Draft Watercourse, wetland and riparian lands study

February 2022

northern beaches council

Executive Summary

Watercourses, wetlands and the riparian land surrounding them are important ecological systems that support aquatic and terrestrial habitat and wildlife, provide connectivity and biodiversity, reduce impacts from stormwater runoff and pollution, and contribute to the character, aesthetics and recreational value of the local area. It is important to protect these areas not only for their own intrinsic significance, but also for the benefits they provide in terms of downstream waterbodies and in modulating flood response.

The Draft Watercourse, Wetland and Riparian Lands Study seeks to summarise and combine a series of technical studies undertaken by environmental consulting firm BMT Commercial Australia Pty Ltd and ground truthing by Council staff, which reviewed existing planning controls associated with watercourse and riparian matters, across the three former Council's (Manly, Warringah, Pittwater), and provided recommendations and updated mapping to be incorporated into a unified Northern Beaches Council Local Environment Plan (LEP) and Development Control Plan (DCP).

The outcome of this study includes:

- Accurate mapping to help protect or improve the environmental values and functioning of watercourses, wetlands, and riparian land,

- Key terms and definitions regarding watercourse, wetlands and riparian lands,

- New proposed watercourse and wetland maps including proposed riparian buffers for inclusion in the Northern Beaches LEP/DCP.

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1.0 Introduction

Watercourses, wetlands and the riparian land surrounding them are important ecological systems that support aquatic and terrestrial habitat and wildlife, provide connectivity and biodiversity, reduce impacts from stormwater runoff and pollution, and contribute to the character, aesthetics and recreational value of the local area. It is important to protect these areas not only for their own intrinsic significance, but also for the benefits they provide in terms of downstream waterbodies and in modulating flood response.

Northern Beaches Council aims to protect, enhance and restore waterways and riparian land while ensuring protection of public and private property across the Northern Beaches. The protection for our watercourses and wetlands is consistent with Council's Community Strategic Plan 2018-2028, Towards 2040 - Local Strategic Planning Statement (LSPS) and the Northern Beaches Environment and Climate Change Strategy 2040.

1.1 Background

Waterways and adjacent riparian areas support a variety of aquatic and terrestrial life, provide habitat and breeding grounds for many aquatic plants and animals and are an essential part of larger ecosystems. They are also an important part of the scenic landscape of our region. The term riparian land or riparian zones refers to the area relating to or located on the bank of a watercourse (as a river or creek) or sometimes a lake or other body of water.

The Northern Beaches' waterways are a mix of creeks, watercourses, wetlands, lagoons, estuaries, groundwater and constructed waterways. We have seven major catchments that drain to our coastal lagoons, directly onto the beaches or into North Harbour, Middle Harbour and Pittwater. It is estimated there are approximate 637km of watercourses within the Northern Beaches and 240 hectares of wetlands.

In the past, our waterway systems, including natural creek lines, the constructed stormwater network and all the associated structures used to be seen as just a way to take away nuisance water, the faster the better. This saw a preference for straightening creek lines and lining the channels with concrete. The increased speed of flow carries pollutants, including litter and plastics, from gutters and roads to natural creek lines to waterways and to the ocean.

We now value our waterways for their part in local and regional ecosystems, contribution to our own standard of living, and their aesthetic value. We want to restore our waterway systems to as natural a condition as we can. Allowing our watercourses to meander and slow down the flow of water improves the water quality entering our receiving waters - our lagoons, harbours and beaches, as well as providing riparian and in-stream habitat. There are significant challenges to balance the protection of our waterways with development while also considering the impact of flooding and erosion in these areas.

Flooding and prolonged periods of drought from climate change will alter the natural flow patterns of our waterways. Through mitigation, we are doing our bit to reduce future climate change and protect our waterways and watercourses. We need to embrace Water Sensitive Urban Design principles to improve the ability of urban environments to capture, treat and reuse stormwater. Bringing water into our environment also helps to cool our urban areas and reduce the impacts of the increased heat waves that we expect with our changing climate.

A significant mechanism for protecting our waterways is through the application of provisions and controls within our Local Environment Plan (LEP) and Development Control Plan (DCP).

2.0 Study Context and Objectives

Northern Beaches Council is comprised of three former Councils that were amalgamated by the NSW State Government in 2016 – Pittwater Council, Warringah Council and Manly Council. Each of these three Councils had their own LEPs and DCPs for the purpose of regulating development and land use within their local government area. Each of these LEP's and DCP's are in force across each relevant area of Northern Beaches Council.

While the protection of waterways, watercourses, wetlands and riparian land is dealt with differently under current LEPs and DCPs, all share the same objective - that waterways and riparian areas need to be protected, and that risks associated with waterways such as bank erosion need to be managed.

For example, Manly LEP 2013 contains maps and provisions relating to protection and maintenance of watercourses and wetlands when assessing development applications, and Warringah LEP 2000 (applying to the deferred lands) contains a provision requiring maintenance and enhancement of natural watercourses and aquatic habitat. Warringah DCP 2011 contains maps and has objectives aimed at protecting or enhancing waterways and riparian land, as well as minimising risk to life and property from stream bank erosion by incorporating appropriate controls.

Pittwater LEP 2014 also has objectives aimed at restoring and enhancing riparian corridors and waterways but does not map them. Pittwater 21 DCP 2014 contains provisions protecting wetlands, waterways and riparian areas. Currently only some instruments contain maps.

Through our Northern Beaches Environment and Climate Change Strategy 2040, Council is committed to:

- Protecting our receiving waters and riparian areas,
- Protecting and improving the condition of creeks and riparian vegetation,
- Minimising threats to aquatic ecosystems,
- Reducing the impact of urban runoff on our waterways,
- Actively working to remove single use plastics and other litter from our network.

The Draft Watercourse, Wetland and Riparian Lands Study (the Study) objective is to review the different LEP/DCP's and provide recommendations on how to harmonise the mapping of watercourses and riparian areas for inclusion in the new LEP and DCP so these natural areas are protected.

3.0 Literature Review and Mapping Methodology

There are numerous State, regional and local planning instruments 'mandating' protection and enhancement of waterways and wetlands. At present there is not a consistent

approach to how watercourses and their riparian areas are defined, mapped or protected across the local government area (LGA), with the three former Council DCPs having different provisions and development controls. Inclusion of overlay mapping is however, a key mechanism or 'tool' within local planning instruments that can provide for a range of provisions that are supplementary to zoning (e.g. objectives, considerations and matters).

To help harmonise its approach on watercourses and riparian land, Council initiated a project to provide new watercourse and wetland mapping across the LGA, and as a second stage, to propose related LEP/DCPs provisions for public consultation. The project aimed to establish a consistent and evidence-based approach to mapping watercourses and wetlands and to ensure land use policy responses and development controls protect, enhance or restore these areas across the Northern Beaches. The project also considered riparian buffer zones, which are the transition zones between the core riparian zone and the surrounding land.

Council engaged environmental consultants BMT Commercial Australia Pty Ltd (BMT) to undertake a literature review of current practices and develop a consistent watercourse and wetland mapping methodology that could be used throughout the entire LGA.

3.1 Literature Review

In March 2020, BMT produced a report titled "Final Literature Review – Riparian Provisions and Conditions for Northern Beaches Council LEP and DCP" for Council (BMT 2020).

The review identified the following points:

- Relevant NSW legislation, policy and planning instruments at the State and regional levels, confirms there is unequivocal direction 'mandating' the protection, enhancement and restoration of waterways, wetlands and their buffers. Various New South Wales policy and planning instruments recognise both the tangible and intrinsic values, functions and services that wetlands and waterways provide such as, water quality, wildlife habitat, ecological corridors, landscape character, recreation, erosion control, flood attenuation, cultural values and public access etc. These planning instruments provide important direction for the development of riparian related provisions and development controls for the new Northern Beaches LEP and DCP.

- Council's Towards 2040 - LSPS, provides clear and very strong direction for the protection of wetlands and watercourses and sets a solid local policy context underpinning an integrated framework for the protection and enhancement of broader biodiversity, bushland and habitat values, of which wetlands and watercourses are an integral component. The Natural Blue Grid and building on the understanding of community environmental values for waterways will be a key input into developing new riparian policy and mapping.

- A review of best practice approaches by other local governments and jurisdictions indicates that while there is no consistent approach to how riparian areas are defined or mapped, inclusion of overlay mapping is a key mechanism or 'tool' within local planning instruments to trigger approval pathways and to identify spatially where riparian related policy outcomes and development controls apply. The leading practice approaches to riparian related policy and mapping have the following key features:

- Allocate waterways to different ‘categories’ or ‘precincts’ based on a consistent set of existing and future intended values and functions for each specific riparian category.

- Overlay mapping identifies watercourses and wetlands as ‘different shades of blue’, as opposed to ‘one shade of blue’ across the LGA.

- Policy, objectives and development controls are tailored and nuanced to existing and future intended values and functions of the riparian category area.

- Provides a wholistic and integrated approach to watercourse and wetland values, functions and services and considers these as part of a broader framework for biodiversity and nature conservation.

- While the ‘one shade of blue’ approach to mapping riparian areas has traditionally been the accepted practice used by many LGAs, it is considered relatively simplistic, resulting in policy and development controls being generically applied and relying heavily on site-based assessments by applicants. The category-based approach to mapping means that ‘different shades of blue’ can be identified, providing more transparency and greater certainty for policy outcomes and development expectations for the protection and enhancement of riparian areas.

- A review of relevant Land and Environment Court cases also identifies key themes, principles and implications for developing new riparian provisions. While there is no doubt that overlay mapping will be an important tool for implementing riparian provisions, the Court has placed greater emphasis on the definitions, objectives and intent of the underpinning policy. It will be important that definitions align with relevant legislation.

- The suggested approach to developing new riparian policy and methodology for defining and mapping riparian aligns closely with the Council’s vision for the LGA’s coast and waterways and is intended to build a more nuanced or ‘complete’ understanding of the environmental values and uses for each waterway and reflect best practice science.

Based on the findings of the literature review, a suggested roadmap for the mapping of watercourses, wetlands and riparian buffer zones for the LGA was provided to Council by BMT (2020).

3.2 Mapping Methodology

The mapping methodology provided by BMT for Council is summarised in **Figure 1** and described in detail below. The mapping methodology was developed based on their literature review and in response to analysis of available GIS layers and Council feedback.

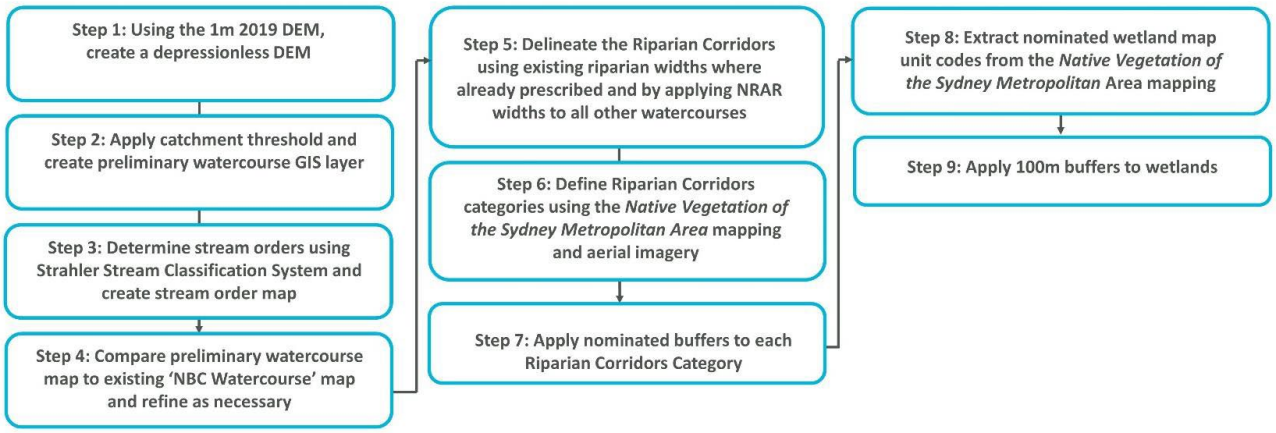

Figure 1: Mapping Methodology Waterways, Riparian Corridors, Wetlands and Riparian Buffers

The full mapping methodology is detailed in the **Appendix:** "Riparian Mapping Methodology for Northern Beaches Council LEP and DCP" (2021) by BMT Commercial Australia Pty Ltd and Ethos Urban. Further refinement and ground-truthing of the map produced by BMT was carried out by Council's technical staff. The methodology and map were also peer reviewed by an independent expert consultant, Mike Shaw – Director, Civil Certification Pty Ltd.

4.0 Discussion

4.1 Key Definitions

Based on the BMT literature review, most key terms relating to waterways are already defined in other legislation. These definitions have been developed by technical experts, have been subject to public notification and have been applied and tested in real world situations. While they are not able to codify every possible scenario, they are considered sound.

BMT have proposed the following key terms and definitions to Council, including their main source, as shown in **Table 1**.

Table 1: Key Terms and Definitions

Term	Definition	Source
Category 1 Riparian Corridors	Riparian Corridor that potentially supports relatively intact native vegetation and habitats within a nominated width measured from the edge of the channel **Note**: refer to **Figure 2** and **Figure 3** below	Consultant team recommendation based on NBC's preferred approach
Category 2 Riparian Corridors	Riparian Corridor that potentially supports disturbed lands within a nominated width measured from the edge of the channel **Note**: refer to **Figure 2** and **Figure 3** below	Consultant team recommendation based on NBC's preferred approach
Channel	The part of the watercourse including the bed and banks in which water flows permanently or intermittently, regardless of the frequency of flow events. The lateral limits of the channel are defined by the outer banks Note: the bed and banks need to be determined on site and may not always be continuous. Assessment of a range of geomorphic, hydrologic and ecological characteristics of the watercourse is necessary to identify the bed and banks. Examples of features which may assist in defining the outer banks include: the typical area in which water is confined during periods of flow; edge of the floodplain; scour marks; depositional features; changes in vegetation; and the bank on the opposite side of the channel	Consultant team recommendation
Riparian corridor	Means the nominated terrestrial environment adjoining the channel to be managed to support waterway functions, values and long-term use and to address risks associated with waterways **Note**: refer to **Figure 2** and **Figure 3** below	Consultant team recommendation based on NBC's preferred approach
Riparian buffer	Means land adjoining the Riparian Corridor that is intended to protect and minimise disturbance to the Riparian Corridor **Note**: refer to **Figure 2** and **Figure 3** below	Consultant team recommendation
Riparian land	Means the 'channel', 'riparian corridor' and 'riparian buffer' **Note**: refer to **Figure 2** and **Figure 3** below	Consultant team recommendation based on NBC's preferred approach
Waterway	Means the whole or any part of a watercourse, wetland or waterbody	Standard Instrument
Watercourse	Means any river, creek, stream or chain of ponds, whether artificially modified or not, in which water usually flows, either continuously or intermittently, in a defined bed or channel, but does not include a waterbody (artificial)	Standard Instrument
Wetland	Means: • an area containing the vegetation communities listed in Schedule 1; and • natural wetland, including marshes, mangroves, backwaters, billabongs, swamps, sedgelands, wet meadows or wet heathlands	NBC's preferred approach and Standard Instrument

	that form a shallow waterbody (up to 2 metres in depth) when inundated cyclically, intermittently or permanently with fresh, brackish or salt water, and where the inundation determines the type and productivity of the soils and the plant and animal communities, or • artificial wetland, including marshes, swamps, wet meadows, sedgelands or wet heathlands that form a shallow waterbody (up to 2 metres in depth) when inundated cyclically, intermittently or permanently with water, and are constructed and vegetated with wetland plant communities	
Waterbody	Means a waterbody (artificial) or waterbody (natural)	Standard Instrument
Waterbody (artificial)	Means an artificial body of water, including any constructed waterway, canal, inlet, bay, channel, dam, pond, lake or artificial wetland, but does not include a dry detention basin or other stormwater management construction that is only intended to hold water intermittently	Standard Instrument
Waterbody (natural)	Means a natural body of water, whether perennial or intermittent, fresh, brackish or saline, the course of which may have been artificially modified or diverted onto a new course, and includes a river, creek, stream, lake, lagoon, natural wetland, estuary, bay, inlet or tidal waters (including the sea)	Standard Instrument

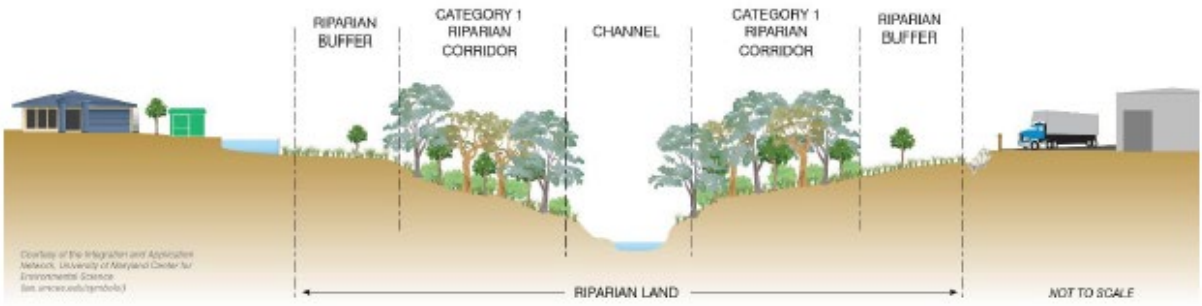

Figure 2: Key Definitions including Category 1 Riparian Corridors

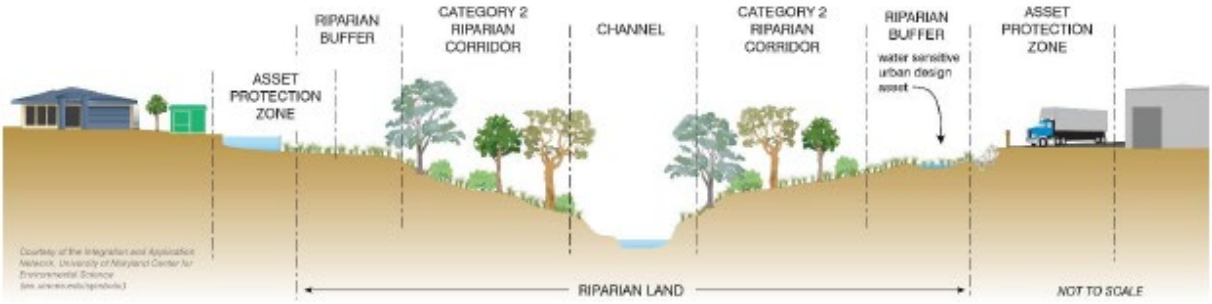

Figure 3: Key Definitions including Category 2 Riparian Corridors

4.2 Purpose of the Map

The proposed Draft Riparian Corridor Categories and Buffers map within the BMT report is intended for inclusion in Council's new draft LEP and DCP. This will be the basis of a consistent approach to protect watercourses and wetlands, and to manage the risks associated with these areas.

This map will be an improvement on the current approach where the planning framework is based on four different LEPs, their accompanying DCPs, and policies. This complex arrangement means that the current approach to considering watercourses and wetlands in the assessment of new development is inconsistent throughout the LGA. Council intends to harmonise these different approaches and deliver an improved planning framework that is fair, consistent and evidence-based.

The map shows the location of watercourses and wetlands within the LGA. The map also shows riparian corridors along watercourses. These are areas where additional provisions will apply that aim to protect environmental values of the waterway, protect the water quality of receiving waters (including the lagoons, Pittwater, North and Middle Harbour and the beaches), and manage any risks associated with the waterways. Two categories of riparian corridors have been identified, based on an assessment of the environmental values of the corridor as shown previously in Figures 2 and 3.

In line with existing provisions and current best practice, it was proposed by BMT that there be an additional 30 metre buffer from the riparian corridor on each side of the watercourse, and a 100m buffer around wetlands. This is also illustrated on the BMT map.

It should be noted that this map and any future accompanying provisions will not be the only mechanism to protect watercourses, wetlands and downstream receiving waterbodies. There will be a range of other provisions in the Northern Beaches LEP and DCP that will address related issues such as stormwater runoff, water cycle management, groundwater, biodiversity, threatened ecological communities and habitat. Protection will also be afforded by land use zoning, where appropriate.

4.3 Riparian Corridors

The riparian corridors form a transition zone between the land and the watercourse. They have a range of important environmental functions including providing bed and bank stability, protecting water quality, providing habitat and providing an interface or buffer between developments and waterways. The intention is to manage these areas to support waterway functions, values and long-term use and to address stability risks associated with waterways. Consistent with the state government's approach to riparian corridors, the widths of corridors were assigned based on the order of the stream, see **Figure 4** and **Table 2** below.

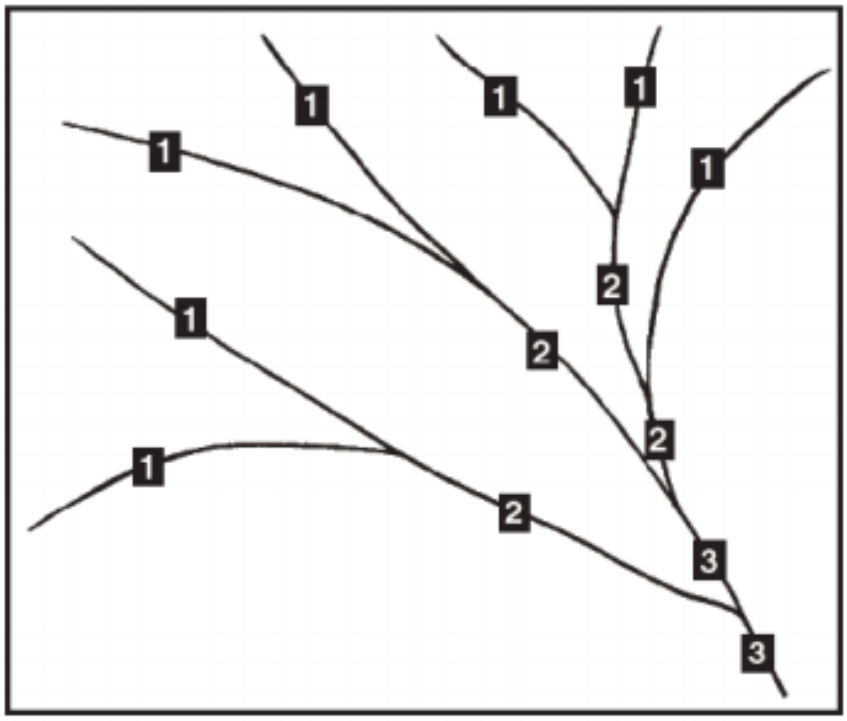

Figure 4: The Strahler System of Stream Ordering, 'Guidelines for controlled activities on waterfront land', Natural Resource Access Regulator, NSW Department of Industry 2018

Table 2: Recommended Riparian Corridor Widths, 'Guidelines for controlled activities on waterfront land', Natural Resource Access Regulator, NSW Department of Industry 2018

Watercourse type	Vegetated Riparian Zone (VRZ)	Total Riparian Corridor (RC) width
1st order	10 metres	20 metres + channel width
2nd order	20 metres	40 metres + channel width
3rd order	30 metres	60 metres + channel width
4th order and greater (includes estuaries, wetlands and parts of rivers influenced by tidal waters	40 metres	80 metres + channel width

It should be noted that as there is no available data to efficiently define the stream banks, the Riparian Corridor widths were measured from the centreline of the watercourse. The exception to this rule was for those previously mentioned wide watercourses (especially the coastal lagoons) where the inner boundary of the Riparian Corridors was measured from the outer bank where visibly discernible on available aerial imagery.

4.4 Defining Riparian Corridor Categories

The type and condition of Riparian Corridors was determined by BMT using the latest version of the Native Vegetation of the Sydney Metropolitan Area mapping (Version 3.1) (OEH, 2016) (VIS_ID 4489) and checked against aerial photography and limited field inspection.

The following two riparian corridor categories were distinguished:

- Category 1: Native Vegetation. This category incorporated all native vegetated areas extracted from the Native Vegetation of the Sydney Metropolitan Area excluding wetlands. (Refer previous **Figure 2**)

- Category 2: Disturbed and Cleared. This category incorporated all other map unit codes from the Native Vegetation of the Sydney Metropolitan Area. All remaining areas within the Riparian Corridors not mapped by the Sydney Metropolitan Area mapping were also included and labelled as disturbed. (Refer previous **Figure 3**)

4.5 Wetland Mapping

The wetland mapping was developed using current NSW DPIE vegetation maps and State Environmental Planning Policy (Coastal Management) 2018 wetland maps. Selected field checking was undertaken to ensure consistency with relevant vegetation types.

The mapped wetlands show the extent of wetland vegetation throughout the LGA and are consistent with the definition in the Standard Instrument LEP, which will be used for

Northern Beaches LEP and DCP. Mangroves will not be included in the Northern Beaches wetland definition but will be protected through vegetation mapping provisions:

> Wetland means:
>
> (a) natural wetland, including marshes, mangroves, backwaters, billabongs, swamps, sedgelands, wet meadows or wet heathlands that form a shallow waterbody (up to 2 metres in depth) when inundated cyclically, intermittently or permanently with fresh, brackish or salt water, and where the inundation determines the type and productivity of the soils and the plant and animal communities, or
>
> (b) artificial wetland, including marshes, swamps, wet meadows, sedgelands or wet heathlands that form a shallow waterbody (up to 2 metres in depth) when inundated cyclically, intermittently or permanently with water, and are constructed and vegetated with wetland plant communities.

4.6 Comparisons Between Existing and Proposed Maps

It is difficult to provide a comparison between the current maps and the new draft mapping as existing mapping is not comparable. Currently, watercourses and wetlands are mapped under Manly LEP 2013, Warringah DCP 2011, and Warringah Policy PL-740 Protection of Watercourses and Riparian Lands Policy. Wetlands and riparian areas have controls in the Pittwater LEP and DCP 2014 but are not mapped. The Warringah deferred lands are addressed through maps and controls in Warringah Policy PL-740.

The main changes to the watercourse mapping are:

- Improved mapping of the important upper catchment watercourses
- Stormwater pipes have been mapped as pipes rather than watercourses
- The foreshores of Pittwater will be protected in other parts of the LEP and DCP
- Improved wetland maps using up-to-date, accurate vegetation and wetland data.

4.6.1 Watercourses

It is proposed that there will be an additional buffer outside the riparian corridor, which is of importance particularly in the upper reaches of watercourses where the riparian corridor is narrower. This buffer is intended to protect and minimise disturbance to the riparian corridor.

The width of the riparian buffer is proposed to extend 30 metres from the outer edge of the riparian corridor on each side of the watercourse. In effect this would mean that upper catchment first order streams would have a riparian corridor of 10 metres on each side of the watercourse, and a buffer of an additional 30 metres, giving a total of 40 metres of riparian land on each side of the watercourse.

Further downstream, for example near the lagoons, the riparian corridor of a 3rd order stream would be 30 metres wide on each side of the watercourse, and a buffer of an additional 30 metres, giving a total of 60 metres of riparian land on each side of the watercourse.

Table 3 outlines proposed riparian corridors compared to existing maps.

Table 3: Watercourse corridors

Basis of current riparian area	Current total riparian area	Proposed total riparian area
Pittwater LEP 2014, internal trigger, not mapped.	40 m from top of bank	1st order = 10m RC + 30m buffer 2nd order = 20m RC + 30m buffer 3rd order = 30m RC + 30m buffer 4th order = 40m RC + 30m buffer
Warringah DCP 2011, Warringah Policy PL-740, mapped	Variable, 20m to 120m from top of bank	
Manly LEP 2013, clause 6.6, described in LEP, not mapped	40 m from top of bank	

4.6.2 Wetlands

It is proposed there be a 100m buffer from the edge of the wetland. These figures are consistent with current best practice and are in keeping with the existing mapping widths.

Table 4 summarises proposed and existing buffers for wetlands.

Table 4: Wetland buffers

Basis of current buffer	Current buffer	Proposed buffer
Pittwater DCP Clause B4.14	DCP refers to entire catchment of wetland, need for 'adequate buffer', and 10m minimum setback	100m
Warringah DCP 2011, Warringah Policy PL-740	100m	
Manly LEP 2013, clause 6.7	Not specified	

5.0 Consultation

Consultation regarding the new map has taken place internally within Council's Strategic and Place Planning and Environment and Climate Change Units. In addition, the mapping methodology and map has been peer reviewed by an industry expert.

Council has approached NSW Department of Industry, Natural Resource Regulator (NRAR) and NSW DPIE in regard to the mapping, however their preference is for these decisions to be made at a local level.

The draft watercourse and wetland map is now recommended to Council for public exhibition to allow for community engagement and consultation.

6.0 Conclusion

Council is in the process of a strategic land-use planning program to prepare a single LEP and DCP for the Northern Beaches Council area. While the protection of waterways, watercourses, wetlands and riparian land is dealt with differently under current LEPs and DCPs, all share the same objective - that waterways and riparian areas need to be protected, and that risks associated with waterways such as bank erosion need to be managed.

Council is proposing new watercourse, wetland and riparian lands map for inclusion in Council's new draft LEP and DCP. They will be the basis of a consistent approach to protect watercourses and wetlands, and to manage the risks associated with these areas across the LGA.

This map will be an improvement on the current approach where the planning framework is based on four different LEPs, their accompanying DCPs, and policies. The map shows the location of watercourses and wetlands within the LGA.

7.0 References

BMT Commercial Australia Pty Ltd, March 2020, "Final Literature Review – Riparian Provisions and Conditions for Northern Beaches Council LEP and DCP"

BMT Commercial Australia Pty Ltd, May 2020, "Final Briefing Report – Riparian Provisions and Conditions for Northern Beaches Council LEP and DCP"

BMT Commercial Australia Pty Ltd, March 2021, "Riparian Mapping Methodology for Northern Beaches Council LEP and DCP"

Appendix – Riparian Mapping Methodology for Northern Beaches Council LEP and DCP

Riparian Mapping Methodology for the Northern Beaches Council LEP and DCP

Reference: R.B24023.003.03.MappingMethodology.docx
Date: March 2021

Document Control Sheet

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Document:	R.B24023.003.03.MappingMethodology.docx
Title:	Riparian Mapping Methodology for the Northern Beaches Council LEP and DCP
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Client:	Northern Beaches Council
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REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
3	3 March 2021	Geoff Withycombe		Paul Dubowski	
2	1 March 2021				
1	11 February 2021				
0	9 February 2021				

DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
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BMT File	PDF	PDF	PDF	PDF							
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1 Introduction

To support the preparation of the new Northern Beaches Council (NBC) Local Environmental Plans (LEPs) and Development Control Plans (DCPs), NBC has initiated a project to provide new watercourse, riparian and wetland mapping and related LEP/DCP planning provisions. This project aims to establish a consistent and evidence-based approach for this mapping across the local government area (LGA) and to ensure land use policy responses and development controls protect, enhance or restore associated waterway and wetland values across the Northern Beaches.

This report and the associated mapping are the outcomes of the third phase of the project. The objective of this report was to outline the mapping methodology including the rules adopted for setting watercourse and wetland riparian and riparian buffer widths. A section on nomenclature precedes the description of mapping methodology to enable the reader to understand the terms used in this report. Further information is contained in the LEP/DCP Provisions.

2 Nomenclature

2.1 Identification of Relevant Definitions

This section provides an overview of definitions recommended for the DCP and LEP provisions. The provisions clarify the role of the riparian corridor categories and riparian buffers, and describe the development and management intent with respect to these. These definitions may be further refined in the drafting of the DCP and LEP provisions.

Table 2-1 Definitions

Term	Definition	Source
Channel	The part of the watercourse including the bed and banks in which water flows permanently or intermittently, regardless of the frequency of flow events. The lateral limits of the channel are defined by the outer banks Note: the bed and banks need to be determined on site and may not always be continuous. Assessment of a range of geomorphic, hydrologic and ecological characteristics of the watercourse is necessary to identify the bed and banks. Examples of features which may assist in defining the outer banks include: the typical area in which water is confined during periods of flow; edge of the floodplain; scour marks; depositional features; changes in vegetation; and the bank on the opposite side of the channel	Consultant team recommendation
Riparian corridor	Means the nominated terrestrial environment adjoining the channel to be managed to support waterway functions, values and long-term use and to address risks associated with waterways **Note**: refer to Figure 2-1 and Figure 2-2 below	The approach adopted following consultation with NBC
Category 1 Riparian Corridors	Riparian Corridor that potentially supports relatively intact native vegetation and habitats within a nominated width measured from the edge of the channel	The approach adopted following consultation with NBC
Category 2 Riparian Corridors	Riparian Corridor that potentially supports disturbed lands within a nominated width measured from the edge of the channel	The approach adopted following consultation with NBC
Riparian buffer	Means land adjoining the Riparian Corridor that is intended to protect and minimise disturbance to the Riparian Corridor **Note**: refer to Figure 2-1 and Figure 2-2 below	Consultant team recommendation
Riparian land	Means the 'channel', 'riparian corridor' and 'riparian buffer' **Note**: refer to Figure 2-1 and Figure 2-2 below	The approach adopted following consultation with NBC
Waterbody	Means a waterbody (artificial) or waterbody (natural)	Standard Instrument
Waterbody (artificial)	Means an artificial body of water, including any constructed waterway, canal, inlet, bay, channel, dam, pond, lake or artificial wetland, but does not include a	Standard Instrument

Term	Definition	Source
	dry detention basin or other stormwater management construction that is only intended to hold water intermittently	
Waterbody (natural)	Means a natural body of water, whether perennial or intermittent, fresh, brackish or saline, the course of which may have been artificially modified or diverted onto a new course, and includes a river, creek, stream, lake, lagoon, natural wetland, estuary, bay, inlet or tidal waters (including the sea)	Standard Instrument
Watercourse	Means any river, creek, stream or chain of ponds, whether artificially modified or not, in which water usually flows, either continuously or intermittently, in a defined bed or channel, but does not include a waterbody (artificial)	Standard Instrument
Wetland	Means: • an area containing the vegetation communities listed in Schedule 1 below; and • natural wetland, including marshes, mangroves, backwaters, billabongs, swamps, sedgelands, wet meadows or wet heathlands that form a shallow waterbody (up to 2 metres in depth) when inundated cyclically, intermittently or permanently with fresh, brackish or salt water, and where the inundation determines the type and productivity of the soils and the plant and animal communities, or • artificial wetland, including marshes, swamps, wet meadows, sedgelands or wet heathlands that form a shallow waterbody (up to 2 metres in depth) when inundated cyclically, intermittently or permanently with water, and are constructed and vegetated with wetland plant communities	NBC's preferred approach and Standard Instrument
Waterway	Means the whole or any part of a watercourse, wetland or waterbody	Standard Instrument

Figure 2-1 and Figure 2-2 below provide different variations of a preliminary diagram showing the spatial relationship of the adopted key defintions. These include Category 1 and Category 2 Riparian Corridors which are explained further below. The adopted terminology was adopted following consultation with NBC.

In these diagrams, the Asset Protection Zones (APZs) in Category 2 are shown to be overlapping with the riparian buffers on one side of the watercourse and adjacent on the other side. The intent is to retain some flexibility around the principle of excluding APZs/development from Riparian Corridors to allow for other objectives to be met including the protection of other environmental values beyond the riparian land.

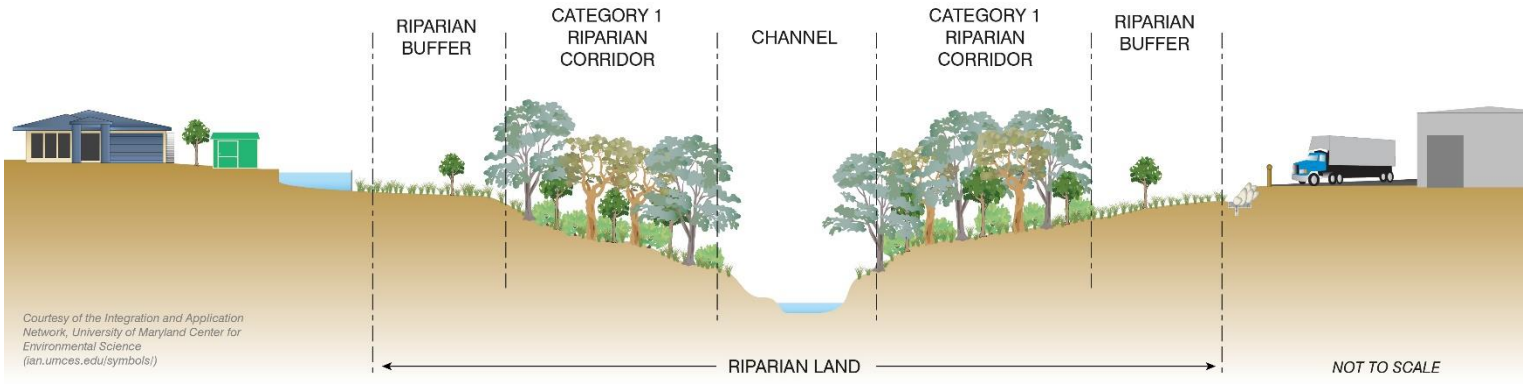

Figure 2-1 Preliminary Diagram Showing Key Definitions including Category 1 Riparian Corridors

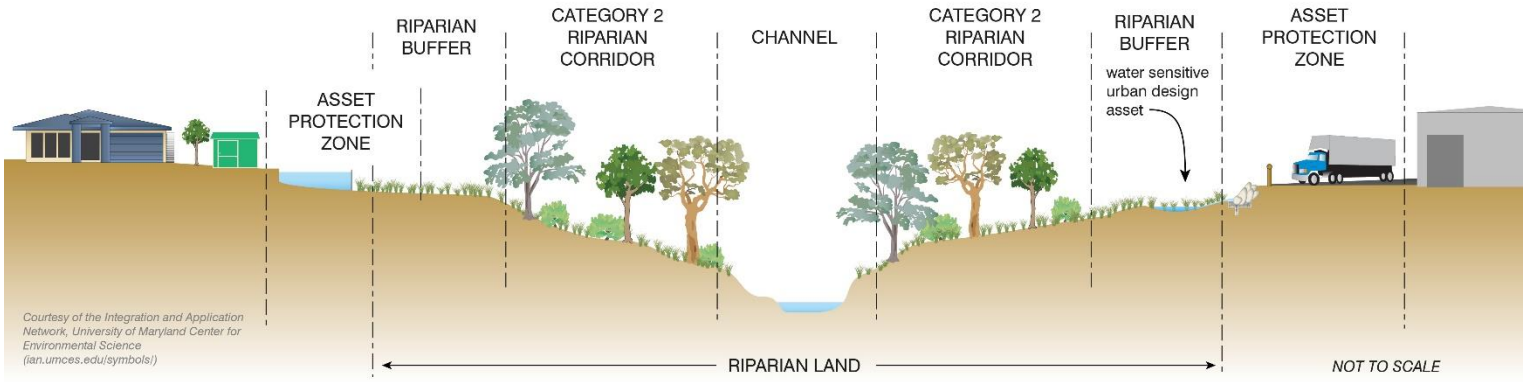

Figure 2-2 Preliminary Diagram Showing Key Definitions including Category 2 Riparian Corridors

3 Mapping Methodology

The mapping methodology NBC adopted for this project is summarised in Figure 3-1 and described in detail below. The mapping methodology was developed based on a literature review and in response to analysis of available GIS layers and Council feedback.

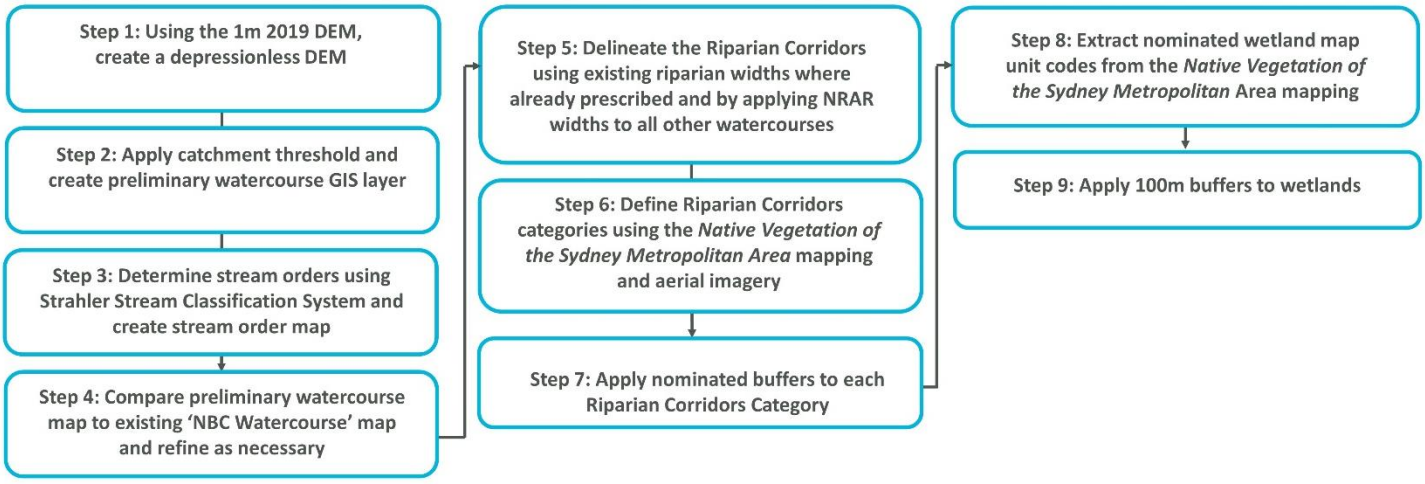

Figure 3-1 Mapping Methodology Waterways, Riparian Corridors, Wetlands and Riparian Buffers

Step 1: Create a depressionless Digital Elevation Model

- Analysis of the 2019, 1 metre Digital Elevation Model (DEM) provided by Council.
- Preliminary assessment of the DEM identified a number of issues which would limit the use of the DEM in determining watercourses and stream orders. Specifically, the DEM includes the following limitations:
  - Gaps in the DEM particularly over large watercourses known as ‘sinks’.
  - Some areas of water that were masked out of the provided DEM did not match watercourse and wetland extents. In these areas, the stream network was manually manipulated to best fit the existing terrain. The image below shows an example of where a sink (area where the aerial photo shows through the DEM) does not match the terrain (shown in blue). The DEM is therefore incorrect (non-existent) in the areas of the sink.

Figure 3-2 Example showing where a sink does not match the terrain of the DEM

  - Areas where the fill process in the DEM has caused a damming effect. This commonly happens where a road crosses a watercourse and the height of the road is taken to be the level of the watercourse, thereby forcing the water to pond upstream of the road and flow incorrectly. The same scenario happens for piped watercourses. The below screen shots show an example of before and after correction of the DEM to enable flow through the highlighted point.

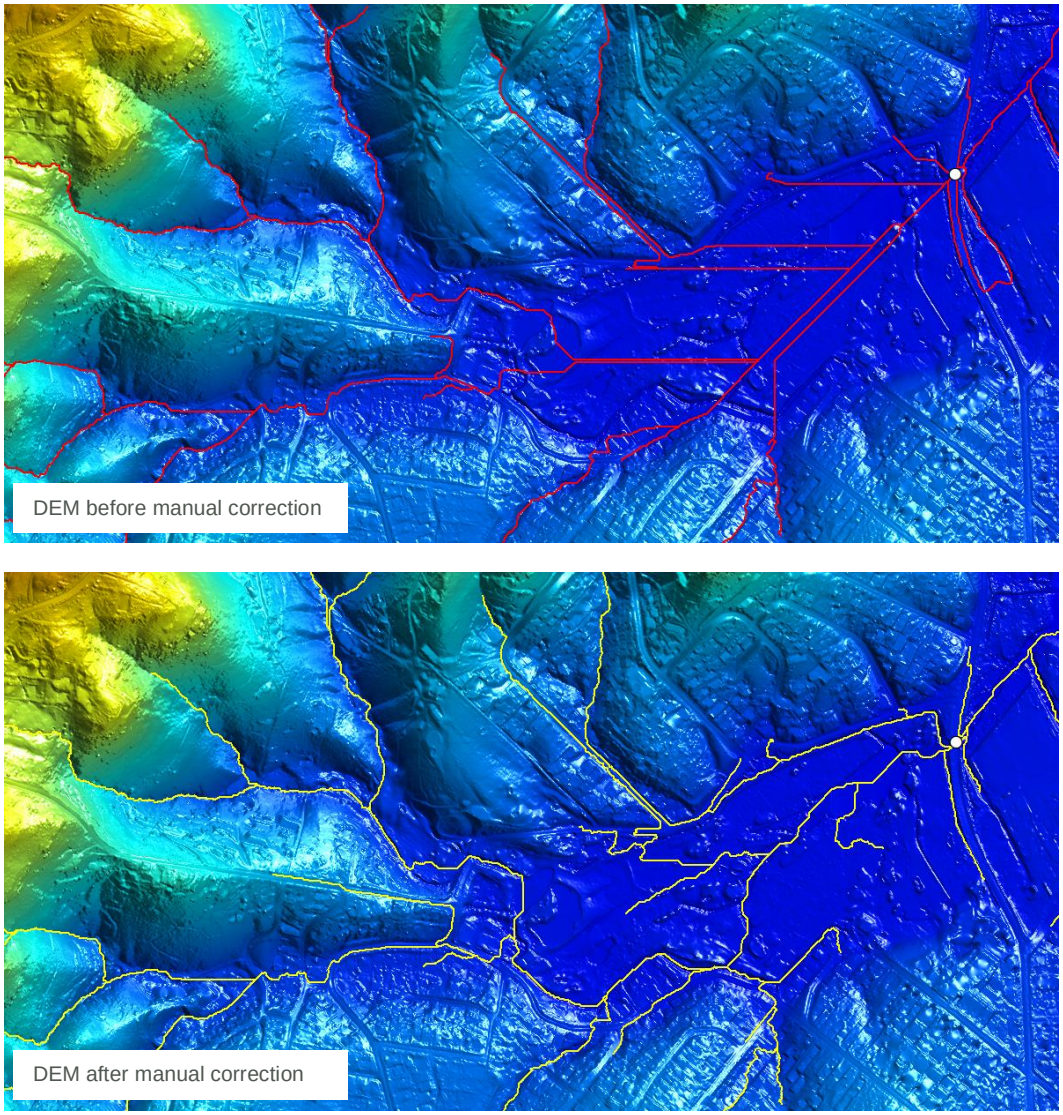

Figure 3-3 An example of before and after correction of the DEM to enable flow through the highlighted point

Collectively, these issues mean that the alignment of watercourses diverts from the actual alignment, in some cases significantly. Consequently, the rules adopted for this step included:

(1) Manually manipulate the DEM to create a depressionless DEM.

(2) After identification and amendments to the DEM are made, repeat the process to identify any further problems.

(3) Correct any further problems identified by visual inspection and correcting those problems manually.

- **Step 2: Applying a catchment threshold to create a preliminary GIS watercourse layer**
  - This step utilises 'Hydrology tools' within the ArcGIS Pro ver.2.5 software environment. It involves a calculation of flow direction followed by flow accumulation. The rule for this step is that stream creation was limited to a flow accumulation threshold of 25000 cells, representing a minimum catchment area of 2.5 hectares.

    This is consistent with the smallest catchment threshold used in the *Waterway Centreline Mapping Report* (Catchment Simulation Solutions 2015) which applied this threshold to Warringah catchments. The threshold was originally based upon *the Warringah Council Pilot Creek Mapping Study (Wheeler Creek) Peer Review* (Shaw 2012), which identified where watercourses generally commenced in the landscape.

    The more the threshold value is decreased, the more streams will be drawn into the network. A smaller threshold would therefore assist in identifying and mapping minor watercourses. It may also result in the maximum stream order increasing.

    While this may be appropriate for catchments which are fully or mostly vegetated (e.g. as in the *Wheeler Creek Peer Review* (Shaw 2012)), it is unlikely to be suitable in highly developed catchments where most of the minor watercourses have historically been fully piped and there is limited opportunity for daylighting those watercourses in the future. This is especially the case given that those pipes flow below valuable urban land uses unlikely to ever revert back to open space.

    Consequently, consideration was given to increasing the threshold value in certain catchments. This option was however, discounted due to a number of reasons including that it may falsely give the impression that some areas are being targeted to identify more watercourses where the lower threshold is retained.

    Instead, the processes adopted was to manually remove stormwater pipes from the draft watercourse map. This step was undertaken by Council.
- **Step 3: Determining stream orders**
  - Determining stream orders was undertaken using the ArcGIS Pro ver.2.5 software environment. The stream order tool relies upon a combination of the flow direction and flow accumulation results to create a stream order grid. This is then vectorised to produce a polyline map product.
  - The rule associated with this step of the mapping process was to apply the Strahler Stream Classification System (Strahler 1952) consistent with the *Guidelines for controlled activities on waterfront land—Riparian Corridors* (NRAR 2018).
  - A stream order GIS layer was produced for the whole NBC LGA.

- **Step 4: Watercourse GIS layer comparison**
  - The preliminary watercourse layer was then compared against Council's best existing watercourse layer i.e. the 'NBC Watercourse' layer. The purpose of this comparison was to analyse which layer provided the most accurate alignment of watercourses based on inspection or aerial photography and vegetation mapping. This enabled further manual refinements to the preliminary watercourse layer which improved upon the 'first pass' mapping. The mapping rule in this step involved identifying discrepancies which included:
    - Unmapped watercourse in one layer identified in the other.
    - The lateral extent of a watercourse being longer in one layer compared to the other.
    - The location/alignment of watercourses better reflects the terrain.
    - The location/alignment in one layer looks like it has not identified pipes, culverts and channelised watercourses.
  - Some ground truthing was undertaken by Council after an initial draft of the map to validate the outcomes of this step and recommend changes. Council undertook ground truthing for both watercourse location and riparian category (described further below).
  - The watercourse layer developed by BMT was manually adjusted at this point using the two watercourse layers to provide a dataset which would be most representative of site conditions.
  - As there is no reliable way to map stream banks using any existing datasets, the Riparian Corridors widths were typically measured from the centreline of the watercourse. The exception to this rule was in the case of very wide watercourses (especially the coastal lagoons) where the commencement of the Riparian Corridors was manually adjusted to the approximate edge of the water as visible in aerial photography.
  - This step also included manual removal of piped watercourses through residential and industrial areas (e.g. in Brookvale, Dee Why, Avalon, Manly Vale, Newport etc.).
  - Finally, every watercourse which was manually adjusted 'lost' its stream order numbering. The process described in Step 3 above for determining stream orders could not be repeated on the adjusted watercourse layer because there was no commensurate DEM which could be used in ArcGIS to re-run the stream order tool.
  - The missing stream orders were consequently manually assigned to all adjusted watercourses using the Strahler Stream Classification System (Strahler 1952). Stream order was continued as if the watercourse was continuous even if it had piped sections.
- **Step 5: Mapping Riparian Corridors**
  - The Riparian Corridors were mapped as follows:
    - There were already a number of existing prescribed riparian areas mapped within the LGA including in the Warriewood Valley and Dee Why Creek. This existing mapping was used to determine the Riparian Corridor widths for these watercourses.
  - For all other watercourses, the widths provided in the NRAR 2018 guidelines were adopted as the minimum Riparian Corridor widths. This included:

- Stream order 1: 10m either side of the channel (20 metres total)
- Stream order 2: 20m either side of the channel (40 metres total)
- Stream order 3: 30m either side of the channel (60 metres total)
- Stream order 4 and above: 40 metres either side of the channel (80 metres total).

It should be noted that as there is no available data to efficiently define the stream banks, the Riparian Corridor widths were measured from the centreline of the watercourse. The exception to this rule was for those previously mentioned wide watercourses (especially the coastal lagoons) where the inner boundary of the Riparian Corridors was measured from the outer bank where visibly discernible on available aerial imagery.

Notwithstanding, the LEP/DCP provisions make it clear that a site-based assessment may be required during development applications. Where it is required, this may include:

- Surveying the outer bank of a watercourse or wetland from which the actual measurements are to be taken.
- An ecological survey to determine the edge of any wetland which could potentially be affected by the development. The wetland edge may be influenced by topography, vegetation, hydrology, soils or a combination thereof, as well as other potentially relevant factors such as bathymetry, local climate and groundwater.

- **Step 6: Defining Riparian Corridors Categories**

The type and condition of Riparian Corridors was determined using the latest version of the *Native Vegetation of the Sydney Metropolitan Area* mapping (Version 3.1) (OEH, 2016) (VIS_ID 4489) and checked against aerial photography.

- The following two categories of Riparian Corridors were distinguished:
  - **Category 1: Native Vegetation**. This category incorporated all native vegetated areas extracted from the *Native Vegetation of the Sydney Metropolitan Area* excluding wetland vegetation as defined below in Step 8.
  - **Category 2: Disturbed and Cleared**. This category incorporated all other map unit codes from the *Native Vegetation of the Sydney Metropolitan Area*. All remaining areas within the Riparian Corridors not mapped by the Sydney Metropolitan Area mapping were also included and labelled as disturbed.

- **Step 7: Applying the Riparian Buffers to the Riparian Corridors**

The riparian buffers applied to the CRZ included 30 metre riparian buffers for both Category 1 and Category 2 areas. The width was determined by NBC as a balance between 100m/50m buffer discussed in the literature review for Category 1 and a pragmatic approach noting that other controls will assess impacts on water quality and quantity from developments throughout the catchment further away from the waterway itself. These will be covered in other parts of the LEP and DCP.

NBC elected not to apply buffers in intensive zones (residential/business/industrial) due to the highly impervious nature of these zones and the fact that other provisions will address water management in these areas.

Riparian buffers do not extend into the waterbodies of the lagoons, Pittwater and the harbour.

- **Step 8: Wetland Mapping**

The following Map Unit Codes identified by NBC were extracted from the *Native Vegetation of the Sydney Metropolitan Area - Version 3.1* (OEH, 2016) (VIS_ID 4489) to generate the NBC Wetlands layer:

Schedule 1: Wetlands

State-wide Class	Map Unit Code	Community Name	NSW Threatened Ecological Community	EPBC Act Threatened Ecological Community
Forested Wetlands	S_FoW03	S_FoW03: Coastal Freshwater Swamp Forest		
Forested Wetlands	S_FoW08	S_FoW08: Estuarine Swamp Oak Forest	Swamp Oak Floodplain Forest	Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community
Forested Wetlands	S_FoW12	S_FoW12: Coastal Swamp Paperbark-Swamp Oak Scrub	Swamp Oak Floodplain Forest	Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community
Forested Wetlands	S_FoW21	S_FoW21: Sandstone Cliff-face Soak		
Freshwater Wetlands	S_FrW01	S_FrW01: Coastal Upland Damp Heath Swamp	Coastal Upland Swamp	Coastal Upland Swamps in the Sydney Basin Bioregion
Freshwater Wetlands	S_FrW02	S_FrW02: Coastal Upland Wet Heath Swamp	Coastal Upland Swamp	Coastal Upland Swamps in the Sydney Basin Bioregion
Freshwater Wetlands	S_FrW03	S_FrW03: Coastal Freshwater Wetland	Sydney Freshwater Wetlands	
Freshwater Wetlands	S_FrW06	S_FrW06: Estuarine Reedland	Swamp Oak Floodplain Forest	Subtropical and Temperate Coastal Saltmarsh (possible)
Freshwater Wetlands	S_FrW13	S_FrW13: Coastal Sand Swamp Scrub	Sydney Freshwater Wetlands	

- **Step 9: Wetland Buffers**

100 metre buffers were applied to the wetlands identified in Step 8 in accordance with the *State Environmental Planning Policy (Coastal Management) 2018*. Buffers do not extend into the waterbodies of the lagoons, Pittwater and the harbour.

SEE INSET

LEGEND

- Wetlands
- Wetlands 100m Buffer
- NBC_LGA

Riparian Corridor

- Category 1
- Category 2
- 30m Buffer

Title:

Draft Riparian Corridor Categories and Buffers

DRAFT

Figure: **3-4**

Rev: **A**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

N

0 800 1,600m
Scale - Inset

0 2 4km
Scale - Main Map

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Filepath: I:\B24023.i.ajs_Riparian Provisions & Conditions for Northern Beaches\DRG\ECO_030_150520_Draft_Categories_Buffers.wor

4 DCP and LEP Development Controls

The DCP and LEP development controls which are being prepared in Phase 4 of this project include:

(1) Finalisation of the key terms and definitions described in Section 2 above.

(2) A description of the application of the mapping including:

  (a) Clarification for how the mapping relates to the planning provisions.

  (b) Clarification about managing any discrepancies between the Riparian Lands and Wetlands Map and on the ground conditions.

(3) Categories of environment assessment.

(4) Objectives and controls.

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