

19 Non-Aboriginal heritage

This chapter assesses potential impacts from the project on non-Aboriginal heritage. A Statement of Heritage Impact (SoHI) has been prepared addressing potential impacts to individually listed items and can be found in **Appendix N** (Statement of heritage impact). **Table 19-1** sets out the SEARs relevant to non-Aboriginal heritage and identifies where the requirements have been addressed in this EIS.

Table 19-1 SEARs - Non-Aboriginal heritage

Assessment requirements	Where addressed
1. The Proponent must identify and assess any direct and/or indirect impacts (including cumulative, vibration and visual impacts) to the heritage significance of listed (and nominated) heritage items inclusive of:	Section 20.3 and section 20.4
c) environmental heritage, as defined under the Heritage Act 1977 (including potential items of heritage value, conservation areas, open space heritage landscapes, built heritage landscapes and archaeology);	Section 19.3.1 and section 19.3.2
d) items listed on the State, National and World Heritage lists; and	Section 19.2.2
e) heritage items and conservation areas identified in local and regional planning environmental instruments covering the project area.	Section 19.2.2
2. Where impacts to State or locally significant heritage items or archaeology are identified, the assessment must:	Section 19.3
a) Include a significance assessment and statement of heritage impact for all heritage items (including any unlisted places that are assessed of heritage value);	Section 19.2.3 and Appendix N (Statement of heritage impact)
b) Provide a discussion of alternative locations and design options that have been considered to reduce heritage impacts;	Chapter 5
c) In areas identified as having potential archaeological significance, undertake a comprehensive archaeological assessment and management plan in line with Heritage Council guidelines which includes a methodology and research design to assess the impact of the works on the potential archaeological resource and to guide physical archaeological test excavations and include the results of these excavations. This is to be carried out by a suitably qualified archaeologist and is to discuss the likelihood of significant historical and Aboriginal archaeology on the site, how this may be impacted by the project, and include measures to mitigate any impacts;	Section 19.2.4 Section 19.3
d) Consider impacts to the item of significance caused by, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, increased traffic, visual amenity, landscape and vistas, curtilage, subsidence, hydrological changes and architectural noise treatment (as relevant);	Section 19.3
e) Provide a comparative analysis to inform the rarity and representative value of any heritage places proposed for demolition;	Section 19.7
f) Outline mitigation measures to avoid and minimise identified impacts in accordance with the current guidelines; and	Section 19.6
g) Be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria).	Section 19.1.5

19.1 Assessment methodology

19.1.1 Overview

The methodology for the non-Aboriginal heritage assessment is as follows:

- Identify the study area relevant to non-Aboriginal heritage
- A literature and database review, including a search of relevant heritage registers and schedules to identify heritage items that may be impacted during construction and operation of the project
- Undertake a one day site inspection of the project area to examine the area for both known (previously identified (i.e. properties along Gibbs Street and Farr Street)) and previously unidentified heritage items and archaeological sites
- Record previous unknown heritage items if found during the site inspection
- Assess the heritage significance of heritage items that may be impacted by the project
- Assess the likely level of impact during construction and operation on identified heritage items
- Prepare statements of heritage impact for impacted non-Aboriginal heritage items
- Assess the potential for archaeological deposits within project area according to Heritage Division guidelines and to determine the need for further investigations
- Provide mitigation and management measures, including measures to avoid significant impacts and an evaluation of the effectiveness of the measures.

19.1.2 Relevant legislation and guidelines

The *Heritage Act 1977* is the primary legislation providing for the protection and conservation of non-Indigenous (non-Aboriginal) cultural heritage items. The Heritage Act imposes requirements including:

- Section 32, where places, buildings, works, relics, moveable objects or precincts of heritage significance are protected by listing on the State Heritage Register
- Section 170, which requires that NSW Government agencies, including Roads and Maritime, maintain a register of heritage assets and requires consideration where the assets may be impacted.

The non-Aboriginal heritage assessment was also undertaken in accordance with the following guidelines:

- *Heritage Curtilages* (NSW Heritage Office and NSW Department of Urban Affairs and Planning, 1996)
- *NSW Heritage Manual* (Heritage Office and Department of Urban Affairs and Planning, 1994)
- *Assessing Heritage Significance* (NSW Heritage Office, 2001)
- *Levels of Heritage Significance* (NSW Heritage Office, 2008)
- *Assessing Significance for Historical Archaeological Sites and Relics* (NSW Heritage Branch, 2009)
- *The Burra Charter* (the Australia ICOMOS charter for places of Cultural Significance) (ICOMOS Australia), 2013).

As the Project is being undertaken as a State significant infrastructure (SSI) project, the heritage provisions in Rockdale Local Environmental Plan 2011 (Rockdale LEP) LEP, and the Canterbury Local Environmental Plan 2012 (LEP) for the permanent power supply alignment, do not apply. However as part of identifying known heritage items within the Project corridor, Schedule 5 of the Rockdale LEP and Canterbury LEP was searched for previously listed heritage items.

19.1.3 Study area

The study area was defined by the surface works required above the tunnels, the locations of the construction compounds, the permanent power supply alignment and any other ancillary facilities. The study area also includes those areas immediately adjacent to the surface works as these areas may be subject to direct and/or indirect impacts as a result of construction and operation of the project. Refer to **Figure 1-2** for the project overview.

19.1.4 Literature and database review

A review of archaeological and historical literature and data relevant to the project was undertaken. This review was used to identify any known non-Aboriginal heritage items located in the vicinity of the project footprint. Databases searched include:

- World Heritage List
- Commonwealth Heritage List
- National Heritage List
- NSW State Heritage Register
- NSW State Heritage Inventory
- Roads and Maritime Section 170 Heritage and Conservation Register
- Transport for NSW Section 170 Heritage and Conservation Register
- Sydney Water Section 170 Heritage and Conservation Register
- Sydney Trains Section 170 Heritage and Conservation Register
- Schedule 5 of Rockdale LEP
- Schedule 5 of Canterbury LEP.

Searches of non-statutory databases were also undertaken and included the Register of the National Estate and the Register of the National Trust of Australia.

Additional literature was reviewed for relevant information about the non-Aboriginal heritage in the vicinity of the project, including:

- A review of historical documents, including parish maps and plans, to determine the historical context of the area surrounding the project and to identify any potential for archaeological heritage items
- Archives from the National Library of Australia, State Library of NSW, Land and Property Information's on-line Historical Lands Records Viewer, Trove digitised newspaper collections and relevant local libraries.

Non-Aboriginal Heritage items identified through these searches are summarised in **section 19.2.2**, **Table 19-2** and shown in **Figure 19-2** and **Figure 19-3**.

19.1.5 Field survey

Heritage items identified as having the potential to be either directly or indirectly affected by the project (both surface works and tunnelling) were inspected during a field survey. This sought to establish their specific location and current condition. This survey was carried out by an AECOM Senior Archaeologist and Heritage Specialist (Qualifications: Bachelor of Archaeology (Hons) Flinders University) on 16 January 2018.

The locations of inspections were informed by the results of the desktop assessment. All inspections were undertaken from publicly-accessible locations. Where heritage items were identified as being present they were documented through notes and photos, with relevant features identified.

A summary of the physical description of the areas investigated as part of the field survey as well as photos are provided in **Appendix N** (Statement of heritage impact).

19.1.6 Significance assessment

Where particular non-Aboriginal heritage items were identified in close proximity to the project, assessments were undertaken to determine relative importance ('assessments of significance'). The significance assessment criteria are provided in **Appendix N** (Statement of heritage impact). Assessment of these heritage items evaluated current condition in comparison to historical inspections and the descriptions provided within the heritage listing. Statements of significance were obtained from the respective published registers for each item.

19.1.7 Impact assessment

A detailed description of the project is provided in **Chapter 6** (Project description) and **Chapter 7** (Construction). Impacts as a result of the project have been categorised as follows:

- Direct – where the project footprint is located within the curtilage of the heritage item and/or would involve damage, modification or demolition of that heritage item
- Potentially direct – where impacts to a heritage item may occur subject to the condition of that item (i.e. vibration impacts to sensitive items), the construction methodology employed and/or through the implementation of management measures (i.e. acoustic treatments)
- Indirect – where the project would introduce new visual elements or result in changes to the surrounding landscape context (such as through changes to the ground and /or surface water).

Impacts to heritage items that would affect their value or significance would vary depending on the type of construction work, its duration and the proximity. As a result, a set of impact ratings was established to determine the degree of impact. The heritage impact criteria and Statements of Heritage Impacts for affected non-Aboriginal heritage items are provided in **Appendix N** (Statement of heritage impact), while the comparative assessment is provided in **section 19.7**.

19.2 Existing Environment

19.2.1 Overview

The historical context of the project area around President Avenue is directly related to the settlement along the coastal area along Brighton-Le-Sands and encroachment of early to mid-twentieth century residential development.

The first land grant was awarded in 1803. This first grant was soon followed by a grant to Hanna Laycock of 500 acres called “Kings Grove Farm”. The track to her property became the major route south, and by 1830 this route became the main road south of the settlement at Sydney.¹

The Cooks River was the main factor preventing settlement expanding further to the south. A dam crossing Cooks River was opened in 1839 enabling travellers to cross into what is now the Rockdale area. A direct road to the Illawarra was planned and constructed, and in 1843 the Illawarra Road was opened.

By 1848, most of the occupations were believed to be rural occupations. Most subdivisions, or sales of subdivided land until the 1870s, were aimed at providing sizeable acreages of land, suitable for farms, villas and other large area activities such as market gardens, many of which did not have houses built on them.

Growth and development along the coastal fringe south of the Cooks River was slower. This was mainly due to the gentrification of the area. Given the proximity of the waters of Botany Bay, then in an unpolluted state, the area became the resort of the wealthy and fashionable of Sydney.² By the late 1860s more houses were being built along the coastal strip. The more notable land owners, including Thomas Holt, persuaded the government to dedicate low-lying land alongside Scarborough Park for development.³

As more people were attracted to the coast, low lying lands that were set back between the coast and the train line were used for market gardens, piggeries and poultry farms. By 1906 pressure for more land for residential needs was increasing. Larger plots of land, including the existing private race courses and tourist resorts were being subdivided from 1910 onwards. This allowed for smaller allotments that allowed modest residential houses to be built. These subdivisions began to encroach on the swamp and low-lying areas, however, the market gardens along Muddy Creek and adjacent to the swamp areas continued to be farmed (Walker and Kass, 1991).

Pressure to reclaim Patmore Swamp began in the 1890s with petitions sent to the government to reclaim the swamp areas to make way for housing (*Daily Telegraph* 19 May 1892). It was noted at the time that the surrounding water run off drained into Patmore Swamp and that filling the swamp would create other greater issues. These plans never eventuated but continuing pressure remained for Rockdale Council to reclaim the swamp. In 1916 the NSW Government proposed buying the swamp area to maintain the wetlands and protect them from development (*Sydney Morning Herald* 1 July 1916). The sale of the swamp to the NSW government does not seem to have eventuated.

¹ A.O. Map 5123 in Walker and Kass, 1991

² Walker and Kass, 1991

³ Geeves and Jervis, 1954



Figure 19-1 Portion of West Botany. Note President Avenue has not crossed the swamp at this stage. Rockdale tunnel site and President Avenue outlined in red (Source: Trove <https://nla.gov.au/nla.obj-229916244/view>)

The health of the swamp area was called into question in 1929 when the Department of Health was called to take water samples of Patmore Swamp. Offensive odours were noted by local residents and samples revealed that the water was found to be “offensive”. The cause was deemed to be decomposing vegetation and animals (*St George Call newspaper* 22 March 1929).

Sustained pressure for Rockdale Council to drain and reclaim the swamp areas resulted in Council calling for tenders to reclaim four acres of the swamp and for the potential digging of a channel in the early 1930s (*St George Call* 21 Oct 1932). Details relating to the eventual successful tender are scant however, a description from the opening of the new “Scarborough Park” in November 1934 indicates that extensive reclamation works enabled installation of 15 cricket pitches and a large artificial lake (*St George Call* 30 Nov 1934)(refer **Plate 1**).

Other notable developments in the area include the subdivision and eventual development of the western side of West Botany Street. The allotments appear to have been subdivided for housing sometime between 1890 and 1906. The allotments along what later became West Botany Street appear at this time to be larger and irregularly shaped, and a market garden is located in this area.

The 1943 aerial photo shows there is a shed or possibly a house present in the location of 439 West Botany Street. The remainder of this area consists of what appear to be lightweight sheds and market gardens (**Plate 2**). These allotments were later subdivided in 1969 to create six allotments fronting West Botany Street that become known as Numbers 431 to 439, after which the existing brick warehouses were built. A brick warehouse at 431 West Botany Street was demolished in 2016, however the other brick warehouses remain.



Plate 1 Scarborough Park c1934 (Source: Government Printing Office 1 – 01702)

Between 1970 and the early 1980s there were no development changes to Patmore Swamp on either side of President Avenue. The next phase of changes to the area were in the lead up to the Australian Bicentenary in 1988 when Rockdale Council upgraded the then swamp area north of President Avenue to include a new open grassed field, carpark on the western side of the watercourse, and new playing fields on the eastern side. The redesign included large scale landscaping works that redefined the layout of Patmore Swamp. Once completed the northern side of Patmore Swamp was renamed Bicentennial Park and Memorial Park. A bridge was constructed linking the two parks over the watercourse that remained from the swamp as a result of the works. Smaller additions have since been made to the park, including adding a skate park and playground.



Plate 2 1943 aerial of the Kings Wetland and Patmore Swamp. (Source Six Viewer Online). 439 West Botany Street shown in red.

19.2.2 Listed historic heritage items

A search of relevant heritage registers and databases identified eight listings of heritage items listed in **Table 19-2** within or immediately adjacent to the project footprint which includes the permanent power supply connection route (refer **Figure 19-2**, **Figure 19-3** and **Figure 19-4**). It is noted that some items are listed on more than one register.

Table 19-2 Listed non-Aboriginal heritage items potentially impacted by project

Register	Listed item	Distance from project area
Commonwealth		
World Heritage List	None identified	-
National Heritage List	None identified	-
Commonwealth Heritage List	None identified	-
Register of the National Estate (non-statutory)	None identified	-
State		
State Heritage Register	Arncliffe Market Gardens (SHR 01395)	Above project area
	Dappeto (00638)	275 metres to the East
	Lydham Hall (00477)	355 metres to the West
	Wilsons Farm House (00487)	Above project area
	Rockdale Railway Station (01238)	380 metres to the Southwest
	Western Outfall Main Sewer (SHR 01647)	50 metres to the South
	Alexandra Canal (SHR 01621)	250 metres to the Northeast
	Toomevara Lane Chinese Market Gardens (SHR 01394)	580 metres to the South
State Heritage Inventory	None identified	-
Roads and Maritime S170 Register	None identified	-
TfNSW S170 Register	Banksia Railway Station Group (4801160)	100 metres to the North
	Bardwell Park Railway Station Group (4801896)	Within the project area
Sydney Water S170 Register	None identified	-
Sydney Trains S170 Register	None identified	-
Department of Urban Affairs and Planning S170 Register	Kings Wetland (SHI 3490033)	Within the project area
Conservation areas – permanent power supply connection route		
Register of the National Estate (non-statutory)	Brighton Le Sands Urban Conservation Area (RNE Indicative Place 102111)	Within the project area
Register of the National Estate (non-statutory)	Banksia Urban Conservation Area (RNE Indicative Place 102110)	Within the project area
Register of the National Estate (non-statutory)	Bardwell Park Urban Conservation Area (RNE Indicative Place 102101)	Within the project area
Register of the National Estate (non-statutory)	Clemton Park Urban Conservation Area (RNE Indicative Place 102071)	Within the project area
Register of the National Estate (non-statutory)	Earlwood Urban Conservation Area (RNE Indicative Place 102069)	Within the project area
Local		
Rockdale LEP 2011	<ul style="list-style-type: none"> • Kings Wetland (I169) • Patmore Swamp (I202) • Brighton-Le-Sands Public School (I167) • Arncliffe Market Gardens (I193) 	Within the project area Within the project area Adjacent to the project Above the project area

Register	Listed item	Distance from project area
Rockdale LEP 2011	<ul style="list-style-type: none"> • Sandstone Federation cottage (I2) • Newstead (I4) • Palm trees (I14) • Californian Bungalow house (I16) • Californian Bungalow house (I17) • Coburra (I28) • Wilga (I29) • Californian Bungalow house (I30) • Dappeto (I62) • Federation house (I63) • Federation house (I65) • Fairview (I66) • House (I67) • Federation house (I68) • Sandstone Victorian cottage (I69) • House (I70) • Sandstone Victorian cottage (I71) • Sandstone Victorian cottage (I72) • Sandstone Victorian cottage (I73) • Part of single-storey terraced cottages known as Jackson's Row (I74) • Part of single-storey terraced cottages known as Jackson's Row (I75) • Stone house (I76) • Stone Victorian house (I77) • Stone house (I78) • Gardiner Park (I79) • Stone cottage (I80) • Stone Federation house (I81) • Californian Bungalow cottage (part of a street precinct) (I82) • Californian Bungalow cottage (part of a street precinct) (I83) • Californian Bungalow cottage (part of a street precinct) (I84) • Californian Bungalow house (I88) • Brick Californian Bungalow cottage (I89) • Hillsdon's Nursery Cottage (I90) • Stone cottage (I91) • Stone cottage (I92) • Market Gardens (I93) • Girrahween Park gates (I109) • St Andrew's Church (I128) • School building (1916) - Brighton-Le-Sands Public School (I167) • Kings Wetland (I169) • Rock Lynn (I207) • Roslyn Hall (I208) • Sandstone Victorian cottage (I210) • House (I211) • Palm trees on verge (I213) • Jacaranda trees (I214) • Yamba Worra (I215) • Victorian house (I216) • Lydham Hall (I217) • Federation house (I218) • Rockdale Public School (I219) • Rockdale Town Hall (I220) • Brick buildings on platforms, signal box and overhead booking office (I222) • Wilson's Farmhouse (I224) • Wollie Creek Valley (I237) 	<400 metres

19.2.3 Significance assessment

Assessment of potential impacts to non-Aboriginal heritage items first requires an understanding of the significance of each heritage item. Assessments of significance provide an understanding of why a heritage item is significant and to appropriately delineate the heritage curtilage. Many of the heritage items within the vicinity of the project already have statements of heritage significance prepared by public authorities, however based on research undertaken as part of the project, statements would be updated if required.

Summaries of the significance of individual non-Aboriginal heritage items within the study area are provided in **Table 19-3**. It is noted that no statements were updated as part of this assessment.

Table 19-3 Summary of the significance of relevant heritage items in the study area

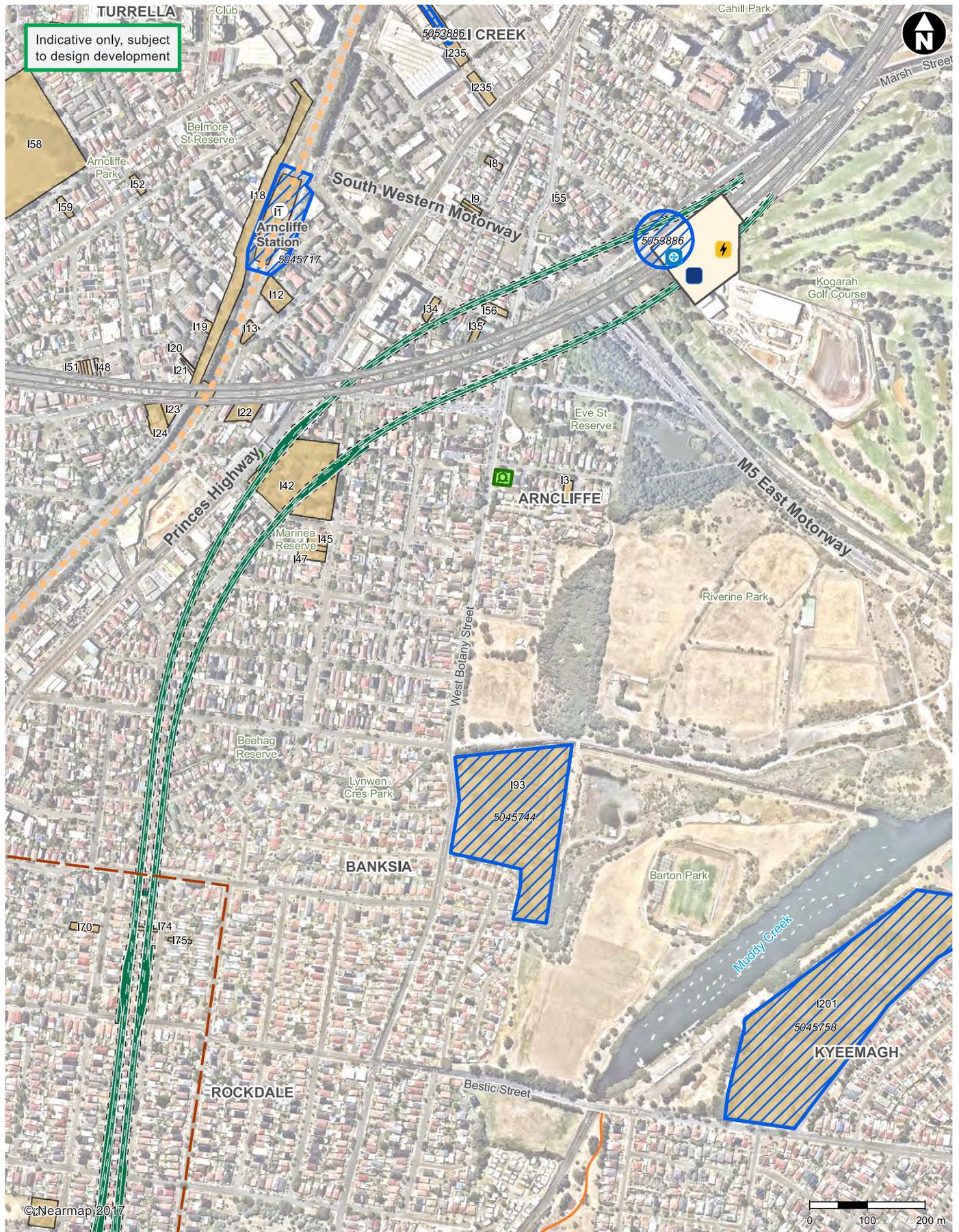
Listing	Summary of heritage significance
Arncliffe Market Gardens (SHR 01395)	The Arncliffe Market Gardens are of high significance for their association with the Chinese community and their demonstration of a continuous pattern of land use since the late nineteenth century. They are one of only three such surviving market gardens in the Inner Sydney region and one of few similar surviving examples in the Sydney Metropolitan Region.
Wilson's Farm House (SHR 00487)	Wilson's Farm House is the last surviving example of the modest pioneer homes built along the banks of Muddy Creek. It demonstrates the early rural and more recent market garden development of Rockdale. It is an extant example of a simple nineteenth-century colonial farmhouse. It is associated with an early small holding settler family, the Wilson's.
Kings Wetland (I169)	The Kings Wetland is an area of regionally significant aquatic plants and demonstrates the geography and vegetation of the area prior to white settlement. The destruction of wetland habitats in the Sydney Metropolitan Region, for the purposes of urban expansion, are of considerable concern and any surviving wetland habitats are considered to be of high significance.
Patmore Swamp (I202)	Patmore Swamp is technically significant for its contribution to the Central Scarborough wetland area which is an integral part of the wetlands corridor. The place also has historical value for its role in the depression era program of public works. The wetland reserve contributes to amenity and character of the area.
Brighton-Le-Sands Public School (I167)	The school is a distinctive Federation style building representative of education in Brighton Le Sands from the early twentieth century and contributing to the history and streetscape of the area.
Bardwell Park Railway Station Group Statement of Significance	Bardwell Park Railway Station has historical significance as a major public work completed as an unemployment relief project during the Great Depression, and as a major transport hub for Bardwell Park since 1931. Bardwell Park Railway Station is of aesthetic significance as an austere 1930s railway building with simple Art Deco detailing and fine brick workmanship that is evocative of the effects of the Depression on building programs for the NSW railways. Bardwell Park Railway Station is representative of the cohesive collection of 10 East Hills line railway stations from Turrella to East Hills.

Source: NSW Office of Environment and Heritage

19.2.4 Archaeological Potential

Based on the site inspection and an understanding of the historical land use of the area, predictions about the archaeological potential can be made. Rockdale Bicentennial Park and Memorial Park were largely left as undeveloped swamp lands until the depression era reclamation works between 1932 and 1934. The reclamation works reworked much of the swamp area, building them up and creating a new water course and lake area north of President Avenue.

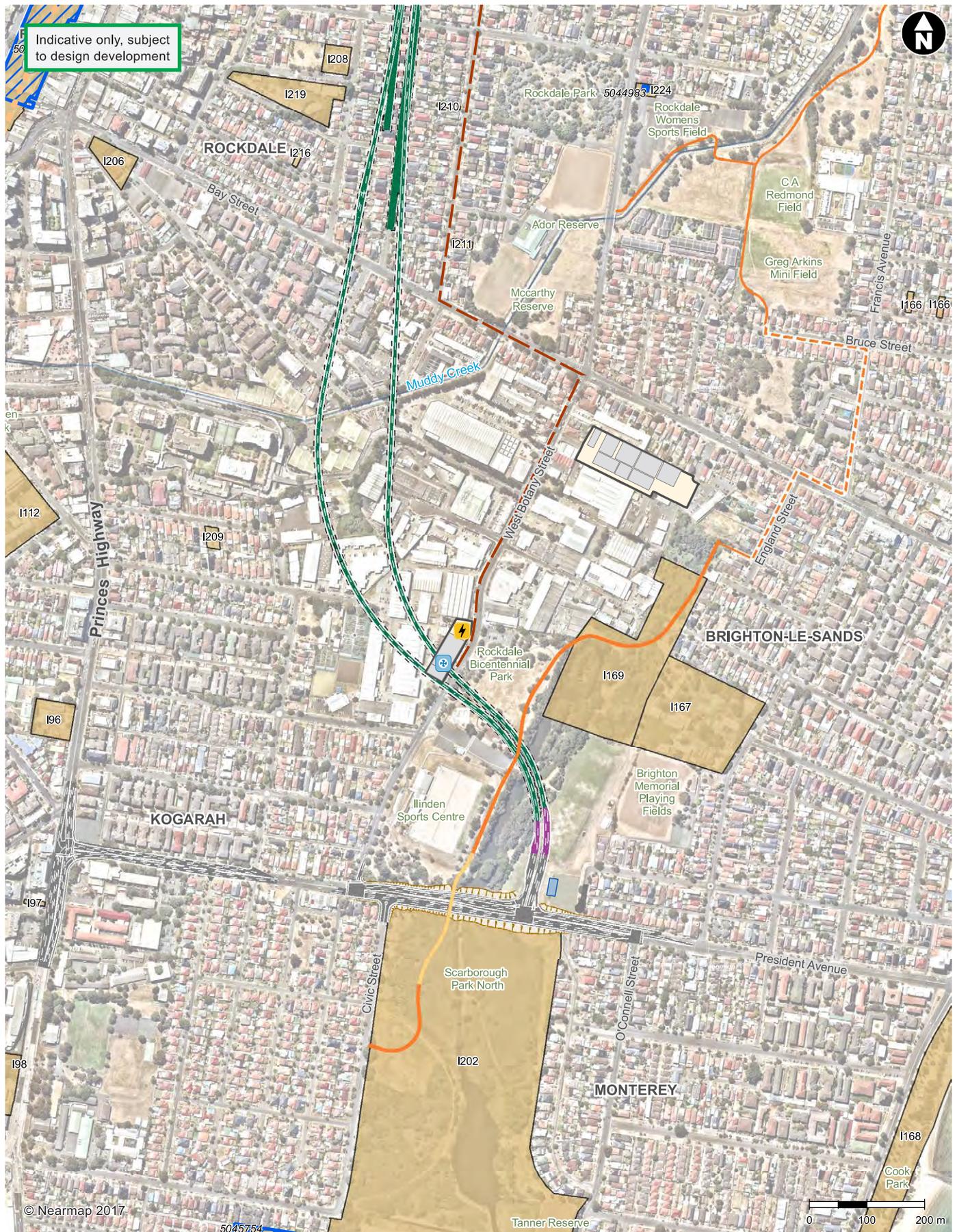
No areas of archaeological potential have been identified.



LEGEND

The project in tunnel	New M5 Tunnel	State Heritage Register
Shared cycle and pedestrian pathways	Arncliffe ventilation facility*	Rockdale LEP
Substation	S170 RMS heritage item	S170 RMS heritage area
Water treatment facility	Railway station	Railway line
Permanent power supply line	* Under construction as part of the New M5 Motorway project	

Figure 19-2 Non-Aboriginal heritage items within the vicinity of the project



LEGEND

- The project in tunnel
- The project on surface
- The project as an open slot
- Water quality basin
- On-road cycleway
- Shared cycle and pedestrian pathways
- President Avenue shared cycle and pedestrian bridge
- Building
- Embankment
- Water quality basin
- Substation
- Rockdale ventilation facility
- Permanent power supply line
- State Heritage Register
- Rockdale LEP
- Railway station
- Railway line



Figure 19-3 Non-Aboriginal heritage items within the vicinity of the project

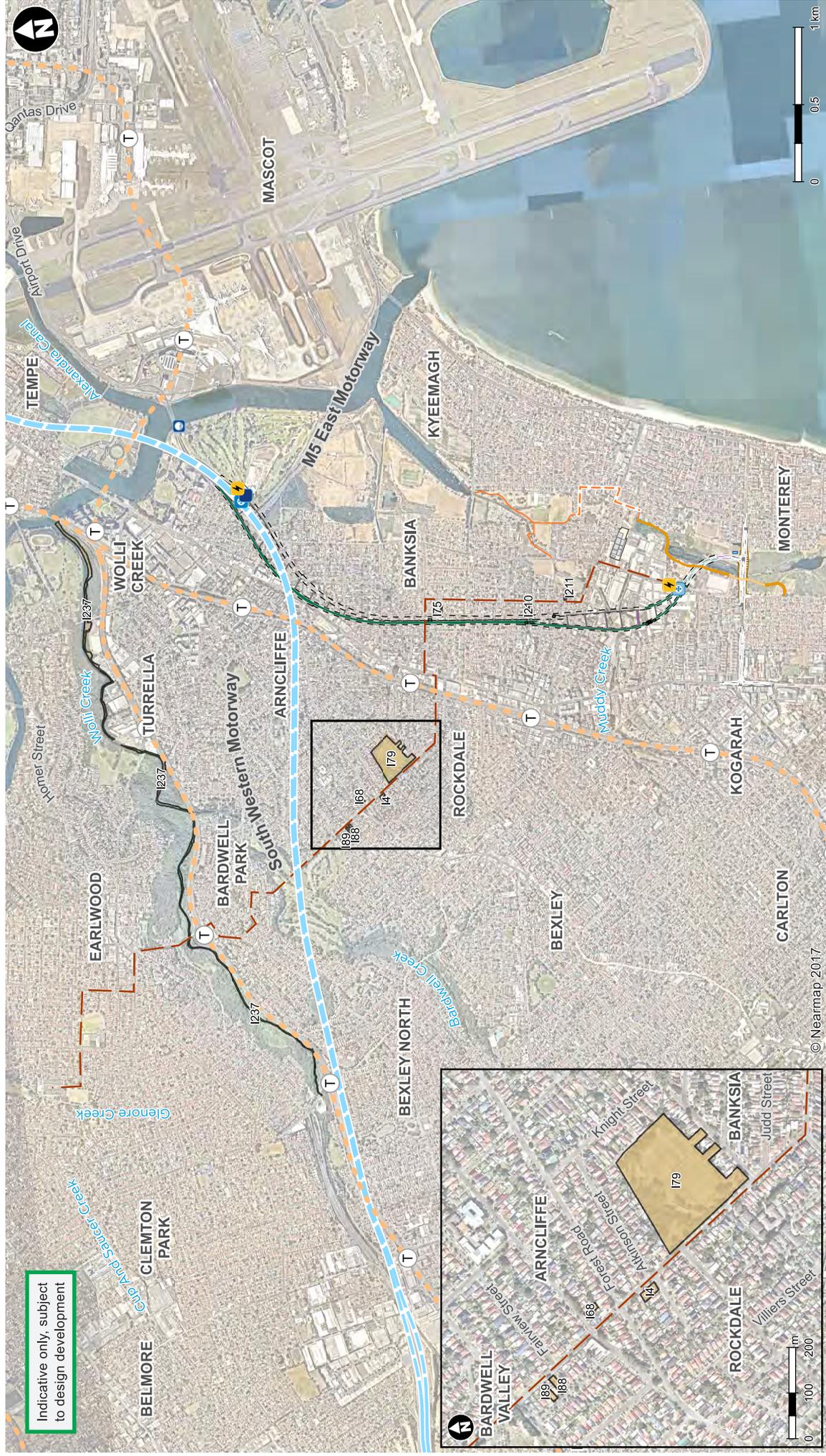


Figure 19-4 Non-Aboriginal heritage items located within the vicinity of the permanent power supply line route

19.3 Potential impacts – construction

The project affects two heritage items listed on the Rockdale LEP with local significance, Kings Wetland (I169) and Patmore Swamp (I202), located to the north and south of President Avenue, respectively.

Impacts to the Kings Wetland site would include clearing of trees located along the eastern boundary of the wetlands adjacent to the Brighton-Le-Sands school. These trees would be removed to allow for the construction of a haul road. The existing trees present along the bank of the wetland are proposed to be retained and would not be disturbed. At the conclusion of construction works, the area would be rehabilitated back to the original state of the wetlands prior to construction. The shared cycle and pedestrian pathways would also cause impacts to the Kings Wetland site. There would be no direct impacts to Brighton-Le-Sands school or to the identified heritage building.

The proposed project footprint in relation to Patmore Swamp is shown on **Figure 19-5**. Impacts to Patmore Swamp include the acquisition of a 30 metre strip along the frontage of President Avenue for the upgrade of President Avenue. A shared cycle and pedestrian bridge would also be constructed over President Avenue. A shared cycle and pedestrian pathway would extend from the shared cycle and pedestrian bridge and continue south through Patmore Swamp and would link up with Civic Avenue near Annette Avenue. This section of the shared cycle and pedestrian pathway would need to be raised above the current ground level of Patmore Swamp. In all, the shared cycle and pedestrian pathway would be approximately 150 metres long and up to six metres at its widest point through the swamp. The construction of the shared pathway would include the removal of the existing vegetation for the network to link President Avenue with Civic Avenue in the vicinity of Annette Avenue.

The permanent power supply route passes through the curtilage of one S170 listed item (Bardwell Park Railway Station Group) and five conservation areas. The proposed works would involve a temporary visual impact to the conservation areas which would be limited to the construction period. The identified heritage values of these conservation areas are vested in the houses and streetscape, therefore no permanent heritage impacts are likely to occur from the powerline. The Bardwell Park Railway Station Group has the potential to be directly impacted and therefore avoidance should be sought as a first preference, with mitigation measures required should the works require egress through the listed curtilage.

19.3.1 Direct impacts

Construction vibration

The safe working distance identified for vibration in the noise and vibration assessment was 25 metres to avoid cosmetic damage to structures, assessed against the maximum rating for plant such as a vibratory roller, hydraulic hammer, vibratory pile driver, pile borer and jack hammer (see section 5.5 in **Appendix G** (Noise and vibration technical report)). Analysis of mapped heritage items has identified that the only known heritage item within 25 metres of the proposed surface works with a potential for vibration impacts is the Shop and Residence listed on the Kogarah LEP 2012 as I97 with local significance. No direct impacts are proposed for this item which is located at 111 Princes Highway, adjacent to proposed surface works in that area (approximately seven metres from the closest work area location).

To avoid indirect impacts to this item use of machinery should be limited to a maximum plant use of vibratory roller < 100 kN (Typically 2-4 tonnes), the medium hydraulic hammer (900 kilograms – 12-18 tonne excavator) and the hand-held jack hammer, which the noise and vibration assessment has identified as safe plant to use within a seven metre distance and to avoid cosmetic damage to existing structures.

Ground movement

Ground movement is an expected outcome of tunnelling projects. The ground movement anticipated is predominantly settlement (also termed subsidence). Upward ground movement (also termed heave) may also occur.

The causes of ground movement due to tunnelling can be classified as:

- Consolidation of the soil profile - due to water inflow in to the tunnel resulting in groundwater drawdown in the overlying soil profile. This results in an increase in stress in the soil matrix as water is lost from the soil pores (settlement only)
- Tunnel induced movement - due to the change in stresses in the surrounding rock mass and ground loss caused by the tunnel excavation (settlement or upward heave).

The areas that are most likely to be affected by settlement are usually when tunnelling is closest to the ground surface and around the tunnel portals and entry and exit ramps. The majority of the tunnel is expected to create less than 10 mm of subsidence. It is generally accepted that the risk of damage to surface features is negligible when subjected to total settlements of less than 10 mm (R.J. Mair, R.N.Taylor, J.B. Burland, 1996). For the majority of the tunnel length, the ground settlement is predicted to be less than 10mm due to the depth of the tunnel. Increased levels of settlement (up to around 30mm) may be observed at the southern end of the project, where the tunnel is shallower. **Table 19-4** contains details of the heritage items and heritage conservation areas that directly intersect with the tunnelling alignment.

Table 19-4 Heritage items and Heritage Conservation Areas on Local and State Registers intersecting with the tunnelling alignment

Item Name	Address	Significance	Listing	Depth of Tunnel	Impact Type	Impact Ranking
Rock Lynn	58 Bestic Street, Rockdale	Local	1207	Greater than 60 metres below ground	Unlikely to be impacted	Neutral
Part of singlet-storey terraced cottages known as Jackson's Row	11 Gibbes Street, Banksia	Local	174	Greater than 60 metres below ground	Unlikely to be impacted	Neutral
Arncliffe Public School and Teluba	168–170 Princes Highway, Arncliffe	Local	142	Greater than 60 metres below ground	Unlikely to be impacted	Neutral
Sandstone Victorian cottage	15 Kyle Street, Arncliffe	Local	134	Greater than 60 metres below ground	Unlikely to be impacted	Neutral
House	31 Kyle Street, Arncliffe	Local	135	Greater than 60 metres below ground	Unlikely to be impacted	Neutral
House	73 West Botany Street	Local	156	Greater than 60 metres below ground	Unlikely to be impacted	Neutral
Western Outfall Main Sewer (Rockdale to Homebush)	Valda Avenue (off south side of Kogarah Golf Course) Arncliffe	State Area	5053886	Greater than 60 metres below ground	Unlikely to be impacted	Neutral

Statements of heritage impact

There would be the potential for direct impacts to both Kings Wetland and Patmore Swamp from the works associated with this Project. These impacts have been assessed against the significance criterion (as discussed in **section 19.1.6** above). The full heritage impact assessment for both Kings Wetland and Patmore Swamp can be found in **Appendix N** (Statement of heritage impact), while a summary of each is provided below.

The Proposed Works would have an impact to the current heritage listings associated with Patmore Swamp and Kings Wetland only. There are no other historical archaeological or potential built heritage sites that would be affected by the proposed works.

Patmore Swamp

There would be direct construction impacts to Patmore Swamp associated with this project. A 30 metre wide portion of the swamp along the whole of the President Avenue frontage would be acquired and the shared cycle and pedestrian pathways constructed. These works would result in approximately four percent of the Patmore Swamp listed area being impacted (refer **Figure 19-5** for extent of works). This would have a minor impact to the heritage significance of Patmore Swamp. The removal of the portion of the swamp along President Avenue is considered to be a **negative impact**. The construction of the shared cycle and pedestrian pathways proposes associated landscaping works through the swamp. These landscaping works would promote the aesthetic significance of the swamp and have a positive heritage outcome. Overall the negative and positive impacts result in an overall medium residual impact in this area.

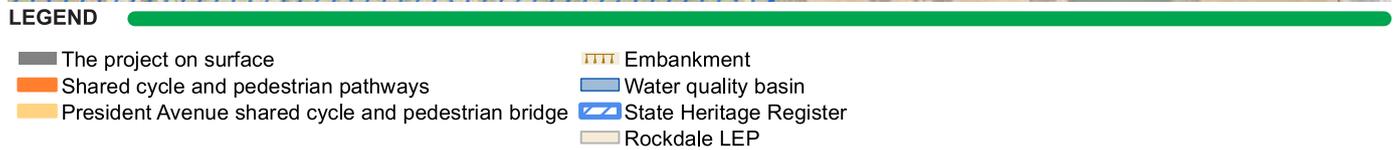


Figure 19-5 Project features within Patmore Swamp

Kings Wetland

The project works are likely to have a **moderate impact** to the Kings Wetland heritage listing. Existing vegetation along the eastern boundary of the listed area would be removed to enable construction of a haul road. The existing vegetation along the wetland/creek area would not be impacted. As shown in the historical research and from aerial photography (refer Plate 3 of **Appendix N** (Statement of heritage impact)), the area of Kings Wetland to the north of Kings Road represents the remnant vegetation that can be associated with the pre-1788 environment associated with the wetland. The area to the south of Kings Road within the Kings Wetland heritage listed area has been significantly modified post 1940s and does not represent the pre-1788 natural vegetation landscape associated with a wetland.

Archaeological potential

With the exception of the potential archaeological remnants of market gardens present around the swamp area periphery, the only archaeological potential that may be present is likely to relate to active drains installed as part of the modification and reclamation works at Patmore Swamp. These items, however, are not likely to have any archaeological significance or research potential. Also, former or active drains are not considered to be ‘relics’ but are ‘works’ defined by the *Heritage Act 1977*, and therefore no permit is required to impact on these items.

Given the extent of reclamation and modification works, including along the sites of 431 to 439 West Botany Street where a former market garden was present, any archaeological potential associated with former farming practices in this area is likely to be highly disturbed.

It has been assessed that there are no areas of archaeological potential within Rockdale Bicentennial Park, including Memorial Park, or Patmore Swamp.

19.3.2 Indirect impacts

Visual impacts

Impacts to the heritage items as a result of visual impacts of construction are as follows:

- **Kings Wetland** – There would be high-moderate visual impacts experienced in views from the Kings Wetland due to the high level of modification caused by the removal of trees, major earthworks, tunnelling and construction works, and moderate sensitivity of these views
- **Patmore Swamp** – There would be a moderate-low visual impact on views from Patmore Swamp due to the removal of vegetation, earthworks, roadworks and construction of the President Avenue shared cycle and pedestrian bridge resulting in a moderate level of modification to these low sensitivity views
- **Brighton-Le-Sands Public School** - There would be a moderate visual impact on views from the Brighton-Le-Sands school, due to the removal of trees and scale of construction work in proximity to this location.

The visual impacts of the project on non-Aboriginal heritage items and management measures to mitigate impacts are discussed in **Chapter 13** (Landscape and visual).

19.4 Potential impacts – operation

Potential impacts to non-Aboriginal heritage (either direct or indirect) during the operation of the project largely relate to impacts to urban design landscape character and visual amenity. Operational impacts such as increased noise, vibration or air quality are not considered likely to affect any of the known heritage-listed sites, including Kings Wetland or Patmore Swamp.

The design of the project, including post construction landscaping works, would rehabilitate the portion of the Kings Wetland area that would be impacted during construction works. Additionally, through design of the works along the boundary of Patmore Swamp with President Avenue, including the shared cycle and pedestrian pathways through Patmore Swamp, the project has minimised total ground disturbance required for the project.

Visual impacts

Through the preparation of an urban design and landscape strategy, the project aims to blend new infrastructure such as bridges associated with the shared cycle and pedestrian pathways, portals and other facilities into the existing visual surrounds where reasonable and feasible to do so. Furthermore, existing vistas from heritage items would be considered during future design phases and any rehabilitation strategies (for items such as Kings Wetland and Patmore Swamp) in a manner sympathetic with the heritage significance of the item. Specific impacts to each item are as follows:

- Kings Wetland – There would be moderate-low visual impacts from Kings Wetland due to the reinstatement of parkland and introduction of new vegetation, which would in time soften the appearance of views to the tunnel entry and exit lanes, ramps and portal
- Patmore Swamp – There would be a high-moderate impact from Patmore Swamp into the project entry and exit ramps due to the extensive changes to these views which would be transformed from open space to an intersection and tunnel entrance
- Brighton-Le-Sands Public School - There would be a moderate-low visual impact on views from the Brighton-Le-Sands school due to intervening existing and new vegetation.

19.5 Cumulative impacts

The project has been assessed as having an overall minor heritage impact. This has been achieved through:

- Construction in land that was not considered suitable for residential development in the 19th century, and largely reserved for its amenity value in the 20th century
- Minimising impacts to established suburban precincts which may contain heritage items among their building stock
- Design of the extension works to be a tunnel route rather than a surface road route
- Design and refinement of the intersection at President Avenue
- Location of ventilation shaft outlets and co-location of infrastructure with existing compounds and facilities
- The modest overall scale of the project.

Collectively these measures have reduced the likelihood of impact to non-Aboriginal heritage to a minor level.

By comparison, the WestConnex series of projects are located in a far more densely populated part of Sydney, historically occupied throughout the 19th and 20th centuries, where reserved or under-utilised land is limited and less well-placed to minimise impact. The additional impact of the project is relatively minor and does not affect the overall quantum of motorway impacts that have been approved within the past decade.

The future stages of the F6 Extension propose an additional motorway connection from President Avenue south towards Loftus. No detailed design is available at this stage, meaning that any understanding of the cumulative impacts of proposed future works can only be considered in a broader context. As these future works would potentially combine controlled surface infrastructure with underground tunnels, and listed heritage items to the south of President Avenue are known, it should be possible to complete a design that is sensitive to these items and avoids major impacts to heritage. Cumulative impacts can be avoided primarily through avoidance, with underground tunnels an effective method of retaining surface heritage features. Any mitigation measures that are needed would have to be considered when a detailed design is available, should total avoidance of all heritage prove unworkable.

A full description of the cumulative effects of the project can be found in **Appendix N** (Statement of heritage impact).

19.6 Management of impacts

Based on the historical research, site inspection and understanding of the project construction works, the following management and mitigation measures have been prepared. It is noted that management measures relating to non-Aboriginal heritage items have also been addressed in other relevant sections of the EIS, including:

- Vibration resulting from construction in **Chapter 11** (Noise and vibration) and **Appendix G** (Noise and vibration technical report)
- Visual impacts resulting from construction and operation in **Chapter 13** (Landscape and visual) and **Appendix C** (Place making and urban design)
- Urban design and landscape context in **Appendix C** (Place making and urban design).

Table 19-5 Environmental management measures – non-Aboriginal heritage

Impact	Reference	Environmental management measure	Timing
General	NAH1	A Construction Heritage Management Plan will be prepared for the project. The plan will detail measures to minimise impacts on identified heritage features within the project boundary and will also detail procedures to manage unexpected heritage finds.	Prior to construction
	NAH2	Impacts to non-Aboriginal heritage items will, to the greatest extent practicable, be avoided and minimised. Where impacts are unavoidable, works will be undertaken in accordance with the relevant management strategy as defined for the non-Aboriginal heritage item.	Prior to construction Construction
Kings Wetland	NAH3	Consultation will be undertaken with Bayside Council regarding the impacts that would occur to the Kings Wetland (heritage item listed on the Rockdale LEP 2011). Roads and Maritime will provide a copy of the proposed landscape rehabilitation plan to Council to facilitate comment on the proposed impacts and mitigation measures.	Prior to construction
Patmore Swamp	NAH4	Notification and consultation will be undertaken with Bayside Council outlining the impacts that would occur to the Patmore Swamp (heritage items listed on the Rockdale LEP 2011).	Prior to construction
Kings Wetland	NAH5	A protection area will be established either side of the proposed haul road to reduce impacts within the boundaries of the heritage listing. The delineation of the protection area will be maintained throughout the construction period. As part of the detailed design phase, the haul road through the boundaries of the heritage listing will be further optimised with a view to reducing the requirement for the removal of vegetation, as far as is practical. At the conclusion of construction, parts of the area within the boundaries of the heritage listing will be rehabilitated.	Detailed design Construction
Patmore Swamp	NAH6	A protection area will be established as a no-go area during construction along either side of the proposed shared cycle and pedestrian pathways and along the new boundary of President Avenue and Patmore Swamp, to preserve as much of the existing vegetation as is practical within the boundaries of the heritage listing. The delineation of the protection area will be maintained throughout the construction period. A heritage interpretation strategy will be prepared to outline opportunities for heritage interpretation being integrated into the design of the shared cycle and pedestrian pathway through Patmore Swamp.	Construction

Impact	Reference	Environmental management measure	Timing
Bardwell Park Railway Station group	NAH7	The installation of the permanent power supply across the Bardwell Park Railway Station group overbridge would be undertaken to avoid permanent changes to the fabric and visual appearance of the bridge. Should this be unavoidable, further assessment will be undertaken during detailed design.	Prior to construction
Shop and residence	NAH8	Use of machinery should be limited within a seven metre distance to avoid cosmetic damage to existing structures. A visual inspection and assessment should be undertaken by a heritage specialist before works commence to ensure no additional mitigation measures are required.	Pre-Construction and Construction

19.7 Comparative assessment

Based on the impacts the project will have, **Table 19-6** presents a comparative analysis of other heritage wetlands and swamps in the Sydney region.

Table 19-6 Comparative analysis

Item	Heritage Listing	Significance (SHR Criteria)	Comparison to Kings Wetland and Patmore Swamp
Kings Wetland	S170	Criteria A, C, D, E, F & G	N/A
Patmore Swamp	LEP	Criteria A, B, C, E & G	N/A
Botany Water Reserves	SHR, S170, LEP	Criteria A, C, D, E, F & G	Botany Water Reserve is associated with Sydney's water source from 1850 through to 1870s. The listing is 58 ha of wetlands and includes smaller wetland and ponds. The larger ponds are similar in size to the natural ponds (known as Lachlan Swap) prior to their modification into the current ponds. This listing also includes non-Indigenous heritage items and historical plantings. There are also considered remnant sections of Eastern Suburbs Banksia Scrub present. The Botany Bay Water Reserves are considered to be of higher significance for both its natural and historical cultural values, being associated with Sydney's Water supply than that associated with the Kings Wetland and Patmore Swamp.
Centennial Park, Moore Park, Queens Park	SHR, S170, LEP Nominated to the National heritage list	Criteria A, C, D & E	Centennial Park is historically significant as part of the site of the second Sydney Common and public open (1811); Sydney's second and third water supply, Busby Bore and the Lachlan Water Reserve; and use as a major public event space. The most significant periods in the history of the park are: pre-European, natural environment pre-1788; Lachlan Water Reserve 1811-1887; Centennial Park 1888-1930, 1984-present [1990]. The natural and cultural significance of the site, including both indigenous and non-indigenous heritage, is considered to be unique and exceptional at a State and National level. The natural and cultural significance of the Centennial parklands is considered to be greater than that attributed to Kings Wetland and Patmore Swamp.
Lower Duck River Wetlands	LEP	Criteria C & E	The Lower Duck River Wetlands is located along the foreshore of Duck River and is a representative indigenous vegetation, fauna and flora habitat and an aesthetic element on the Parramatta River. This heritage listed wetland is listed for its natural heritage values, similar to both Kings Wetland and Patmore Swamp. Both Kings Wetland and Patmore Swamp have been extensively modified culturally, including landscaping and plantings.

Item	Heritage Listing	Significance (SHR Criteria)	Comparison to Kings Wetland and Patmore Swamp
Wolli Creek Wetlands	LEP	Criteria A, B & F	Wolli Creek Wetlands is considered to be an intact mangrove and salt marsh habitat in the Sydney region. The Salt marsh community is rare and poorly conserved in NSW. This area also acts as an important wildlife corridor for migratory Wading Bird Treaty, have been sighted in the area. Compared to both Kings Wetland and Patmore Swamp, this wetland is considered to be of a similar heritage value, however, the Wolli Creek Wetland is listed solely for its natural indigenous heritage values and no cultural heritage values. Both Kings Wetland and Patmore Swamp are both heavily impacted and highly landscaped sites that do not reflect much on their indigenous natural heritage values.

19.8 Environmental risk assessment

An environmental risk assessment was undertaken in three phases as part of the project:

- During the preliminary environmental assessment, carried out as part of the SSI application report to allow for early identification of key non-Aboriginal heritage issues
- Through an assessment of the key issues identified in the SEARs for the project
- During the EIS to confirm the impacts based on the results of detailed investigations.

The assessment process used a likelihood and consequence occurrence risk approach. Likelihood and consequence category descriptions can be found in **Appendix O** (Methodologies)

The risk analysis undertaken for non-Aboriginal heritage identified the following risks:

Table 19-7 Environmental risk analysis – non-Aboriginal heritage

Summary of impact	Construction/operation	Management and mitigation reference	Likelihood	Consequence	Residual Risk
Potential indirect impacts on features of local heritage significance (e.g. altered viewsheds), including Kings Wetland, Patmore Swamp and Brighton Le Sands Public School	Construction	NAH3, NAH4, NAH5, NAH6	Likely	Moderate	Medium
Direct impacts to local heritage item Patmore Swamp by the proposed surface works to President Avenue	Construction	NAH6	Certain	Minor	Low
Impacts to items of non-Aboriginal heritage which are discovered during demolition or earthworks	Construction	NAH1	Unlikely	Moderate	Low

One medium level residual risk has been identified in this residual risk assessment. Through the detailed design of the project there is further opportunity to:

- Develop effective construction methodologies and planning with the construction contractor to ensure that management and mitigation measures are effectively implemented

- Implement a process of review, correction and audit for the CEMP as detailed in **Chapter 29** (Summary of environmental management measures). This is a process of continuous improvement that would form part of the CEMP and OEMP and allow for management measures to be updated or improved during construction and operational phases where practical.

Impacts identified as having a low residual risk are considered to have already been managed to a reasonable and feasible level.