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Moore Point Planning Proposal: Aquatic Ecology Assessment

Joint Landowner Group

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1. Introduction

Moore Point is the largest privately-led urban renewal project in Australia, led by a Joint Landowner Group (JLG) comprised of Coronation Property Co and Leamac Property Group.

The 31.4 hectares site, set within the Liverpool Collaboration Area (LCA), is a unique opportunity to deliver a model for urban renewal at a metropolitan scale consistent with the strategic priorities of Government, it will be a catalyst for Liverpool City Council (Council) to realise its objectives for the LCA and the Western Parkland City.

When delivered, Moore Point will consolidate Liverpool's role as Australia's a great river city, providing a high-quality living and working environment for future generations. It will deliver homes, jobs and open space up to 2060, in a highly accessible location with unparalleled recreational amenity along the Georges River and Lake Moore.

At a glance, Moore Point will deliver:

- Approximately 11,000 dwellings set within distance of Liverpool CBD and LCA,
- A Significant contribution of employment generating floorspace and associated jobs to complement the expansion of Liverpool CBD, and
- Over 10 hectares of publicly accessible open space supported by bridge crossings from Liverpool CBD to a fully accessible Georges River foreshore and Haigh Park.

The site plays a critical role in fulfilling the connectivity, liveability, productivity and sustainability priorities of the LCA and support the vision to make Liverpool Australia's next great river city. These include:

- New housing and jobs within a highly accessible location (five minutes' walk to Liverpool CBD and transport interchange) via new bridge crossings over the Georges River. This will support active and sustainable modes of travel within the LCA.
- Critical links from the CBD and LCA to the Georges River, Haigh Park and Lake Moore. This will support the creation of a new interconnected high-performance green and blue infrastructure network, which will support healthy urban growth.
- A genuine riverside precinct with high levels of activation, amenity and accessibility, facilitating Council's vision of celebrating the river and prioritising great places for people.
- A diverse range of new and enhanced social and civic infrastructure outcomes to benefit both current and future generations.

1.1 The site

Moore Point is located east of Liverpool CBD across the Georges River in the suburb of Moorebank. It is located within the LCA and comprises 31.4 hectares of the 38 hectare Georges River North Precinct.

The subject land comprises of the following addresses and lots within the Liverpool City Council LGA:

- 3 Bridges Road, Moorebank (Lot 200 DP 1009044)
- 5 Bridges Road, Moorebank (Lot 100 DP 775780)

- 6 Bridges Road, Moorebank (Lot 10 DP 875626)
- 8 Bridges Road, Moorebank (Lot 111 DP 1133744)
- 11 Bridges Road, Moorebank (Lot 201 DP 1009044)
- 16 Bridges Road, Moorebank (Lot 1 DP 329572)
- 361 Newbridge Road, Moorebank (Lot 101 DP 827141).

The subject land is defined by the Georges River along the western and northern edge and Lake Moore along the eastern edge. A large open space is located adjacent to the north-eastern corner and Lake Moore (a constructed lake) is located directly east of the subject land. Newbridge Road, a major arterial road, forms the southern boundary of the subject land.

Part of the site contains heritage items including the Former MM Cables Factory and Cable Makers Australia Factory Pty Ltd Group, including inter-war administration building, factory and interiors.

The subject land currently accommodates large industrial, commercial development and open space, largely lacking native vegetation. The subject land has been subject to considerable vegetation disturbance. Aerial photography from 1943 shows remnant vegetation as being cleared within and round the subject land. The landscape has been raised with fill material and flattened as part of historical clearing and development (ACS Environmental 2015). Revegetation work has occurred along the riparian buffer of Georges River and Lake Moore. Revegetation includes planted native trees, shrubs and ground cover species within the north, east and western riparian buffer along the perimeter of the subject land. Planted native vegetation within horticultural gardens and open grassland with opportunistic weeds occur throughout the subject land.

The subject land is currently zoned as E4 (General Industrial) under the Liverpool Local Environmental Plan (LEP) 2008 with the planning proposal to rezone the area as MU1 (Mixed Use) and RE1 (Public Recreation).

The land subject of the planning proposal relates to the land owned and under the control of the JLG, as defined in Figure 1.

1.2 Background

Following adoption of the Liverpool Collaboration Area Place Strategy (Place Strategy) by the Greater Sydney Commission (GSC) in September 2018, Council indicated to landowners in Moore Point that it was prepared to consider a rezoning of land in the precinct that would meet the intention expressed in the Liverpool Collaboration Area Place Strategy.

Council indicated to landowners that had previously submitted planning proposals that a precinct-wide approach to development of Moore Point should be undertaken, including a structure plan for the entire precinct.

On this basis, a planning proposal was lodged with Council on 15 April 2020 for the consolidated Moore Point site. The planning proposal replaced RZ-6-2015 and withdrew all other previous site-specific planning proposals that were submitted.

The Planning Proposal was endorsed by Council on 25 November 2020, subject to the following:

1. *Notes the advice of the Liverpool Local Planning Panel;*
2. *Endorses in principle the planning proposal request with the following amendments:*
 - a. *An additional 1.5 hectares of open space marked as 'Open Space Investigation' adjacent to Haigh Park;*
 - b. *A minimum 40m RE1 – Public Recreation zone is provided along Lake Moore;*
3. *Endorses an Urban Design Study and Structure Plan for the Georges River North precinct, with the above amendments, to guide the assessment of future planning proposals in this area (Figure 2).*



Figure 2: Endorsed Structure Plan

*The alignment of the northern pedestrian bridge over the Georges River is subject to further discussions with affected landowners. The alignment of the pedestrian bridge is subject to change

The Planning Proposal was then forwarded to DPE for Gateway in December 2020. At the same time, Council were finalising a Regional Flood Evacuation Analysis. Council wrote to DPE requesting the proposal be submitted once the analysis was completed and its findings could inform the proposal. The advice was to relodge the planning proposal once the findings of Council's Regional Flood Study were understood. The Georges River Flood Evacuation Analysis was finalised in March 2022 and the planning proposal was relodged by Council for Gateway on 4 May 2022.

In March 2022, in response to the flooding of the Northern Rivers region, the NSW Government commissioned an independent expert inquiry into flooding. The inquiry recommended a review of planning rules for developing on flood-prone land. DPE reviewed current planning proposals in relation

to the flood risk each proposal presented, to determine if proposals can proceed or whether further flood risk and mitigation measures and evacuation capacity was required. Considering the recommendation of the NSW Flood Inquiry, DPE sought advice from a Flood Advisory Panel (the Panel) regarding the flood risk associated with Moore Point. The Panel found that there was sufficient case-specific merit to pursue the flood risk mitigation measures and allow the proposal to proceed to Gateway, subject to conditions that have been informed by the Technical Advisory Group (TAG) and other material before the Panel.

To guide assessment of the Panel recommendations, DPE have appointed an independent peer reviewer to ensure the recommendations have been fulfilled as part of the assessment process. Council has also engaged a technical flood advisor to support Council's review of the revised planning proposal. These processes were funded by the JLG to support the progression of the proposal.

On 4 April 2023, DPE concluded the planning proposal could proceed subject to conditions. These conditions are addressed as part of the updated planning proposal package submitted to Council for assessment. A summary of the timeline is below in Figure 3.



Figure 3: Timeline summary

1.3 The Vision

In preparing the planning proposal, the JLG have developed the following vision for Moore Point:

Liverpool has the ambition to be the next Great River City of the world. A city where the Georges River is its beating heart unifying both sides of the river into a pulsating riverfront experience.

The Moore Point vision will shape the city's eastern bank into an internationally renowned destination loved by locals and visitors alike. Reimagined riverfront parklands, river pools, creative heritage quarter and marketplace inspire our people and residents to be the most productive, most happy, and most healthy people on the planet.

The proposal will create the first truly integrated riverfront development at scale. At the heart of this attraction will be a revitalised riverbank which will undergo an ecological transformation and create a natural, healthy and vibrant river ecosystem.

The river will also offer a diverse range of recreational opportunities, providing activities that meet the needs of a diverse community, and which encourages an active outdoor lifestyle.

1.4 The proposal

The planning proposal seeks to amend the *Liverpool Local Environmental Plan 2008* (the LEP) to transform the zoning from industrial to mixed-use and public recreation, including changes to floor space ratio, height of buildings and site-specific provisions.

In response to the Gateway conditions, the planning proposal and supporting structure plan has been updated. The planning proposal has enhanced and improved many of the key elements of the originally endorsed Structure Plan and planning proposal by Council on 25 November 2020 meeting including:

- Celebrating Heritage - Enhanced heritage response, including the retention of the heritage grid, Factory 1 and the Administration Building with partial retention of Factory 2 and adaptive reuse of additional outbuildings along the Georges River foreshore.
- Foreshore Park – Embellishment of a new 7 hectare linear foreshore park and completing the missing link between Lighthorse Park and Haigh Park.
- Bridges and Community Anchors – Creation of new pedestrian bridges to Liverpool CBD and LCA, facilitating access from the wider area to a 1,000 capacity primary school, community facilities and retail amenity.
- Street Hierarchy and Boulevards – A new movement and access network to facilitate active transport from Georges River to Lake Moore and a ring road to support vehicular movement.
- Pedestrian Lanes and Pocket Parks – Creation of a diverse range of pocket parks, passive open space areas and pedestrian laneways between blocks to enhance access to open space, views and access to the waterfront.

The JLG engaged Yerrabingin in 2021 to prepare an Indigenous Narrative Report. The report establishes Connecting with Country themes for the revised masterplan and public domain. This includes bringing river ecology up and over into the foreshore, including restoration of endemic/native species through naturalised revetment treatment that will support habitat.

The revised planning proposal has been informed by a suite of interdisciplinary technical consultants through an iterative process to ensure the creation of a successful place that comprehensively addresses the Gateway conditions.

1.5 Structure plan and indicative masterplan

The planning proposal is supported by a structure plan (Figure 4) and indicative masterplan (Figure 5). Each plan serves a distinct purpose in supporting the outcomes of the project.

- **Structure Plan** - Sets out the spatial parameters for Moore Point that will remain constant throughout the delivery of the project. This includes the open space network, primary school, foreshore, roads and streets, heritage items to be re-used and development blocks.
- The Structure Plan informs the basis for masterplan development and the preparation of a future site specific Development Control Plan (DCP) and will also allow Moore Point to respond flexibly to changing market demands and policy contexts.

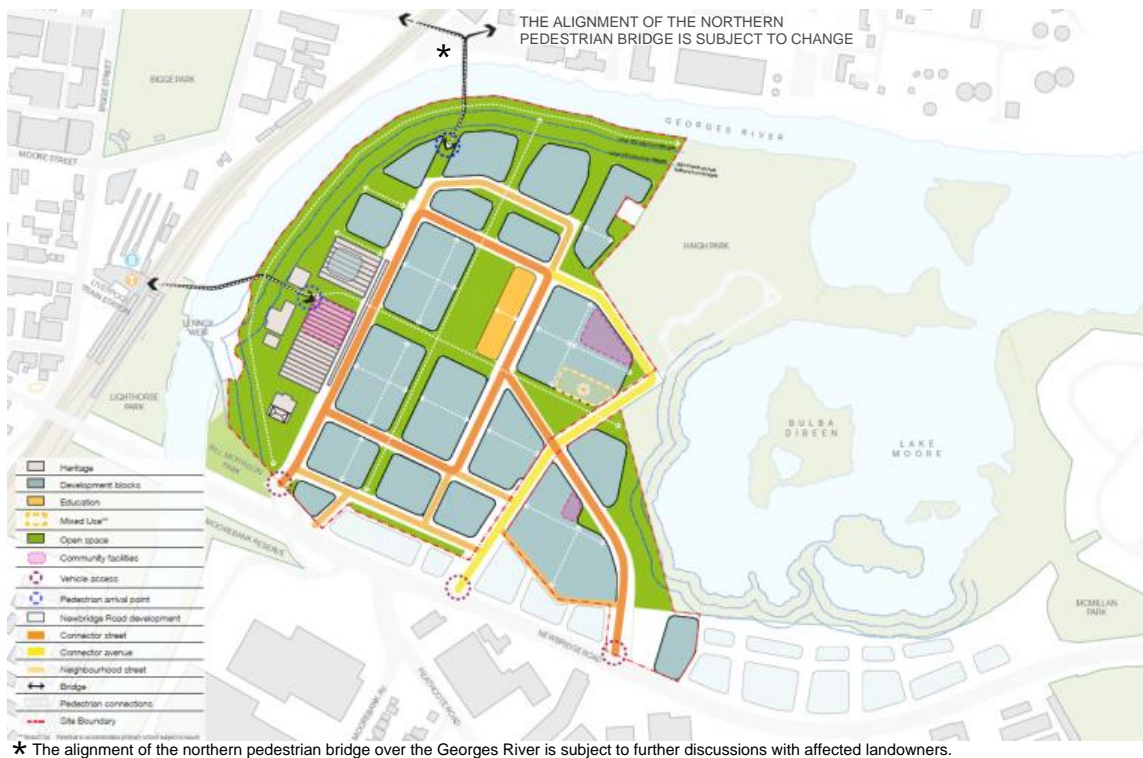


Figure 4: Updated Structure Plan

- **Indicative Masterplan** – Depicts one of many potential land use and built form outcomes set within the development blocks. This includes potential residential and non-residential uses, typologies and built form configurations.
- The level of information provided in the indicative masterplan has been prepared to address the issues raised by the Gateway determination including assessment against design standards and environmental considerations. The purpose of the masterplan, at this stage, is to both allow for technical testing (such as urban design, traffic, economics, flooding, evacuation) and to set a high quality vision for the development of the site.



★ The alignment of the northern pedestrian bridge over the Georges River is subject to further discussions with affected landowners.

Figure 5: Indicative masterplan including Haig Park (Source: Turf Design Studio 2024)

1.6 About this report

Eco Logical Australia Pty Ltd (ELA) has been engaged to complete an aquatic ecology assessment for the Moore Point Planning Proposal involving redevelopment for mixed use and riverbank reshaping works at Moore Point on the Georges River (Figure 6). This report accompanies the Biodiversity Development Assessment Report (BDAR) (ELA 2024) in addressing the Gateway Determination conditions issued by the Department of Planning and Environment (4 April 2023) (Table 1).

Indicative cross sections, artist renditions and concept designs are included in Appendix A. In summary the works would:

- Demolish all structures and vegetation marked for redevelopment
- Redevelop land as a mixed-use precinct containing residential and commercial structures, public spaces and amenities
- Clear all riparian vegetation from the weir for approximately 800 m downstream (right-hand bank of the Georges River, when facing downstream)
- Reshape steep bank to become a stepped and/or gentle slope
- Install rock toe of bank above and below the Mean High Water Mark (MHW) to help stabilise new bank grade
- Reinstall riparian and fringing aquatic vegetation and habitat on the new bank
- Provide foreshore vantage points for passive recreation.

This assessment aims to meet the Department of Primary Industries – Fisheries (DPI Fisheries) environmental assessment requirements for foreshore developments and address impacts to key fish habitat (KFH) as defined in Fisheries’ *Policy and Guidelines for Fish Habitat Conservation and Management* (2013 update) (Fairfull 2013).

This assessment has also addressed potential impacts to threatened or protected aquatic species listed under the NSW *Fisheries Management Act 1994* (FM Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A discussion is provided to guide future DAs (for construction) to meet development controls related to coastal management areas of the ‘coastal zone’ under the *State Environmental Planning Policy (Resilience and Hazards) 2021*.

This report does not assess riparian guidelines under the *Water Management Act 2000* (WM Act) or *Fisheries Management Act 1994*, as a report has been prepared by Northrop 2024 (Moore Point Riparian Assessment). Terrestrial impacts are assessed in a BDAR (ELA 2024).

Table 1: Gateway Determination conditions issued by the Department of Planning and Environment (4 April 2023) and ELAs response

Gateway condition	Response
<i>5. The Biodiversity Assessment must be updated to:</i>	
a. Identify land comprising coastal protection, and the attributes and sensitivities of this site.	Section 4.1 for coastal wetlands and the Georges River. Other Environmentally Sensitive Land is addressed in the BDAR (ELA 2024).
b. Address the impacts on the water quality, river flows, bushland and sensitive environments such as wetlands, freshwater and estuarine ecosystems.	Section 5 for a range of impacts to aquatic ecosystems. Other Prescribed Impacts are addressed in the BDAR (ELA 2024).
c. Reflect all current legislation, guidelines and assessment criteria.	Section 2 for legislation and guidelines.
d. Identify which order stream the Georges River is and update the report accordingly.	Georges River is a 7 th order stream (Strahler classification), as shown in Figure 6.
e. Ensure all species references and credit species references are correct.	This relates to the BDAR (ELA 2024).
f. Identify the biodiversity values and consider the impact of the proposed development on the land identified to be zoned RE1 within the Precinct, including any indirect impacts to Haigh Park, The Georges River and Lake Moore. This should also include consideration of the impacts of any development proposed within these areas such as upgrades to Haigh Park, the installation of pathways, lighting, and overshadowing.	Section 5 for a range of impacts to aquatic ecosystems. Other indirect impacts are addressed in Section 10.3 of the BDAR (ELA 2024).
g. Adequately justify any impact to threatened ecological communities.	No threatened aquatic ecological communities occur in the study area.

Gateway condition	Response
	Terrestrial communities are addressed in the BDAR (ELA 2024)
h. Update the Biodiversity Assessment Report to include a discussion on how the existing biodiversity values informed the land zoning and development footprint.	Avoiding and minimising impacts on biodiversity values is addressed in Section 9 of the BDAR (ELA 2024).
i. Review and address NSW Environment and Heritage Group (EHG) comments in regards to: <ul style="list-style-type: none"> i. exclusions of ecosystems credits and; ii. undertake targeted surveys in the correct times of the year. 	This relates to the BDAR (ELA 2024)



Figure 6: Location and context

2. Legislative context

2.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Under the EPBC Act, the Commonwealth Environment Minister needs to approve any development that is likely to have a significant impact on Matters of National Environmental Significance (MNES). Should such an impact, as defined in the EPBC Act Policy Statement 1.1 – Significant Impact Guidelines (DEWHA 2009), be likely, the preparation and submission of a Referral is required. MNES relevant to this study (aquatic only) may include threatened aquatic ecological communities, flora and fauna species, and migratory species listed under the Act. Terrestrial species are addressed in the BDAR (ELA 2024).

2.2 NSW Fisheries Management Act 1994

The FM Act provides for the protection, conservation, and recovery of threatened species, populations, and ecological communities defined under the Act, as well as the protection of fish and fish habitat in general. If a species, population or ecological community listed under Division 2 of the FM Act is likely to occur on site and be impacted, an Assessment of Significance must be undertaken. Section 220ZZ of the FM Act outlines the factors that must be taken into account to determine whether the action proposed is likely to cause a significant impact.

The proposed works would occur on Key Fish Habitat (KFH). Waterfront developments or instream works may require a permit from DPI Fisheries under Part 7 of the FM Act, for:

- harming marine vegetation
- dredging and/or reclamation of the bed or bank
- obstruction of fish passage.

The future works would be classed as *dredging and reclamation*, but are unlikely to *harm marine vegetation* or *obstruct fish passage*. The need for permits depends on whether future development applications are assessed as State significant development.

Riparian buffers are not discussed in this report (see other documents in Section 2.3).

2.3 NSW Water Management Act 2000 (WM Act)

The WM Act aims to provide for the sustainable and integrated management of water sources for NSW. The Act requires developments on waterfront land to be ecologically sustainable and recognises the benefits of aquatic ecosystems to agriculture, fisheries, and recreation. This report does not assess the proposed riparian corridor widths, as a separate riparian assessment is provided by Northrop (2024).

2.4 NSW Coastal Management Act 2016 (CM Act)

The objectives of the CM Act are to manage the coastal environment of NSW in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the State. Part 2 of the CM Act identifies objectives related to four coastal management areas of the 'coastal zone':

- 1) Coastal wetlands and littoral rainforests area
- 2) Coastal vulnerability area
- 3) Coastal environment area
- 4) Coastal use area.

The *State Environmental Planning Policy (Resilience and Hazards) 2021*, maps these four coastal zones, plus a fifth 'Land in Proximity to Coastal Wetlands' and provides development controls under Part 2.2. The proposed works fall within the 'Coastal Environment Area', 'Coastal Use Area' and 'Land in Proximity to Coastal Wetlands'. Where zones overlap, the management objectives are resolved in favour of the highest-ranked zone numbered above. The Planning Proposal intends that the development precinct lies outside of the 'Coastal Wetland' boundary.

2.5 Liverpool Local Environment Plan (LEP) 2008

The site is currently zoned E4 General Industrial. The Planning Proposal aims to rezone the site to MU1 Mixed use and RE1 Public Recreation.

The site is not subject to the Biodiversity or Riparian overlay under the LEP. However, Georges River and Lake Moore and their land buffer are included in Environmentally Sensitive Land under Additional Local Provisions of the LEP. The area mapped as Environmentally Significant Land is zoned Open Space and should be protected from development.

The study area contains Class 5 Acid Sulfate Soils and requires the implementation of an acid sulfate soils management plan. This is addressed in a separate report.

2.6 State Environmental Planning Policy (Biodiversity and Conservation) 2021

The development site is located within the Georges River Catchment in accordance with Chapter 6 of the *State Environmental Planning Policy (Biodiversity and Conservation) 2021*. Therefore, development controls under Division 2 (clauses 6.6 – 6.10) apply:

- Water quality and quantity – the effect on the quality of water entering a natural waterbody will be as close as possible to neutral or beneficial, and, the impact on water flow in a natural waterbody will be minimised.
- Aquatic ecology – the development is to have minimal impacts, whether direct, indirect or cumulative, to adjacent and downstream waterbodies and wetlands.
- Flooding – the development, if flooded, is not to release pollutants or obstruct natural flows to nearby wetlands and riverine ecosystems.
- Recreation and public access – foreshore access is not to cause an adverse impact on natural waterbodies, watercourses, wetlands or riparian vegetation.
- Total catchment management – the consenting authority must consult with downstream Councils before granting development consent.

3. Methods

3.1 Desktop review

Databases and reports were reviewed as part of a desktop assessment. Online database searches were used to confirm the presence of recorded species in the region. The desktop search covered a 10 km radius around the site. Other literature and datasets were reviewed to narrow the list of potential species that may use the site or adjacent aquatic habitat.

Only species known to use estuarine/marine water or intertidal foreshores were considered in this aquatic assessment. Databases accessed include:

- EPBC Act – Protected Matters Search Tool
- FM Act – Listed protected and threatened species and populations, including species profiles, Fisheries Spatial Portal, 'Primefact' publications and expected distribution maps (Riches et al 2016)
- Online Zoological Collections of Australian Museums (OZCAM) – individual species searches to determine the likelihood of occurrence of threatened species.
- A review of Council's acid sulphate soil (ASS) maps and eSPADE ASS maps was also undertaken to determine the likelihood of acid sulphate soils occurring in the study area.

3.2 Field survey

A survey of intertidal and subtidal aquatic habitat occurred on 25 July 2023 by Ian Dixon and Erin Hodgkin during a low tide (0.6 m). Subtidal habitat within about 10 m of the low tide mark was assessed via drop camera livestreamed to a boat. Each distinct habitat was identified by its KFH sensitivity type, and extent mapped on a GPS-enabled tablet.

4. Results

4.1 Desktop results

Table 2 lists threatened species and management areas produced from the online datasets, along with their relevance to the proposal. Amphibians and wetland birds are discussed in a separate report (BDAR, ELA 2024).

Table 2: Threatened species and management zones relevant to the study area

Dataset or literature	Result	Relevance to proposal
Commonwealth Protected Matters Search (EPBC Act)	Three species of threatened fish. Five species of threatened marine turtles.	None are considered likely to use the study area or be impacted by the proposal. See assessment in Appendix B.
Fisheries Spatial Portal and Primefact Species Profiles (FM Act)	Mapped as Key Fish Habitat (Sydney Metro). Mapped as 'Fair' Fish Community Status. No modelled occurrence of any freshwater threatened species. Three threatened marine species/populations in Botany Bay. Nearest mapped marine macrophytes are mangroves, over 6 km downstream. The nearest mapped seagrass is over 8 km downstream (Figure 8). Nearest <i>Marine Protected Area</i> is 28 km downstream at Towra Point. Aquaculture leases and oyster reefs are located 25 km downstream. No registered critical habitat.	Impacts to Key Fish Habitat requires consultation/permits with DPI Fisheries, and triggers their offset policy to ensure no-net loss. No threatened fish or seagrass populations are considered likely to use the study area or be impacted by the proposal. See assessment in Appendix B. No harm to marine vegetation is expected. No indirect or significant cumulative impacts are expected to downstream habitats and protected areas.
Resilience and Hazards SEPP 2021	The development area is inside the following management zones (Figure 9): <ul style="list-style-type: none"> Proximity to coastal wetlands or littoral rainforest Coastal environment area Coastal use area 	The consent authority must be satisfied that considerations listed under Clauses 2.8, 2.10 and 2.11 of the Resilience and Hazards SEPP have been met.
eSpade and Liverpool LEP	Acid Sulfate Soils risk (Figure 10): <ul style="list-style-type: none"> Land north - Class 1 Land south – Class 3 and H1 (high probability <1 m below ground surface) River - Class 5 and Hm (high probability, bottom sediments). 	A contamination report is required to verify the need for an Acid Sulfate Soils Management Plan.
Biodiversity of the Georges River Catchment: Aquatic Biodiversity, Chapter 4 Estuarine Fish (DIPNR 2004)	In a fish survey of the Georges River estuary (from Botany Bay to about 6 km downstream of the study site), DIPNR did not find any threatened species from 5300 individuals (87 species) captured. However, one of the species has since been listed as Endangered: <i>Hippocampus whitei</i> (White's Seahorse). White's Seahorse and other protected Pipefish (Syngnathidae) were only recorded in Botany Bay, where seagrasses are dense, and salinity is higher than the upper estuarine channel of the river. Museum	These sources confirm White's Seahorse and other protected Syngnathids are unlikely to occur in the upper estuarine reach of the river. Seagrass was recorded around the study site in small patches (see field results in Section 4.2), and DIPNR note that

Dataset literature	or Result	Relevance to proposal
	<p>records of White's Seahorse only occur east of Captain Cook Bridge. The authors also noted a lack of seagrass in the upper channel of their study area.</p> <p>Of the total fish catch, 557 individuals from 23 species were in the Riverine Channel portion of their study area, closest to the development site. Species were dominated small-sized glassfishes, gobies, sprat and gudgeon; and medium sized whiting, mullets, bream and silver belly.</p>	<p>due to longer residence times of pollutants in upstream reaches, distribution and abundance of seagrass may be related to water quality.</p> <p>One recommendation made by DIPNR is that where there is potential to enhance fish habitat, particularly in the Riverine Channel, foreshore rehabilitation programs should be initiated.</p>
Georges River Data Compilation and Estuary Processes Study (SMEC 2010)	<p>SMEC note in their study the following water, sediment and erosion features in or close to the study site:</p> <p>Tidal range is relatively constant along the river with differences in levels of less than 0.1 m between the Liverpool Weir (mean spring range of 1.31 m) and Botany Bay (mean spring range of 1.25 m).</p> <p>The strong tidal influences associated within the lower reaches of the estuary, towards Botany Bay, is reflected by the higher salinity levels (34 – 37 ppt) in Dolls Point, comparable to sea water. This salinity gradually decreases with increasing distance upstream to 0-10 ppt at Liverpool Weir. The upper estuary is typically dominated by freshwater but is subject to daily tidal action.</p> <p>There is a veneer of fine surface sediment overlaying medium to coarse sands between Liverpool Weir and Lake Moore, indicating a low tidal influence (low flow and low tidal velocities).</p> <p>The geology of the upper section of the Georges River, between Liverpool Weir and East Hills which consists predominantly of dispersive clays and shales, which amplifies turbidity in the channel.</p> <p>The upper sections of the Georges River, between Liverpool Weir and East Hills, experience higher turbidity levels, and recovery after rainfall is slower than less affected downstream areas towards the mouth of the river. Tidal exchange especially in the upper reaches does not contribute strongly to the recovery rate; rather sedimentation is likely to be the primary mechanism for recovery. However, clear water spilling from the weir would assist in flushing turbid water downstream.</p> <p>Dredging too close to the riverbanks has caused slumping and significant erosion issues and scouring of the bed. A bed scour depth ranging from 3 to 9 m has been predicted between Liverpool Weir and East Hills.</p> <p>Two major kinds of erosion are identified along the Georges River: Scouring – in the form of bed scouring and toe scouring; Mass failure – common in high and steep riverbanks which results commonly from toe scour.</p> <p>Some erosion prone riverbank materials, presence of dispersive clay and change in flow regime at the Weir, Lake Moore inlet, river bend downstream of William Long Bridge and inlet to Chipping Norton Lake are also amongst the major contributing factors to erosion.</p>	<p>The key points of the study by SMEC confirm:</p> <p>There is low salinity levels near the site, which would influence what marine species can use the site.</p> <p>Historic bank erosion is widespread (e.g. Figure 7) and supports the justification that stabilisation is required.</p> <p>Turbidity is high compared to downstream, and sedimentation is more likely due to less tidal flushing. This would influence the type of marine species that could tolerate the site (e.g. light would not penetrate far into the water column to support extensive beds of subtidal macrophytes like seagrasses, but macroalgae may be more tolerant).</p>

Dataset literature	or	Result	Relevance to proposal
		<p>A general channel widening has been observed along the Georges River between Liverpool Weir and Monash Reserve at East Hills.</p> <p>In response to construction of several instream lakes, the river channel located between Moore and Chipping Norton Lakes and between Moore Lake and Liverpool Weir was deepened and the banks were mostly eroding during the same period.</p>	

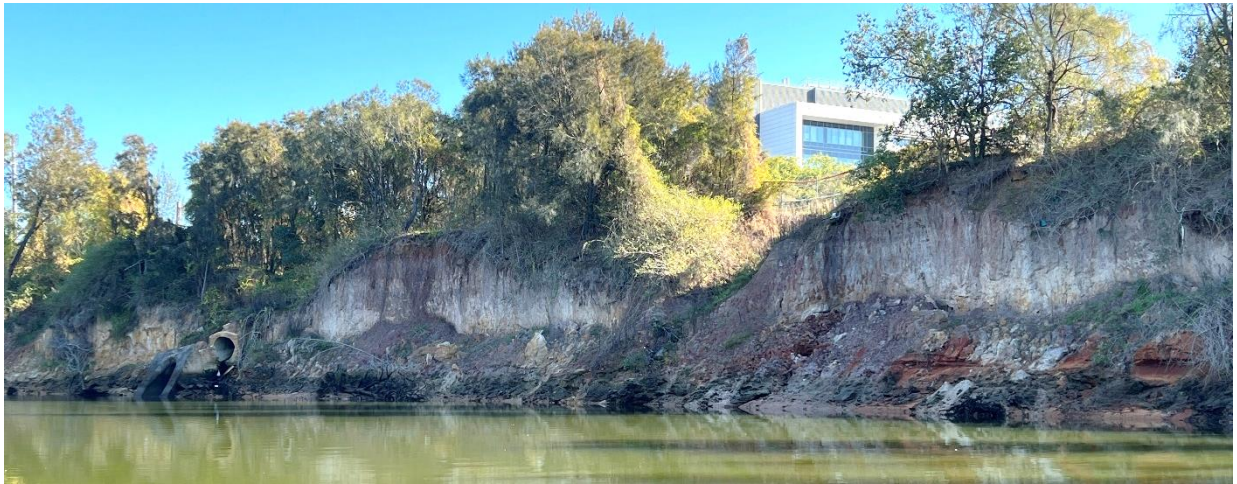


Figure 7: Example of historic erosion of the Georges River, directly opposite the study area (25 July 2023)



Figure 8: Marine macrophyte mapping (DPI Fisheries Portal)



Figure 9: Resilience and Hazards SEPP management areas

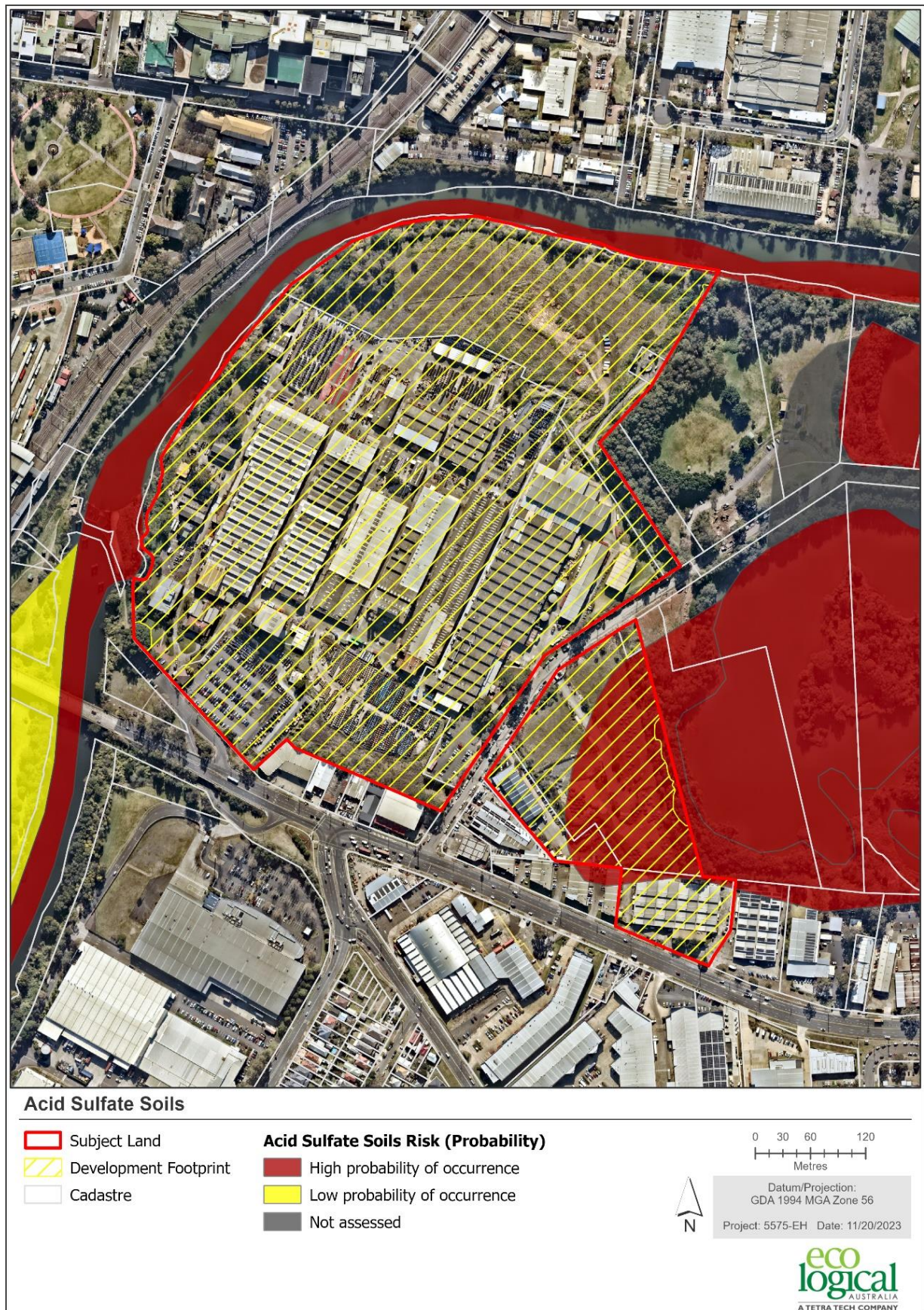


Figure 10: Acid sulfate soils risk



Figure 11: Field-validated terrestrial vegetation (ELA 2024)

4.2 Field results

DPI Fisheries identify three types and four classes of KFH in their *Policy and Guidelines for Fish Habitat Conservation and Management* (Fairfull 2013). Field mapping of KFH around the study site is shown in Figure 12, and summarised in Table 3. Where KFH Types overlap (e.g. Coastal Wetlands overlapping mangroves), the more sensitive type applies when referring to the Fisheries Policy and Guidelines. Representative photos are shown in Figure 13.

Table 3: Key Fish Habitat (KFH) types in the study area

KFH Type or Class	Description
Class 1	Estuarine waterway.
Type 1 (highly sensitive)	<p>The foreshore around Lake Moore is mostly mapped as Coastal Wetlands under the Resilience and Hazards SEPP 2021, dominated by <i>Casuarina glauca</i> (Swamp Oak) and <i>Aegiceras corniculatum</i> (River Mangrove).</p> <p>Seagrass occurred in small, isolated patches around the shallowest areas of the lake, <i>Zostera</i> sp. (Eelgrass).</p> <p>No saltmarsh was observed, as banks were either too steep (main channel) or occupied by dense <i>Casuarina</i> trees shading the intertidal zone (Lake Moore).</p>
Type 2 (moderately sensitive)	<p>Mangroves dominated the foreshore of the lake, comprised of a row of <i>Aegiceras corniculatum</i> (River Mangrove) growing beneath the Swamp Oak canopy, plus the occasional <i>Avicennia marina</i> (Grey Mangrove) in more open areas.</p> <p>Reeds were also present along the lake's foreshore, occupying the narrow space where mangroves were absent. Only scattered reeds occurred along the main river channel where soft sediment, gentle flows and adequate depth allowed. Each reed bed was dominated by one of three species: <i>Phragmites australis</i> (Common Reed), <i>Schoenoplectus Validus</i> (River Clubrush) and <i>Typha domingensis</i> (Narrow-leaved Cumbungi). As this is an estuarine environment, the reeds do not fall under the Type 1 KFH for freshwater aquatic plants, but they can tolerate fresh or brackish water. Salinity on the day of field work was between 5.4 and 6.4 ppt (from downstream of the weir to the confluence with the lake).</p> <p>Snags (fallen trees and logs >3 m) submerged or partially submerged, were common along the main channel, and scattered within the lake. As this is not a freshwater system, the snags are not classed as Type 1 KFH, but they still provide a similar function as fish shelter and hard surface.</p> <p>Rocky rubble occurred infrequently in the intertidal zone, with only a small portion extending into the subtidal channel.</p> <p>No marine macroalgae was observed.</p>
Type 3 (minimally sensitive)	<p>The remainder of the intertidal and subtidal study area was classed as unvegetated sand or mud substrate, estuarine sandy beaches with minimal or no benthic invertebrates.</p> <p>The noxious algae <i>Caulerpa taxifolia</i> was not observed.</p> <p>Riparian vegetation was dominated by scattered <i>Eucalyptus</i> spp. and <i>Casuarina glauca</i> trees and understorey weeds, as documented in the BDAR (see Figure 11 above).</p>

The right-hand bank (when facing downstream) along the Georges River channel ranged from steep and eroded to well-vegetated native riparian land. Although disturbed in parts, this bank contrasted the opposite bank, which was heavily rock-armoured near the train line and severely eroded with near-vertical bank further downstream. The banks of Lake Moore were gentle with soft silty-sands. Some undercutting was present beneath tree roots. The lake is a no-boating zone and doesn't have a flow-through current, therefore, it is protected from boat wash and scouring.

A couple of anglers were observed along the lake's foreshore, one with a successful haul of Mullet at Haigh Beach.

Gandangara Island, located between Lake Moore and the Georges River channel, supported a large number of Pelicans roosting on its broad intertidal sand bank.

Other observation from the site visit were a large amount of discarded goods in the shallows, particularly in two areas with walking trails from Haigh Park. This appeared to be deliberately placed, rather than litter blown or washed into watercourses.



Figure 12: Field validated key fish habitat types (25 July 2023)



Left: Georges River – weir obstructing tidal movement. Right: native reeds along intertidal zone and weedy bank.



Left: Georges River – snag in intertidal zone with sparse vegetation. Right: Phragmites reeds and native riparian vegetation.



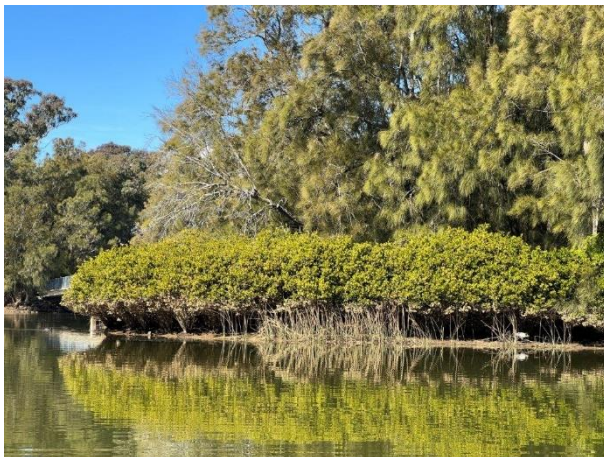
Left: Georges River – mixed native riparian vegetation and intertidal snags. Right: concrete rubble, weeds and intertidal sand.



Left: opposite bank – severe erosion common. Right: opposite bank – rock armour along rail corridor.



Left and right: Lake Moore – Phragmites reeds on narrow intertidal flat in front of Casuarinas.



Left and right: Lake Moore – narrow band of River Mangrove is common along the intertidal zone.



Left and right: Lake Moore – small dense patch of Zostera seagrass in shallowest subtidal zone.



Left and right: Lake Moore – underwater photos of Zostera seagrass (leave blade <9 mm wide, various tip shapes).



Left and right: Lake Moore – underwater photos of Zostera seagrass (leave blade <9 mm wide, various tip shapes).



Left: Lake Moore – bare sandy beach near public path. Right: River Mangroves dominant less accessible areas around the lake.

Figure 13: Representative site photos of key fish habitat types and bank condition (25 July 2023)

5. Impact assessment

5.1 FM Act requirements

Potential direct and indirect impacts from the Concept Masterplan are assessed in Table 4.

Table 4: Potential direct and indirect impacts

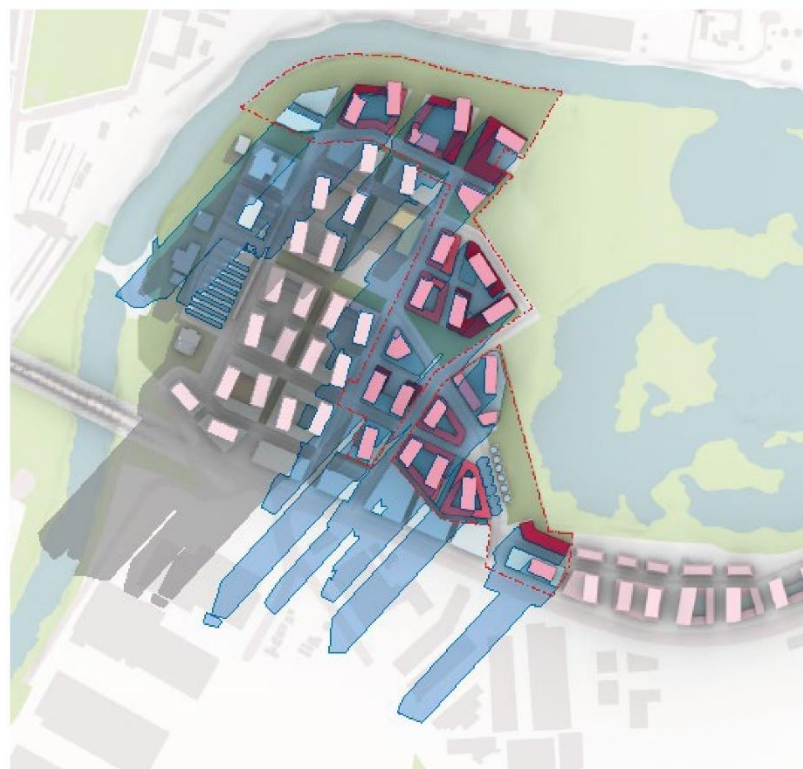
Feature	Description	Potential severity of impact
Threatened aquatic flora and fauna (FM and EPBC Acts)	No threatened aquatic species, populations or communities are likely to occur on site or nearby	None
Key fish habitat	Bank reshaping will remove Type 3 KFH but replace it with a more stable and vegetated riparian corridor (total 800 m). Snags would be removed during bank stabilisation, resulting in a loss of shelter for estuarine fish.	With targeted habitat features, the replacement riparian and intertidal habitat could ensure there is no net loss of KFH.
Coastal wetlands	All works are outside the mapped coastal wetlands. Indirect impacts are discussed below in 'harm to marine vegetation'.	No direct impact and low indirect impact (see section 5.2 below).
Harm to marine vegetation	Most of Lake Moore is fringing by a narrow band of mangroves. Seagrass occurs in small, isolated patches around the lake, in the shallowest subtidal zone where light availability is better in turbid water. All works are outside of marine vegetation. A shading model is shown in Figure 14.	No direct impact but moderate indirect impact if sediment plumes during earthworks smother or block light reaching seagrass. The Water Cycle Management Statement (Appendix in Northrop 2024) demonstrates that water running off the site would be treated to comply with contemporary water quality criteria so it does not compromise the values of the Georges River. The treatment of nutrients from the site would minimise the risk to seagrasses that can become smothered by epiphytic growth associated with higher nutrient loads. Indirect impact from building shadows would have a minor effect on the coastal wetland. Shading would commence around 1 pm, and by 3 pm most of the western side and part of the southern side of Lake Moore would be shaded. Mangroves that occur in this location are unlikely to be affected though, as they appear tolerant to the existing afternoon shade caused by the overhanging riparian forest (Figure 15). Seagrass beds in this area are small, isolated patches that are close to shore, and would already receive shading in the late afternoon. Ambient conditions may still provide a sufficient source of sunlight to this seagrass. Nonetheless, seagrass is highly

Feature	Description	Potential severity of impact
		sensitive to disturbance, and a small loss of sunlight compounded with other external riverine influences may result in thinning or full loss of seagrass beds in this location (85 m ² of <i>Zostera</i> sp.)
Riparian vegetation	Bank reshaping would removal 800 m of riparian vegetation, and replanting will be managed on the new bank (see Riparian Assessment, Northrop 2024)	High impact (but potentially positive with restoration). The Masterplan has been amended to provide a minimum 40 m wide vegetated riparian zone facing the Georges River, and minimum 30 m wide vegetated riparian zone facing Lake Moore. After development there will be no structures proposed in the riparian zone.
Bank morphology	Bank reprofiling (dredging) will create a gentle or tiered slope compared to the current steep slope (total 800 m).	High impact earthworks and risk of exposing Acid Sulfate Soils, but long-term stabilisation is a benefit to downstream habitats.
Critical habitat (FM Act)	None in catchment	None
Commercial fisheries (aquaculture)	None near site	None
Key threatening processes (FM Act)	<p>Works would activate two key threatening processes:</p> <ul style="list-style-type: none"> • “The degradation of native riparian vegetation along NSW watercourses” • “Removal of large woody debris from New South Wales rivers and streams”. 	<p>High impact <u>local</u> loss of native and weedy riparian vegetation, with some restoration proposed that would benefit in the long term.</p> <p>High impact <u>local</u> loss of large woody debris (snags) in the river. At the time of survey, 12 areas of snags occurred along the bank proposed to be reconstructed. Few snags occurred on the opposite bank, and 11 snags occurred outside of impact area within the marine study area. The importance of these snags would vary with tides, floods and repositioning from fast flows. During calm periods, fish may shelter around these snags after reaching the weir that obstructs their movement upstream. The opposite bank is severely eroded and has less-value instream shelter, therefore, the removal of snags is considered a high impact between the weir and Lake Moore.</p>

Technical Design Considerations and ADG Testing

DRAFT

Shadow Study



9am

- Shadows from Within Site
- Other Shadows
- - - Site Boundary



10am

SJB

153

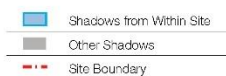
Technical Design Considerations and ADG Testing

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Shadow Study



11am



12pm

SJB

154

Technical Design Considerations and ADG Testing

DRAFT

Shadow Study



1pm



2pm

SJB

155

Technical Design Considerations and ADG Testing

DRAFT

Shadow Study



3pm

Figure 14: Building shade model (winter solstice) relative to the location of coastal wetlands and seagrass beds (draft design, SJB October 2023)



Figure 15: Mangroves (yellow line) on the lake's western shore shaded by riparian canopy

5.2 Resilience and Hazards SEPP requirements

The site is affected by three types of coastal management areas mapped under Chapter 2 of the Resilience and Hazards SEPP (Figure 9):

- Land in proximity to coastal wetlands (Table 5)
- Coastal environment area (Table 6)
- Coastal use area (Table 7).

Future investigation is required during design development to address how the works could meet development controls for each coastal management area. Preliminary guidance is discussed below in Table 5 – Table 7 for a selection of considerations related to aquatic ecology. Please refer to the published Resilience and Hazards SEPP for full text:

<https://legislation.nsw.gov.au/view/html/inforce/current/epi-2021-0730#ch.2-pt.2.2>

Table 5: Clause 2.8 – Development on land in proximity to coastal wetlands

(1) Development consent must not be granted to development on land identified as “proximity area for coastal wetlands” or “proximity area for littoral rainforest” on the Coastal Wetlands and Littoral Rainforests Area Map unless the consent authority is satisfied that the proposed development will not significantly impact on—	Action
(a) the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest, or	<p>Biophysical and ecological integrity – the definitions of these attributes overlap. ‘Ecology’ or ‘biophysics’ is understanding how the biotic component (flora and fauna) interact with the abiotic component (water, fire, soil, nutrients, sunlight etc). The integrity of the biota can be protected by avoiding direct impacts (clearing) and ensuring indirect impacts are managed (e.g. weeds, erosion, and water quality), ensuring the adjacent wetland can provide functions and processes to support its ecosystem.</p> <p>Hydrological – the development would not impede the hydrology within the wetland or obstruct connectivity with the river. Flows leaving the site and entering the wetland would likely be similar before and after development. The design should consider how surface flows currently flow across open spaces into the wetland and aim to replicate discharge to avoid a change in local hydrology.</p>
(b) the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest.	<p>The quality of water running off the development into the wetlands should aim to be equal or better than the current situation. An integrated Water Cycle Management Plan is required to demonstrate that suspended solids, nitrogen and phosphorus loads will be less than or equal to the current situation and meet agreed targets. This is confirmed in the Water Cycle Management Statement as an Appendix to Northrop’s Riparian Assessment (2024). Discharge can be controlled through a stormwater treatment train comprising WSUD elements to trap and/or treat gross pollutants, sediment, nutrients and other pollutants before entering waterways. No groundwater impacts are foreseen. Suitable vegetation should be assigned for public spaces:</p> <ul style="list-style-type: none"> • Implement a Vegetation Management Plan for riparian areas. • Avoid planting deciduous trees within 40 m of waterways, or in areas where excessive leaf drop cannot be contained from stormwater runoff. Seasonal leaf drop can have detrimental effects on the aquatic ecology, such as decreased dissolved oxygen due to leaf decomposition, and irregular food sources for detritivores that support the food web. • Avoid planting species that may become weeds in the adjacent riparian corridor.

Table 6: Clause 2.10 – Development on land within the coastal environment area

(1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following—	Action
(a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,	<p>Biophysical and ecological integrity – the definitions of these attributes overlap. ‘Ecology’ or ‘biophysics’ is understanding how the biotic component (flora and fauna) interact with the abiotic component (water, fire, soil, nutrients, sunlight etc). The integrity of the biota can be protected by avoiding direct impacts (clearing) and ensuring indirect impacts are managed (e.g. weeds, erosion, and water quality), ensuring the estuary can provide functions and processes to support its ecosystem.</p> <p>Hydrological – the development would not impede the hydrology or obstruct connectivity within the estuary. Flows leaving the site and entering the wetland would likely be similar before and after development. The design should consider how surface flows currently flow across open spaces into the estuary and aim to replicate discharge to avoid a change in local hydrology.</p>
(b) coastal environmental values and natural coastal processes,	Existing values and processes would not be affected.
(c) the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,	The marine estate includes estuaries and coastal wetlands, which are present on or adjacent to the study site. No sensitive coastal lakes occur in the catchment.
(d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,	<p>Marine vegetation would not be harmed.</p> <p>Native vegetation would be harmed, and impacts have been calculated in a BDAR for this planning proposal (ELA 2024). Offsets or onsite compensation may be triggered.</p> <p>The headland reserve (Moore Point) would not be developed under this proposal.</p> <p>No rock platforms are known to occur nearby.</p>
(g) the use of the surf zone.	The development is not in the surf zone.

Table 7: Clause 2.11 – Development on land within the coastal use area

(1) Development consent must not be granted to development on land that is within the coastal use area unless the consent authority—(a) has considered whether the proposed development is likely to cause an adverse impact on the following—	Action
(ii) overshadowing, wind funnelling and the loss of views from public places to foreshores,	The shadow analysis in Figure 14 demonstrates shading from the proposed tall structures intersects with the coastal use zone early in the morning, before 9 am near the weir, and after 1 pm at Lake Moore. These areas contain public open space, but other unshaded areas are provided nearby.

(1) Development consent must not be granted to development on land that is within the coastal use area unless the consent authority—(a) has considered whether the proposed development is likely to cause an adverse impact on the following—	Action
	Impact to vegetation from shading would be minor (see Table 4 for impact to marine vegetation).

5.3 Biodiversity and Conservation SEPP requirements

Development controls under Division 2 (Clauses 6.7 – 6.10) are assessed against the Concept Masterplan in Table 8 to Table 11.

Table 8: Clause 6.7 – Water quality and quantity

(2) Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied the development ensures—	Action
(a) the effect on the quality of water entering a natural waterbody will be as close as possible to neutral or beneficial, and	A Water Cycle Management Statement (Appendix in Northrop 2024) has been prepared which demonstrates how compliance with water quality targets set out within the Liverpool DCP 2008. Can be achieved for any future Development Applications.
(b) the impact on water flow in a natural waterbody will be minimised.	Flooding patterns will not be significantly altered. The river flows dwarf the runoff flows generated by the development (Water Cycle Management Statement in Northrop 2024).

Table 9: Clause 6.8 – Aquatic ecology

(2) Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied of the following—	Action
(a) the direct, indirect or cumulative adverse impact on terrestrial, aquatic or migratory animals or vegetation will be kept to the minimum necessary for the carrying out of the development,	See Section 5.1 above.
(b) the development will not have a direct, indirect or cumulative adverse impact on aquatic reserves,	The nearest aquatic reserve is at Towra Point, 25 km downstream. Water leaving the development site would be of neutral or beneficial quality (see Table 8) and would, therefore, not impact the reserve.
(c) if a controlled activity approval under the <i>Water Management Act 2000</i> or a permit under the <i>Fisheries Management Act 1994</i> is required in relation to the clearing of riparian vegetation—the approval or permit has been obtained,	To be advised through future an Integrated Development Approval process, or State Significant Development process.
(d) the erosion of land abutting a natural waterbody or the sedimentation of a natural waterbody will be minimised,	Bank reprofiling would require permits or consultation under the <i>Water Management Act 2000</i> and/or <i>Fisheries Management Act 1994</i> . Conditions of consent would outline

(2) Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied of the following—	Action
	the need for a Sediment and Erosion Control Plan for the construction. A Vegetation Management Plan would also be required to ensure long-term stability of the banks and any naturalised waterfront land.
(e) the adverse impact on wetlands that are not in the coastal wetlands and littoral rainforests area will be minimised.	See Section 5.2 above.

Table 10: Clause 6.9 – Flooding

(2) Development consent must not be granted to development on flood liable land in a regulated catchment unless the consent authority is satisfied the development will not—	Action
(a) if there is a flood, result in a release of pollutants that may have an adverse impact on the water quality of a natural waterbody, or	A Water Cycle Management Statement (Appendix in Northrop 2024) has been prepared which demonstrates how compliance with water quality targets set out within the Liverpool DCP 2008 can be achieved for any future Development Applications.
(b) have an adverse impact on the natural recession of floodwaters into wetlands and other riverine ecosystems.	The development site does not lie between the river and any flood-dependant ecosystems, and would not affect the hydrology of the wetlands downstream in Moore Lake.

Table 11: Clause 6.10 – Recreation and public access

(2) Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied of the following—	Action
(a) the development will maintain or improve public access to and from natural waterbodies for recreational purposes, including fishing, swimming and boating, without adverse impact on natural waterbodies, watercourses, wetlands or riparian vegetation,	Large amounts of public open spaces is provided along the foreshore (Appendix A).
(b) new or existing points of public access between natural waterbodies and the site of the development will be stable and safe,	To be addressed at detail design stage, where access paths are to be constructed and positioned in a manner that does not cause erosion or sedimentation of the river.
(c) if land forming part of the foreshore of a natural waterbody will be made available for public access as a result of the development but is not in public ownership—public access to and use of the land will be safeguarded.	Large amounts of public open spaces is provided along the foreshore (Appendix A).

5.4 Water quality targets

The Water Cycle Management Statement (Appendix in Northrop 2024) prepared for this Planning Proposal describes a suite of water cycle management interventions and design measures to ensure

compliance with water quality targets set out within the Liverpool DCP 2008. The suite of measures represent a best practice and contemporary approach to water management that is designed to minimise impacts to ecosystems. Compliance will be demonstrated quantitatively (MUSIC modelling and MUSIC Link) and qualitatively. Compliance is also demonstrated against the Georges River Water Quality Objectives and River Flow Objectives.

Modelling of stormwater quality running off the site will be addressed under individual Development Applications. All future works in the study area should consider potential impacts to the coastal wetlands, even if not occurring in the proximity buffer (Figure 9), because the weir on the Georges River creates a tidal rebound that reduces flushing capacity of the estuary, effectively creating a low-dilution 'dead-end' where sediment may settle locally and smother seagrass beds and reduce water quality. Assessment of development near sensitive environments should consider whether the works during construction and operation would:

- have any identifiable potential impact on water quality
- contain any water quality impact on the development site and prevent it from reaching any watercourse, waterbody or drainage depression on the site
- transfer any water quality impact outside the site where it is treated and disposed of to standards approved by the consent authority.

It can generally be assumed that impacts are acceptable if a development can demonstrate it would not result in:

- a concentration of flow of water
- the impedance of flow of water
- discharge of effluent, dust pollutants or stormwater
- other matters considered to result in a water quality impact, such as the potential for contamination.

6. Conclusion and recommendations

The development of the Moore Point precinct would change the existing land use and landform along the foreshore of the Georges River, but with the intent to improve bank stability and riparian/aquatic habitat. The river and adjacent Moore Lake have been heavily modified and disturbed by historic dredging (in channel and lake), impoundment (weir), bank slumping and weed invasion. A field survey confirmed the quality of riparian and aquatic habitat along the riverbank was low-moderate, and high in Lake Moore where mangroves, coastal wetlands and seagrass occurred. All future Development Applications and works in the study area should consider potential impacts to these wetlands, even if not occurring in the proximity buffer because the weir creates a tidal rebound that reduces flushing capacity of the estuary, effectively creating a low-dilution 'dead-end' where sediment may settle locally and smother seagrass beds and reduce water quality.

No threatened aquatic species, populations or communities are predicted to occur on or near the site, and further assessment is unlikely to be triggered under the FM Act and EPBC Act (aquatic).

The proposed bank reprofiling has the potential to have a long-term positive impact on the intertidal and shallow subtidal habitat along the reach. Through the incorporation of targeted habitat features in the bank design, the future development applications could ensure the Fisheries policy of 'no net loss' of KFH is met, noting the context of the current low-moderate condition and intended city foreshore landscape.

As the designs for the site progress, we recommend consideration of the following:

- If bank reprofiling intends to create a tiered or stepped profile to accommodate intertidal saltmarsh species, then species selection needs to consider the salinity of the estuary below the weir. The reedlands around the coastal wetlands and Lake Moore would provide a guide to what species are tolerant to the local conditions (noting they are in a protected bay and may not tolerate faster flows when the weir spills).
- The proposed toe of the bank (rock or piled) would create a hard substrate for some estuarine species (molluscs and macroalgae) if the salinity and turbidity is suitable. This area should be left for self-colonisation rather than attempting to plant macroalgae or macrophytes in the subtidal zone.
- Designing habitat variety and complexity would increase the value of the riverbank for aquatic species. For example, depressions and cavities that retain water when the tide drops helps create refuges for small organisms; and using complex rock of various sizes and positioning, rather than smooth homogenous walls would increase the surface area and habitat options for small marine species.
- Establishing marine or brackish vegetation on the new bank may be challenging due to high freshwater influence, tidal rebound off the weir and low flushing potential. Lessons may be taken from existing bank stabilisation works on the opposite bank near the rail corridor (e.g. to monitor what species have naturally colonised those intertidal areas, then replicating suitable conditions on the new bank).

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- SMEC 2010. *Georges River Data Compilation and Estuary Processes Study.* Georges River Combined Councils Committee.

Appendix A Concept diagrams of proposed masterplan (Turf Design Studio 2024)



*The alignment of the northern pedestrian bridge over the Georges River is subject to further discussions with affected landowners. The alignment of the pedestrian bridge is subject to change

Public Space Framework

4.2. Test Scheme

The Test Scheme delivers a well - connected network of open space and recreation servicing the local needs of the future Moore Point community. A green necklace of riverfront activation draws users to the edge from within the urban park and square public spaces.

Key:

1. Passive Recreation
2. Pocket Park
3. Market Hall
4. Outdoor Amphitheatre and Gathering Space
5. Linear Park
6. School
7. Local Park
8. Active Recreation
9. Dedicated Cycleway
10. Water Play
11. Fitness and Exercise
12. Public Plaza
13. Local Play

Heritage Curtilage

Coastal Wetland Protection Zone

Inner VRZ Line

Outer VRZ Line

Site Boundary

1:5000 at A3

0 50 100 200m



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★ The alignment of the northern pedestrian bridge over the Georges River is subject to further discussions with affected landowners.

Note: 3.1. Environment summarises inputs from Advision, Royal Haskoning, Northrop and Ecological Australia. See individual reports for further information.

3.1.3. Habitat

Green spaces create opportunity for humans, flora and fauna to coexist, increasing biodiversity and contributing to the local ecosystem. The existing vegetation on site is degraded and consists of three vegetation communities, as identified in a field assessment by EcoLogical Australia (June 2021). These include:

- Swamp Oak Floodplain Forest (SOFF) – an endangered ecological community (EEC)
- River Flat Eucalypt Forest (RFEF) – an EEC
- Planted native or exotic vegetation

It is critical that the riverfront is stabilised and restored to sustain the river ecology of the Georges River. The riparian corridor along the entirety of the Moore Point precinct provides a continuous environment zone that is an intrinsic ecological asset to the river system. It is integral as part of this proposal the river's edge is restored. Connecting with Country principles and more broader, the Greener Places Framework emphasises the needs for increased biodiversity and protection of our waterways.

Opportunities:

- Design a holistic riverfront foreshore that protects and enhances the riparian corridor
- Retain and enhance aquatic and terrestrial ecologies, and contribute to the biodiversity of the Georges River and Lake Moore frontages.
- Encourage a diverse planting character that responds to the river's edge. Encourage green corridors from the river through to the inner neighbourhood.
- Incorporate native species and macro and micro habitats that will improve water quality and improve the health of the river and lake systems.

3.1.4. Riparian Corridors on Waterfront Land

Moore Point has a series of varying conditions along the river edge, requiring different treatments that cater to the river's demands.

Given the history of landform and riverine modification that has occurred in the past, and that the development seeks to activate the Georges River foreshore, the foreshore strategy does not seek to align with the full intent of the Guidelines for controlled activities on waterfront land: Riparian Corridors (DPI 2018). A merit-based assessment of the foreshore strategy is proposed, and this is consistent with the Guidelines.

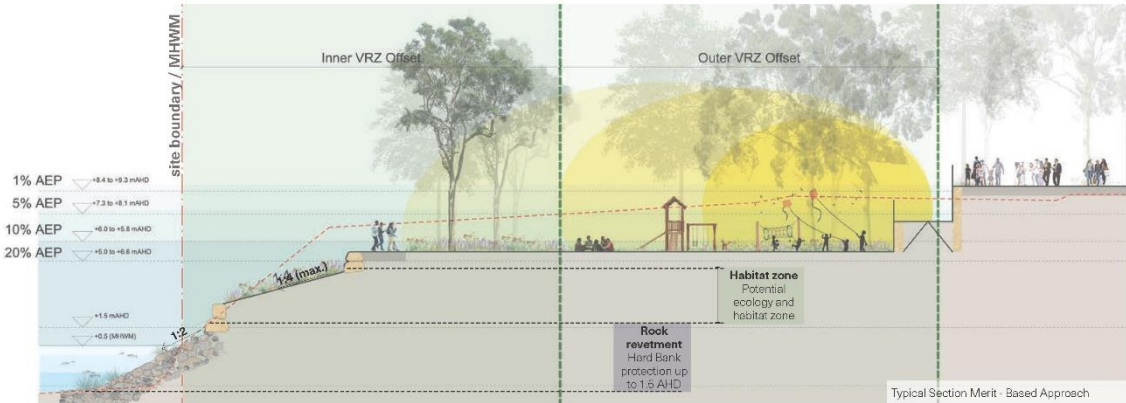
Georges River is a 4th order waterway and as a result a 40m wide riparian zone is proposed from the toe of the bank (MHWM). This results in 20m wide Inner and Outer VRZs.

Prior to sand mining, the current Lake Moore frontage used to front Anzac Creek. It is therefore valid to adopt Anzac Creek as the reference waterway for assigning riparian zone. Anzac Creek is a third order watercourse in this location, and so a 30m wide riparian zone is proposed from the toe of the bank (MHWM). This results in 15m wide Inner and Outer VRZs.

The typical section articulates the tiered level design approach, with inner VRZ prioritising bank stabilisation and environment and outer VRZ introducing passive and active recreation.

Opportunities:

- Activate the foreshore with diverse passive and active recreation within the outer VRZ zone
- Offer opportunities for people to engage with environment and the river's edge
- Moore Point riverfront to incorporate tiers at different flood levels to create an adaptive and functional riparian corridor.








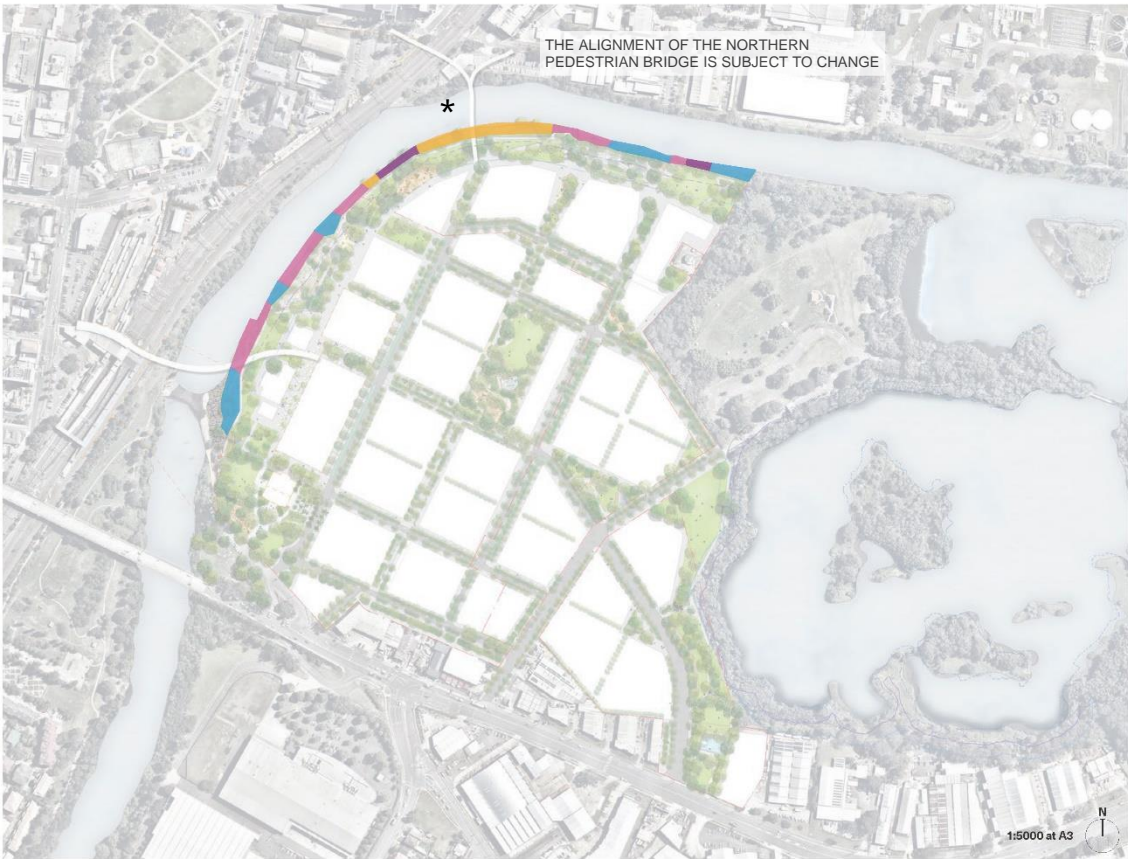
Moore Point Public Spaces — Riverbank Strategy

5.1.1.4. Riverbank Typologies

As discussed in **Section 3.1.**, the existing riverbank is in a vulnerable state and rapidly degrading. Improving the riverbank is critical in delivering a successful resilient and environmentally considered riverfront district park.

A merit-based strategy based on flood levels, bank stability and river morphology has been established that utilises a combination of natural and environmentally engineered approaches with Royal Haskoning, Northrop and Advision to improve the quality of the Georges River.

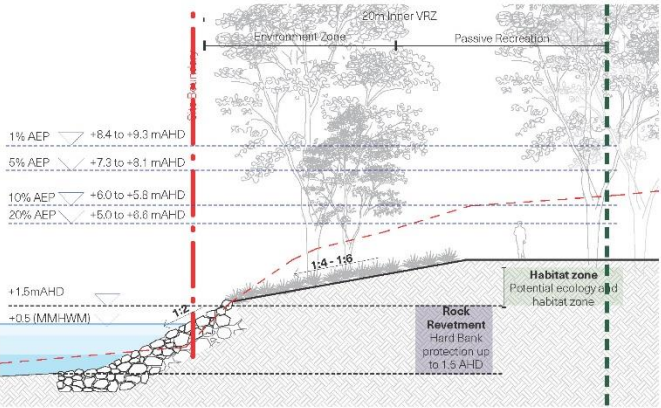
-  **Type 1** - Planting embankment (1:4 max)
-  **Type 2** - Tiered planting embankment
-  **Type 3** - Tiered planting embankment (less than 12m width)
-  **Type 4** - Tiered planting embankment with habitat opportunities
-  **Type 5** - River access / outdoor river amphitheatre (connection with nature)



★ The alignment of the northern pedestrian bridge over the Georges River is subject to further discussions with affected landowners.

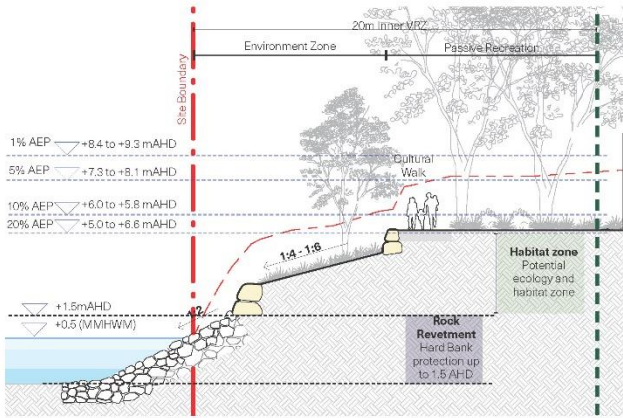
Moore Point Public Spaces — Riverbank Strategy

Riverbank — Type 1



For areas requiring minimal treatment and of low intensity. Combination of rock revetment to stabilise the toe of the bank supported by a more gentle slope of native planting to the top of bank. Type 1 can be integrated with sandstone when conditions are more constrained (Type 2 and 3).

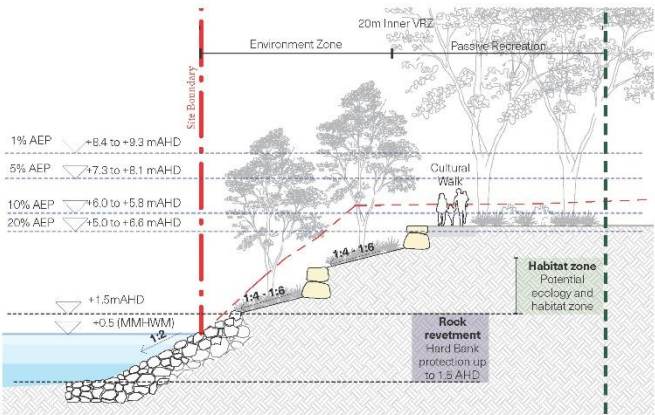
Riverbank — Type 2



At the river bend, tiered sandstone is added in combination with rock revetment and planting to protect the toe of the bank. Sandstone mitigates the impacts of wave action and erosion and is stacked to assist in areas of greater level change.

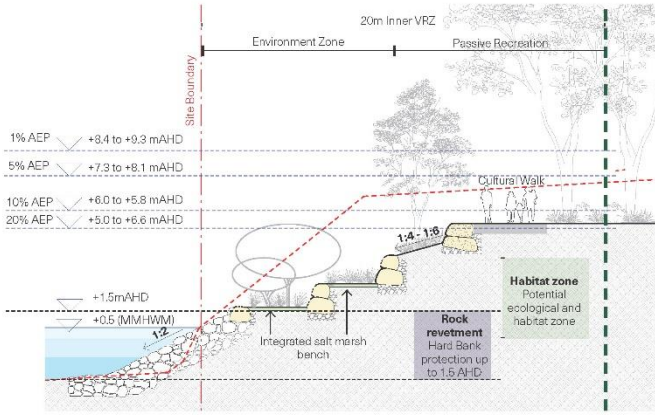
Moore Point Public Spaces — Riverbank Strategy

Riverbank — Type 3



Similar to Type 3, tiered sandstone is added in combination with rock revetment and planting to protect the toe of the bank. Sandstone mitigates the impacts of wave action and erosion and is stacked to assist in areas of greater level change.

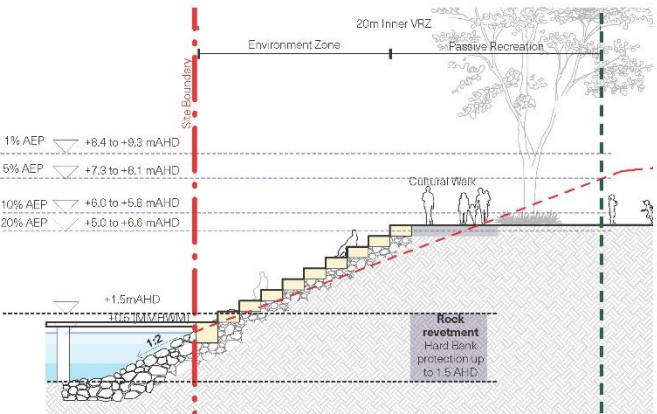
Riverbank — Type 4



Opportunity for habitat integration such as saltmarsh benching at areas of low velocity and low erosion. Tiers of sandstone are integrated to support pockets of habitat with rock revetment to the toe of the bank to stabilise.

Moore Point Public Spaces — Riverbank Strategy

Riverbank — Type 5

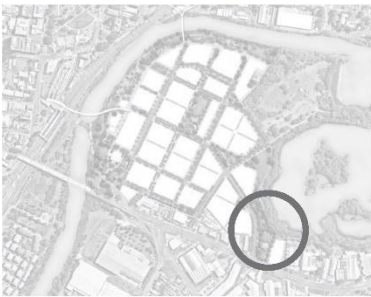


Informal sandstone block bleachers integrated with planting to the waters edge. Stacked sandstone with rock revetment to the toe of the bank mitigates wave action and erosion in areas of high intensity, such as Liverpool Weir.

5.1.2. Local Parks
5.1.2.1. Lake Moore Local Park

- Key:
- 1. Cultural Walk
 - 2. Passive Recreation
 - 3. Active Recreation
 - 4. Amphitheatre and Gathering Space
 - 5. Upper Promenade
 - 6. Pocket Park

- Heritage Curtilage
- Coastal Wetland Protection Zone
- Inner VRZ Line
- Outer VRZ Line
- Site Boundary



Moore Point Public Domain — Parks Character

Celebration and protection of Lake Moore's existing coastal wetland zone. The area is highly passive with minimal infrastructure along the lake's edge, maintaining strong views to the water. This brings biodiversity and environment to the forefront, allowing users to feel connected and embrace local river ecology. A highly activated recreation area at the south supports local residents, encouraging community sport and exercise.



Moore Point Public Spaces — Parks
Lake Moore Ecopark Section 9

Objective 1 - Protect and enhance the coastal wetland zone through localised revitalisation of the banks, including increasing local vegetation species and habitat.

Objective 2 - Low impact recreation surrounding the coastal wetland areas to ensure regeneration and limited disturbance to the existing communities.

Objective 3 - Maintain equal access from the street to boundary to allow all users to experience the natural landscape.

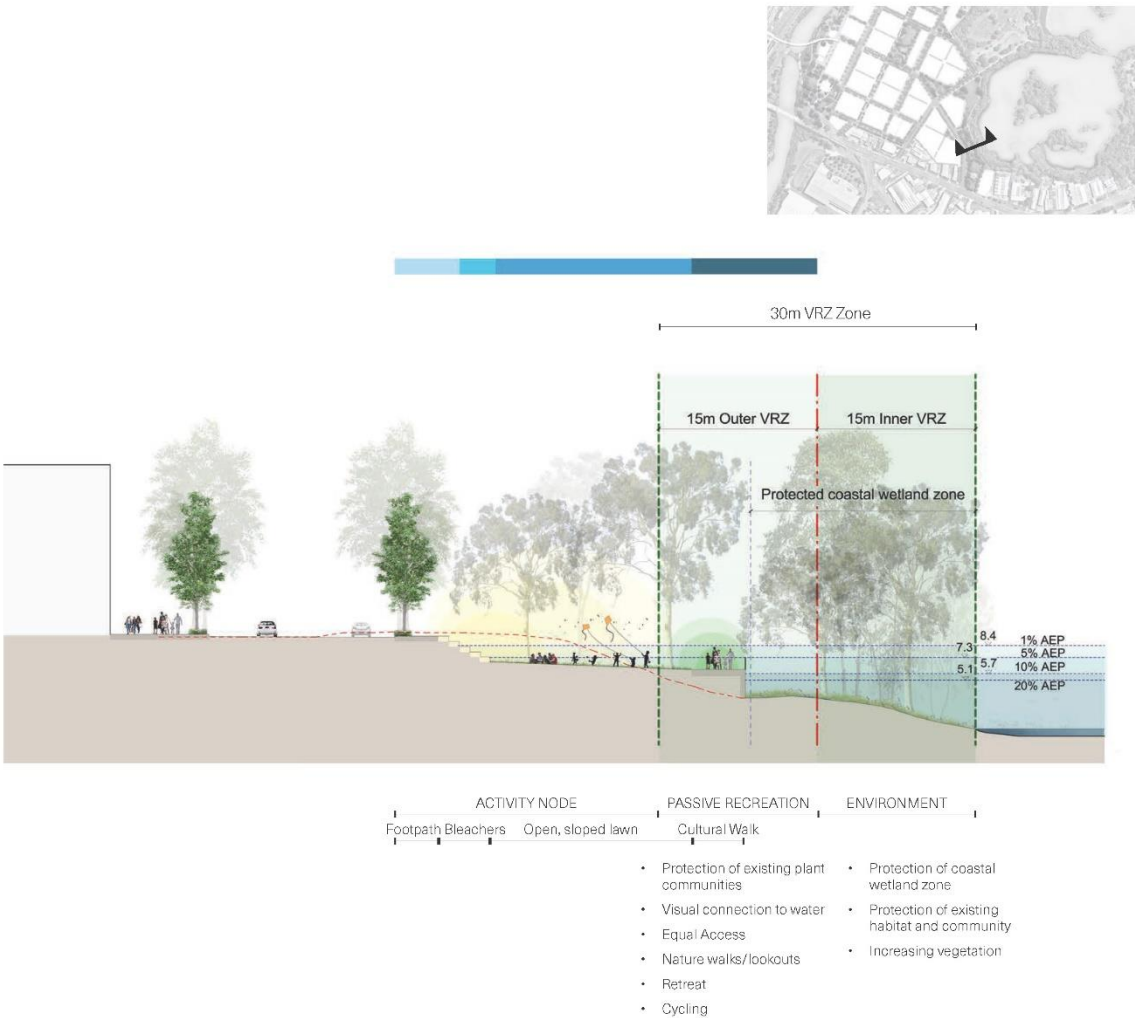
Objective 4 - Offer self-directed activities amongst the local landscape to create a sense of place.

Objective 5 - Maintain access to public open green space.

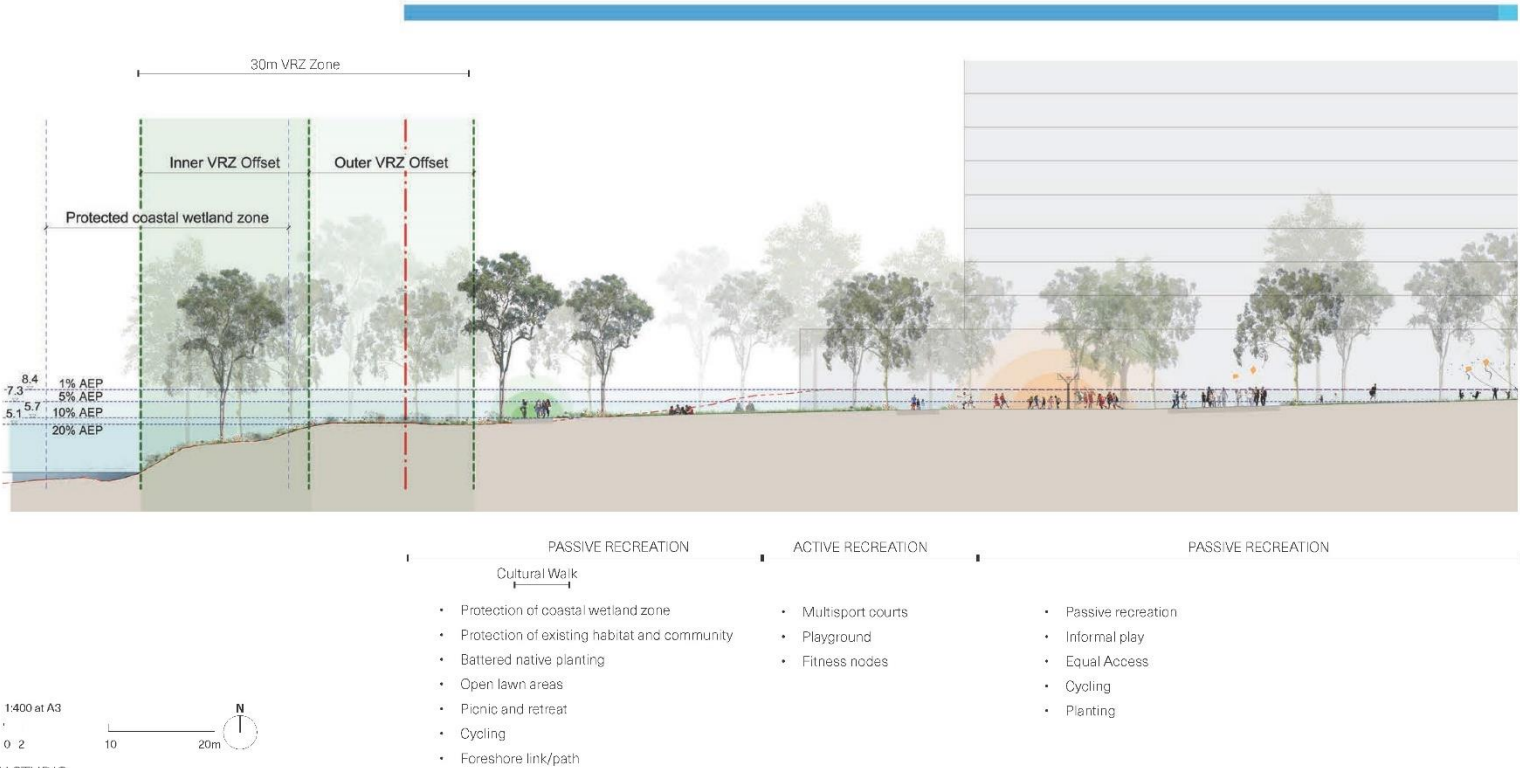
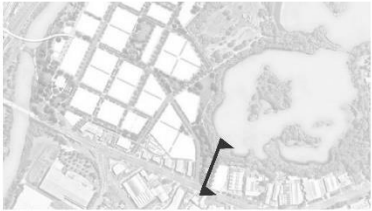
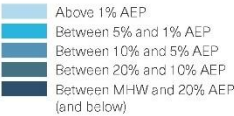
- Active Recreation
- Local Play
- Gathering Ground, Public Plaza
- Passive Recreation
- Water play
- Foreshore Promenade
- Environment
- Outdoor Amphitheatre



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Moore Point Public Spaces — Parks
Lake Moore Ecopark Section 10



TURF DESIGN STUDIO

Appendix B Likelihood of occurrence of threatened species

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database and other records, presence or absence of suitable habitat, features of the proposal site, results of the site inspection and professional judgement. The terms for likelihood of occurrence are defined below:

- “known” = the species was or has been observed on the site
- “likely” = a medium to high probability that a species uses the site
- “potential” = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- “unlikely” = a very low to low probability that a species uses the site
- “no” = habitat on site and in the vicinity is unsuitable for the species.

A test of significance would be conducted for threatened species, populations or ecological communities that were recorded within the study area or had a higher likelihood of occurring and were not recorded during the site visit. It is noted that some threatened fauna species that are highly mobile, wide-ranging and vagrant may use portions of the study area intermittently for foraging. For these fauna species, the habitat present and likely to be impacted is not considered to be important to the threatened species, particularly in relation to the amount of similar habitat remaining in the surrounding landscape. As such, a test of significance in reference to State or Commonwealth legislation was not considered necessary.

Type	Species name	Common name	FM Act Status	EPBC Act Status	Use of site	Is an impact assessment required?
Fish	<i>Epinephelus daemeli</i>	Black Rockcod	V	V	No suitable habitat present for adults, e.g. rock crevices or caves. Juveniles are known to use turbid shallow estuaries, so may explore Lake Moore. No impacts are anticipated to their habitat.	No
	<i>Macquaria australasica</i>	Macquarie Perch	E1	E	Freshwater only	No

Type	Species name	Common name	FM Act Status	EPBC Act Status	Use of site	Is an impact assessment required?
Turtle	<i>Prototroctes maraena</i>	Australian Grayling	E	V	No records in catchment (modelled to occur south of Wollongong – Riches et al 2016)	No
	<i>Hippocampus whitei</i>	White's Seahorse	E	-	Records are east of Captain Cook Bridge in Botany Bay. Low salinity and lack of expansive seagrass beds connected to the upper reach of the estuary would preclude seahorses near the site.	No
	<i>Caretta caretta</i>	Loggerhead Turtle	E1	E		No
	<i>Chelonia mydas</i>	Green Turtle	V	V	Unlikely this far upstream, but may briefly explore the estuary, with recent observations suggesting juveniles may forage on jellyfish in estuaries.	No
	<i>Dermochelys coriacea</i>	Leatherback Turtle	E1	E		No
Seagrass	<i>Eretmochelys imbricata</i>	Hawksbill Turtle		V,Bonn		No
	<i>Natator depressus</i>	Flatback Turtle		V,Bonn		No
	<i>Posidonia australis</i> - Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie populations	Posidonia australis	E2		No Posidonia was found during field survey. It is unlikely this far upstream as it doesn't tolerate poor water quality or low salinity compared to other seagrasses. The nearest mapped population is east of Captain Cook Bridge in Woollooware Bay.	No
	<i>Posidonia australis</i> seagrass meadows of the Manning-Hawkesbury ecoregion	Posidonia australis		E		No
	<i>Subtropical and Temperate Coastal Saltmarsh</i>	Coastal Saltmarsh		V	None observed, and the bank gradient between mangroves and Casuarinas is too steep to provide the specific habitat requirements for saltmarsh (flat high tidal zone).	No

FM Act: E1 = Endangered, E2 = Endangered Population, E4 = Extinct, E4A = Critically Endangered, V = Vulnerable

EPBC Act: Bonn = Listed migratory species under Bonn Convention, CD = Conservation Dependent, CE = Critically Endangered, E = Endangered, V = Vulnerable, X = Extinct

