) 	Potential displacement of water by hoardings, buildings, stockpiles and other structures.
C7 Victoria Road civil site	<ul style="list-style-type: none"> Buildings Parking 	<ul style="list-style-type: none"> Rozelle Bay catchment Outside of PMF flood extent Leichhardt Flood Study (Cardno 2014a) 	None anticipated – area outside of PMF flood extent.
C8 Iron Cove Link civil site	<ul style="list-style-type: none"> Dive structure into Iron Cove Link tunnel Buildings Temporary water treatment plant Workshop and storage 	<ul style="list-style-type: none"> Iron Cove catchment Overland flow paths on Victoria Road for 10 year ARI event Leichhardt Flood Study (Cardno 2014a), AECOM flood modelling (2016) 	Potential displacement of water by bunding of ramps to prevent floodwater ingress, as well as activities to widen the road.
C9 Pymont Bridge Road tunnel site	<ul style="list-style-type: none"> Temporary access tunnel for construction Buildings and laydown area Workshop Parking Acoustic shed and spoil handling area Temporary sub-station 	<ul style="list-style-type: none"> Johnstons Creek catchment Overland flow in 10 year ARI event, depths of over 1m limited to Bignell Lane Johnstons Creek Catchment Flood Study (WMA Water 2015), Leichhardt Flood Study (Cardno 2014a) 	Potential displacement of water by bunding of ramps to prevent floodwater ingress, as well as presence of temporary noise walls, buildings/hoardings, acoustic shed, offices and other structures.

Construction ancillary facility	Facilities	Existing flood risk (source, mechanisms)	Potential impacts
C10 Campbell Road civil and tunnel site (part of New M5 project footprint).	<ul style="list-style-type: none"> • Dive structure into the mainline tunnel • Buildings and laydown area • Parking • Acoustic shed and spoil handling area 	<ul style="list-style-type: none"> • Alexandra Canal • Outside of 20 year ARI and PMF flood extent associated with mainstream flooding • New M5 EIS (2015), AJJV Detailed Design (2016) 	<p>The New M5 project is providing the construction site platform within the St Peters interchange, including designing to protect the construction site from flooding.</p> <p>No impacts anticipated on the basis that the New M5 project is assessing impacts and providing mitigation, such as a temporary stormwater drainage strategy to divert flows around and away from stockpile sites and other vulnerable infrastructure.</p>

Localised flooding and drainage

All construction works would have the potential to impact local overland flow paths and existing minor drainage paths. Disruption of existing flow paths, both of constructed drainage systems or those of overland flow paths, could occur as a result of:

- Disruption of existing drainage networks during decommissioning, upgrade or replacement of drainage pits and pipes
- Interruption of overland flow paths by installation of temporary construction ancillary facilities
- Sediment entering drainage assets and causing blockages
- Overloading the capacity of the local drainage system.

These are typical impacts faced on most construction projects and would be addressed by adopting industry standard mitigation measures. Consideration of these impacts would be included during future detailed design and construction planning phases, along with consideration of the typical mitigation measures described in **section 17.5** and **Appendix F** (Utilities Management Strategy). Assessment and mitigation of sedimentation is provided in **Chapter 15** (Soil and water quality).

17.3.2 Hydrological impacts

Water balance

The SEARs make reference to a detailed water balance for ground and surface water. Due to the staging and variable nature of construction activities, presence of a potable water supply and highly disturbed nature of the receiving waterways, the water balance assessment has been limited to estimation of rainwater and groundwater reuse volumes and daily treated wastewater discharge volumes. Volume estimates are provided in **Appendix Q** (Technical working paper: Surface water and flooding). A summary of the findings for water use and water discharges is provided below.

The total volume of water required during construction of the project is estimated to be around 900 megalitres. The use of non-potable water would be preferred over potable water where possible.

Non-potable water demands include:

- Surface activities such as dust suppression, wheel washing and plant washing
- Underground activities such as road header dust suppression, rock bolting and plant washdown.

Stormwater and other non-potable sources such as treated tunnel groundwater and treated 'dirty' construction water would be reused for non-potable water demands during construction. It is not proposed that surface water would be extracted from the local urban waterways.

The extent to which non-potable water sources can be used would be variable and governed by workplace health and safety considerations, economic feasibility, the functional specifications of the design and the availability and quality of non-potable water.

Construction wastewater (including stormwater, groundwater and construction water) would be generated from all temporary construction ancillary facilities with the exception of the Northcote Street civil site (C3a), which would be used for parking and construction support only.

The total volume of wastewater generated during construction would vary according to rainfall, construction activities taking place, the amount of groundwater infiltrating into the tunnel, and the length of the tunnel that has been excavated.

Indicative daily discharge rates, ranging from 10 kilolitres per day at The Crescent civil site (C6) to 2,400 kilolitres per day at Rozelle civil and tunnel site (C5) are provided in **Appendix Q** (Technical working paper: Surface water and flooding). A qualitative assessment of the impacts of the discharges to the receiving waterways and bays is provided in the following section.

Discharges

The discharge of treated construction water would generate a minor increase in the base flow rates of the receiving waterways. Anticipated discharges are likely to be continuous. The locations of discharge points into Dobroyd Canal (Iron Cove Creek), Hawthorne Canal, Easton Park drain and Alexandra Canal, all modified waterways, are within reaches that are tidally influenced. As the flow variability and water level at the discharge locations is dominated by tides, and given the urban setting and artificial nature of the waterways, it is unlikely that discharges during construction would significantly impact on natural processes at these locations. The ultimate discharge point to Johnstons Creek from Pyrmont Bridge Road tunnel site (C9) could potentially be slightly upstream of the tidal limit. Given the artificial nature of the waterway, the indicative additional baseflow is unlikely to impact on any natural processes within the waterway.

Iron Cove and Rozelle Bay would also receive direct discharges from the project. As they are large tidal waterbodies associated with the Parramatta River Estuary and Sydney Harbour, the discharge volumes would not impact on flow variability or water levels within the bay. Given this, and the highly disturbed nature of these receiving waterways, the construction site discharges are not considered to pose an impact on any natural processes within Iron Cove or Rozelle Bay.

Waterway works

It is proposed to divert the Easton Park drain at Rozelle into a new channel to convey flows through the Rozelle Rail Yards. Once these diversions works are complete, the former Easton Park drain would be decommissioned. Given the artificial nature of the waterway, the decommissioning of the existing drain would be unlikely to impact on natural processes.

Works would also be undertaken on Whites Creek as part of the redevelopment of the City West Link and The Crescent intersection and proposed naturalisation of Whites Creek. Given the artificial and tidal nature of the waterway, whilst water levels are likely to be controlled locally to facilitate the construction works (for example, using a coffer dam); this is unlikely to impact on any natural processes within the waterway. Potential water quality impacts are assessed in **Chapter 15** (Soil and water quality).

17.4 Assessment of potential operational impacts

This section describes the flooding and drainage impacts associated with the project during operation and includes:

- Operational flood risks at locations where the potential flooding impacts required that a quantitative assessment of flood risk be undertaken (see **section 17.2.3**)
- Consideration of emergency management and response procedures
- Potential impacts of future climate change on the operation of the project
- Impacts on existing drainage infrastructure
- Hydrological impacts including stormwater runoff and discharge into waterways.

17.4.1 Operational flood risks

The Rozelle interchange, Iron Cove Link and Darley Road motorway operations complex (MOC1) would be partially located within the PMF flood extent, which has the potential to impact on the interchange and tunnel portals. The design of the interchange would prevent flooding of the portals for events up to the PMF or the 100 year ARI event plus 0.5 metres freeboard (whichever is greater). Freeboard is a safety factor for greater protection against different types of flooding and is typically expressed in metres above a flood level for flood protective or control works. Therefore, mitigation measures are required to prevent any floodwater ingress during these events.

Preventing floodwater ingress has the potential to displace floodwaters where the interchange blocks existing flow paths, or reduces available floodplain storage. This may result in potential impacts on surrounding properties. This is particularly the case at Rozelle Rail Yards, as this area functions as a floodway and provides a significant amount of storage of floodwater in larger events such as the 100 year ARI and PMF.

Rozelle interchange

Due to the high risk of flooding at the Rozelle interchange, the proposed layout and design has been influenced by flood risk and drainage considerations. An assessment of potential flood impacts at the proposed Rozelle interchange was undertaken. This included modelling the installation of bunds/walls set at or above the greater of the PMF flood level or 100 year ARI plus 0.5 metres around the perimeter of the portals/ramps associated with the interchange (refer to **Chapter 5** (Project description) for portal descriptions), to prevent floodwater ingress into the tunnel.

At the Rozelle interchange tunnel portals, the PMF flood levels are generally greater than the 100 year ARI plus 0.5 metre levels. The preliminary results for the 100 year ARI event indicated that there would be a re-distribution of flows due to the proposed changes to existing overland flow paths.

Around the Easton Park drain (north of the Rozelle interchange) and along Whites Creek, the installation of more efficient drainage channels as part of the project (refer to **Chapter 5** (Project description)) would reduce flood levels. In the remainder of the Rozelle Rail Yards site, the proposed new buildings and other infrastructure would be raised above ground for flood protection, meaning flood levels would generally be higher than existing.

The proposed tunnel ventilation facilities, substation and water treatment plant would be located adjacent to the new western and northern channels and would need to be set above PMF flood level or 100 year ARI plus 0.5 metres (whichever is greater). Raising surface levels along City West Link to prevent floodwater ingress into the Rozelle interchange was shown to influence overland flows spilling from Whites Creek (upstream and around The Crescent) during the PMF. The model indicated that raising of surface levels and obstructing the overland flow path could lead to a potential increase in flood levels of up to 0.5 metres upstream of The Crescent in the 100 year ARI event. This would have the potential to impact surrounding properties.

To retain the existing function of the site as a flood storage area, minimise impacts in the 100 year ARI event (as per the design standards listed in **Table 17-2**) and mitigate the potential increase in flood risk for surrounding properties, the design now includes:

- Large transverse conveyance systems for the existing Easton Park drain and the catchment to the west, passing through the interchange under City West Link and discharging into Rozelle Bay
- An increase to the waterway area for the Whites Creek bridge structure under The Crescent.

The conveyance system modelled for Easton Park drain and the western catchment includes a 'low-flow' channel to carry flows of around a two year ARI event, with a defined landscaped overland flow path sized to convey larger flows up to the 100 year ARI. PMF flows would then spread across the adjacent open space areas. The western channel would cross under the proposed New M5 tunnel connection to City West Link ramps and Western Harbour Tunnel ramps (within the Rozelle Rail Yards site) before combining with the northern channel to then pass under City West Link and discharge into Rozelle Bay. The channels would range in width from about two metres to six metres and the overbank flow path from about nine metres to 18 metres through the Rozelle interchange. The large open channels and allowance for floodwaters to spread out onto adjacent areas compensates for the loss of informal flood storage that the Rozelle Rail Yards provide under existing conditions.

The flood modelling suggests that this approach, combined with improved local road drainage along Lilyfield Road to convey runoff to the Easton Park drain, is likely to reduce potential impacts to an acceptable level ie no adverse flood impacts on adjoining properties for the 100 year ARI event. This conforms to the standards provided in **Table 17-2**. Peak flood depths for the 10 year and 100 year ARI event and PMF under proposed design conditions are shown in **Figure 17-22** to **Figure 17-24**.

To minimise flood impacts, the proposed interchange limits the raising of road crest levels for City West Link and The Crescent to generally within 0.3 metres of existing levels. Flood modelling has indicated that this would maintain the flood immunity of City West Link, but would still allow floodwaters to overtop the road in extreme events, such as the PMF.

Adverse flood level impacts on the north of City West Link are generally contained within the project boundary in events up to the 100 year ARI. Where flood impacts extend outside the project boundary, the increases in flood levels are minor and localised which means there is unlikely to be any impact

on surrounding properties. In the PMF, potential flood level impacts of up to 0.04 metres are estimated to the east of Victoria Road, outside of the site. The design of the Rozelle interchange infrastructure would take into account increases in flood levels within the site.

To the south of City West Link, along Whites Creek, no adverse flood impacts are modelled in events up to the 100 year ARI (see **Figure 17-25**). The Crescent would be realigned west of its current alignment, roughly following the light rail corridor before crossing over Whites Creek. The new bridge has been designed to provide 100 year ARI flood immunity.

The skewed angle of The Crescent when realigned, and additional lanes, would result in a wider bridge structure than presently existing. To achieve increased hydraulic conveyance and compensate for the wider bridge, the length of the new bridge would be increased to two 16 metre spans. The topography of the land between the new bridge and Rozelle Bay (immediately south of Whites Creek on the right overbank) would be re-profiled to provide a landscaped overland flow path. When the capacity of the Whites Creek channel is exceeded, floodwater would spill over the southern bank, pass underneath The Crescent and discharge into Rozelle Bay. Bridge piers are proposed to be located along the overland flow path and not within the main channel to minimise flood impacts.

In the PMF, flood impacts of up to 0.4 metres are estimated along Whites Creek (see **Figure 17-26**). This is due to the larger footprint of the proposed road embankments and wider bridge structure (compared to existing). Further widening of the Whites Creek channel is constrained by the existing light rail embankment and raising the road levels on City West Link would potentially raise flood levels, so neither of these are feasible options.

These changes in flood behaviour under PMF conditions would be investigated further during detailed design to identify potential impacts on critical infrastructure and significant changes in flood hazard as a result of the project.

Peak flow velocities outside Whites Creek and the new drainage channels would generally remain below 0.5 metres per second in the 100 year ARI, which is similar to existing conditions. At the new bridge over Whites Creek at The Crescent, peak flow velocities entering Rozelle Bay are likely to increase due to the increased conveyance capacity of the new structure. Velocities for the new overland flow path under the bridge would be up to two metres per second. It is expected that peak flow velocities entering Rozelle Bay from the Rozelle Rail Yards would generally be less than two metres per second. Appropriate scour protection of the new overland flow path and stabilisation of all the outlets to Rozelle Bay would be installed. This would be undertaken to prevent scour of potentially contaminated sediments in Rozelle Bay.

Peak flow velocities in the new drainage channels through the Rozelle Rail Yards would generally be less than 1.5 metres per second. The flood hazard for the land near the interchange would not change substantially from existing conditions. The new drainage channels through the former Rozelle Rail Yards would be high hazard areas (as defined in the Floodplain Development Manual (NSW Government 2005)) as they are formal conveyance systems, like the Easton Park drain and Whites Creek. The overland flow paths through the Rozelle Rail Yards would have a low flood hazard, which is consistent with flood hazards in recreational areas that are flood prone in the vicinity, such as Easton Park to the north.

The proposed drainage channels and new waterway structures would maintain the flood immunity of City West Link and The Crescent by providing 100 year ARI flood immunity around the interchange. Flood conditions along City West Link would be improved in events greater than the 100 year ARI and up to the PMF. Flood depths under existing conditions at the low point on City West Link to the north of the intersection with The Crescent are up to one metre in the PMF. Under proposed conditions these could be significantly reduced to around 0.5 metres. The flood modelling undertaken suggests that the mitigation measures would minimise impacts on surrounding properties for the 100 year ARI event and therefore satisfy the required design standards. Refinements to the flood model would be required to inform the detailed design of the proposed interchange.

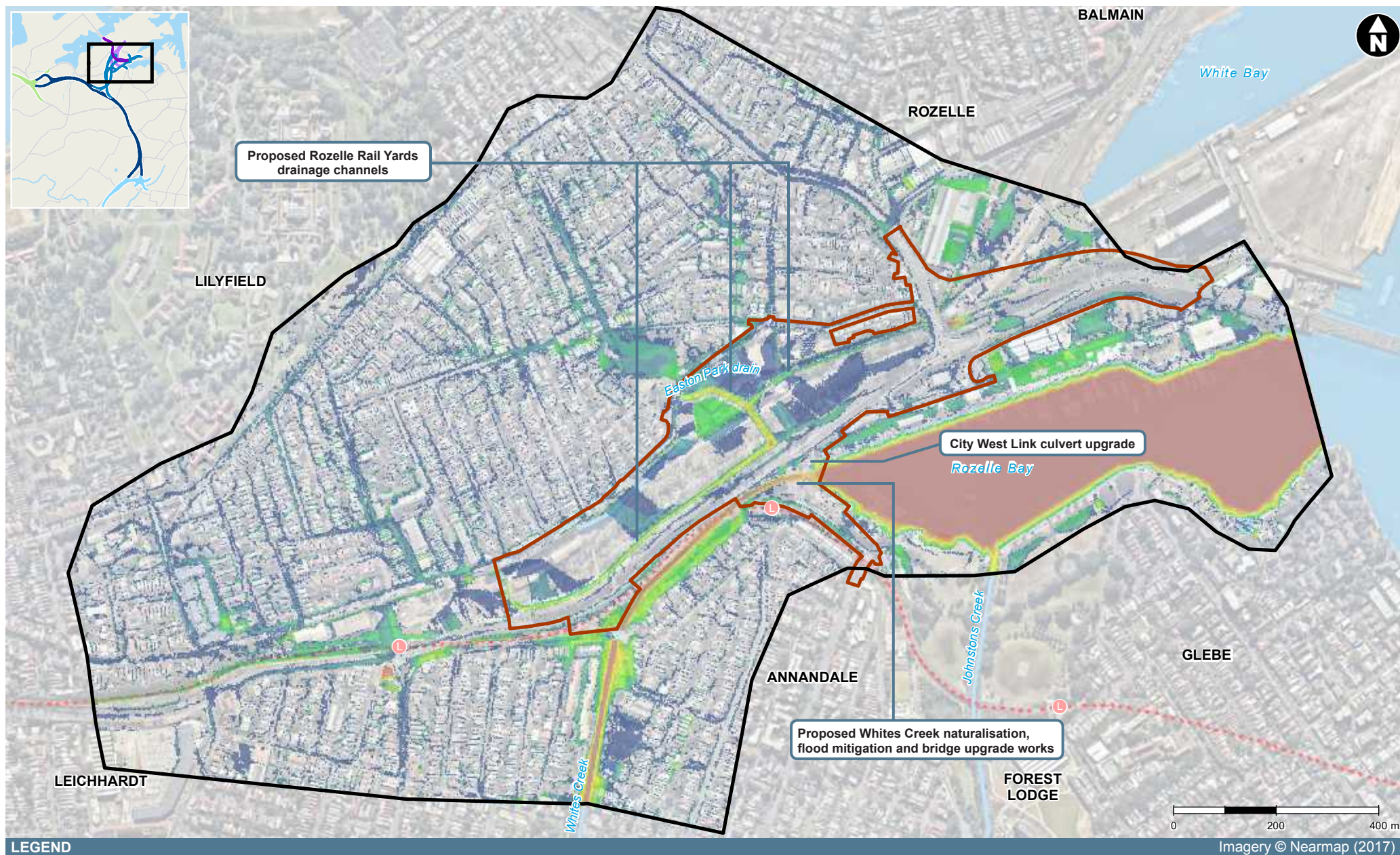


Figure 17-22 Proposed design conditions flood behaviour – Rozelle interchange - peak flood depths (10 year ARI)

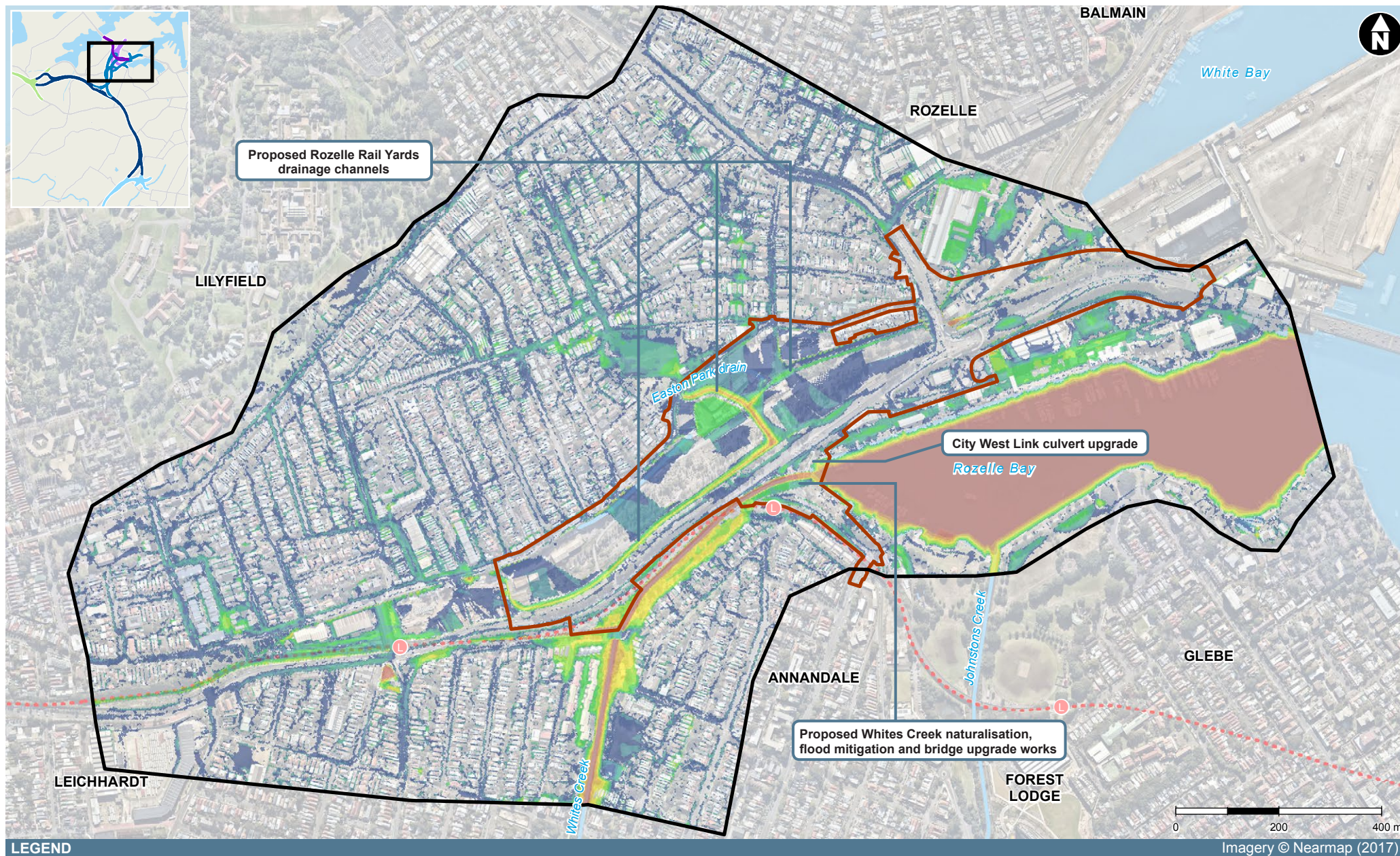


Figure 17-23 Proposed design conditions flood behaviour – Rozelle interchange - peak flood depths (100 year ARI)

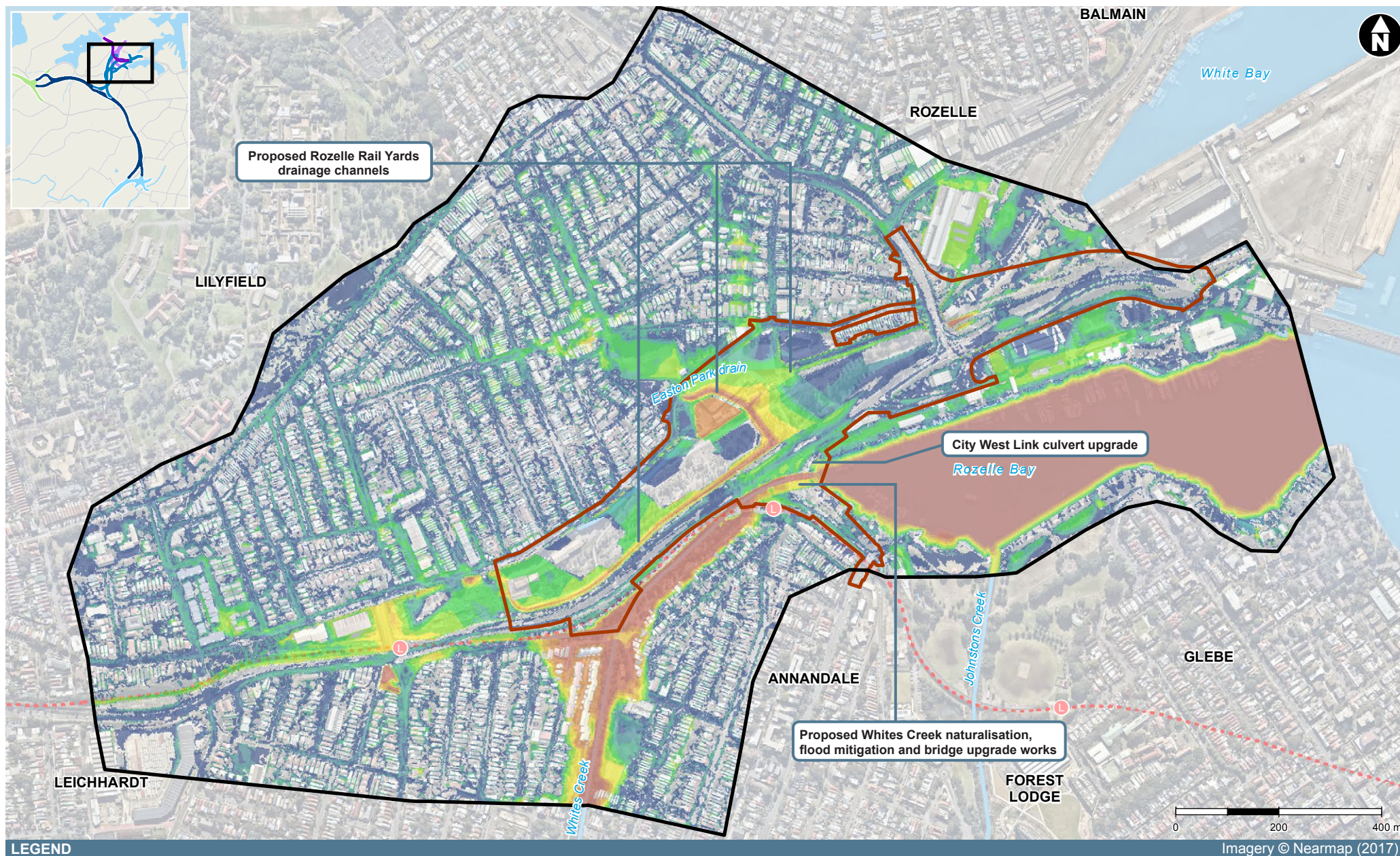


Figure 17-24 Proposed design conditions flood behaviour – Rozelle interchange - peak flood depths (PMF)

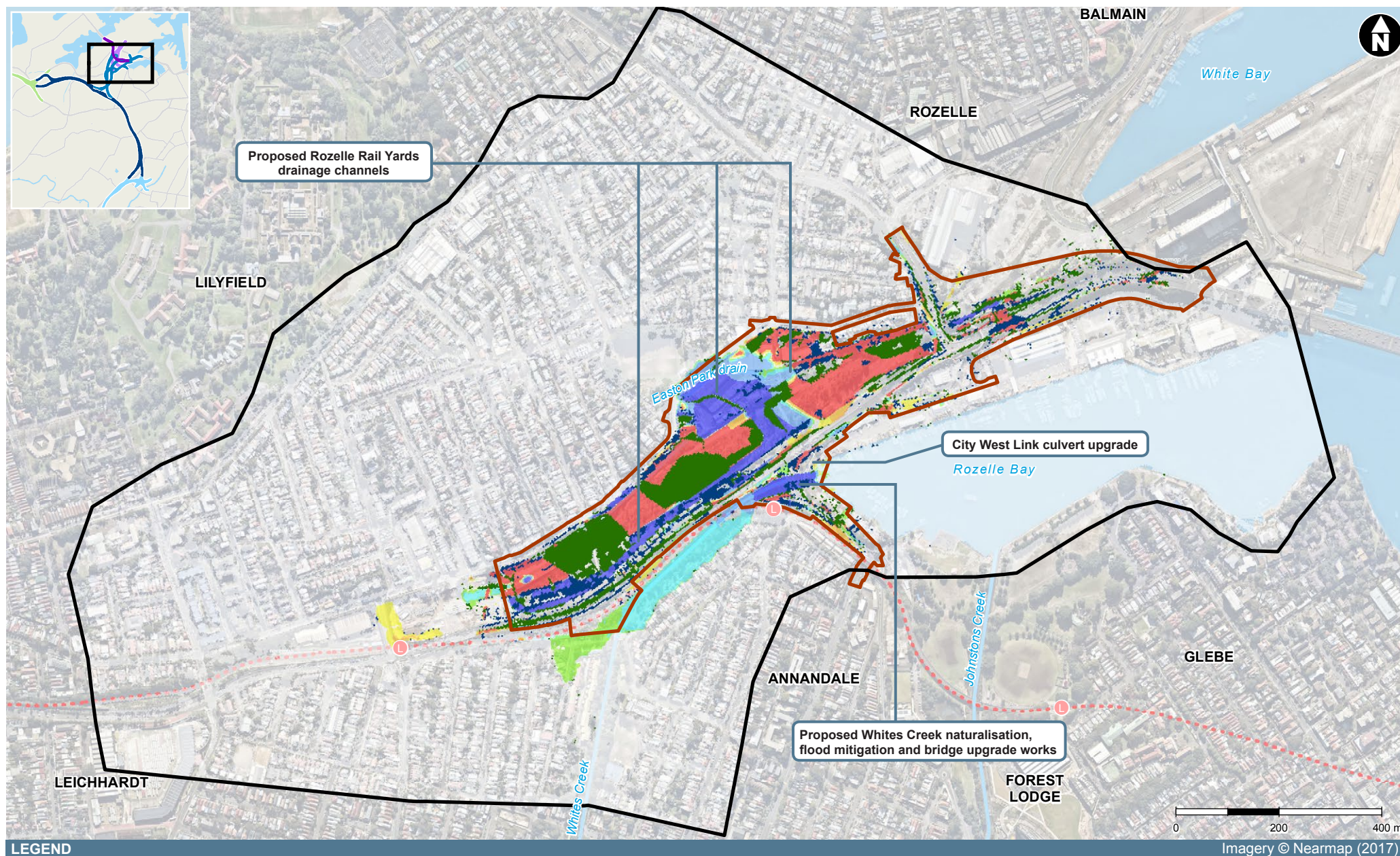


Figure 17-25 Proposed design conditions flood behaviour – Rozelle interchange - relative flood impact (100 year ARI)

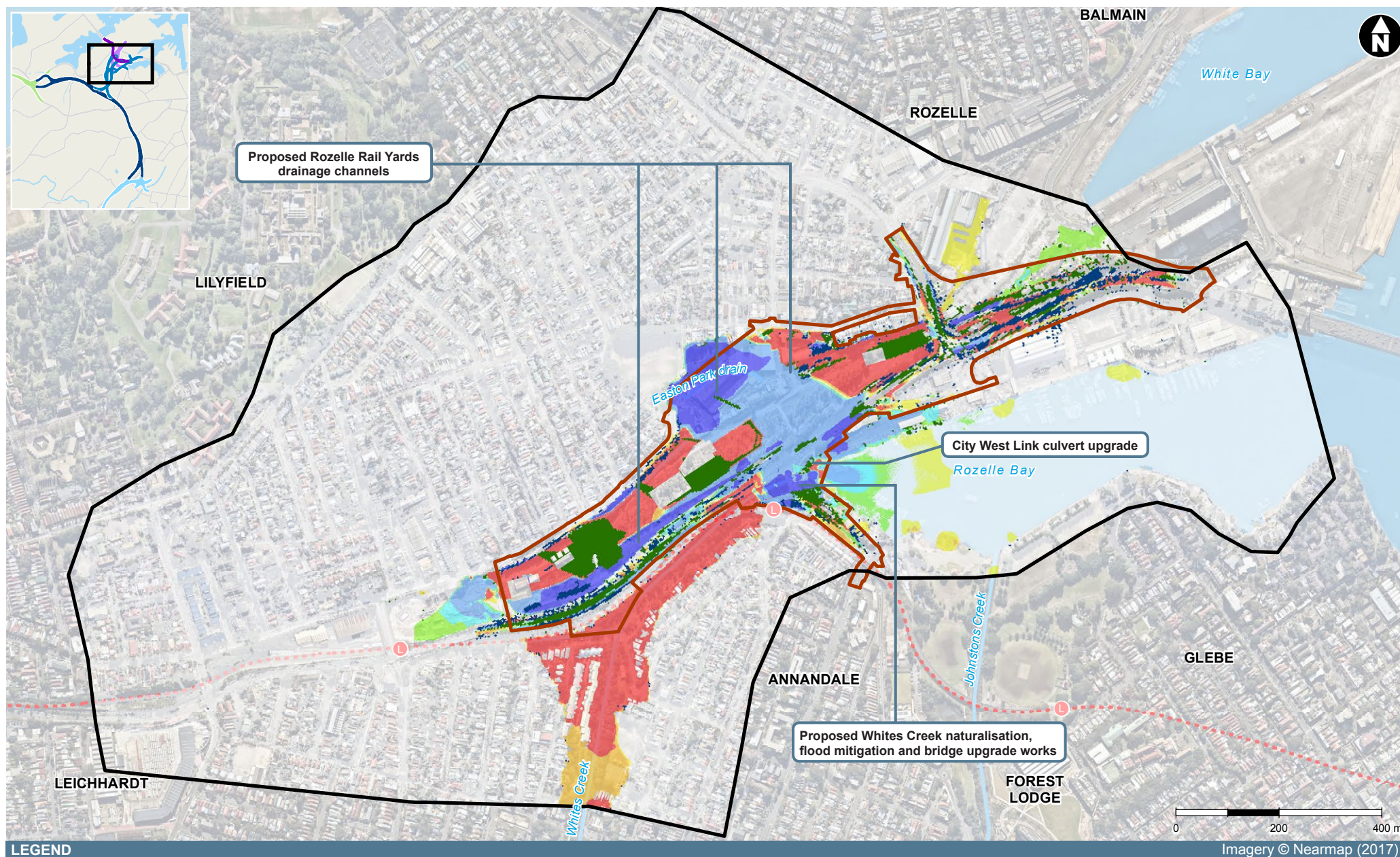


Figure 17-26 Proposed design conditions flood behaviour – Rozelle interchange - relative flood impact (PMF)

Iron Cove Link

Peak flood depths for the 10 year ARI event, 100 year ARI event and PMF under proposed design conditions are shown in **Figure 17-27** to **Figure 17-29**.

Within the Iron Cove Link, floodwater on the southern (westbound) carriageway heading towards Iron Cove Bridge reaches depths of between 0.5 metres and 0.8 metres in the 10 year ARI and PMF, respectively. This is associated with a topographic depression in the proposed road levels at this location.

Increases in flood levels are predominantly limited to within the Iron Cove Link and Victoria Road for the 100 year ARI and PMF event. The catchment at Iron Cove generally drains from the northeast towards the Iron Cove Link. Changes in road levels along the main alignment, particularly at the intersections with existing local roads could lead to localised flood impacts along the northern (eastbound) carriageway. These impacts would be managed through limiting the raising of road levels and upgrading the road drainage system to manage changed overland flow paths. The road levels and drainage system would be confirmed during detailed design, assessed as necessary and managed in accordance with the measures outlined in **Appendix F** (Technical working paper: Utilities Management Strategy).

There is also a risk of flood impacts on adjoining properties at the edge of Iron Cove east of the alignment (see **Figure 17-30** and **Figure 17-31**). Between Terry Street and Iron Cove Bridge, the portals would reduce the number of surface traffic lanes on Victoria Road from four lanes to three lanes. As the road acts as a major overland flow path, the reduced road width would also mean a reduced flow path width and more concentrated flows. This could be managed through upgrading the road drainage network to compensate for the reduced overland flow path width.

To minimise the residual risk of flooding of the road and the portals, the design of the road drainage system around the tunnel portals would be designed to manage surface runoff in this area, particularly for the southern tunnel due to the topographic low at this location.

The drainage network under Victoria Road would be upgraded to collect local surface water runoff draining to the portals up-gradient of Crystal Street and at Terry Street. The water would then be diverted into a new drainage network and discharged into Iron Cove. Barriers or flood bunds would be set at or above the PMF flood level (or 100 year ARI plus 0.5 metres, whichever is the greater) to provide protection to the exposed sections of the portal from runoff from the adjacent roads.

To minimise the potential impact on surrounding properties, the road would be graded and kerb lines used to keep runoff away from the portals, and within the road reserve; to a discharge point into Iron Cove (exact location to be determined during detailed design). Where possible, the road runoff would be directed to the proposed new bioretention facility within King George Park, adjacent to Manning Street at Rozelle, prior to discharge to Iron Cove.

Infrastructure such as the Iron Cove Link motorway operations complex (MOC4) and substation are proposed to be located at the southern end of the interchange. This infrastructure would be protected from local stormwater runoff flooding the site through the provision of bunds or raising floor levels to the PMF or 100 year ARI plus 0.5 metres (whichever is greater). At the Iron Cove interchange the 100 year ARI level plus 0.5 metres is usually greater than the PMF level.

Peak flow velocities within the Iron Cove Link area are predicted to be up to 2.2 metres per second in the 100 year ARI, which is similar to existing conditions. The flood hazard for the land near Iron Cove Link does not change substantially from existing conditions.

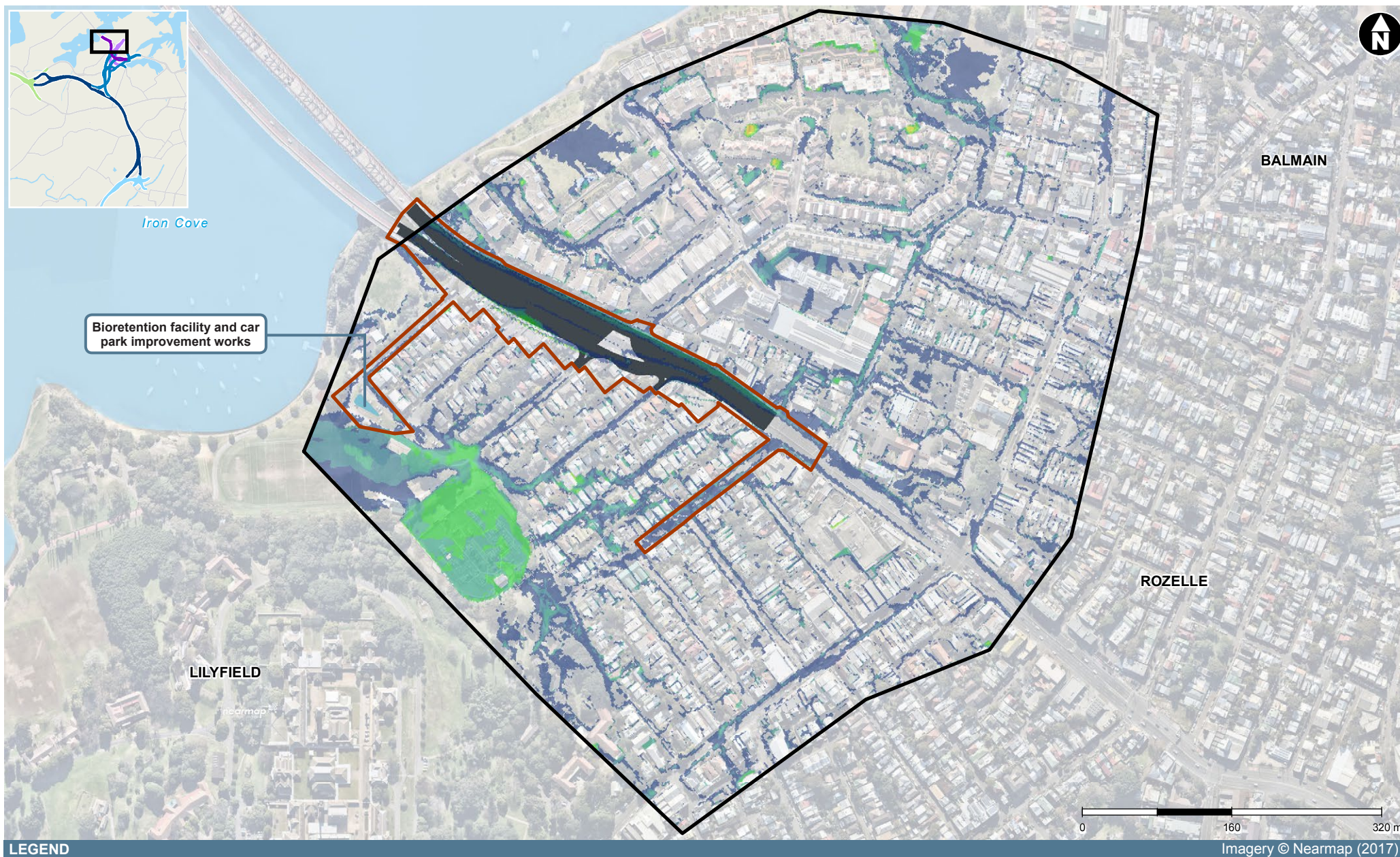


Figure 17-27 Proposed design conditions flood behaviour – Iron Cove Link - peak flood depths (10 year ARI)



Figure 17-28 Proposed design conditions flood behaviour – Iron Cove Link - peak flood depths (100 year ARI)



Figure 17-29 Proposed design conditions flood behaviour – Iron Cove Link - peak flood depths (PMF)

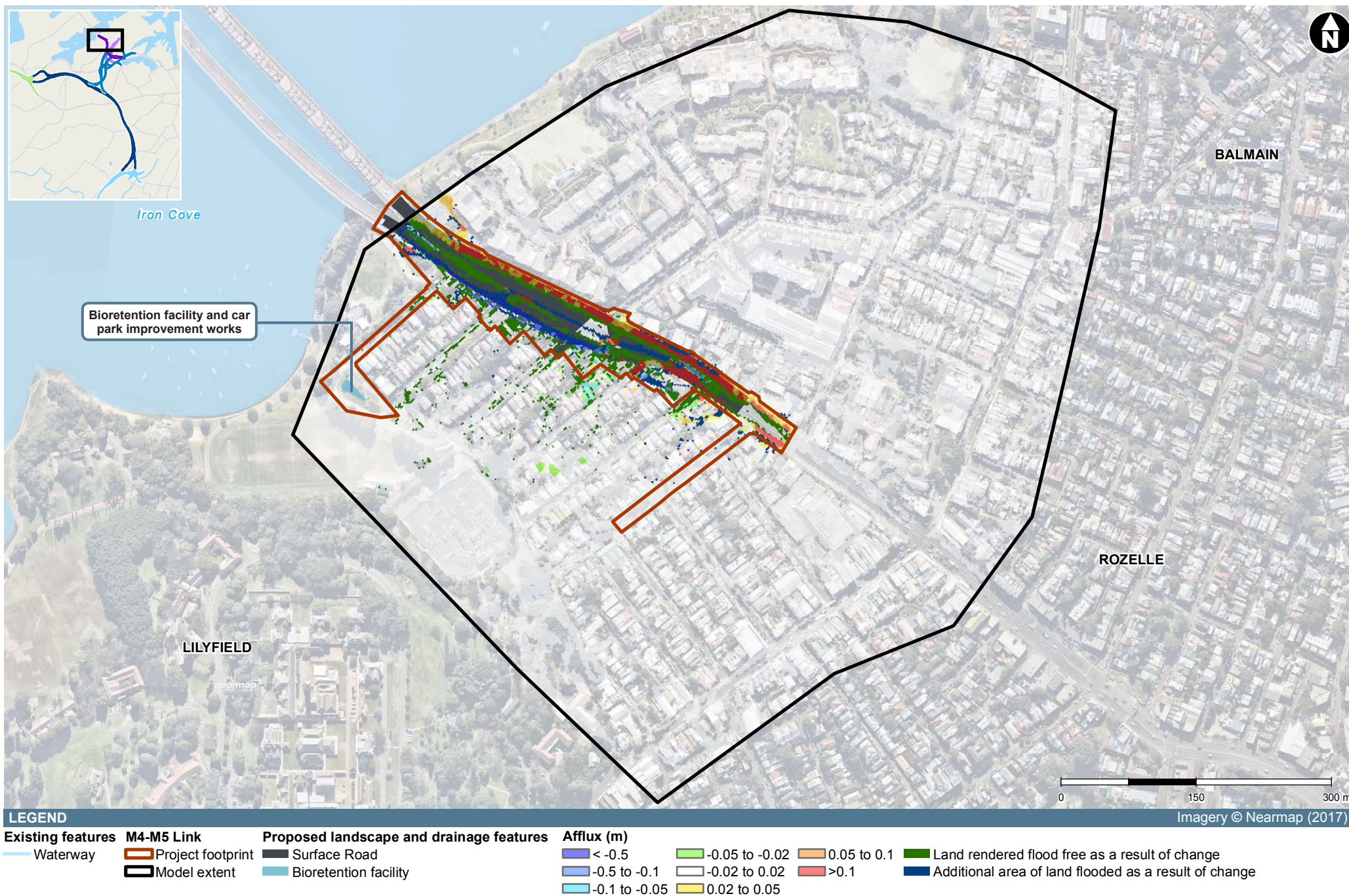


Figure 17-30 Proposed design conditions flood behaviour – Iron Cove Link - relative flood impact (100 year ARI)

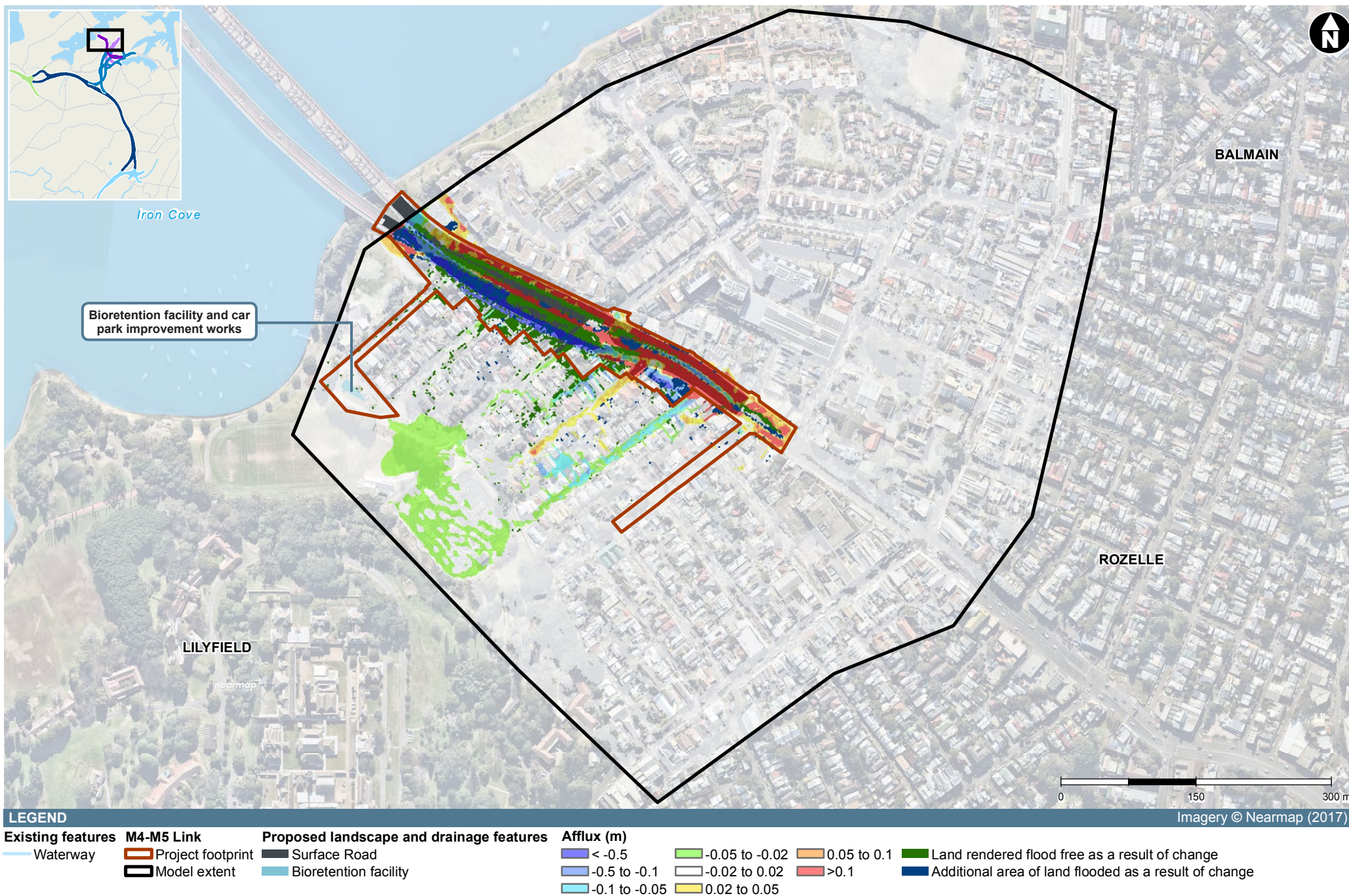


Figure 17-31 Proposed design conditions flood behaviour – Iron Cove Link - relative flood impact (PMF)

Darley Road

The proposed Darley Road operational facilities would include an operational water treatment plant for tunnel drainage and a substation.

An assessment of potential flood impacts at the Darley Road site for events up to the PMF event was undertaken by assuming bunds/walls around most of the site in order to prevent floodwater ingress to the water treatment plant and substation.

Flood protection for vulnerable infrastructure, such as the Darley Road motorway operations complex (MOC1) need to be set at PMF flood level or 100 year ARI plus 0.5 metres, whichever is the greater. At the Darley Road site, there are locations where the 100 year ARI level plus 0.5 metres is greater than the PMF level. Peak flood depths for the 10 year ARI event, 100 year ARI event and PMF under proposed design conditions are shown in **Figure 17-32** to **Figure 17-34**.

It was found the water exclusion strategy for the vulnerable infrastructure on the site (water treatment plant and substation) would lead to localised increases in flood levels on Darley Road and the Inner West Light Rail line (see **Figure 17-35** and **Figure 17-36**). Surrounding properties would not be adversely impacted in the events up to the 100 year ARI. In the PMF, minor flood impacts of up to 0.3 metres are estimated to the west of the site along Darley Road and Charles Street. Impacts on the Inner West Light Rail line would need to be managed in consultation with Transport for NSW by either providing a managed flow path through the site, while still protecting vulnerable infrastructure, and/or by providing additional piped drainage systems. This strategy would be further developed during detailed design when site layouts are finalised.

Peak flow velocities along Darley Road would be similar to existing conditions at 1.5 metres per second. Provisional flood hazards would also be similar to existing conditions.

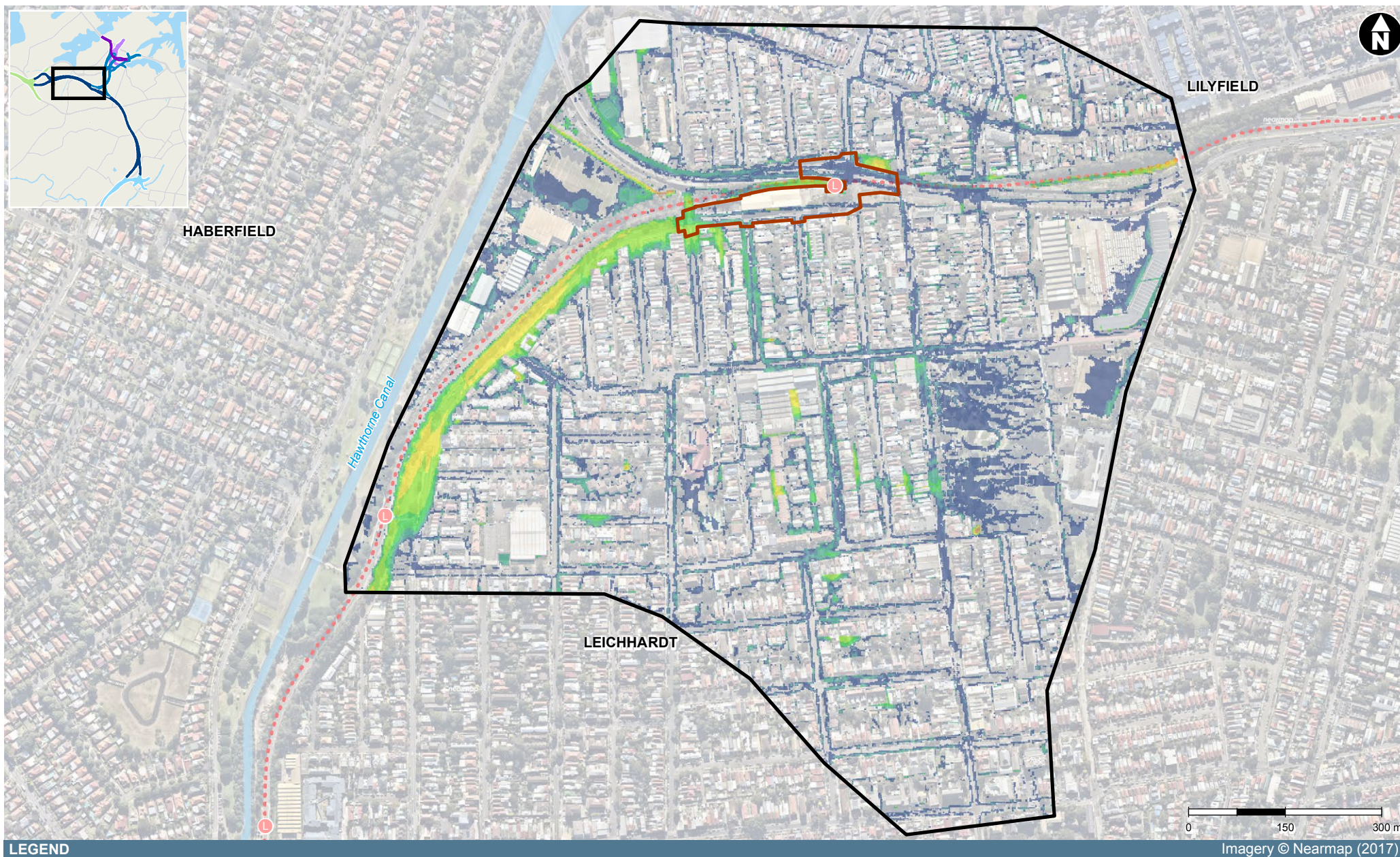


Figure 17-32 Proposed design conditions flood behaviour – Darley Road - peak flood depths (10 year ARI)



Figure 17-33 Proposed design conditions flood behaviour – Darley Road - peak flood depths (100 year ARI)

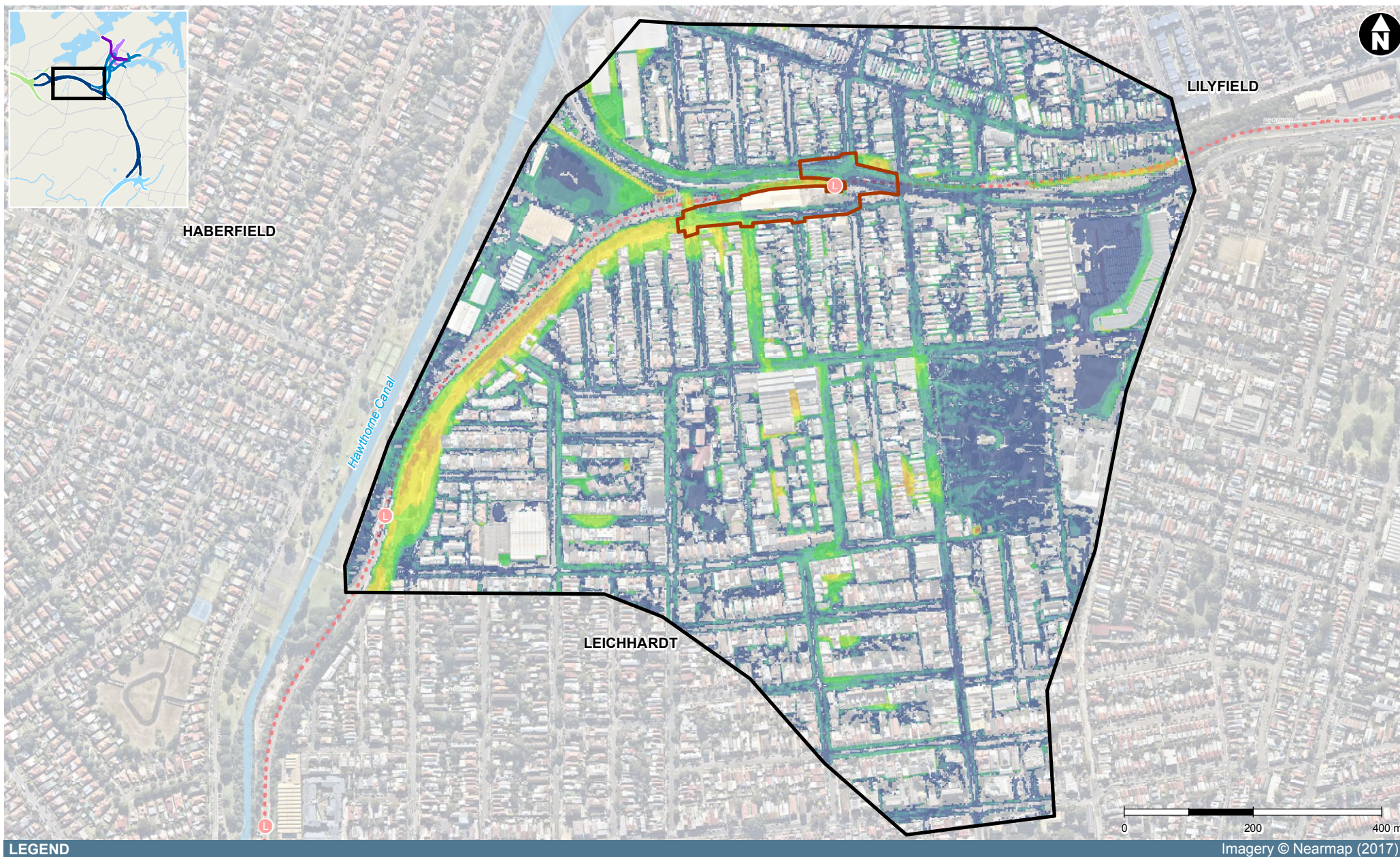


Figure 17-34 Proposed design conditions flood behaviour – Darley Road - peak flood depths (PMF)

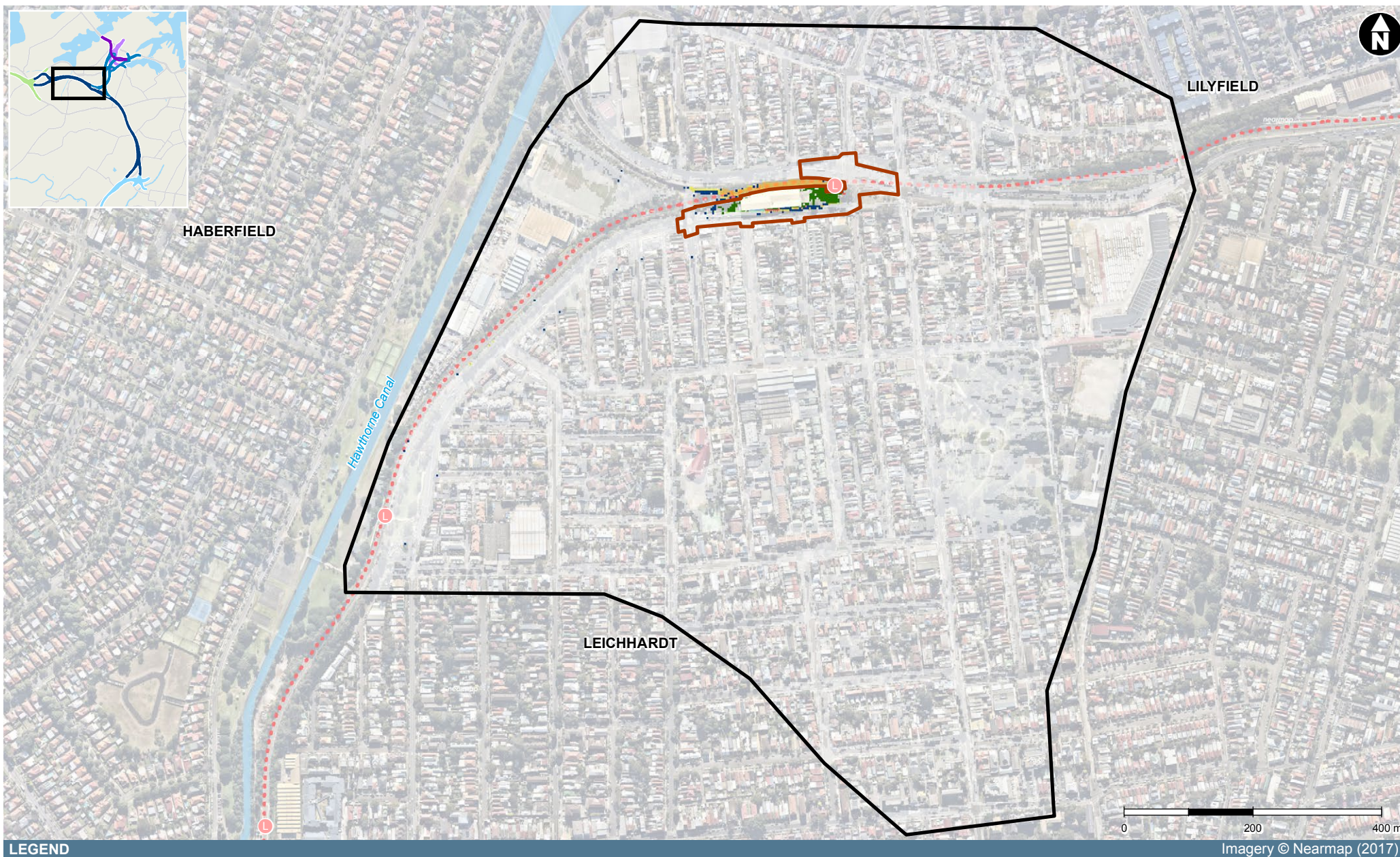


Figure 17-35 Proposed design conditions flood behaviour – Darley Road - relative flood impact (100 year ARI)

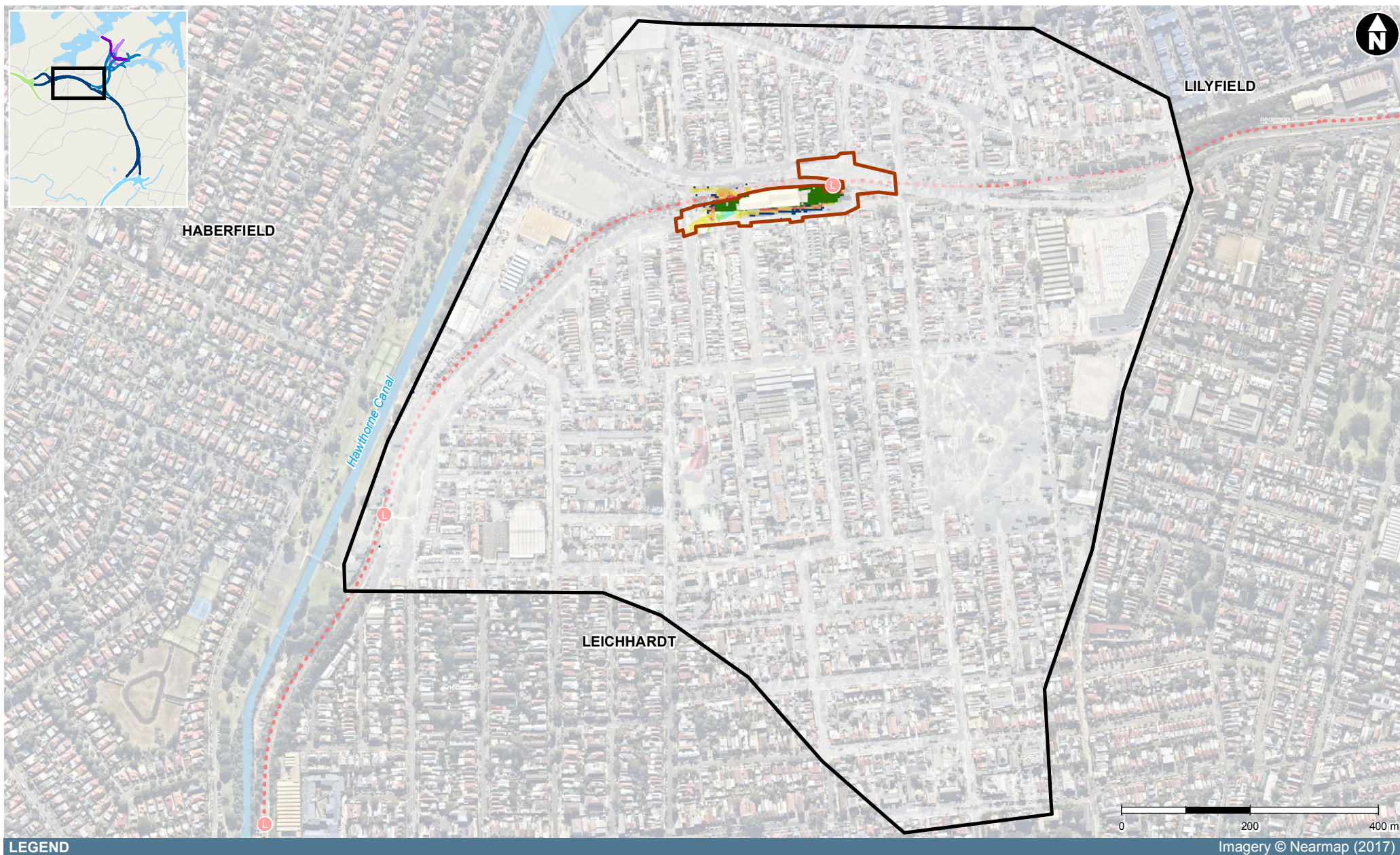


Figure 17-36 Proposed design conditions flood behaviour – Darley Road - relative flood impact (PMF)

17.4.2 Emergency management and response procedures

Council emergency management and response procedures relating to flooding have not been assessed in detail as they are still under development as part of the Inner West Council's Floodplain Risk Management Study and Plan. The Inner West Council is working toward formation of a Floodplain Risk Management Committee. Consideration would be given to council emergency and response procedures during detailed design, dependent on the timing for finalisation of these by the relevant council.

There are no local State Emergency Services (SES) flood plans for the area. The NSW State Flood Plan, which is a sub plan of the State Emergency Management Plan, has been reviewed as part of this assessment. The design has taken into consideration the general recommendations set out in the NSW State Flood Plan with regards to managing flooding. The flood assessment has been undertaken in accordance with the *Floodplain Development Manual* (NSW Government 2005) and has sought to minimise adverse flood impacts. During the detailed design stage, relevant flooding information would be provided to council and SES to assist in informing the Floodplain Risk Management process.

17.4.3 Potential impacts of future climate change

Future climate change could lead to sea level rise and a potential increase in rainfall intensity and frequency. This could affect flood behaviour over the life of the project. As a result, an assessment of the potential impact of climate change on flood behaviour near the project has been undertaken. For further detail on the potential impacts of future climate change refer to **Appendix Q** (Technical working paper: Surface water and flooding) and **Chapter 24** (Climate change and risk adaption).

Wattle Street and St Peters interchanges

For the Wattle Street and St Peters interchanges, potential impacts of future climate change have already been considered in the design of the M4 East and New M5 projects. Climate change impact assessments are described in the design documentation for those projects. Therefore, no additional climate change assessments are required for these areas.

Rozelle interchange

The Rozelle interchange is close to Rozelle Bay and both sea level rise and potential increases in rainfall intensity could exacerbate flooding near the interchange.

Based on the guidelines set out in *The Floodplain Risk Management Guideline – Practical Consideration of Climate Change* (DECC 2007), a number of different scenarios were adopted in the assessment of the potential climate change impacts at the Rozelle interchange over the design life of the project. These scenarios are summarised in **Appendix Q** (Technical working paper: Surface water and flooding) and were based on a combination of:

- 200 year and 500 year ARI rainfall intensities, assumed to represent 10 per cent or 30 per cent increase in 2016 (present day) rainfall intensities, respectively
- A rise in sea level by 0.4 metres or 0.9 metres.

The flood model developed for the flood assessment around the Rozelle interchange was used to assess potential changes in flood behaviour under the various climate change scenarios. The climate change assessment has been based on the proposed design conditions. Peak flood levels at key locations for present day (2016) as well as for the assessed climate change scenarios are summarised in **Appendix Q** (Technical working paper: Surface water and flooding).

Potential impacts are as follows:

- Potential increases in rainfall intensities by up to 10 per cent would lead to flood level increases of around 0.06 metres for areas that are not affected by sea level rise in the 100 year ARI event. Increases in rainfall intensities by up to 30 per cent would lead to flood level increases of up to 0.15 metres. This means that more properties could be affected by flooding or experience more frequent flooding under future climate change conditions around Rozelle Bay and the Rozelle Rail Yards

- At the new bridge over Whites Creek at The Crescent, sea level rise would lead to increases in peak flood levels of between 0.26 metres and 0.82 metres in the 100 year ARI event. This would reduce the freeboard to the underside of the bridge. This means that properties adjacent to Whites Creek, particularly along Railway Parade could experience much more frequent flooding under future climate change conditions
- At the tunnel portal, the effect of sea level rise would be less pronounced than at The Crescent. Sea level rise would lead to increases in peak flood levels of between 0.1 metres and 0.67 metres in the 100 year ARI event. This would reduce the freeboard to the portal, but peak flood levels would still be more than 0.5 metres below the PMF level
- At the new culverts under City West Link, sea level rise would lead to increases in peak flood levels of between 0.1 metres and 0.66 metres in the 100 year ARI event. Peak flood levels would still be more than 0.5 metres below the PMF level which would set the minimum level for the tunnel portal
- Neither potential increases in rainfall intensities nor sea level rise would lead to overtopping of The Crescent or City West Link in the 100 year ARI event
- At the tunnel portal, sea level rise would lead to minor increases in peak flood levels of between 0.01 metres and 0.04 metres in the PMF. Peak PMF flood levels at the tunnel portal are therefore not very sensitive to a sea level rise of up to 0.9 metres
- Flood behaviour with potential increases in rainfall intensities and sea level rise in a 100 year ARI and PMF events are shown in **Appendix Q** (Technical working paper: Surface water and flooding).

Iron Cove Link

Iron Cove Link would be situated at a level that is above the influence of any sea level rise associated with climate change. Therefore, only the influence of increases in rainfall intensities was considered as part of the climate change assessment. Design rainfall intensities for the 200 and 500 year ARI events were adopted as being similar to the 100 year ARI design rainfall intensity, being increased by 10 per cent and 30 per cent respectively.

The peak flood levels at Iron Cove Link or surrounding roads did not vary significantly under the higher rainfall intensity scenarios of the 200 year and 500 year ARI events. Along roads and other areas with reasonable hydraulic gradients and shallow depths, the increase in flood level would only be between 0.01 metres and 0.05 metres.

Darley Road

Darley Road is near Hawthorne Canal, which would be influenced by sea level rise as well as increased rainfall intensities and frequencies.

The climate change assessment at Darley Road involved determining the potential influence on flood levels as a consequence of higher rainfall intensity. Design rainfall intensities for the 200 year and 500 year ARI events were adopted as being similar to the 100 year ARI design rainfall intensity, being increased by 10 per cent and 30 per cent respectively.

The peak flood levels at Darley Road did not vary significantly under the higher rainfall intensity scenarios of the 200 year and 500 year ARI events. Along roads and other areas with reasonable hydraulic gradients and shallow depths the increase in flood level would only be between 0.01 metres and 0.05 metres. In ponding areas, flood levels could rise by up to 0.16 metres under future climate conditions.

17.4.4 Impact on existing drainage infrastructure

There is limited existing drainage infrastructure at many of the project sites that would be impacted or need to be modified. For the operational sites, the surface water runoff would be managed to minimise flood impacts on adjoining properties. Where the operational sites propose to connect directly to existing drainage infrastructure, flow rates from the sites would match existing flow rates where possible so as not to overload the existing drainage system or cause adverse flood impacts on adjoining properties. Further details on the relocation and adjustments to drainage infrastructure can be found in **Appendix F** (Technical working paper: Utility Management Strategy). The impacts the

project may have on the social and economic costs to the community as consequence of flooding are considered to be minimal with the adoption of the mitigation measures provided in **section 17.5**.

17.4.5 Hydrological impacts

Surface water balance

Stormwater runoff volumes generated within the project footprint would increase as a result of an increase in impervious surfaces associated with surface road widenings, ramps and ancillary surface infrastructure. The footprint included within the modelling and the change in impervious area is provided in **Appendix Q** (Technical working paper: Surface water and flooding).

Modelling was undertaken to estimate changes in annual stormwater runoff volume to receiving waterways caused by the project. The modelling results are provided in **Appendix Q** (Technical working paper: Surface water and flooding). The results indicate that annual runoff volumes would be slightly increased as a result of the project, with increases occurring at Rozelle Bay and White Bay with no change to Whites Creek. A slight decrease in runoff volume would occur at Iron Cove.

Treated tunnel water flows from the operational water treatment plants at Darley Road (MOC1) and Rozelle would ultimately discharge to Hawthorne Canal and Rozelle Bay respectively, leading to an increase in base flow rate to those waterways. It is estimated that up to 725 megalitres per year and 693 megalitres per year of treated groundwater would be discharged to Hawthorne Canal and Rozelle Bay respectively.

It is estimated that up to 50 megalitres per year of tunnel drainage from about one kilometre of the northbound and 600 metres of southbound tunnel would be captured by the New M5 drainage system and conveyed to the New M5 operational water treatment plant at Arncliffe, prior to discharge to the Cooks River. A post development mean annual water balance is provided in **Appendix Q** (Technical working paper: Surface water and flooding).

Discharges

The flow variability within the receiving waterways is dominated by tides at the discharge locations. Therefore, the minor increases in stormwater flow within Rozelle Bay and Whites Bay and increase in base flow to Hawthorne Canal and Rozelle Bay is not considered to pose a material impact on the flow variability or natural processes within the receiving waterways. As Hawthorne Canal is hard-lined, increased discharge volumes would not impact on bed or bank stability or the geomorphology of the waterway. Scour and/or dissipation measures would minimise any sediment disturbance impacts at the outlets to the receiving bays and waterways. Further information on scour impacts and proposed management measures is discussed in **Chapter 15** (Soil and water quality).

The impacts associated with discharges from the Arncliffe operational water treatment plant were assessed as part of the New M5. The additional tunnel drainage flow (around 1.6 litres per second) associated with the project would be negligible compared to flows within the Cooks River. It is therefore considered that impacts on levels and velocities in the Cooks River would be negligible. The existing scour protection and/or energy dissipation measures would minimise any sediment disturbance impacts near to the outlet.

Environmental water availability

No surface water is proposed to be extracted directly from adjacent waterways or bays during the operational phase. Discharge volumes are likely to slightly increase as a result of the project. All operational discharges would be to unregulated, artificial and tidally influenced waterways or bays. Therefore, no impacts on environmental water availability or flows are likely to occur.

17.5 Management of impacts

The flood mitigation standards established for the project infrastructure have been achieved by demonstrating that there is no impact on properties in the 100 year ARI. Therefore, it is not anticipated that floor level impacts would occur, however this would be confirmed during detailed design. If changes to flooding in larger events such as the PMF were found to impact tunnels or critical infrastructure, further flood mitigation measures would be adopted.

Public safety is one of the driving factors for assessing and mitigating flood impacts. This is reflected in the hydrologic standards that have been set for both construction and operation of the project as set out in **section 17.1.3**. In terms of flooding, public interest has specifically been taken into account by:

- Providing PMF flood immunity to tunnel portals and other critical infrastructure such as motorway control centres and substations
- Providing drainage channels within the Rozelle Rail Yards that have 100 year ARI capacity, leaving the overbank areas flood free up to the 100 year ARI and opening the area up to recreational uses
- Widening of Whites Creek which reduces 100 year ARI flood levels along Whites Creek.

Environmental management measures relating to flooding and drainage for the construction and operation of the project are provided in **Table 17-5**. Specific management measures for each construction ancillary facility are provided in **Appendix Q** (Technical working paper: Surface water and flooding). The environmental management measures listed in **Table 17-5** should be read in conjunction with the environmental management measures provided in **Chapter 15** (Soil and water quality).

Table 17-5 Environmental management measures – flooding and drainage

Impact	No.	Environmental management measure	Timing
Impacts on flood behaviour from construction and operation	FD01	<p>A Flood Mitigation Strategy will be prepared by a suitably qualified and experienced person in consultation with directly affected landowners, DPI-Water, OEH, SES, Sydney Water and the relevant local councils. It will include but not be limited to:</p> <ul style="list-style-type: none"> • Identification of flood risks to the project and adjoining areas, including consideration of local drainage catchment assessments and climate change implications on rainfall, drainage and tidal characteristics • Identification of design and mitigation measures to protect proposed operations and not worsen existing flooding characteristics during construction and operation, including soil erosion and scouring • Identification of drainage system upgrades • The 100 year ARI flood level will be adopted in the assessment of measures which are required to mitigate flood risk to the project, as well as any adverse impacts on surrounding property • Changes in flood behaviour under PMF conditions will also be assessed in order to identify impacts on critical infrastructure and significant changes in flood hazards as a result of the project • Consideration of limiting flooding characteristics to the following levels: <ul style="list-style-type: none"> - A maximum increase in inundation time of one hour in a 100 year ARI rainfall event - No inundation of floor levels which are currently not inundated in a 100 year ARI rainfall event - A maximum increase of 10 mm in inundation at properties where floor levels are currently exceeded in a 100 year ARI rainfall event 	Construction

Impact	No.	Environmental management measure	Timing
		<ul style="list-style-type: none"> - A maximum increase of 50 mm in inundation at properties where floor levels will not be exceeded in a 100 year ARI rainfall event - Or else provide alternative flood mitigation solutions consistent with the intent of these limits • Consideration of the EIS documents. 	
	FD02	<p>Hydrologic and hydraulic assessments will be carried out for all temporary project components (including ancillary facilities) and permanent design features that have the potential to affect flood levels in the vicinity of the project.</p> <p>The results of the assessment will inform the preparation of the Flood Mitigation Strategy (FD01) as well as the design development of temporary and permanent works.</p>	Construction
	FD03	Measures developed to manage potential flood impacts, as identified in the Flood Mitigation Strategy, will be incorporated into the design of temporary and permanent project components and construction and operational management systems as relevant.	Construction
	FD04	All entries (portals) into the tunnels will be designed so that they are located above the peak level of the PMF or the 100 year ARI design flood plus 0.50 metres, whichever is greater. The same hydrological standard will be applied to tunnel ancillary facilities such as tunnel ventilation and emergency response facilities, electrical substations and water treatment plants where the ingress of floodwaters will also have the potential to flood the tunnels.	Construction
	FD05	Bridge crossings over existing waterways and proposed drainage channels will be designed for the underside of bridge structure to be above the peak 100 year ARI design flood level.	Construction
	FD06	The need to maintain flood conveyance will be factored into construction planning associated with the new bridge structure over Whites Creek.	Construction
	FD07	Parts of the site that will be adversely affected by floodwaters, such as tunnel dive shafts, portals and cut and cover sections, will be protected from floodwater ingress during construction. The flood level adopted for design of temporary protection will be informed by consideration of both mainstream and local overland flows, the potential risk to the environment, safety and the potential disruption and damage to project works.	Construction
	FD08	The Pyrmont Bridge Road tunnel site (C9) will be designed with consideration of and to appropriately manage the existing surface water flow path on Bignell Road.	Construction
	FD09	The permanent surface water conveyance solution within the Rozelle Rail Yards will be implemented as soon as possible.	Construction

Impact	No.	Environmental management measure	Timing
	FD10	Flood contingency measures will be prepared and implemented where construction ancillary facilities and vulnerable temporary facilities (including fuel storages, water treatment plants and substations) are located in the 20 year ARI design flood extent.	Construction
Impacts on stormwater drainage systems	FD11	Further hydrological and hydraulic modelling based on the detailed design will be undertaken to determine the ability of the receiving drainage systems to effectively convey drainage discharges from the project once operational. The modelling must be undertaken in consultation with the relevant council(s). It will include, but not be limited to: <ul style="list-style-type: none"> • Confirming the location, size and capacity of all receiving drainage systems affected by the operation of the project • Assessing the potential impacts of drainage discharges from the project drainage systems on the receiving drainage systems • Identifying all feasible and reasonable mitigation measures to be implemented where drainage from the project is predicted to adversely impact on the receiving drainage systems. 	Construction
	FD12	Where drainage systems are to be upgraded or replaced during the project, existing systems will be left in place and remain operational during the process wherever possible.	Construction
	FD13	Runoff generated from project construction and operational facilities will be managed to mitigate risk of overloading the receiving drainage system.	Construction
	FD14	Entry points to the stormwater used by or immediately downgradient from the project sites will be inspected regularly for blockages and cleaned as required to maintain performance.	Construction
Impacts on flood behaviour from future climate change	FD15	Hydrological and hydraulic assessments of the permanent design will consider the climate change related flood risk to the project and flood impacts from the project, and will confirm requirements for any management measures. The assessment will be undertaken in accordance with the <i>Practical Considerations of Climate Change – Floodplain Risk Management Guideline</i> (DECC 2007).	Construction
Impacts on property and infrastructure	FD16	Where peak levels in the 100 year ARI design flood are predicted to increase at any residential, commercial and/or industrial buildings due to construction or operation of the project, a floor level survey will be carried out. If the survey indicates flood impacts in excess of the limits set in FD01, further refinements will be made to the temporary or permanent designs as required to minimise impacts.	Construction

Impact	No.	Environmental management measure	Timing
	FD17	<p>A flood review report will be prepared after the first defined flood event affecting the project works for any of the following flood magnitudes – the five year ARI event, 20 year ARI event and 100 year ARI event - to assess the actual flood impact against those predicted in the design reports or as otherwise altered by the FMS. The Flood Review Report(s) must be prepared by an appropriately qualified person(s) and include:</p> <ul style="list-style-type: none"> • Identification of the properties and infrastructure affected by flooding during the reportable event • A comparison of the actual extent, level, velocity and duration of the flooding event against the impacts predicted in the design reports or as otherwise altered by the FMS • Where the actual extent and level of flooding exceeds the predicted level with the consequent effect of adversely impacting of property(ies), structures and infrastructure, identification of the measures to be implemented to reduce future impacts of flooding related to the M4-M5 Link project including the timing and responsibilities for implementation. <p>Flood mitigation measures will be developed in consultation with the affected property, structure and/or infrastructure owners, OEH and the relevant council(s).</p>	Construction and operation