Roads and Maritime Services/Sydney Airport Corporation Limited

Sydney Gateway Road Project

Environmental Impact Statement/ Preliminary Draft Major Development Plan

Chapter 14 Flooding

November 2019

Contents

Tables

Figures

Chapter 14
Flooding

This chapter describes the existing hydrological environment and potential for flooding, identifies potential impacts during construction and operation, and provides measures to mitigate and manage the impacts identified. Further information is provided in Technical Working Paper 6 (Flooding).

The SEARs relevant to flooding are listed below. There are no MDP requirements specifically relevant to flooding, however there is a requirement under section 91(1) of the Airports Act to assess the potential environmental impacts associated with a development (section 91(1)(h)), and to specify how those impacts may be dealt with (section 91(1)(j)). Full copies of the SEARs and MDP requirements, and where they are addressed in this document, are provided in Appendices A and B respectively.

Reference	Requirement	Where addressed
Key issue SEARs		
9	**Flooding**	
9.1	The EIS must include maps illustrating the following features relevant to flooding as described in the *NSW Floodplain Development Manual* (2005): (a) flood prone land; (b) flood planning areas and any areas below the flood planning level; (c) hydraulic categorisation (floodways and flood storage areas); and (d) flood hazard.	Section 14.2.2, Figure 14.2 to Figure 14.6
9.2	The Proponent must assess and (model) the impacts on flood behaviour during construction and operation for a full range of flood events (including a minimum of the 5% Annual Exceedance Probability (AEP), 1% AEP) up to the probable maximum flood (taking into account sea level rise and storm intensity due to climate change) including:	
	(a) any detrimental increases in the potential flood affectation of other properties, assets and infrastructure;	Section 14.3.1
	(b) consistency (or inconsistency) with applicable Council floodplain risk management plans/studies;	Section 14.3.2
	(c) compatibility with the flood hazard of the land;	Section 14.3.3
	(d) compatibility with the hydraulic functions of flow conveyance in floodways and storage areas of the land;	Section 14.3.4
	(e) adverse effects to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the proposal;	Section 14.3.5
	(f) redirection of flow, flow velocity and scour potential (including erosion, siltation, and bank stability of water courses from removal of riparian vegetation);	Section 14.3.6
	(g) impacts the development may have upon existing community emergency management arrangements for the full range of food risks. These matters must be discussed with the State Emergency Services and Council; and	Section 14.3.7
	(h) any impacts the development may have on the social and economic costs to the community as a consequence of flooding.	Section 14.3.8
9.3	The assessment should take into consideration any flood studies undertaken by local government councils and State government agencies.	Section 14.1.2

14. Flooding

14.1 Assessment approach

When new road and bridge infrastructure is built, it is important to ensure that it will not be adversely affected by flooding. It is also just as important to ensure that the infrastructure does not contribute to flooding impacts in the catchment area. This is achieved by undertaking detailed flood modelling to ensure that potential flooding issues are identified and managed through project design.

The assessment of potential impacts of the project on existing flood regimes has been undertaken with consideration of the *Floodplain Development Manual* (DIPNR, 2005). The key objectives of this policy are to identify potential flood hazards and risks, reduce the impact of flooding and flood liability on owners and occupiers of flood prone property, and reduce public and private losses resulting from floods.

The assessment was carried out to inform the project design and the impact assessment identified the potential impacts of existing flooding conditions on the project, as well as potential flood impacts from project implementation. Potential impacts during project construction and operation were considered.

An overview of the approach to the assessment is provided below, including the legislative and policy context and a summary of the assessment methodology.

14.1.1 Legislative and policy context to the assessment

The assessment has been undertaken in accordance with the SEARs and MDP requirements (provided in Appendices A and B) and with reference to the following:

- Relevant legislation, including the EP&A Act, the Airports Act and associated regulations
- The flood related planning controls contained in local planning instruments relevant to the study area – the *Marrickville Local Environmental Plan 2011, Botany Bay Local Environmental Plan 2013, Rockdale Local Environmental Plan 2011* and the *Sydney Local Environmental Plan 2012*
- *Managing Urban Stormwater – Soils and Construction Volume 1, 4th Edition* (Landcom, 2004), *Volume 2B Waste Landfills* (DECC, 2008a) and *Volume 2D, Main Road Construction* (DECC, 2008b) (collectively referred to as the 'Blue Book' in this document)
- *Australian Rainfall and Runoff; A Guide to Flood Estimation* (Geoscience Australia, 2019)
- *Cooks River Flood Study* (PB-MWH Joint Venture, 2009)
- *Coastal Risk Management Guide: Incorporating Sea Level Rise Benchmarks in Flood Risk Assessments* (DECCW, 2010b)
- *Floodplain Development Manual* (DIPNR, 2005)
- *Hydrology Model Development Report – Cooks River Flood Modelling* (Aurecon Jacobs Joint Venture, 2016)
- *Mascot, Roseberry and Eastlakes Floodplain Risk Management Study and Plan* (RH DHV, 2017)
- *Marrickville Local Flood Plan* (SES, 2015)
- *Floodplain Risk Management Guideline: Practical Considerations of Climate Change* (DECC, 2007)
- NSW government planning directions and guidelines, including the *Guideline on Development Controls on Low Flood Risk Areas* and *Direction 4.3 – Flood Prone Land*
- *Sea Level Rise Policy Statement* (DECCW, 2009)
- *Sydney Airport Flood Study* (AECOM, 2018)
- *Sydney Airport Master Plan 2039* (SACL, 2019a)
- *Sydney Airport Environment Strategy 2019-2024* (SACL, 2019b).

14.1.2 Methodology

Study area

The study area for the flooding assessment includes the project site (as described in Chapter 2 (Location and setting)) and the Alexandra Canal, Tempe Wetlands and Mill Stream catchments. Alexandra Canal and Tempe Wetlands form part of the larger Cooks River catchment, while both the Cooks River and Mill Stream drain to Botany Bay. The catchments are described in section 14.2.1.

Key tasks

The project involves providing new infrastructure in an area subject to existing flooding. As a result, a flooding assessment was undertaken as an input to the design. The flooding assessment involved:

- Reviewing available data and existing flood studies within the identified catchments including:
  - *The Cooks River Flood Study* (PB-MWH Joint Venture, 2009), the *Sydney Airport Flood Study* (AECOM, 2018) and the *Hydrology Model Development Report - Cooks River Flood Modelling* (Aurecon Jacobs Joint Venture, 2016)
  - Existing and future flooding conditions
  - Existing drainage infrastructure
- Developing a set of hydrologic and hydraulic models (referred to as 'flood models') of the catchments located within the study area (see below)
- Refining the project design to minimise flooding impacts where possible
- Assessing potential flooding impacts and risks associated with the project, which involved:
  - Comparing potential flood impacts against the base case scenario to identify the extent of impacts
  - Considering catchment flooding conditions using the above models, as well as ocean flooding in the areas of the Cooks River and Alexandra Canal (due to tidal influences)
  - Identifying the potential for impacts on flooding during construction
  - Identifying the potential for impacts on flooding of neighbouring properties and assets due to changes to ground levels and the introduction of new structures
- Developing measures to minimise potential changes to the flood regime as a result of the project.

The flood models used were originally developed as part of the flooding investigations undertaken for the New M5 EIS. A RAFTS model of the Cooks River catchment and a DRAINS model of the Alexandra Canal catchment were used to generate design discharge inputs to the hydraulic models, while flooding patterns in the vicinity of the project site were defined using the Lower Cooks River TUFLOW two dimensional hydraulic modelling software. The models were developed and updated as needed for application to the project. Further information on the models used, their development and validation, is provided in Annexure A of Technical Working Paper 6 (Flooding).

The frequency of flood events is generally referred to in terms of their Annual Exceedance Probability (AEP). For example, for a five per cent AEP flood, there is a five per cent probability (or a one in 20 chance) that there would be floods of a greater magnitude each year. For a one per cent AEP flood, there is a one per cent probability (or a one in 100 chance) that there would be floods of greater magnitude each year.

To assess the potential impacts associated with the project, a full range of flooding events from the 0.2 per cent to the 50 per cent AEP event were modelled for the:

- Existing case (what would occur without the project)
- Developed case (what would occur with the project).

The probable maximum flood (PMF) event was also modelled for the existing and developed case. The PMF is considered to be the worst-case flood event for an area. The PMF represents extreme flooding conditions. Land susceptible to flooding during a PMF event is known as flood prone land.

The impact of climate change was incorporated into the flood modelling processes by considering the *Floodplain Risk Management Guideline: Practical Considerations of Climate Change* (DECC, 2007) and *Sea Level Rise Policy Statement* (DECCW, 2009). Specifically, this involved increasing the one per cent AEP design rainfall intensity by between 10 and 30 per cent and an increase in sea level consistent with a predicted increase of between 0.4 and 0.9 metres by 2050. The outcomes are described in section 14.4.1. Further information on relevant policies and model scenarios is provided in chapters 2 and 3 of Technical Working Paper 6.

14.1.3 Risks identified

An environmental risk assessment was undertaken as an input to the impact assessment (see Appendix G). This involved identifying potential environmental risks during construction and operation, and rating the potential risks according to likelihood, consequence and overall level of risk, in general accordance with *AS/NZS ISO 31000:2009 Risk management – Principles and guidelines*. Flooding risks with an overall assessed risk rating of medium or above, identified by the environmental risk assessment, included:

- Obstruction or modification of existing drainage infrastructure that results in changes to overland flows, and associated impacts on adjacent land uses and public safety
- Impacts on existing flood evacuation routes and flood planning areas during construction and operation
- Changes to flooding regimes, including potential for increased property inundation, increased flood duration or changes to flood hazards.

The flooding assessment included consideration of these potential risks.

14.2 Existing environment

14.2.1 Catchments and key waterbodies

The project site is mainly located within the lower reaches of the Cooks River catchment, a sub-catchment of the larger Botany Bay catchment. A small portion of the project site, near the intersection of Sir Reginald Ansett Drive and Keith Smith Drive, discharges to Mill Stream via the Sydney Airport stormwater system. Mill Stream drains to Botany Bay, which is part of the Georges River catchment.

Both the Cooks River and Georges River catchments have been extensively developed meaning that the rainfall-runoff response of the catchments has been altered from a natural state. This has resulted in changes to the quantity and speed of runoff within the catchments.

Key watercourses and waterbodies in the study area are described in Table 14.1 and shown on Figure 14.1. Further information regarding the catchments and key waterbodies is provided in Chapter 16 (Surface water).

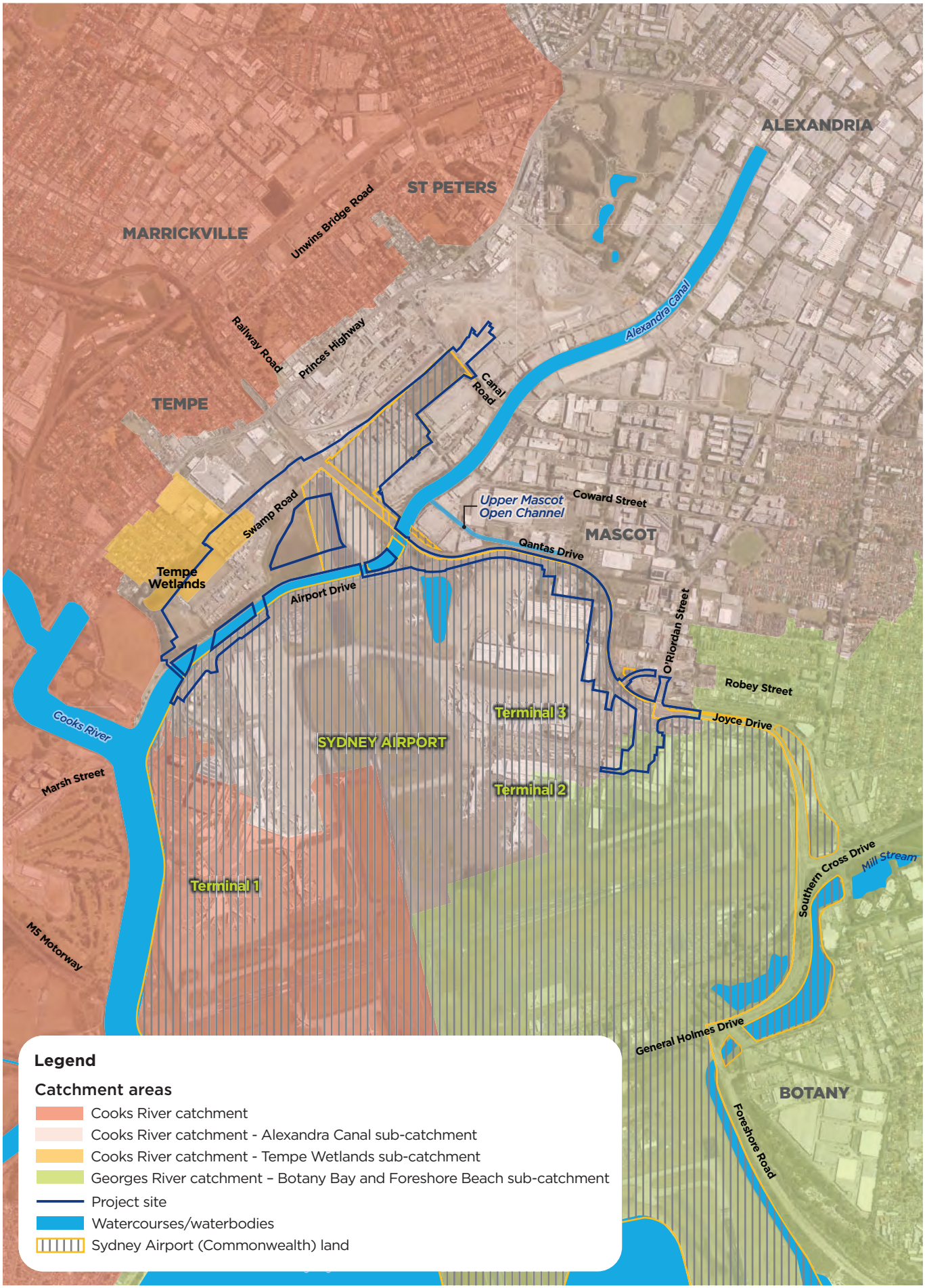

Figure 14.1 **Catchments and key waterbodies**

Table 14.1 Key watercourses and waterbodies within the study area

Waterbody	Description
Alexandra Canal	The majority of the project site is located within the Alexandra Canal catchment, which is a sub-catchment of the Cooks River catchment. Alexandra Canal is one of the main tributaries of the Cooks River and the main watercourse in the vicinity of the project site. The canal is a four kilometre long constructed watercourse that discharges to the Cooks River to the south-west of the project site near the Tempe Recreation Reserve. The canal is owned and operated by Sydney Water Corporation. The tidal influence from the Cooks River extends to the head of the canal.
Tempe Wetlands	The Tempe Wetlands forms part of the Cooks River catchment. It is an artificial wetland, located to the west of Alexandra Canal and adjacent to South Street in Tempe. The wetlands, which are about 2.8 hectares in area, provide temporary detention of flood waters. The project site crosses the Tempe Wetlands catchment to the east of the wetlands.
Mill Stream	A small portion of the project site is located within the Mill Stream catchment, which is a sub-catchment to the Georges River catchment. In the project site, the Mill Stream catchment covers an area of about 2.7 hectares and consists of sealed roads, commercial and re-vegetated land. Engine Pond and Mill Pond are located to the south-east of the project site and are fed by Mill Stream, which has its source in the Lachlan Swamps and further upstream in Eastlakes.

14.2.2 Existing flooding and drainage conditions

As noted above, the Cooks River and Georges River catchments are both highly urbanised and dominated by impervious surfaces. This means that these systems experience very low flows during dry periods and very high flows after storms, causing erosion and flooding in some areas. Key flooding information relevant to the project site is summarised below.

Alexandra Canal

Flooding along Alexandra Canal is mainly confined to the channel itself for floods up to the five per cent AEP event. However, during a one per cent AEP event, flooding tops the canal banks upstream of the Botany Rail Line, causing inundation of adjacent commercial and industrial development of depths exceeding one metre at several locations. This can result in hazardous flooding conditions to persons and property. Flooding also occurs downstream of the Botany Rail Line during the one per cent AEP event, discharging over Airport Drive and inundating Sydney Airport land at a depth typically less than 0.1 metre.

During a 10 per cent AEP event, inundation of a low point along Qantas Drive, located about 300 metres to the east of Alexandra Canal, can occur to a maximum depth of one metre. This can increase to 1.2 metres during a one per cent AEP event and 2.1 metres during a PMF event. Higher ground to the north and south of this low point make it susceptible to significant depths of inundation that would be hazardous to road users.

During a 10 per cent AEP event, inundation of a low point along Airport Drive discharges in an easterly direction into a trapped depression within Sydney Airport, where depths of inundation can occur to a maximum depth of 0.7 metres. This can increase to 1.1 metres during a one per cent AEP event and 1.5 metres during a PMF event.

A significant portion of the project site, which is located on Sydney Airport land between the Botany Rail Line and Canal Road, is affected by overland flow that discharges from the Cooks River Intermodal Terminal and the Botany Rail Line.

Tempe Wetlands

At the existing drainage system located on the Princes Highway, flooding travels overland along Station Street, Hart Street, Wentworth Street and Fanning Street in an easterly direction before discharging into Tempe Wetlands. During a one per cent AEP flood event, the depth of inundation along these streets can be up to 0.3 metres.

Mill Stream

Flooding that exceeds the capacity of the local drainage system at the southern end of Ninth Street in Sydney Airport can pond at its intersection with Shiers Avenue. During a one per cent AEP flood event, flooding can occur to a maximum depth of 0.4 metres. Depths of ponding in a PMF event can exceed 0.8 metres, which is sufficient to result in hazardous flooding conditions to persons or property.

The extent and depth of existing flooding for the one per cent AEP event and the PMF are shown on Figure 14.2 and Figure 14.3, respectively. Figure 14.3 shows Alexandra Canal, Tempe Wetlands, an area between the Cooks River Intermodal Terminal and north of the Botany Rail Line, and parts of Sydney Airport south of Airport Drive as being flood prone areas. Additionally, existing low points along sections of Airport Drive (about 900 metres long) and Qantas Drive (about 200 metres long) north of the Robey Street intersection are shown to be subject to substantial existing inundation.

Flood planning areas

A flood planning level is defined as a combination of flood levels derived from historical flood events or floods of specific AEPs (DIPNR, 2005). The flood planning level is defined in the *Rockdale Local Environmental Plan 2011* and the *Marrickville Development Control Plan 2011* as land located below the one per cent AEP flood level plus 0.5 metres. A flood planning area is the area of land below the flood planning level subject to flood planning controls.

Figure 14.4 shows the areas identified as being below the flood planning level within the project site. The figure indicates that the site is highly constrained in all directions by existing flooding conditions, including areas of flood prone land shown in Figure 14.3.

Hydraulic categorisation of areas

There are three categories of floodplain defined by the *Floodplain Development Manual* (DIPNR, 2005) as follows:

- Floodways – areas of a floodplain where a significant discharge of water occurs during floods, often aligned with obvious natural channels. These are areas that, even if only partially blocked, would cause a significant increase in flood levels and/or a significant redistribution of flood flow, which in turn may adversely affect other areas.
- Flood storage areas – areas of a floodplain that are important for the temporary storage of floodwaters during the passage of flood
- Flood fringe – areas of land affected by flooding, after floodway and flood storage areas have been defined. Development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels.

Figure 14.5 shows the preliminary hydraulic categorisation of the study area based on a one per cent AEP event. As shown in the figure, Alexandra Canal and the Cooks River are the main floodways within the study area. The Tempe Wetlands and an area of land between the Cooks River Intermodal Terminal and the Botany Rail Line comprise flood storage areas. A large part of Sydney Airport south of Airport Drive is identified as a flood fringe area.

Flood hazard areas

Floods create hazardous conditions to which humans are particularly vulnerable. Fast-flowing shallow water or slow-flowing deep water can unbalance people, sweep away vehicles and undermine buildings or other structures. The flood hazard within an area is determined from a combination of the depth and velocity of floodwaters. Figure 14.6 shows the provisional low and high flood hazard conditions within the study area, as outlined in the Floodplain Development Manual.

As shown in the figure, high flood hazard areas are located in Alexandra Canal, Cooks River, Tempe Wetlands and Sydney Airport northern ponds. Low hazard areas are located between the Cooks River Intermodal Terminal and north of the Botany Rail Line, parts of Sydney Airport land south of Airport Drive, and along sections of Airport Drive and Qantas Drive.

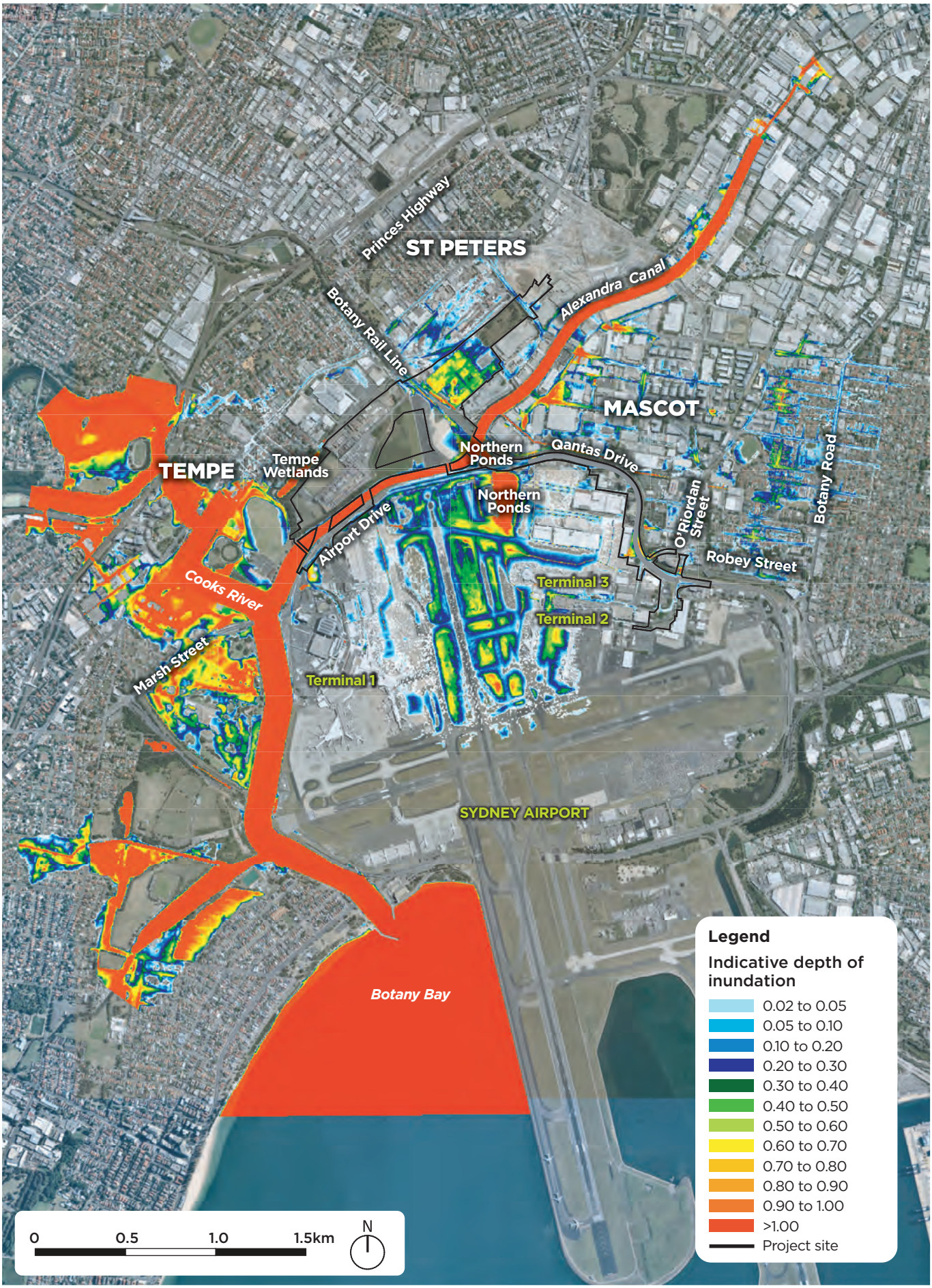

Figure 14.2 **Existing flood depth and extent – one per cent AEP event**

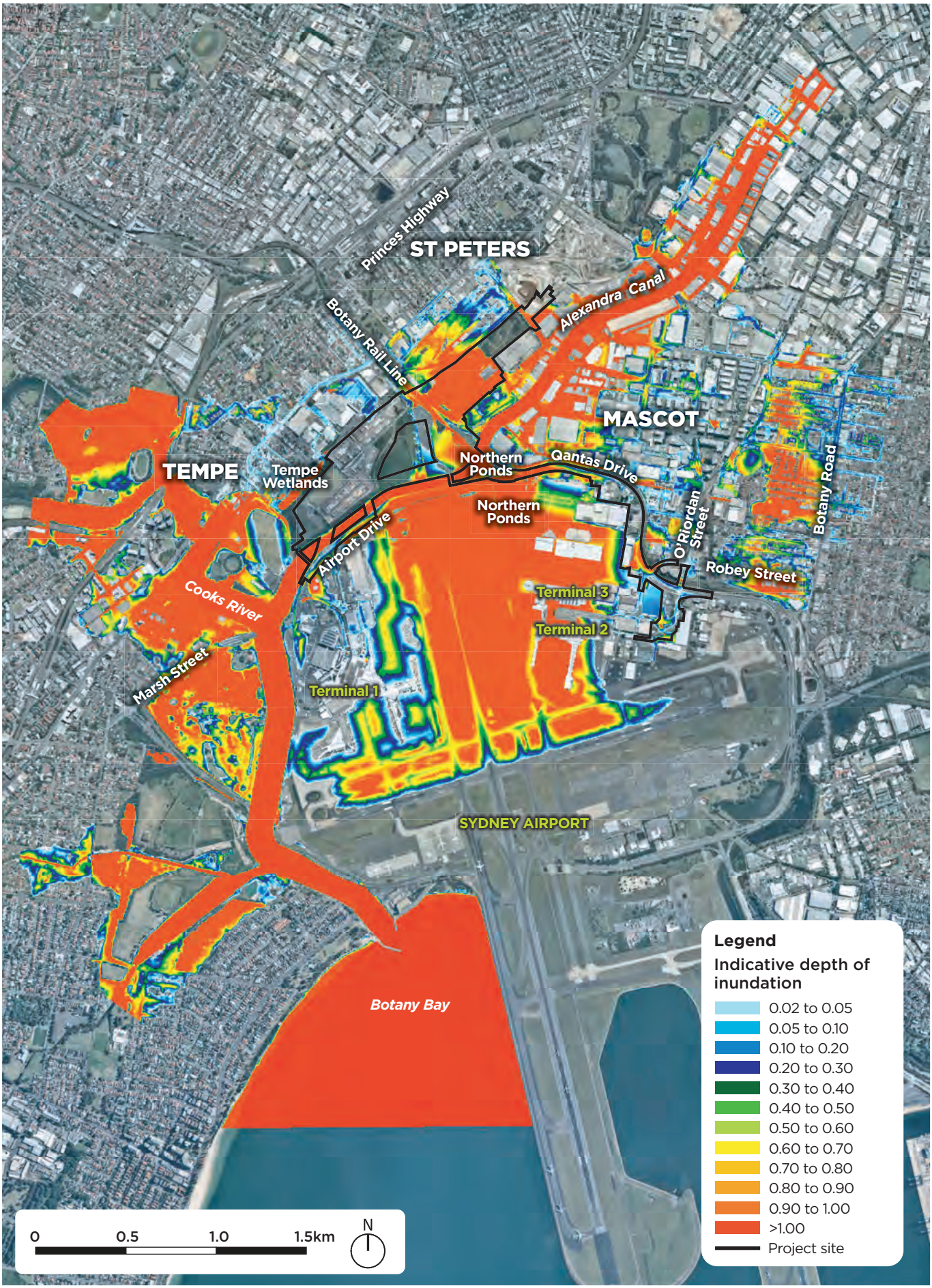

Figure 14.3 **Existing flood depth and extent – probable maximum flood event**

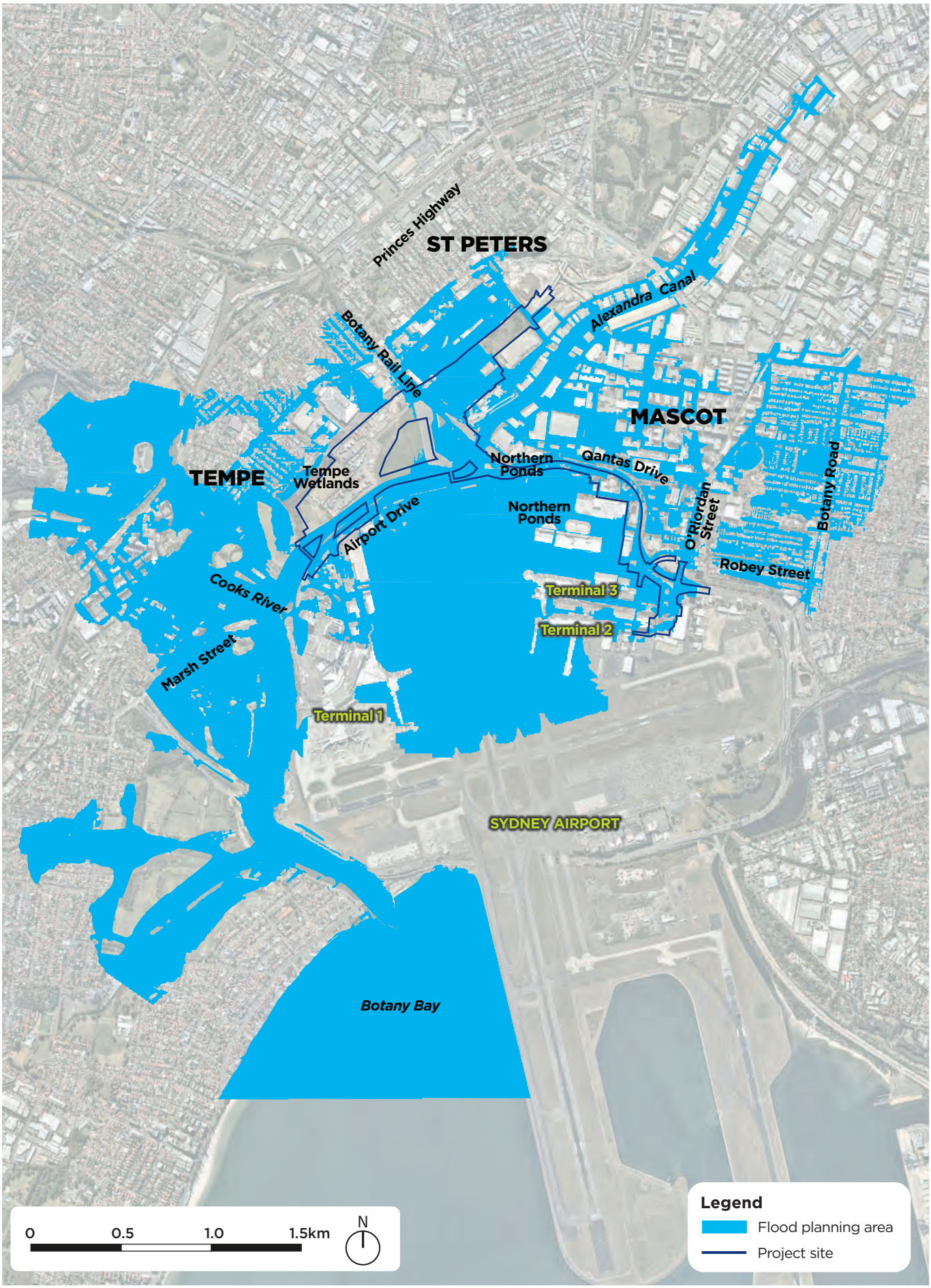

Figure 14.4 **Flood planning level for a one per cent AEP event plus 0.5 metres**

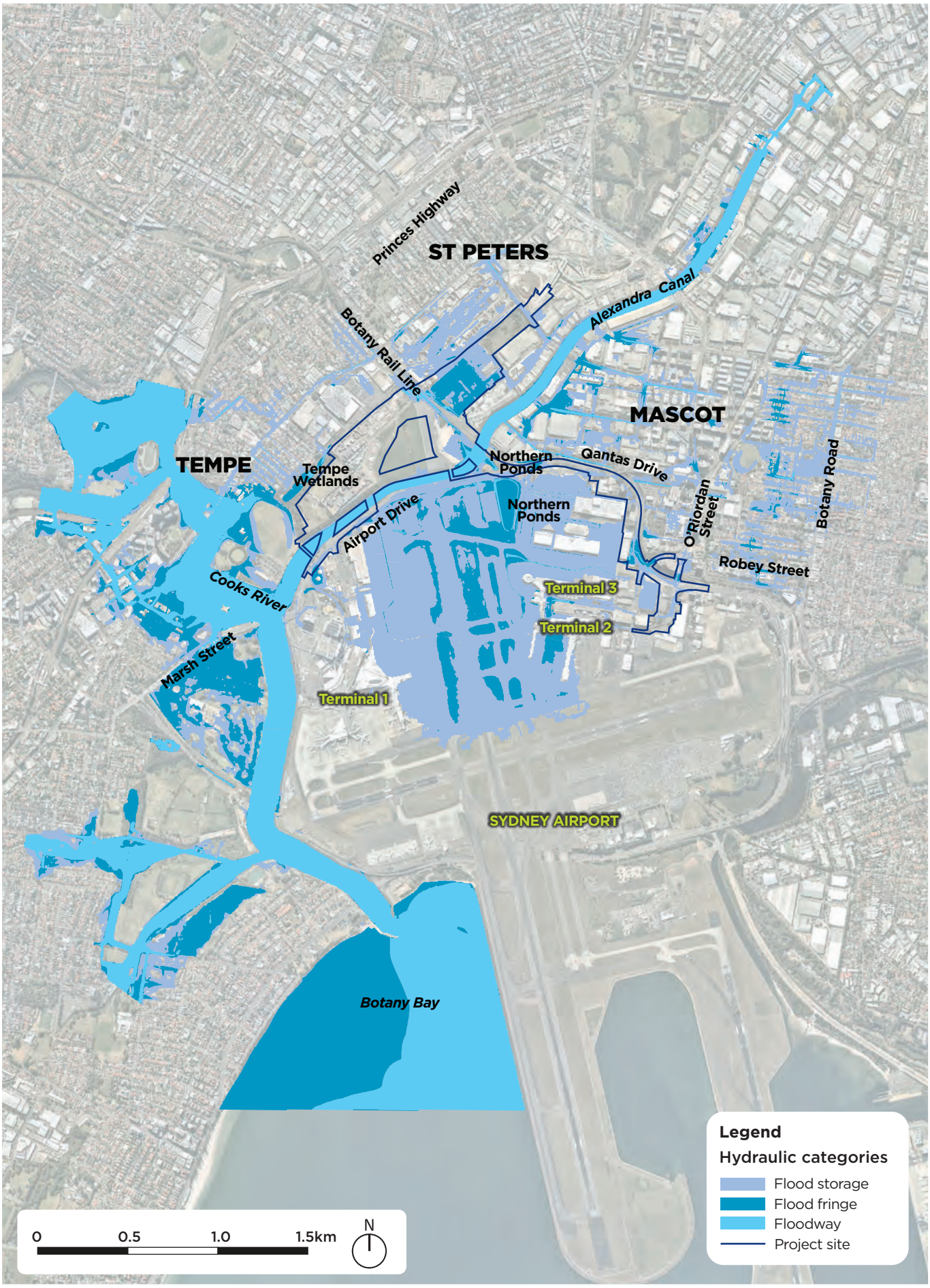

Figure 14.5 **Preliminary hydraulic categorisation of areas during a one per cent AEP event**

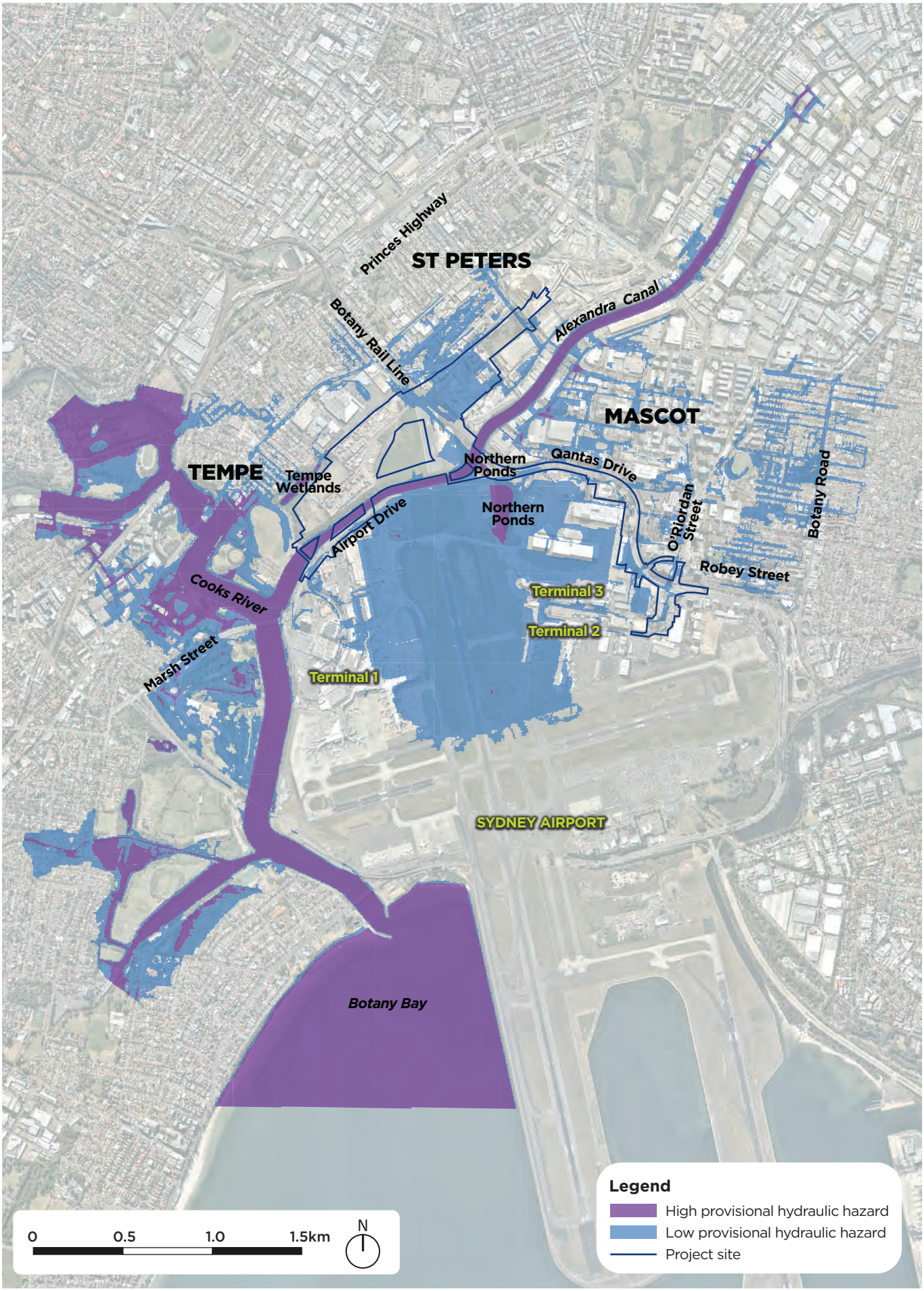

Figure 14.6 **Preliminary flood hazard areas during a one per cent AEP event**

14.2.3 Summary of the flooding characteristics of Sydney Airport (Commonwealth) land

The project site is mainly located within the lower reaches of the Cooks River catchment. Alexandra Canal, Tempe Wetlands and Mill Stream are the key waterbodies in the project site. A small portion of the project site, near the intersection of Sir Reginald Ansett Drive and Keith Smith Drive, drains to Mill Stream via the Sydney Airport stormwater system.

Sydney Airport land is affected by overland flow that discharges from the Cooks River Intermodal Terminal and the Botany Rail Line. A large part of Sydney Airport south of Airport Drive is identified as a flood fringe area. High flood hazard areas are located in the Sydney Airport northern ponds and low hazard areas are located in parts of Sydney Airport land south of Airport Drive, and along sections of Airport Drive and Qantas Drive.

14.3 Assessment of construction impacts

Construction compounds and activities have the potential to change overland flow patterns and exacerbate flooding by affecting areas of flood conveyance and storage, potentially changing levels of inundation upstream. The potential increase in water level upstream of structures, which can obstruct flow, is known as afflux.

14.3.1 Changes in flood affectation of property, assets and infrastructure

The key findings of the assessment for a one per cent AEP design event are summarised below and in Table 14.2. Figure 14.7 shows the potential change in flood inundation as a result of construction.

The assessment identified that while construction activities would involve works within existing flood affected areas, the greatest potential for adverse impacts on flood behaviour would be associated with works for the St Peters interchange connection and along Qantas Drive. This is due to a combination of existing flood behaviour in these locations as well as the proposed works occupying areas of flood storage and intercepting existing surface water flows. The modelling indicates that construction would result in an increase in flood inundation of up to 0.05 metres (50 millimetres) above existing flood inundation levels (between 0.3 to 0.8 metres depending on location). These increases in flood levels are minor.

While the findings of the assessment provide an indication of the potential impacts of construction on flood behaviour, further investigation is needed during detailed design and construction planning. This should adopt a merits-based approach, taking into account the relatively short duration of the works (about 3.5 years) in relation to the likelihood of a large infrequent storm event occurring.

Table 14.2 Summary of changes to peak flood levels during the one per cent AEP event

Work area/compound	Changes in peak flood levels and depths
St Peters interchange connection work area	
St Peters interchange connection compound WestConnex interface compound Other areas	Peak flood levels would increase by a maximum of 0.03 metres along Alexandra Canal north of the Botany Rail Line, leading to a minor increase in the depth of inundation at a number of commercial and industrial properties located along the canal's eastern and western banks and the Beaconsfield West Substation. Subject to further hydraulic assessment during detailed design, floor level surveys may be required to confirm whether construction would increase above-floor inundation and flood damages in affected properties.
Eastern bridges work area	
Eastern bridges compound Other areas	There would be an increase in the depth of inundation along the southern side of the Botany Rail Line by a maximum of 0.05 metres (above the existing depth of inundation of 0.4 metres).

Work area/compound	Changes in peak flood levels and depths
Western bridges work area	
Western bridge compound Freight terminal bridge compound Other areas	Construction is expected to have a negligible impact on existing flood behaviour in the immediate vicinity of this location.
Qantas Drive work area	
Qantas Drive compound Qantas Drive bridge compound Other areas	Peak flood levels would increase by a maximum of 0.02 metres along Alexandra Canal south of the Botany Rail Line. This is a minor change and the impacts would be mainly confined to the canal with the exception of: ■ An area along Airport Drive where the depth of inundation would increase by 0.02 metres (above the existing depth of inundation of 0.3 metres) ■ An area along the western bank of the canal on Sydney Airport land where the depth of inundation would increase by 0.02 metres (above the existing depth of inundation of 0.4 metres) ■ An area within Sydney Airport land to the south of Airport Drive where the depth of inundation would increase by 0.01 metres (above the existing depth of inundation of 0.5 metres).
Terminals 2/3 access work area	
Ninth Avenue compound	There would be a negligible impact on existing flood behaviour in the immediate vicinity of this location.
Airport Drive work area	
Terminal 1 connection bridge compound Other areas	There would be a minor increase in the depth of inundation within an area of Sydney Airport land to the south of Airport Drive where the depth of inundation would increase by a maximum of 0.01 metres (above the existing depth of inundation of 0.8 metres).

14.3.2 Consistency with council floodplain risk management plans

The policies, guidelines and flood planning documents used to guide the approach and methodology for the assessment are listed in section 14.1. This includes the *Mascot, Rosebery and Eastlakes Floodplain Risk Management Study & Plan* (RH DHV, 2017), which includes part of the Alexandra Canal catchment to the north of Qantas Drive. This study defines the hydraulic and hazard categorisation of the floodplain and sets out general, non-structural and location-specific structural measures that need to be undertaken to manage the flood risk associated with future development. The measures include:

- Developing emergency response measures and improved flood awareness
- Providing detention basins
- Upgrading stormwater drainage infrastructure.

Construction of the project would not prevent or compromise these measures. The project is therefore considered to be consistent with the *Mascot, Rosebery and Eastlakes Floodplain Risk Management Study & Plan*.

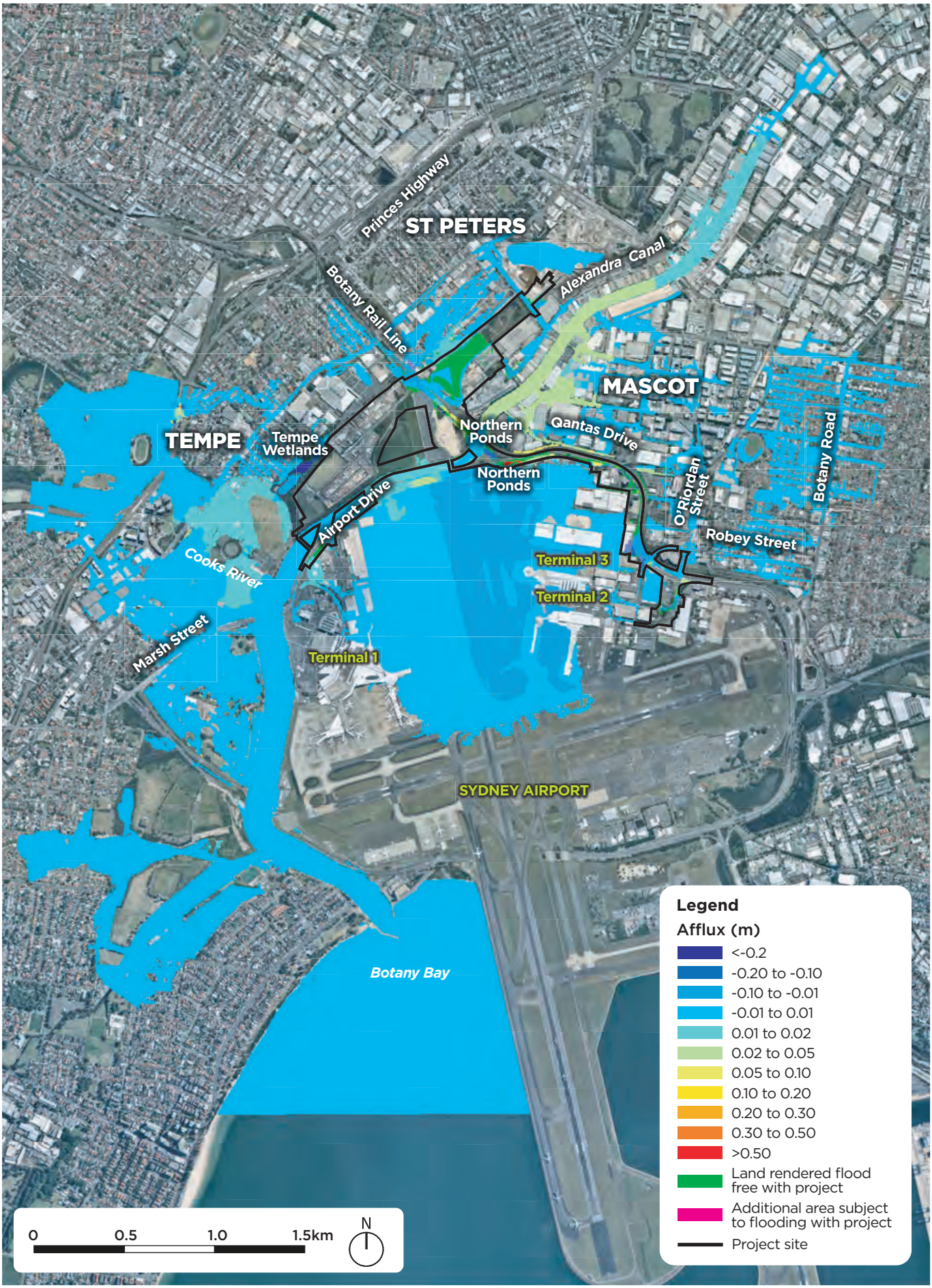

Figure 14.7 **Change in inundation as a result of construction during the one per cent AEP event**

14.3.3 Compatibility with the flood hazard of the land

Some construction activities, work sites, and compounds would be located in areas where there is an existing flood hazard. However, due to the generally small sizes of compounds and work sites relative to the size of the floodplain, there would be minimal impacts on flood hazard. The layout of construction compounds and work sites would be developed with consideration of overland flow paths and would avoid flood-liable land, where practicable. All five construction compound areas, described in Chapter 8 (Construction), include land located outside areas of high hazard during a one per cent AEP event, which would be suitable for site facilities. The location of compounds and work sites would be reviewed during construction planning to avoid high hazard areas.

As construction is not expected to have a significant impact on the preliminary hazard categorisation of the floodplain the project is therefore considered to be compatible with the flood hazard of the land.

14.3.4 Compatibility with the hydraulic functions of the land

Obstruction of flow paths and floodways due to the presence of construction works and equipment has the potential to redistribute flood flows, impact downstream properties, and/or mobilise construction equipment or debris. This may result in downstream safety or water quality impacts.

No construction compounds would be located within identified floodways.

Part of compound C1 north of the Botany Rail Line overlaps with an area identified as flood storage, however the area is small in relation to the total flood storage area identified on Figure 14.5. Smaller areas of compounds C2 and C4 are also located in areas identified as flood storage.

Where compounds are located within or partially within flood-liable land, a detailed review of the proposed location and layout, including siting of buildings and plant, would be undertaken by the appointed construction contractor(s). However, given their relatively small size relative to the overall floodplain area, minimal impacts are expected. Construction of the project is therefore considered to be compatible with the existing hydraulic functions of the land.

14.3.5 Effects on beneficial inundation of the floodplain

Due to the urbanised nature of the floodplain, there are no areas where beneficial inundation currently occurs that would be affected by the project.

14.3.6 Redirection of flow, changes to flow velocity and scour potential

There is the potential for temporary drainage works to impact overland flow paths. This could divert or concentrate flows, potentially resulting in scouring of downstream areas, particularly where soil has been exposed during construction.

Soil and water management measures would be implemented in accordance with the Blue Book to minimise potential impacts resulting from runoff and flooding during construction.

All temporary works associated with construction of the bridges crossing Alexandra Canal would be located outside the canal to avoid potential impacts on flow conveyance in the canal, changes to velocity and the potential for scour. However, there is the potential for localised increases in scour potential as a result of the construction of new and upgraded drainage outlets within the canal. This is considered in Chapter 16 (Surface water).

Based on the construction activities and compounds assessed, no appreciable changes in flow velocities (or scour potential) would occur.

14.3.7 Impacts on existing emergency management arrangements

A number of roads within and surrounding the project site are subject to flooding under existing conditions (described in section 14.2.2). The *Marrickville Local Flood Plan* (SES, 2015) provides a plan for emergency

response to flooding within the former Marrickville local government area (now part of the Inner West local government area), including within the catchments of the Cooks River, Alexandra Canal and Mill Stream. The plan sets out preparedness measures, the process for carrying out response operations and coordination of immediate recovery measures from flooding.

With the implementation of mitigation measures provided in section 14.6, no impacts on existing emergency management arrangements are expected during construction. Inner West Council was consulted during the assessment regarding the results. A letter was also sent to NSW State Emergency Services outlining the key findings. Ongoing liaison would be undertaken with relevant stakeholders during detailed design and the construction period.

14.3.8 Social and economic costs

Although there would be temporary changes during construction, including establishment of site compounds and various construction works, as outlined in section 14.3.1, there is not expected to be a material change in flooding behaviour compared with existing conditions. Given the relatively short duration of construction and the small likelihood of a major rainfall event occurring within this period, no social or economic costs to the community are expected as a result of potential flooding impacts.

14.3.9 Summary of impacts on Sydney Airport (Commonwealth) land

Potential impacts on flood behaviour during construction on Sydney Airport land are described in Table 14.3 and would include a minor increase in inundation levels of between 0.01 and 0.05 metres during a one per cent AEP event.

Table 14.3 Summary of changes to peak flood levels during a one per cent AEP event – Sydney Airport land

Work area/compound	Potential impact of construction on flood behaviour on Sydney Airport land
St Peters interchange connection and Qantas Drive work area	
St Peters interchange connection compound Qantas Drive compound Qantas Drive bridge compound Other areas	Peak flood levels would increase in the following areas: ▪ An area along Airport Drive where the depth of inundation would increase by 0.02 metres (above the existing depth of 0.3 metres) ▪ An area along the western bank of Alexandra Canal where the depth of inundation would increase by 0.02 metres (above the existing depth of 0.4 metres) ▪ An area to the south of Airport Drive where the depth of inundation would increase by 0.01 metres (above the existing depth of 0.5 metres). The above impacts are considered to be minor in terms of the relative increase in the depth of inundation.
Eastern bridges work area	
Eastern bridges compound Other areas	Peak flood levels would increase the depth of inundation along the southern side of the Botany Rail Line by a maximum of 0.05 metres (above the existing depth of inundation of 0.4 metres).
Terminals 2/3 work area	
Ninth Avenue compound Other areas	Construction is expected to have a negligible impact on existing flood behaviour in the immediate vicinity of this work area.

14.4 Assessment of operation impacts

14.4.1 Changes in flood affectation of property, assets and infrastructure

The key findings of the assessment of the potential impacts during a one per cent AEP design event, incorporating the proposed drainage upgrades and flood mitigation basin, are summarised below and in Table 14.4. Figure 14.8 and Figure 14.9 show the predicated changes in flood inundation during a one per cent AEP event and PMF event, respectively.

The assessment determined that once constructed, the project would have only a minor impact on flood behaviour for floods up to a PMF (see Figure 14.9), with the exception of the following impacts within Sydney Airport land:

- One per cent AEP flood levels in an area of Sydney Airport to the existing low point on Qantas Drive would increase by a maximum of 0.03 metres over an area that includes several plant and commercial buildings and other infrastructure
- During a PMF, the depth of inundation in an area immediately adjacent to the southern approach ramp of the Terminal 1 connection bridge would increase by a maximum of 0.32 metres, with impacts extending east to the freight terminal bridge. Under pre-project conditions, the depth of inundation in the affected area is typically between 0.4 and 1.5 metres.

Where the assessment has identified the potential for an increase in existing flood levels, further assessment is proposed, as described in section 14.6. The project would not have a significant impact on the future development potential of land located outside the project site.

Table 14.4 Summary of changes to peak flood levels during operation one per cent AEP and PMF – entire project

Catchment	Changes in peak flood levels and depths
Alexandra Canal	
St Peters interchange connection Terminal 1 connection Qantas Drive upgrade and extension Terminals 2/3 access Terminal links Northern lands access Active transport facilities	Flooding in Alexandra Canal: ■ During a one per cent AEP event, there would be a localised increase in peak flood levels in Alexandra Canal in the vicinity of the Botany Rail Line by a maximum of 0.04 metres. These impacts are confined to the canal and would not affect adjoining properties. Along other areas of the canal, the increase in peak flood levels would be negligible (ie 0.01 metres or less). ■ There would either be no change or a slight reduction in PMF levels along the Alexandra Canal to the south of the Botany Rail Line, while PMF levels north of the rail line would increase by up to 0.06 metres. There would be no significant increase in the extent of inundation during a PMF event. Flood behaviour in the vicinity of Qantas Drive including Sydney Airport land to the south-east: ■ Peak one per cent AEP flood levels in an area of Sydney Airport land adjacent to Qantas Drive would increase by a maximum of 0.03 metres over an area that includes several buildings and other structures. Similar increases in peak flood levels would also occur during the two per cent, five per cent and 10 per cent AEP events. ■ A negligible increase in the depth of inundation (by 0.01 metres) in the car park located within Sydney Airport land to the west of Lancastrian Road. ■ The upgrade of the drainage system along Qantas Drive between Lancastrian Road and Robey Street would generally result in a reduction in overland flow and therefore the depth of inundation in the area of Sydney Airport land immediately to the west. Flood behaviour in the vicinity of Airport Drive including the portion of Sydney Airport land to the south-west: ■ During a one per cent AEP, the depth of inundation at the trapped depression to the north of Arrivals Court would increase by 0.03 metres above existing depth of 0.6 metres, and there would be a minor increase in the extent of inundation.

Catchment	Changes in peak flood levels and depths
	■ There would be a slight reduction in peak flood levels within the northern pond closest to Alexandra Canal. ■ During a PMF, the depth of inundation in an area of Sydney Airport immediately adjacent to the southern approach ramp of the Terminal 1 connection bridge would increase by a maximum of 0.32 metres, with impacts extending east to the freight terminal bridge. The existing depth of inundation is typically between 0.4 and 1.5 metres. ■ There would be a slight reduction in peak flood levels within the northern pond closest to Alexandra Canal during a two per cent and one per cent AEP event. There would be no change in peak flood levels within the pond during flood events between the 50 per cent and five per cent AEPs. PMF levels would increase by a maximum of 0.04 metres. Flood behaviour along the western bank of Alexandra Canal between the Botany Rail Line and Canal Road: ■ There would be a minor change in the depth of inundation within the Cooks River Intermodal Terminal for all events up to 0.25 per cent AEP. During a PMF, depths of inundation in the Cooks River Intermodal Terminal would increase by a maximum of 0.08 metres (on existing depths of between 0.6 and 1.2 metres). ■ During a one per cent AEP event there would be an increase in the depth of inundation along the northern side of the Botany Rail Line by a maximum of 0.02 metres (on an existing depth of 0.4 metres).
Tempe Wetlands	
Terminal 1 connection	There would be a slight reduction in peak flood levels in the Tempe Wetlands for all events up to the PMF.
Mill Stream	
Terminals 2/3 access	For all events up to one per cent AEP, there would be minor changes in the depth of inundation in the vicinity of the Terminals 2/3 access. During a PMF, the depth of inundation in areas to the north and south of the Terminals 2/3 access would be increased by a maximum of 0.6 metres but typically 0.03 metres or less. Impacts would be confined to an area of road and the carpark within Terminals 2/3. There would be no impacts to critical infrastructure or a significant increase in flood hazard.

The assessment of flow velocities and duration of inundation found that within the Alexandra Creek catchment area, changes in velocities are estimated to be generally less than 0.1 to 0.2 metres per second. This is anticipated at all locations during the one per cent AEP event as a result of the project. This is considered a minor impact to the existing flood hazard. There would also be relatively minor changes in the duration of inundation.

There is the potential for an increase in scour potential in Alexandra Canal as a result of the proposed upgrade of the drainage system and an increase in peak flows discharging into the canal. Appropriate methods of scour protection at identified locations would be identified during detailed design.

Given the small scale of works within the Mill Stream catchment, the project would result in a negligible to minor increase in peak flow velocities and the duration of inundation in this area.

Effects of climate change

The effects of climate change and project impacts on existing flood behaviour was assessed during a 0.5 per cent (lower climate change scenario) and a 0.2 per cent (upper climate change scenario) AEP event. These events were adopted as substitutes for assessing the sensitivity to an increase in rainfall intensity of the one per cent AEP event due to climate change.

Based on the climate change assessment guidelines listed in section 14.1, the assessment indicated that results would be similar to the one per cent AEP scenario and there would be relatively minor increases in flood impacts under both the lower and upper climate change scenarios.

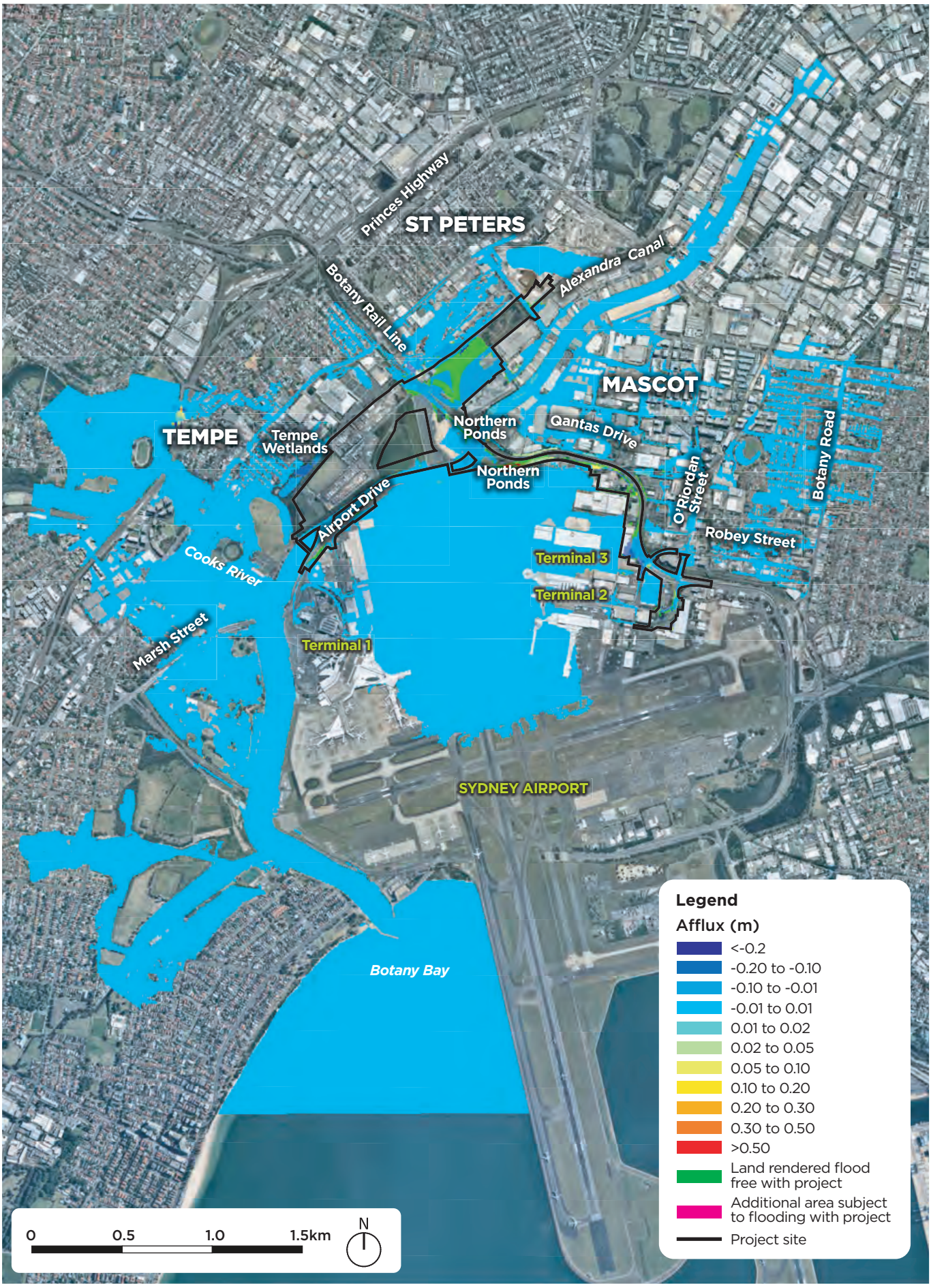

Figure 14.8 **Change in inundation due to the project during a one per cent AEP flood event**

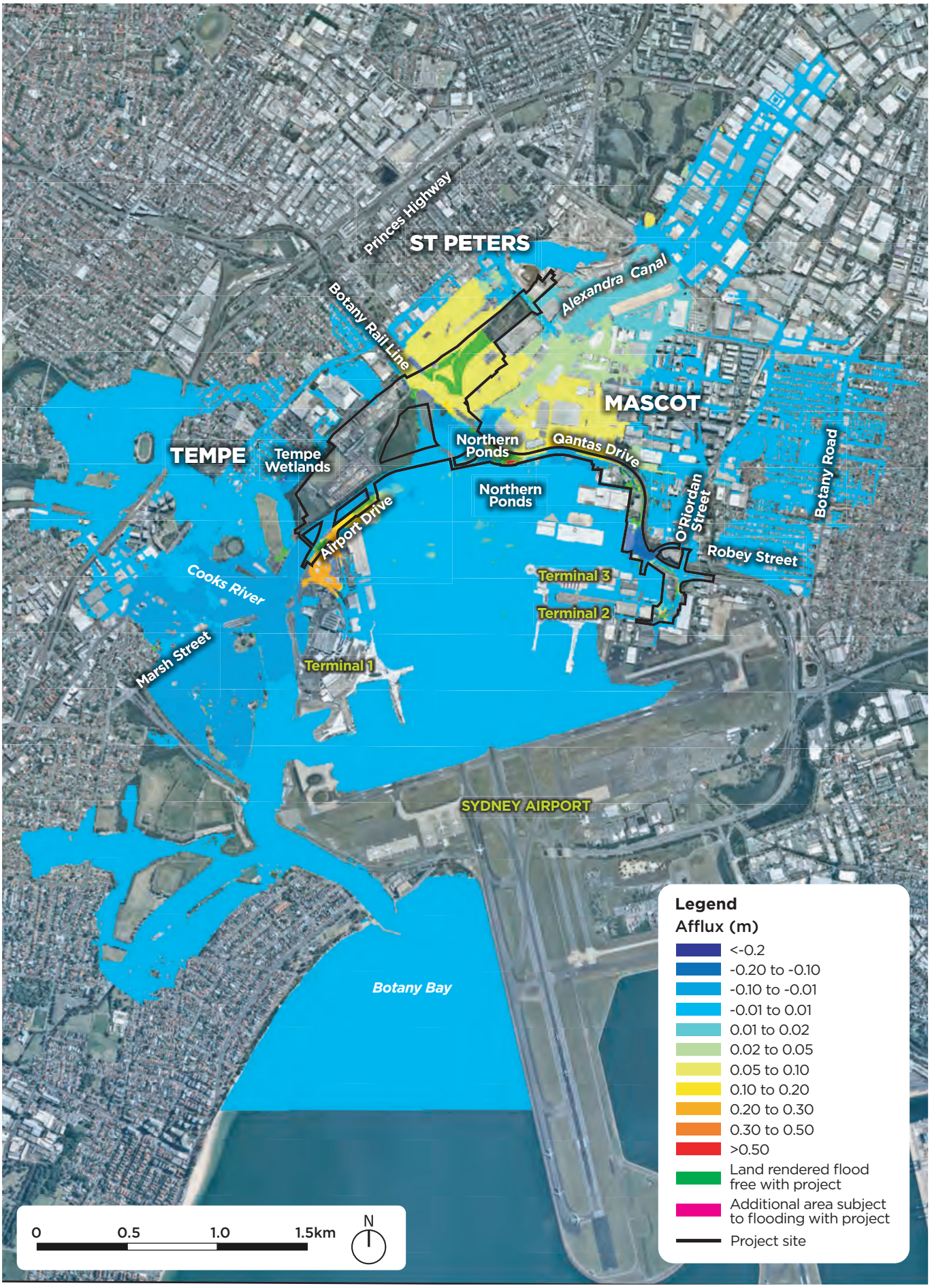

Figure 14.9 **Change in inundation due to the project during a probable maximum flood**

Active transport link bridge

The proposed active transport link includes a new bridge across Alexandra Canal to the west of the Botany Rail Line. The proposed link would depart from the western side of the canal to the east of the Nigel Love Bridge, crossing under the proposed Qantas Drive bridge, landing on the eastern side of the canal to the north of the outlet from Sydney Airport's northern ponds. The proposed link is located in a critical area of the canal where overbank flooding and discharges from the northern ponds occurs during events less frequent than the one per cent AEP.

The bridge would be designed to be 0.5 metres above the one per cent AEP flood level in the canal with the intent to also be above the PMF if possible. A key constraint is the minimum clearance required to the underside of the Qantas Drive extension bridge and the overall height of the bridge structure.

The landing points and approach ramps of the bridge would need to be carefully designed to minimise any influence on overbank flows, with particular regard to discharges from Sydney Airport's northern ponds. Modelling to confirm the extent of any potential changes to predicted flood impacts would be provided at a later project stage.

14.4.2 Consistency with council floodplain risk management plans

As described in section 14.3.1, the project would generally result in minor changes in existing flood extent and depth. Therefore, the project is considered to be compatible with the local floodplain risk management plans described in section 14.3.2. Where the assessment identifies the potential for an increase in existing flood levels and extent (see Table 14.2 and Table 14.4), further assessment is proposed in conjunction with design refinement (see section 14.6). This would take into consideration the consistency with council floodplain risk management plans, where relevant.

14.4.3 Compatibility with the flood hazard of the land

The flood modelling indicates that the project would not materially change the existing flooding behaviour or the depth and velocities of floodwaters. As such, the project is considered compatible with the flood hazard of the land.

14.4.4 Compatibility with the hydraulic functions of the land

The project would result in changes to the flood behaviour of local surface water systems in specific locations. However, the implementation of proposed drainage or mitigation measures would result in no significant changes to the major floodways or floodplain storage areas. The project is considered compatible with the existing hydraulic functions of the land.

14.4.5 Effects on beneficial inundation of the floodplain

Due to the urbanised nature of the floodplain, there are no areas where beneficial inundation currently occurs that would be affected by the project.

14.4.6 Redirection of flow, changes to velocity and scour potential

As described in section 14.4.1, changes in peak flow velocities due to the project are estimated to be generally less than 0.2 metres per second within the Alexandra Canal catchment, while minor changes in flow velocities are predicted within the Tempe Wetlands.

The changes in peak flow velocities in Alexandra Canal during a one per cent AEP event would have the potential to cause bed erosion and bank instability. As the increase is minor, the potential impact is considered to be minor. There is also the potential for localised increases in scour potential due to the predicted increase in peak flows discharging into the canal from new and upgraded drainage outlets. Chapter 16 (Surface water) describes the potential impact of the project on scour potential in Alexandra Canal and provides mitigation measures to reduce the mobilisation of bed sediments in the canal.

Given the nature of proposed works within the Mill Stream sub-catchment, the project would not impact on peak flows and velocities in Mill Stream.

14.4.7 Impacts on existing emergency management arrangements

The project would have a relatively minor impact on flood behaviour for all events up to the PMF. As a result, there are not expected to be any impacts on existing emergency management arrangements across the majority of the project site.

Within Sydney Airport to the north of Arrivals Circuit, there is the potential for the project to result in localised flood level increases during the PMF of up to 0.32 metres. However, the proposed freight terminal bridge would provide an emergency access from the impacted area to land that is located above the PMF flood level. As a result, no adverse impacts of the project on existing emergency management arrangements are expected.

Consultation has been conducted with Inner West Council during the development of the technical study regarding the results. A letter was also sent to the NSW State Emergency Services outlining the key findings. Ongoing liaison would be undertaken with relevant stakeholders during detailed design.

14.4.8 Social and economic costs

Section 14.4.1 indicates that the project has the potential to result in minor increases in flood inundation based on the concept design. However, the characteristics of the study area are such that even minor increases in flooding could result in impacts on adjacent properties.

During detailed design, a floor level survey would be undertaken for properties where there is a potential for increases in peak flood levels for events up to one per cent AEP. This would confirm the extent to which the project may increase above-floor inundation and flood damage, and therefore the scope of mitigation that may be required. At this preliminary stage, the number of buildings within Sydney Airport that may be affected is estimated to be around five or six. A key objective of detailed design would be to reduce this potential impact as far as reasonably practicable.

14.4.9 Summary of impacts on Sydney Airport (Commonwealth) land

Potential impacts on flood behaviour during operation on Sydney Airport land are summarised in Table 14.5.

The preliminary assessment has demonstrated that the project is unlikely to increase the extent, duration or magnitude of flooding such that there would be a significant impact on Sydney Airport land. The potential adverse impacts of flooding during operation would be minimised by implementing the mitigation measures provided in section 14.6.

Table 14.5 Summary of project impacts on flood behaviour – Sydney Airport land

Flood characteristic	Summary of impact on Sydney Airport land
Peak flood levels and depths	■ Peak one per cent AEP flood levels in an area adjacent to the existing low point in Qantas Drive that includes several buildings and other structures, located about 300 metres to the east of Alexandra Canal, would increase by a maximum of 0.03 metres over an area. ■ For all events up to one per cent AEP, there would be minor changes in the depth of inundation in the vicinity of the Terminal 1 and freight terminal connections. ■ During a PMF, the depth of inundation in an area adjacent to the southern approach ramp of the Terminal 1 connection bridge would increase by a maximum of 0.32 metres, with impacts extending east to the freight terminal bridge. The existing depth of inundation in the affected area is typically between 0.4 and 1.5 metres. ■ For all events up to one per cent AEP, there would be a slight reduction in the depth of inundation in an area to the south-east of the St Peters interchange connection. During a PMF, the depth of inundation would increase by a maximum of 0.08 metres (on existing depths of more than one metre). ■ For all events up to one per cent AEP, there would be minor changes in the depth of inundation in the vicinity of the Terminals 2/3 access. During a PMF, the depth of inundation in areas to the north and south of the Terminals 2/3 access would increase by a maximum of 0.06 metres (but typically 0.03 metres or less). Impacts would be confined to areas of road and car park within Terminals 2/3.
Peak flows and velocities	■ In areas to the south of the existing low points on Qantas Drive, peak one per cent AEP flow velocities would increase by between 0.1 and 0.2 metres per second above existing velocities of 0.5 metres per second. Potential impacts would be confined to an existing access road and car park where the scour potential would be low. The change in velocity would have a minor impact on the existing flood hazard. ■ Changes in peak one per cent AEP flow velocities in the vicinity of the Terminals 2/3 connection would be confined to the new section of road where peak flow velocities would be less than one metre per second.
Extent and duration of inundation	■ During a one per cent AEP event, there would be a reduction in the extent of inundation within an area to the south of Qantas Drive between Lancastrian Road and Robey Street. Across the remainder of the Alexandra Canal catchment, there would be relatively minor changes in the extent of inundation for all events up to the PMF. ■ There would be minor changes in the duration of inundation within the grassed areas in the vicinity of the runways and taxiways during a 20 per cent AEP event.

Consistency with the Sydney Airport Master Plan

Sections 12.1 and 14.6.5 of the *Sydney Airport Master Plan 2039* (SACL, 2019a) (the Master Plan) refer to the requirement for flood modelling of new developments, and the achievement of minimum flood immunity criteria or other mitigation approaches, to ensure on and off-site impacts are minimised. These sections also require that the effects of climate change on the performance of the stormwater drainage network are considered and the feasibility of implementing infrastructure works to mitigate issues are assessed.

The assessment described in sections 14.3 and 14.4 outlines the results of flood modelling and identifies that overall, the project would have only a minor impact on the functionality of the existing stormwater drainage systems and flood behaviour in Sydney Airport for floods up to the PMF.

The following residual flood impacts have been identified on existing infrastructure within Sydney Airport:

- Peak one per cent AEP flood levels in an area of Sydney Airport adjacent to the existing low point on Qantas Drive would be increased by a maximum of 0.03 metres over an area that includes several buildings and other structures. Similar increases in peak flood levels would also occur during storms with AEPs of two per cent, five per cent and 10 per cent.
- During a PMF, the depth of inundation in an area immediately adjacent to the southern approach ramp of the Terminal 1 connection bridge would increase by a maximum of 0.32 metres, with impacts extending east to the freight terminal bridge. The existing depth of inundation in the affected area is typically between 0.4 and 1.5 metres

The proposed works at Airport Drive and Qantas Drive would, as a minimum, maintain the level of flood immunity of the existing sections of road while in other locations, the flood immunity would be substantially improved.

An assessment of the impact that climate change could have on the project was completed. This showed relatively minor increases in flood impacts as a result of the project under both the lower and upper bound climate change assessment scenarios. A coordinated approach with Sydney Airport would be adopted to manage the impact of climate change on flooding for the new and upgraded sections of road.

14.5 Cumulative impacts

This section presents an assessment of the potential impacts on flood behaviour in combination with the following major projects approved or currently under construction in the vicinity of the project site:

- Botany Rail Duplication
- New M5
- M4-M5 Link.

The cumulative assessment focussed on impacts during operation, given the relatively short-term nature of exposure to potential flood impacts during construction, together with the general requirement to manage adverse impacts to within acceptable levels on existing development.

Botany Rail Duplication

The proposed Botany Rail Duplication project may impact on the rate of flow discharging to the drainage system across Qantas Drive and through Sydney Airport to the north of Seventh Street.

The Botany Rail Duplication project would also involve works in the Alexandra Canal floodplain. This, in combination with the project, has the potential for cumulative impacts on flood behaviour.

Given the minor nature of flood impacts associated with the Sydney Gateway road project in this area, it is expected that the potential cumulative impacts with the Botany Rail Duplication project would also be minor in nature. If required, these could be managed through appropriate measures to control an increase in the rate of runoff from the future project.

New M5

Flood modelling undertaken during detailed design for the New M5 project, shows that it would have a negligible impact on peak one per cent AEP flood levels along the full length of Alexandra Canal. It would also result in localised increases in peak one per cent AEP flood levels by a maximum of 0.05 metres in the overbank areas of the canal adjacent to the bridge crossings.

The change in peak one per cent AEP flood levels in these areas during operation of the Sydney Gateway road project would be negligible along the section of Alexandra Canal upstream of a location about 50 metres north of the Botany Rail Line. As a result, cumulative impacts with the New M5 project on flood behaviour are considered to be negligible.

M4-M5 Link

There would be no cumulative impacts on flood behaviour as the M4-M5 Link is located in different catchments which are remote from the project.

14.6 Management of impacts

14.6.1 Approach

Approach to mitigation and management

The assessment of flooding impacts has been conducted with reference to the methodology outlined in the Floodplain Development Manual and the other guidance documents outlined in section 14.1. This includes a preliminary assessment to identify the impacts the project would have on existing flood behaviour and to develop a range of potential measures aimed at mitigating its impact on the environment.

The project has been designed, as far as practicable, to minimise the impact of flooding on adjacent property and assets while also providing an appropriate flood immunity for the project. Where reasonable and feasible, the identified flooding impacts would be further reduced during detailed design.

Approach to managing the key potential impacts identified

Potential flooding impacts during construction and operation would be managed in accordance with a flood mitigation strategy. The flood mitigation strategy would build on the preliminary flood assessment and would be based on further design development and flood modelling undertaken during the detailed design stage. It would also include:

- Identifying flood risks to the project, including consideration of local drainage characteristics and the potential impacts of climate change and a partial blockage of watercourse structures on flood behaviour
- Identifying potential flood impacts on the existing environment and future development potential of land, including a floor level survey to confirm whether there would be above-floor inundation to affected residential, commercial or industrial buildings
- Identifying design changes and other mitigation measures to manage the risk of flooding and to not worsen existing flooding characteristics during construction and operation
- Preparing a flood emergency management plan defining measures to be implemented during construction to prepare for a flood, as well as procedures that will be implemented during a flood.

The flood mitigation strategy would be prepared in consultation with Sydney Airport Corporation, Sydney Water, ARTC, NSW State Emergency Services and relevant councils.

Approach to managing other impacts

Potential flooding impacts during construction would also be managed in accordance with the Construction Soils and Water Management Plan, which would be developed as part of the CEMP (see Chapter 27 (Approach to environmental management and mitigation)).

The Construction Soils and Water Management Plan would describe the erosion and sediment control measures to be developed and implemented during construction to minimise sediment disturbance, mobilisation and runoff. Soil and water management measures would be developed and implemented in accordance with the Blue Book.

Project-specific management measures have been developed with the aim of minimising or mitigating, where practicable, the impacts described in sections 14.3 and 14.4. These are provided in section 14.6.2.

Expected effectiveness

Roads and Maritime has experience in managing potential flooding impacts as a result of road developments of similar scale and scope to this project. In particular, these issues are also currently being addressed as part of the F6 Extension and New M5 projects.

The potential impacts on flooding as a result of the project have been modelled. The proposed management strategy is expected to be effective at mitigating the potential flooding impacts. Where

potential flooding impacts were identified, the design of the project would be further refined to minimise these impacts, where possible. Preparing and implementing a Flood Mitigation Strategy would ensure that the appropriate flood standards are set, and that the impacts of the project, including contribution from climate change, are effectively managed.

Construction of the project may result in minor and temporary impacts that would be managed through the implementation of standard construction techniques and protection measures.

Auditing and reporting on the effectiveness of environmental management measures employed during construction is generally carried out to show compliance with management plans and other relevant approvals, and would be outlined in detail in the CEMP.

14.6.2 List of mitigation measures

Measures that will be implemented to address potential impacts on flooding are listed in Table 14.6.

Table 14.6 Flooding mitigation measures

Impact/issue	Ref	Mitigation measure	Timing
Management of the potential for flooding impacts during construction	HF1	A flood mitigation strategy will be prepared and relevant measures will be implemented as part of the design and during construction. The strategy will include undertaking additional flood modelling taking into account detailed design and proposed construction planning and methodologies.	Detailed design, construction
Impacts on flood behaviour from construction	HF2	Hydrologic and hydraulic assessments will be carried out for all temporary and permanent project components (including ancillary facilities) that have the potential to affect flood levels in the vicinity of the project. The results of the assessment will inform the preparation of the flood mitigation strategy (measure HF1) as well as the design of temporary construction facilities and design development.	Detailed design/ pre- construction
Impacts on property	HF3	Where flood levels in the one per cent AEP event are predicted to increase at any residential, commercial and/or industrial buildings as a result of construction or operation of the project, a floor level survey will be carried out. If the survey indicates existing buildings would experience above floor inundation during a one per cent AEP event, further refinements will be made (as required) to the design of temporary and permanent project components to minimise the potential for impacts.	Detailed design
Impacts on drainage systems	HF4	Further modelling will be undertaken based on the detailed design to determine the ability of the receiving drainage systems to effectively convey drainage discharges from the project once operational. The modelling will be undertaken in consultation with Sydney Airport Corporation and relevant council(s). It will include, but not be limited to: ▪ Confirming the location, size and capacity of all receiving drainage systems affected by operation ▪ 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.	Detailed design

Impact/issue	Ref	Mitigation measure	Timing
Potential impacts of climate change on flooding	HF5	The potential impacts of climate change on flooding behaviour will be considered during further modelling, in accordance with the procedures set out in *Floodplain Risk Management Guideline: Practical Considerations of Climate Change* (DECC, 2007) and *Australian Rainfall and Runoff* (Geoscience Australia, 2019). An approach to integrating the identified effects into the design and operation of the infrastructure will be determined and implemented.	Detailed design
Potential flood impacts on ancillary construction facilities	HF6	As a minimum, site facilities will be located outside high flood hazard areas based on a one per cent AEP flood. For site facilities located within the floodplain, the flood mitigation strategy will identify how risks to personal safety and damage to construction facilities and equipment will be managed.	Construction
Adaptive management of infrastructure	HF7	Roads and Maritime and Sydney Airport Corporation will review measures to maintain or improve over time the flood immunity of the infrastructure resulting from the effects of climate change.	Operation

14.6.3 Managing residual impacts

Residual impacts are impacts of the project that may remain after implementation of:

- Design measures to avoid and minimise impacts (see sections 6.4 and 6.5)
- Construction planning and management approaches to avoid and minimise impacts (see sections 6.4 and 6.5)
- Specific measures to mitigate and manage identified potential impacts (see section 14.6.2).

A summary of the potential residual impacts and management approach is provided in Table 14.7.

Table 14.7 Residual impacts – flooding

Potential residual impact	Management approach
Residual construction impacts of the project could include temporary increases in flood levels in rare to extreme flood events.	Measures to manage residual flood impacts during construction will include: ■ Staging construction to limit the extent and duration of temporary works on the floodplain ■ Ensuring construction equipment and materials are removed from floodplain areas at the completion of each work activity or should a weather warning be issued of impending flood producing rain ■ Providing temporary flood protection to properties identified as being at risk of adverse flood impacts during any stage of construction of the project ■ Developing flood emergency response procedures to remove temporary works during periods of heavy rainfall.
The assessment identified the following minor residual impacts on existing infrastructure within Sydney Airport: ■ Peak flood levels in an area of Sydney Airport adjacent to Qantas Drive would increase by a maximum of 0.03 metres over an area that includes several buildings and other structures ■ During a PMF, the depth of inundation in an area immediately adjacent to the southern approach to the Terminal 1 connection bridge would increase by a maximum of 0.32 metres, with impacts extending east to the Freight terminal bridge.	Detailed design will be undertaken with the aim of minimising flood impacts. A flood mitigation strategy will be developed, which will include modelling of the final design and construction approach. The strategy will provide for a merits-based approach to any identified impacts. Consultation with relevant stakeholders would be undertaken as required. A floor level survey will be undertaken to confirm the effect on identified structures and assist in the identification of appropriate mitigation measures.

Potential residual impact	Management approach
Residual operational impacts of the project could include increases in flood levels in rare to extreme flood events of greater than the one per cent AEP event. This could include impacts to surrounding properties, including increased flood depth, potential flood damages during a flood event, and emergency access during times of flooding.	Further consultation with relevant stakeholders and consideration of these potential impacts during the detailed design stage would reduce any residual impacts to an acceptable level.