# 7.0 Environmental assessment

## 7.4 Hydrology and flooding

This section provides an assessment of hydrology and potential flooding impacts of the proposed modification and identifies mitigation measures to address these impacts. A detailed assessment of hydrology and flooding impacts is provided in **Appendix G** (Surface water and flooding assessment).

### 7.4.1 Introduction

Table 7-35 outlines the SEARs that relate to hydrology and flooding and identifies where they are addressed in this modification report.

**Table 7-35 SEARs – Hydrology and flooding**

| Desired Performance Outcome | SEAR | Where addressed within the Modification Report |
|---|---|---|
| **3. Flooding**<br>The project minimises adverse impacts on existing flooding characteristics.<br>Construction and operation of the project avoids or minimises the risk of, and adverse impacts from, infrastructure flooding, flooding hazards, or dam failure. | 1. A flood impact and risk assessment (FIRA) must be undertaken by a qualified flooding engineer. As a minimum the FIRA should consider:<br>a. existing base case scenario, including developing a hydrologic and hydraulic model that is compatible with existing flood information developed by Liverpool, Fairfield and Blacktown Councils' flood studies and floodplain risk management studies and plans;<br>b. existing flood behaviour and flood constraints and risks on the site and its surrounding areas for the full range of events including 5% AEP, 1% AEP, PMF and 0.5% AEP or 0.2% AEP;<br>c. changes in post development flood behaviour, impacts of flooding on existing community and on the development for the full range of events including 5% AEP, 1% AEP, PMF and 0.5% AEP or 0.2% AEP. This should address impacts on flood behaviour and on emergency response management of the site and surrounding areas;<br>d. impacts of climate change on both existing and post development flood behaviour due to increase in rainfall intensities; and | **Section 7.4.4,**<br>**Section 7.4.5** and **Appendix G** (Surface water and flooding assessment). |

| Desired Performance Outcome | SEAR | Where addressed within the Modification Report |
|---|---|---|
| | e. proposed temporary management actions to mitigate impacts of flooding during construction on the community, personnel, machinery, and construction sites.<br>*Note: flood behaviour includes flood volume, extent, depth, level, velocity, duration, rate of rise, flood function and hazard.*<br>2. The assessment must include maps of all features relevant to flooding as described in the Floodplain Development Manual, including flood prone and the flood planning area. | |
| **7. Water – Quality and Hydrology**<br>Assess the impacts of the development on hydrology and waterway health and develop measures to avoid and mitigate these impacts. | 2. An assessment of the impact of the development on hydrology, including: | **Chapter 7.5** (Surface water and groundwater) provides an assessment of construction and operational related impacts of the proposed modification on surface water hydrology in terms of both quality and quantity of runoff; as well as assessment of groundwater impacts. |
| | a. a detailed and consolidated site water balance, including quantity, quality and source; | Section 4.1.6 of **Appendix G** (Surface water and flooding assessment) describes the methodology adopted to assess impacts on the quantity and quality of surface water runoff during operation. An assessment of water demand and likely sources during construction is presented in **Chapter 7.5** (Surface water and groundwater). |
| | b. effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas; | **Chapter 7.5** (Surface water and groundwater) presents an assessment of geomorphology impacts in receiving waterways. **Appendix H** (Biodiversity development assessment report) contains an assessment of impacts to downstream rivers, wetlands, estuaries, marine waters and floodplain areas. |
| | c. effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems; | **Appendix H** (Biodiversity development assessment report) contains an assessment of impacts to aquatic ecosystems, including groundwater dependent ecosystems. |

| Desired Performance Outcome | SEAR | Where addressed within the Modification Report |
|---|---|---|
| | d. impacts to natural process and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches); | **Chapter 7.5** (Surface water and groundwater) presents an assessment on geomorphology impacts of receiving waterways. **Appendix H** (Biodiversity development assessment report) contains an assessment of impacts to downstream rivers, wetlands, estuaries, marine waters and floodplain areas in terms of nutrient flow, aquatic connectivity and access to habitat for spawning and refuge. |
| | e. changes to environmental water availability; | **Chapter 7.5** (Surface water and groundwater) provides an assessment of environmental water availability. |
| | f. mitigation measures for the management of stormwater and wastewater during both construction and operation (including volumes, flow rates, management methods and re-use options); and | **Section 7.4.6** and **Chapter 7.5** (Surface water and groundwater) outline potential measures to mitigate construction and operational related impacts on stormwater runoff. Management of wastewater is dealt with **Chapter 7.16** (Waste). |
| | g. proposed surface and groundwater monitoring activities and methodologies. | **Appendix G** (Surface water and flooding assessment) and **Chapter 7.5** (Surface water and groundwater) describe surface water monitoring undertaken to support the surface water assessment, and outlines proposed surface water quality monitoring. Groundwater monitoring is described in **Chapter 7.5** (Surface water and Groundwater). |

### 7.4.2 Method of assessment

**Legislation and policy context**

The assessment of potential hydrology and flooding impacts of the proposed modification has been undertaken in accordance with the approach set out in the *Floodplain Development Manual* (Department of Infrastructure, Planning and Natural Resources, 2005). The *Floodplain Development Manual* incorporates the NSW Government's flood prone land policy. The key objectives of this policy are to identify potential hazards and risks associated with flooding; 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.

*Australian Rainfall and Runoff* (ARR) is a national guideline for the estimation of design flood characteristics in Australia. The third edition was released in 1987 (Institute of Engineers Australia, 1987), and a fourth edition was issued in 2019 (Geoscience Australia, 2019).

The hydrologic and hydraulic models (collectively referred to as 'flood models') that were relied on for this assessment were based on current models developed by Liverpool City Council and Blacktown City Council as part of the following studies, which were based on the procedures set out in Australian Rainfall and Runoff 1987:

- *Cabramatta Creek Flood Study and Basin Strategy Review* (Bewsher Consulting, 2010)
- *Eastern Creek Catchment Hydrological Assessment* (WMAwater, 2013)
- *Eastern Creek Hydraulic Assessment* (Catchment Simulation Solution, 2014).

For consistency with the studies undertaken for Liverpool City Council and Blacktown City Council, this assessment has also adopted ARR (1987) procedures for defining flood behaviour in the Cabramatta Creek and Eastern Creek catchments. A sensitivity study was also carried out to assess the likely changes in predicted flood behaviour based on the adoption of the ARR 2019 procedures in the Cabramatta Creek and Eastern Creek catchments. The sensitivity analysis found that the adoption of the procedures set out in ARR 1987 represents a more conservative estimate of flood behaviour in the vicinity of the proposed modification during design storm events.

In the absence of existing flood studies for the portion of the Ropes Creek catchment in the vicinity of the proposed modification, new hydrologic and hydraulic models have been developed for this assessment. The derivation of design rainfalls, temporal patterns, and rainfall losses in the Ropes Creek models have been based on the latest procedures that are set out in ARR (2019).

The potential impacts of future climate change on flooding were assessed in accordance with the recommended procedures set out in the *Floodplain Risk Management Guideline – Practical Considerations of Climate Change* (NSW Department of Environment and Climate Change (DECC), 2007). Based on the recommendations set out in DECC 2007, the 0.5% AEP and 0.2% AEP design storms were adopted as being analogous to an increase in 1% AEP design rainfall intensities of 10 and 30 per cent respectively, representing the two climate change scenarios assessed. This range of potential increases also encompasses the values given in ARR 2019.

Further detail on the approach to defining flood behaviour in the vicinity of the proposed modification is provided in **Appendix G** (Surface water and flooding assessment).

Further details on other guidelines which have been taken into consideration as part of the assessment, and discussion regarding the relevance and use of these guidelines in the assessment is provided in **Appendix G** (Surface water and flooding assessment).

**Method of assessment**

The approach taken to assessing the potential hydrology and flooding impacts associated with the proposed modification included:

- Review of available data and existing flood studies of the catchments within the study area (refer to **Section 7.4.3**)
- Development of a set of hydrologic and hydraulic models (collectively referred to as 'flood models') of the catchments that are located within the study area
- Running the flood models and preparing mapping showing flood behaviour under existing conditions (i.e. prior to the proposed modification) for design floods with an Annual Exceedance Probability (AEP) of 20% (1 in 5), 5% (1 in 20), 1% (1 in 100) and 0.2% (1 in 500), as well as the Probable Maximum Flood (PMF). AEP refers to the frequency of floods (refer to **Appendix G** (Surface water and flooding assessment) for further details of flood frequency)
- Assessment of the potential impact of the proposed modification during construction and modification on flood behaviour for the design flood events
- Assessment of the impact that future climate change would have on flood behaviour during operation of the proposed modification
- Assessment of the impact that a partial blockage of major hydraulic structures would have on flood behaviour during operation of the proposed modification

- Identification of measures to mitigate the risk of flooding to the proposed modification and its impact on existing flood behaviour.

***Adopted assessment criteria and standards***

Flood related assessment criteria and standards that have been established for the proposed modification, with consideration of the relevant policies and guidelines, are presented in Section 4.2.2 of **Appendix G** (Surface water and flooding assessment).

### 7.4.3 Study area

The proposed modification is located within the following three catchments, which form the study area for this assessment:

- Cabramatta Creek
- Ropes Creek
- Eastern Creek.

Cabramatta Creek forms part of the larger Georges River catchment, while Ropes Creek and Eastern Creek are located within the Hawkesbury-Nepean River catchment. The extent of the catchments is shown in Figure 7-32.

### 7.4.4 Existing environment

This section provides an overview of the hydrological baseline in the study area. Further information can be found in **Appendix G** (Surface water and flooding assessment).

**Catchments and flooding behaviour**

A summary of the existing environment in each catchment within the study area is provided in Table 7-36. Land use is further described in **Section 7.9** (Land use and property).

Patterns of mainstream flooding and major overland flow under existing conditions are presented in Figure 5.3 to Figure 5.5 in **Appendix G** (Surface water and flooding assessment) for 5% AEP, 1% AEP, and PMF respectively. Flooding patterns for 1% AEP under pre-proposed modification conditions is also shown in Figure 7-33. A brief description of flooding patterns within the catchments of Cabramatta Creek, Ropes Creek, and Eastern Creek is also provided in in Table 7-36.

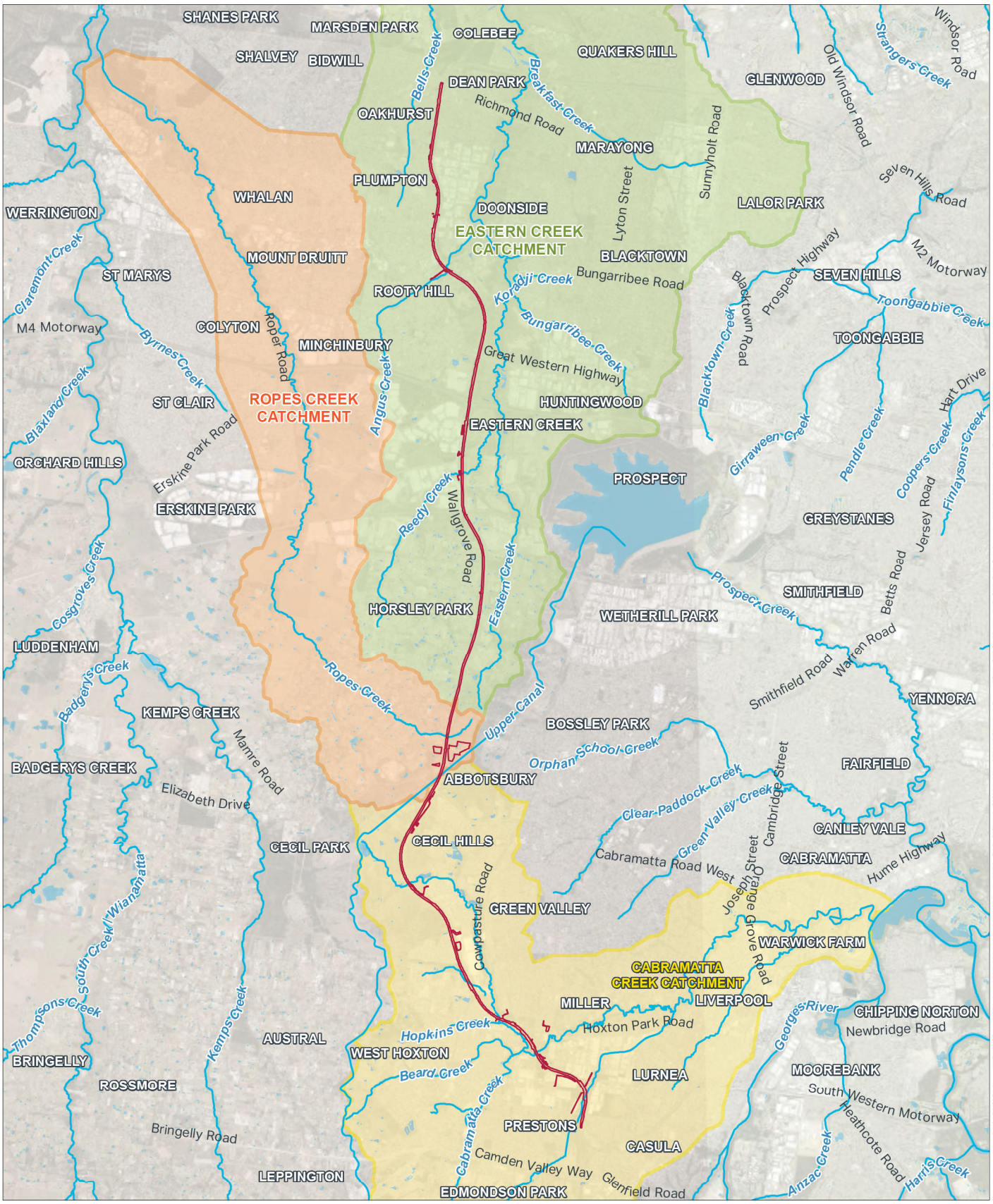


**FIGURE 7-32:** FLOOD CATCHMENTS IN THE STUDY AREA

N

0 1 2 km

AECOM

Legend

- Construction footprint
- Waterbody
- Watercourse
- Ropes Creek catchment
- Eastern Creek catchment
- Cabramatta Creek catchment



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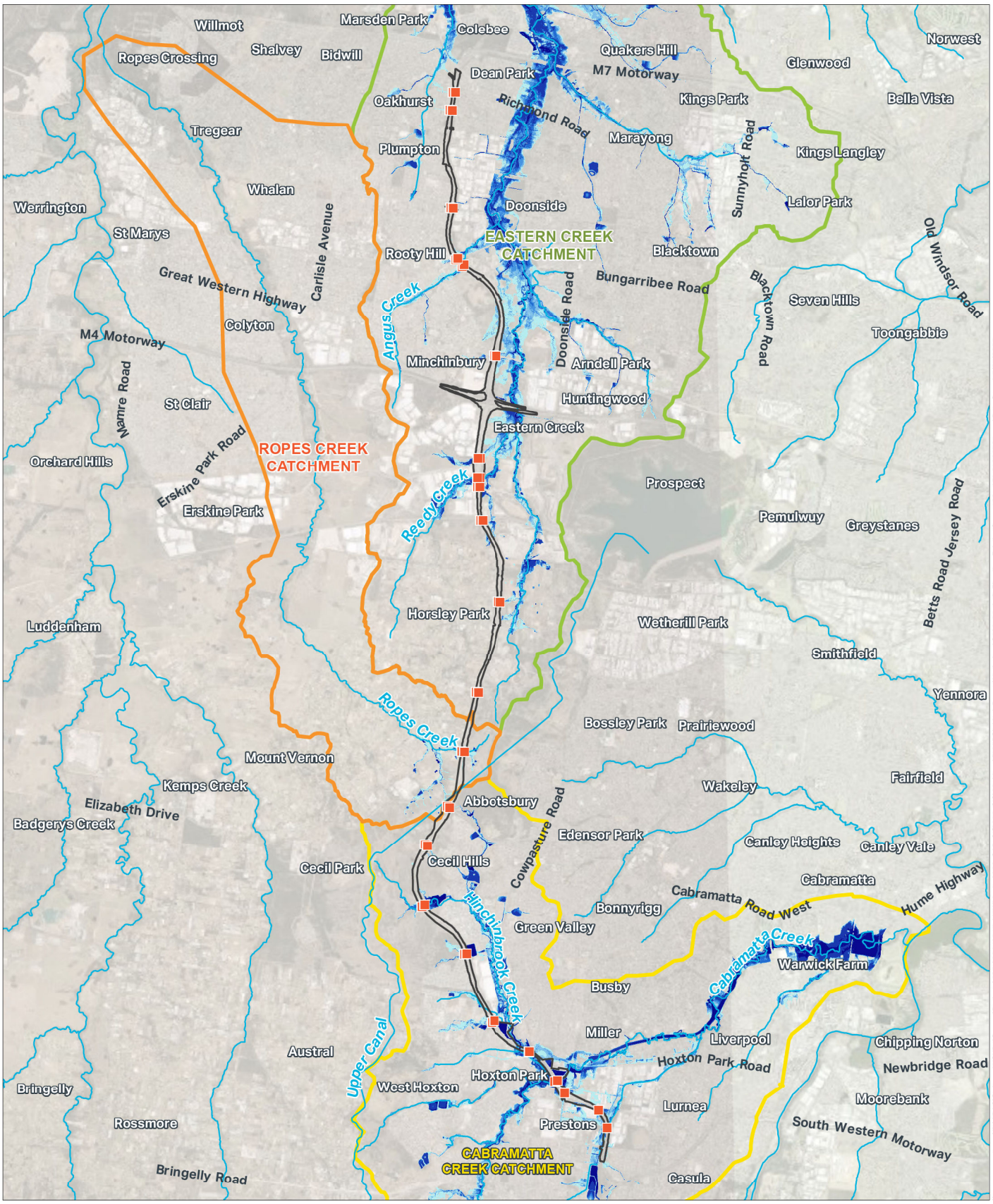


**FIGURE 7-33:** PRE-PROPOSED MODIFICATION CONDITIONS - 1% AEP

N 0 1 2 km

AECOM

Legend

- Operational footprint
- Watercourse
- Transport for NSW bridge
- Ropes Creek catchment
- Eastern Creek catchment
- Cabramatta Creek catchment

**Flood Level (m)**

- 0 - 0.25
- 0.25 - 0.5
- 0.50 - 0.75
- 0.75 - 1
- 1 - 2
- >2

**Table 7-36 Catchments relevant to the proposed modification**

| Catchment | Description | Flood behaviour |
|---|---|---|
| Cabramatta Creek | The section of the Westlink M7 to the south of Elizabeth Drive is located within the Cabramatta Creek catchment. The catchment drains to Cabramatta Creek upstream of its confluence with the Georges River.<br><br>The Westlink M7 crosses Maxwells Creek and Cabramatta Creek, as well as Hinchinbrook Creek in two places its upper and lower reaches.<br><br>Land use within the catchment includes medium density residential, industrial, and commercial development. The Western Sydney Parklands run along the western edge of the catchment, in addition to a series of parks and reserves along creek corridors. Significant urban development, particularly in Carnes Hill and Cecil Hills, has included construction of flood mitigation works (detention basins and water quality basins). | *Cabramatta Creek*: During a 1% AEP event, flooding along Cabramatta Creek will encroach into areas of residential and industrial development upstream and downstream of the Westlink M7 to depths typically less than 0.5 m. The Westlink M7 carriageways are more than 2 metres above the peak 1% AEP flood level where its crosses Cabramatta Creek. The shared path section that runs under a bridge along the north overbank of the creek would be inundated to a 1 metre depth during a 1% AEP event.<br><br>*Maxwells Creek*: Inundates areas of its overbank at its crossing with the Westlink M7 under events more frequent than 5% AEP. During a 1% AEP event, the creek can cause flooding to a downstream industrial area of up to 1 metre at several locations. While the Westlink M7 carriageways are more than 2 metres above the peak 1% AEP flood level where its crosses Maxwells Creek, a section of the shared path that runs along the northern side of the motorway on the western overbank of Maxwells Creek would be inundated to depths that exceed 1 metre.<br><br>*Hinchinbrook Creek*: Flooding occurs in several locations including at Hoxton Park Road where it runs under the Westlink M7, and at an unnamed tributary of Hinchinbrook Creek, where it runs under the bridge waterway crossing of the Westlink M7 to the north of Middleton. The main carriageways of the Westlink M7 are more than 3 metres above the peak 1% AEP flood level where a bridge crosses Hinchinbrook Creek and Hoxton Park Road.<br><br>The remainder of the of the Westlink M7 within the Cabramatta Creek catchment is not affected by either mainstream flooding or major overland flow, with the exception of the section to the north of the bridge B9844/45 which is inundated by overland flow that originates in the Ropes Creek catchment. |
| Ropes Creek | Ropes Creek is a major tributary of South Creek, which itself is a tributary of the Hawkesbury Nepean River.<br><br>The Westlink M7 crosses Ropes Creek in a bridge structure that spans the creek as well as local roads that are located on both its northern and southern banks. The upstream creek catchment has largely been cleared for agricultural purposes. A series of farm dams | Flooding along Ropes Creek occurs over a width of about 50 metres and to a depth of 2 to 3 metres where it runs under the M7 Westlink bridge. Flood levels along this section of the creek are controlled by the capacity of a high box culvert that crosses Wallgrove Road. The peak 1% AEP flood level at the box culvert is about 2 metres below the adjacent level of the road.<br><br>During a Probable Maximum Flood (PMF), flow that surcharges the inlet to the transverse drainage structure discharges onto the Westlink M7 to the south of its interchange with Elizabeth Drive. |

| Catchment | Description | Flood behaviour |
|---|---|---|
| | have been constructed along the creek over this section while some remnant vegetation still exists between farm dams. | While the main carriageways of the Westlink M7 are not affected by mainstream flooding from Ropes Creek, a section of the southbound carriageway to the south of the creek is subject to relatively shallow overland flow during storms that result in surcharge of the existing stormwater drainage system. |
| Eastern Creek | Eastern Creek is a major tributary of South Creek, which itself is a tributary of the Hawkesbury-Nepean River. The catchment drains to Eastern Creek upstream of the construction footprint and its main tributaries comprise Reedy Creek, Eskdale Creek, Angus Creek, Bells Creek and Breakfast Creek.<br>The Westlink M7 crosses Reedy Creek, Eskdale Creek and Angus Creek.<br>Land use within the portion of the catchment upstream of the Westlink M7 comprises medium density residential, industrial, and commercial development. Significant areas of industrial development are located in the suburbs of Eastern Creek, Huntingwood, Arndell Park, Blacktown, and Kings Park. Open space includes Western Sydney Parklands and Nurragingy Reserve that run north-south along the corridor of Eastern Creek. Areas downstream (north) of the Westlink M7 have undergone extensive urban development as part of the North West Growth Centres and Western Sydney Employment Area. | *Reedy Creek*: The carriageways of the Westlink M7 are more than 4 metres above the peak 1% AEP flood level in the tributary of Reedy Creek. Wallgrove Road would be inundated to a maximum of 0.3 metres. The shared path is about 2 metres above the peak 1% AEP flood level where it crosses Reedy Creek.<br>*Eskdale Creek*: During a 1% AEP event, flooding along the section of Eskdale Creek to the west (upstream) of where it crosses the Westlink M7 and Wallgrove Road is mainly confined to the drainage reserve through which its main channel runs.<br>*Angus Creek*: Flooding along the section of Angus Creek both immediately upstream and downstream of its crossing with the Westlink M7 is mainly confined to the inbank area of its main channel for floods with AEPs up to 20%. While floodwater would surcharge the banks of the creek during a 1% AEP event it would be mainly confined to areas of open space along its riparian corridor. The main carriageways and the shared path of the Westlink M7 are more than 5 metres above the peak 1% AEP flood level where its crosses Angus Creek. |

**Existing drainage infrastructure along the Westlink M7**

The existing drainage infrastructure of the Westlink M7 includes the following elements:

- A pit and pipe stormwater drainage network that controls runoff from the carriageways of the Westlink M7 and discharges it to either stormwater basins or pollutant control devices
- Stormwater basins and pollutant control devices that discharge runoff into the receiving watercourses
- Bridges and culvert crossings over creeks and other watercourses.

***Existing stormwater quantity and quality controls***

The existing stormwater management infrastructure associated with the Westlink M7 includes numerous detention basins and water quality controls, and was designed to accommodate a future widening of the road pavement into the median.

Runoff from the Ropes Creek and Elizbeth Drive catchments is controlled by a series of on-site detention basins that are typically provided in combination with water quality basins. Within the Cabramatta Creek catchment, stormwater quantity from the existing Westlink M7 is addressed by three regional detention basins, named Basin 18, Basin 22, and Government Road Basin. Water quality basins, spill containment basins, and pollutant control devices are also located within the study area. Further information is provided in Section 5.5.1 of **Appendix G** (Surface water and flooding assessment).

***Transverse drainage and flood mitigation measures***

Approximately 45 bridge and transverse drainage structures are located throughout the construction footprint and were designed to control runoff into the Westlink M7 corridor (specifically to provide a 1% AEP level of flood immunity to its carriageways). Further information is provided in Section 5.5.2 of **Appendix G** (Surface water and flooding assessment).

### 7.4.5 Impact assessment

This section provides an assessment of the hydrology and flood-related impacts of the proposed modification during construction and operation.

**Construction**

Construction activities have the potential to change flood behaviour and impact on the surrounding environment. In addition, flooding has the potential to impact on construction areas within and near the construction footprint (i.e. potential inundation of the construction footprint).

***Flood risks to construction activities/areas of the proposed modification***

Without the implementation of appropriate mitigation measures, the inundation of the construction work areas and ancillary facilities by floodwater has the potential to:

- Cause damage to the proposed modification works and delays in construction programme
- Pose a safety risk to construction workers
- Detrimentally impact the downstream waterways through the transport of sediments and construction materials by floodwater
- Obstruct the passage of floodwater and overland flow, which in turn could exacerbate flooding conditions in surrounding existing development.

Table 7-37 provides a summary of flooding risk during construction of the proposed modification. An assessment of impacts against each construction work area and ancillary facility can be found in **Appendix G** (Surface water and flooding assessment).

**Table 7-37 Potential flood risks at construction work areas and ancillary facilities**

| Activity | Potential impact |
|---|---|
| Construction ancillary facilities | • Low risk of flooding associated with the construction ancillary facilities that are located within the median<br>• Some ancillary facilities associated with bridge construction and construction zone support are subject to flooding conditions that would be considered hazardous, based on the flood hazard vulnerability classification presented in ARR (2019). These include two ancillary facilities during a 20% AEP event, and seven during a 1% AEP event.<br>• Where ancillary facilities are located within the floodplain, these are considered to be within areas of 'high' hazard under the Floodplain Development Manual.<br>• A number of the bridge construction and zone support ancillary facilities include land that would be inundated during a 5% AEP flood. In accordance with standard Transport procedures, contingency planning would be required should site facilities be located in these areas. |
| Spoil management and stockpile areas | • Stockpiles located on the floodplain have the potential to obstruct floodwater and alter flooding patterns.<br>• Inundation of stockpile areas by floodwater can lead to significant quantities of material being washed into the receiving drainage lines and waterways, creating blockages. |
| Earthworks | • Low potential for flooding of the median work areas<br>• Some bridge construction areas and ancillary facilities located in areas that would be frequently inundated by floodwater, with the potential to cause scour of disturbed surfaces and the transport of sediment and construction materials into the receiving drainage lines and waterways, causing blockages<br>• It would be necessary to plan, implement, and maintain measures aimed at managing the diversion of floodwater either through or around the construction areas. |
| Bridge construction | • At bridge crossings, the temporary access roads and working platforms may need to cross part of the main creek channel in areas that would be frequently inundated by flow. It would therefore be necessary to design and construct the temporary access roads and working platforms to manage the potential for scour and transport of material into the watercourses, whilst also maintaining a passage for the conveyance of floodwater through the construction site. |

### *Impact of the proposed modification on flood behaviour*

Construction activities have the potential to exacerbate flooding conditions when compared to both existing and future operational conditions. This is because construction activities would impose a larger footprint on the floodplain due to the need to provide temporary structures, such as ancillary sites, outside the operational footprint which would be removed following the completion of construction. Construction activities that could result in changes to flood behaviour if not mitigated include:

- Clearing of vegetation and topsoil
- Earthworks associated with widening, reshaping of waterways and embankments to accommodate bridge works, trenching for new or realigned stormwater drainage and utilities, and establishment of ancillary facilities
- Demolition of existing structures and infrastructure within the widening areas

- Utility works within Westlink M7 and adjoining roads, particularly around existing motorway bridge substructures
- Provision of temporary water management controls for construction including establishment of waterway crossings
- Bridge widening works including piles, abutments, piers and headstocks and superstructures including beams, girders, decks, and barriers
- Other works including asphalting the carriageway surface, addition of permanent barriers and addition of noise walls.

An assessment of construction areas and activities on flood behaviour is provided in Table 6.2 of **Appendix G** (Surface water and flooding assessment). The assessment found that the potential impacts that construction activities could have on flood behaviour are described as follows:

- The construction activities within the construction footprint would have a minimal impact on flood behaviour
- Temporary access roads and working platforms required to construct the widening of the existing bridges over creeks have the potential to obstruct the conveyance of flow, which in turn may impact the extent and depth of inundation and flow velocities in the creeks and their overbank areas
- Ancillary facilities, stored materials, and perimeter fencing have the potential to obstruct the conveyance of floodwater or displace floodplain storage.

While the findings of the assessment provide an indication of the potential impacts of construction activities on flood behaviour, further investigation would be undertaken during detailed design as layouts and staging diagrams are further developed. Consideration would also need to be given to setting an appropriate hydrologic standard for mitigating the impacts of construction activities on flood behaviour, taking into account their temporary nature and therefore the likelihood of a flood of a given AEP occurring during the construction period.

Without mitigation, the construction of the proposed modification has the potential to result in changes in flood behaviour that may have social and economic costs to the community by causing disruption and exacerbating the impact of flooding to surrounding property and infrastructure. Prior to construction, measures aimed at mitigating the impacts of construction activities on flood behaviour would be identified.

**Operation**

This section provides an assessment of the flood risk to the proposed modification and the impact it would have on flood behaviour during operation. The findings of an assessment into the potential impact of future climate change and impacts of a partial blockage of the local stormwater drainage system on flood behaviour under operational conditions are also presented.

***Flood behaviour***

The proposed modification has the potential to impact on flooding patterns due to:

- An increase in the rate and volume of runoff from the widened road pavement, which has the potential to impact on flooding patterns in the receiving drainage lines downstream of the operational footprint
- The obstruction that is caused by the proposed additional piers to support the widened bridges, which has the potential to impact on flooding patterns in the drainage lines they cross.

In order to assess the impact of the proposed modification on flood behaviour, the flood models representing existing conditions were adjusted to incorporate details of the proposed works, including changes in flow behaviour from the widened road pavement and the potential obstruction caused by the additional piers that are proposed to support the widened bridges.

An operational flood model was used to investigate the impact of the proposed modification on flood behaviour. The results are presented and shown in Figure 7.2 to Figure 7.4 of **Appendix G** (Surface water and flooding assessment) for 5% AEP, 1% AEP, and PMF respectively. Flooding patterns for 1%

AEP under post-proposed modification conditions is also shown in Figure 7-34. The results of this assessment are summarised in Table 7-38 .

**Table 7-38 Summarised results of the operational flood model**

| **Impact of flooding on the proposed modification** | |
|---|---|
| The level of flood immunity to the Westlink M7 would be maintained during operation of the proposed modification. The bridge waterway and transverse drainage structures along the existing Westlink M7 were designed to provide a 1% AEP level of flood immunity to its carriageways. This level of flood immunity would be achieved under both pre- and post-proposed modification conditions. | |
| **Impact of the proposed modification on flood behaviour** | |
| Changes in peak flood levels and depths of inundation | Minor, localised increases in peak flood levels and depths of inundation outside the operational footprint were noted in several locations. For instance, during a 20% AEP design storm event, the depth of ponding in a detention basin that is located immediately to the east (downstream) of bridge waterway structure BR9873/74 would increase by 0.02 metres. Similar increases would occur during storms with AEPs of 10% and 5%, but not at 1%, except for along the southern side of the Main Western Railways to the west (upstream) of the Westlink corridor at transverse drainage structure (C23.10), whereby a maximum increase of 0.014 metres could occur in peak 1% AEP flood levels. In addition, during a 5% and 1% AEP design storm event, depths of flow at the outlet of the Government Road Basin would increase by 0.06 metres, and by a maximum of 0.10 metres in an area of the Western Sydney Parklands to the east (downstream) of transverse drainage structure C16.60. |
| Changes in flow velocities | The proposed modification has the potential to increase scour potential due to localised increased in flow velocities at the outlet of the drainage structures within the Westlink M7 corridor that would control runoff from the widened road. During detailed design, appropriate scour protection and energy dissipation measures would be incorporated into the design of the drainage outlets where it is required to manage localised increases in flow velocity.<br>The proposed modification also has the potential to result in localised increases in flow velocities due to the obstruction caused by the additional piers that are proposed to support the widened bridges.<br>The proposed modification would have only a minor impact on maximum flow velocities for storms with AEPs of 5% and 1%. Increases in maximum flow velocities in the drainage lines downstream of the operational footprint would be typically less than 10% and where it is greater than this, maximum velocity due to the proposed modification would be less than 1 metre per second. As a result, the proposed modification is expected to have only a minor impact on the scour potential in the receiving drainage lines. |
| Changes in the extent and duration of flooding | Given the relatively minor increases in peak flood levels and the depth of inundation that are attributable to the proposed modification, there would also be only minor changes in the extent of inundation for all events up to the PMF.<br>The proposed modification would have only a minor impact (less than one hour) on the duration of flooding in the drainage lines downstream of the operational footprint for storms with AEPs of 20% and 1%. |

| Impact of flooding on the proposed modification | |
|---|---|
| Changes in flood hazard and the hydraulic function of floodways and flood storage areas | Flood hazard is measured in terms of the potential danger to personal safety and damage to property based on the depth and velocity of floodwater. Given the minor nature of the changes in the depth of inundation and velocity of flow, it is expected to have a minor impact on the hazardous nature of flooding.<br>As the carriageways within the operational footprint are located outside areas that are impacted by flooding during a 1% AEP event, the only components of the proposed modification that lie within areas that would be classified as floodway or flood storage areas are the additional piers that are associated with the widened bridges. The footprint of these piers is minor relative to the overall flood extent, and it has been demonstrated that their obstruction to flow in floodways and displacement of floodwater in flood storage areas would have only a minor impact on flood behaviour. |
| Changes in flood volume and rate of rise of floodwaters | Changes in the volume of runoff from the widened road pavement have been incorporated in the flood models representing post-proposed modification conditions. Given the nature of the works associated with the proposed modification and the minor nature of its impact on the aspects of flood behaviour, it would be expected that changes in the rate of rise would also be minor in nature. |

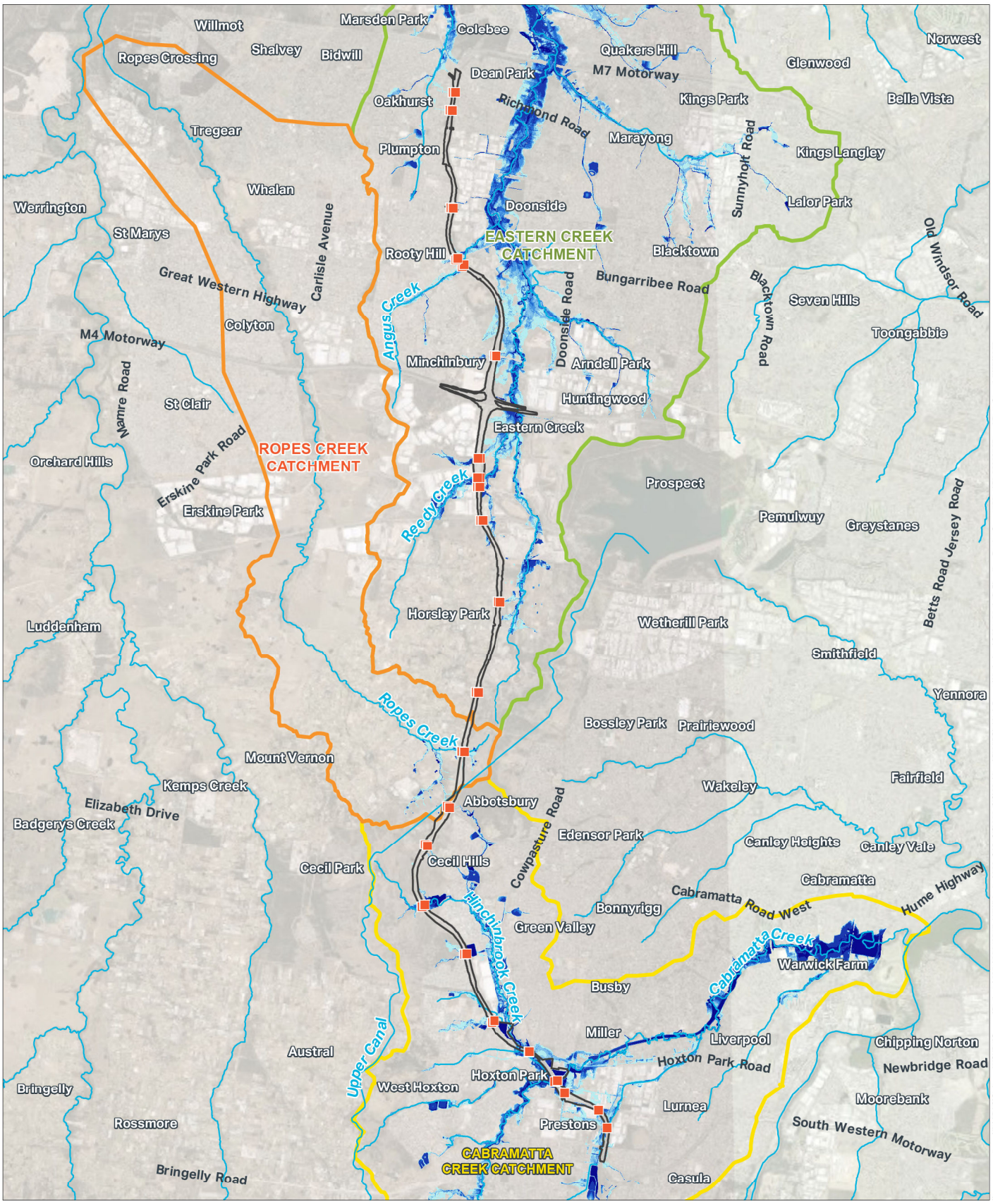


**FIGURE 7-34:** POST-PROPOSED MODIFICATION CONDITIONS - 1% AEP

N 0 1 2 km

AECOM

Legend

- Operational footprint
- Watercourse
- Transport for NSW bridge
- Ropes Creek catchment
- Eastern Creek catchment
- Cabramatta Creek catchment

**Flood Level (m)**

- 0 - 0.25
- 0.25 - 0.5
- 0.50 - 0.75
- 0.75 - 1
- 1 - 2
- >2

***Consistency with council and state government flood-related plans***

A flood planning area has been defined by the current assessment through mapping the extent of land which lies below the peak 1% AEP flood level plus 0.5 metres under existing conditions. As discussed above, the proposed modification would have only a minor impact on peak flood levels during a 1% AEP design storm event as well as the PMF. As a result, the proposed modification would not have a significant impact on the extent of the flood planning area and therefore the area of land to which the flood planning provision (clause 5.21) of both the Liverpool Local Environmental Plan (LEP) 2008 and the Fairfield LEP 2013 would apply. While the Blacktown LEP 2015 does not contain a definition of the flood planning level, the proposed modification would not have a significant impact on the extent of the flood planning area were the Council to adopt the same definition as set out in clause 5.21 of the Liverpool LEP 2008 and the Fairfield LEP 2013.

While a floodplain risk management study and plan has only been prepared for the Cabramatta Creek catchment (Bewsher Consulting, 2004), the results of the operational flood model show that the proposed modification would have only a minor impact on peak flood levels external to the Westlink M7 corridor.

Given the minor changes in both peak flood levels and flow velocities that are attributable to the proposed modification, it can be concluded that it would not increase the flood hazard in existing development for all events up to 1% AEP. It would also not have an adverse impact on NSW State Emergency Service's emergency response arrangements.

***Impact of future climate change on flood behaviour***

The 0.5% AEP and 0.2% AEP storm events have been used as proxies to assess the impact of two climate change scenarios, represented by a 10% and 30% increase in 1% AEP rainfall intensities on flood behaviour in the vicinity of the proposed modification. **Appendix G** (Surface water and flooding assessment) contains a series of figures that show flood behaviour under existing and proposed modification conditions for storm events of 0.5% AEP and 0.2% AEP (climate change scenarios 1 and 2). Comparison of these results against those for a 1% AEP design storm event provides an indication of the impact that future climate change could have on flooding of the proposed modification, as well as the impact that the operation of proposed modification could have on flood behaviour under future climate change conditions.

The assessment of future climate change on flooding during operation of the proposed modification found that while depths of inundation would be increased along any drainage lines that cross the operational footprint, the main carriageways of the Westlink M7 would remain flood-free under both climate change scenarios 1 and 2.

Under future climate change conditions, the operation of the proposed modification would generally have a similar impact on flood behaviour to that described above for a 1% AEP design storm event. Flooding has the potential to increase peak post-climate change 1% AEP flood levels in the following areas:

- Along the southern side of the Main Western Railway to the west (upstream) of the Westlink M7 corridor at transverse drainage structure where the increase in peak 1% AEP flood levels under future climate change conditions would be similar, but would occur over a slightly larger area, when compared to the impact that would occur under current climatic conditions
- Along a section of Eskdale Creek to the west (upstream) of the Westlink M7 corridor where peak 1% AEP flood levels under future climate change conditions could be increased by 0.02 metres over an area that is largely confined to the riparian corridor associated with the creek, under current climatic conditions the proposed modification is not predicted to result in an increase in peak 1% AEP flood levels over this area.

***Impact of a partial blockage of major hydraulic structures on flood behaviour***

The assessment found that while the depth of ponding would be increased should a partial blockage occur to the inlet of transverse drainage structures that are located along the operational footprint, the main carriageways of the Westlink M7 would remain flood free during operation of the proposed modification.

The transverse drainage structures that control runoff from the catchments upstream of the Westlink M7 are not being modified as part of the proposed modification. Therefore, the risk of a partial blockage to the existing transverse drainage structures and the impact that it would have on flood behaviour is the same under pre- and post-proposed modification conditions.

***Application of ARR (2019) to design flood estimation***

As the procedures set out in ARR (2019) are likely to be used by councils to carry out updates to the existing studies within the Cabramatta Creek and Eastern Creek catchments, a sensitivity study was carried out to assess the likely changes that would occur in predicted flood behaviour under the climate change scenarios assessed in the vicinity of the proposed modification where it runs through the Cabramatta Creek and Eastern Creek catchments.

The investigation found that the adoption of ARR (2019) procedures would lead to a reduction in the rate of runoff that would be generated by the Cabramatta Creek and Eastern Creek catchments, which in turn would lead to a reduction in design peak flood levels in the vicinity of the proposed modification when compared to those derived using the procedures set out in ARR (1987).

Based on the above findings, the adoption of the procedures set out in ARR (1987) represents a more conservative estimate of flood behaviour in the vicinity of the proposed modification during design storm events.

### 7.4.6 Mitigation measures

The mitigation measures described in Table 7-39 are proposed to be implemented to manage potential hydrology and flood-related impacts during construction and operation of the proposed modification.

Note that further mitigation measures related to surface water impacts are provided in **Section 7.5** (Surface water and groundwater).

**Table 7-39 Mitigation measures**

| Impact | ID | Mitigation measure | Responsibility | Timing |
|---|---|---|---|---|
| Flood management | FL1 | A Flood Management Plan will be prepared as part of the CEMP for the proposed modification and will detail the processes for flood preparedness, materials management, weather monitoring, site management and flood incident management. The flood management plan will be developed in accordance with relevant guidelines. | Construction contractor<br>Westlink M7 Operator | Prior to construction<br>Construction<br>Operation |
| Impacts on existing drainage systems | FL2 | Activities that may affect existing drainage systems during construction will be carried out so that existing hydraulic capacity of these systems is maintained where practicable. | Construction contractor | Construction |
| Detailed construction planning | FL3 | Detailed construction planning is to consider flood risk at construction sites and construction support sites. This will include:<br>• A review of site layout and construction activity staging to avoid or minimise obstruction of overland flow paths and limit the extent of flow diversion required<br>• Identification of measures to not worsen flood impacts on the community and on other property | Construction contractor | Detailed design<br>Prior to construction |

| Impact | ID | Mitigation measure | Responsibility | Timing |
|---|---|---|---|---|
| | | and infrastructure during construction up to and including the 1% AEP flood event, where reasonable and feasible. This would include flood modelling and assessment to assess the extent of potential impacts and therefore the scope of mitigation measures that may be required.<br>• Measures to mitigate alterations to local runoff conditions due to construction activities. | | |
| Impacts related to siting of spoil stockpiles | FL4 | Spoil stockpiles are to be located in areas not subject to frequent inundation by floodwater, ideally outside the 10% AEP flood extent. The exact level of flood risk accepted at stockpile sites will depend on the duration of stockpiling operations, the type of material stored, the nature of the receiving drainage lines and also the extent to which it would impact flooding conditions in adjacent development. | Construction contractor | Detailed design<br>Prior to construction |
| Impacts related to locations of construction ancillary facilities | FL5 | Construction ancillary facilities should be located outside high flood hazard areas based on a 1% AEP flood. | Construction contractor | Detailed design<br>Prior to construction |
| Flood emergency management | FL6 | Flood emergency management measures during construction are to be prepared and incorporated into relevant environmental and/or safety management documentation in consultation with NSW State Emergency Services (SES) and relevant local councils. | Construction contractor | Detailed design<br>Prior to construction |
| Flooding behaviour related impacts | FL7 | The operational impact of the proposed modification on flood behaviour is to be confirmed during detailed design, and should include consideration of future climate change and a partial blockage of the stormwater drainage system. | Transport | Detailed design<br>Prior to construction |
| Flood hazard impacts to surrounding environment | FL8 | The proposed modification is to be designed and further refinements made (as required) to avoid adverse impacts on:<br>• Residential, commercial, and/or industrial development during a 1% AEP event, or | Transport | Detailed design<br>Prior to construction |

| Impact | ID | Mitigation measure | Responsibility | Timing |
|---|---|---|---|---|
| | | • Critical infrastructure, vulnerable development or increases in risk to life due to a significant increase in flood hazard for floods up to the PMF.<br>Where the above cannot be achieved, alternative mitigation measures may be agreed to with the affected landowner. | | |
| Flood velocity leading to scour | FL9 | Localised increases in flow velocities at drainage outlets that would control runoff from the proposed modification are to be mitigated through the provision of scour protection and energy dissipation measures. | Construction contractor<br>Westlink M7 Operator | Detailed design<br>Construction<br>Operation |
| Impacts to flood emergency management | FL10 | The function of the widened Westlink M7 in flood emergency management measures shall be prepared in consultation with NSW SES and relevant local councils. | Transport<br>Westlink M7 Operator | Detailed design<br>Construction<br>Operation |