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Riparian Lands Study

Lot 1 DP 949932, Taylors Lane Cambewarra

Prepared for Shoalhaven City Council | 20 March 2020

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Document control

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Executive summary

Project outline

The aim of this Riparian Lands Study is to review and confirm the classification of the Subject Watercourse at Lot 1 DP 949932, Taylors Lane Cambewarra. The objective was to investigate the riparian extent and extent of E2 zoned land and identify impacts on riparian values/ riparian health on the site and downstream if the watercourse is to be removed and land is rezoned from E2 Environmental Conservation to R1 General Residential.

Methods

The investigation involved:

- A review of previous mapping and a categorisation of riparian corridor objectives.
- Review of spatial data and spatial analysis to delineate the riparian corridor for the subject watercourse based on analysis of available LiDAR data.
- A site investigation to ground truth spatial analysis and identify hydrological and/or ecological functions of the site.
- Assessment of potential constraints to the development.
- Assessment of potential impacts to the receiving environment if the land is rezoned.
- Recommendations for riparian corridor extent and categorisation in consideration of local and state planning legislation and policy.

Recommendations

The Riparian Lands Study makes the following recommendations in consideration of local and state planning legislation and policy:

- Recategorisation of the subject watercourse from Strahler Stream Order 2 to 1.
- Potential for rezoning a portion of the subject watercourse which has undefined banks from environmental conservation to residential.
- Recommended Minimum Riparian Extent.

The recommended “Minimum Riparian Extent” for the subject watercourse is a 10m buffer of the field validated watercourse centreline. This is in accordance with the *Water Management Act 2000* (WM Act) and recommendations of Natural Resource Access Regulator’s (NRAR) “Guidelines for Riparian Corridors on Waterfront Land” which applies riparian corridor widths to a field validated watercourse, according to Strahler Stream Order.

It would be ideal to be able to incorporate adjacent patches of native vegetation as identified and field validated by EcoPlanning (2019) as “Spotted Gum – Grey Ironbark – Woollybutt grassy open woodlands” and “Native plantings”. The inclusion of these areas would form an “Ultimate” Riparian Corridor for the subject watercourse by meeting the requirements of the WM Act, following the Guidelines and also enhancing the ecological value of the corridor by retaining existing native vegetation and fauna.

Glossary and list of abbreviations

Term or abbreviation	Definition
BC Act	Biodiversity Conservation Act 2016
DCP	Development Control Plan
DIPNR	Department of Infrastructure Planning and Natural Resources
DPIE	Department of Planning Industry and Environment
FM Act	Fisheries Management Act 1994
LEP	Local Environmental Plan
LiDAR	Light Detection and Ranging
MLS	Minimum Lot Size
NRAR	Natural Resource Access Regulator
OEH	Office of Environment and Heritage
PP	Planning Proposal
SCC	Shoalhaven City Council
SEPP	State Environmental Planning Policy
URA	Urban Release Area
VRZ	Vegetated Riparian Zone
WM Act	Water Management Act (2000)

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1. Introduction

1.1 Background

A proponent-initiated planning proposal (PP) has been lodged with Shoalhaven City Council to rezone certain land within Lot 1 DP 949932, Taylors Lane, Cambewarra- referred to in this document as the "Subject Lot". The land that the PP applies to is identified as a watercourse and is referred to in this report as the "Subject Watercourse". The PP aims to enable a proposed residential subdivision of the subject watercourse.

Shoalhaven City Council has engaged Niche Environment and Heritage to prepare a Riparian Lands Study for the "Subject Watercourse" to assist in determining if the planning proposal has merit to proceed.

Figure 1 illustrates the location of the *Subject Lot* and *Subject Watercourse*.

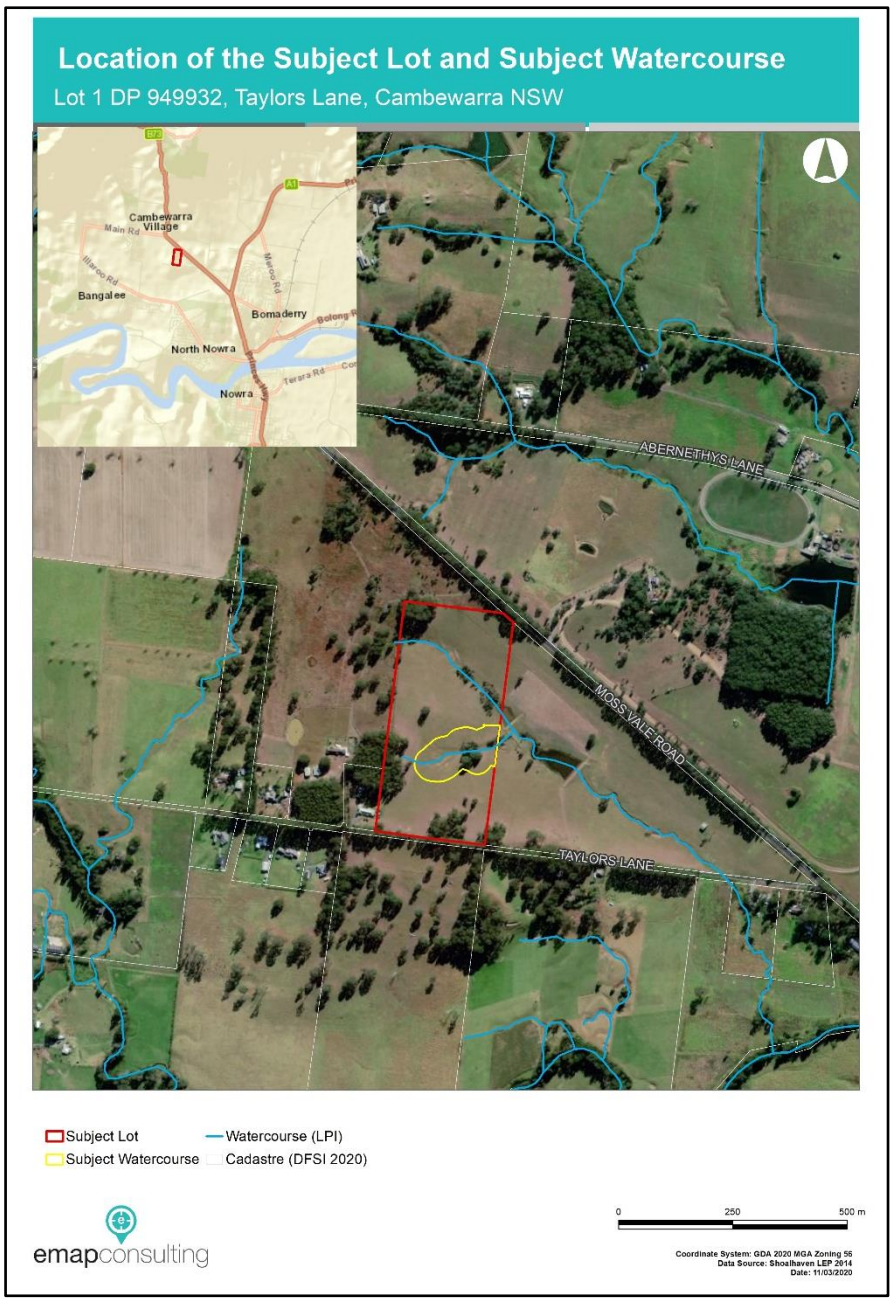


Figure 1: Location of the Subject Lot and Subject Watercourse

1.2 The Planning Proposal

The proposed development of the Subject Watercourse comprises residential subdivision, with associated infrastructure and landscaping works. The proposed development relies on an amendment to the zoning, minimum lot size controls and riparian lands and watercourses map within the LEP to the area identified as the "Subject Watercourse". The PP seeks to:

- Remove the subject watercourse from the Riparian Lands and Watercourses Map.
- Rezone land associated with the subject watercourse from Zone E2 Environmental Conservation to Zone R1 General Residential.
- Reduce the minimum lot size of the subject watercourse (currently 40ha in the E2 zone) to 500sqm and potential to enact Clause 4.1H of SLEP 2014 in appropriate circumstances to allow minimum lot sizes of ≥300sqm.
- Extend the Moss Vale Road South urban release area boundary to include the subject watercourse.

According to the planning proposal prepared by Cardno (2019), the proposed design of the residential subdivision aligns with the adopted Development Control Plan Chapter NB3 for Moss Vale Road South Urban Release Area.

The Subject Watercourse comprises Stage 1c of a wider proposed residential subdivision of the Subject Lot, with Stage 1a immediately to the north and Stage 1b immediately to the south. Stages 1a and 1b are currently under assessment by Shoalhaven City Council for a residential subdivision identified as Development Application SF10632. Stage 1c has been designed to allow for a more standardised linear grid pattern of development, and therefore greater lot capacity (see Figure 2).

1.3 Purpose of the Riparian Lands Study

The aim of this Riparian Lands Study is to review and confirm the classification of the Subject Watercourse, investigate the riparian extent and extent of E2 zoned land, and identify impacts on riparian values/ riparian health on the site and downstream if the watercourse is to be removed and land is rezoned from E2 Environmental Conservation to R1 General Residential.

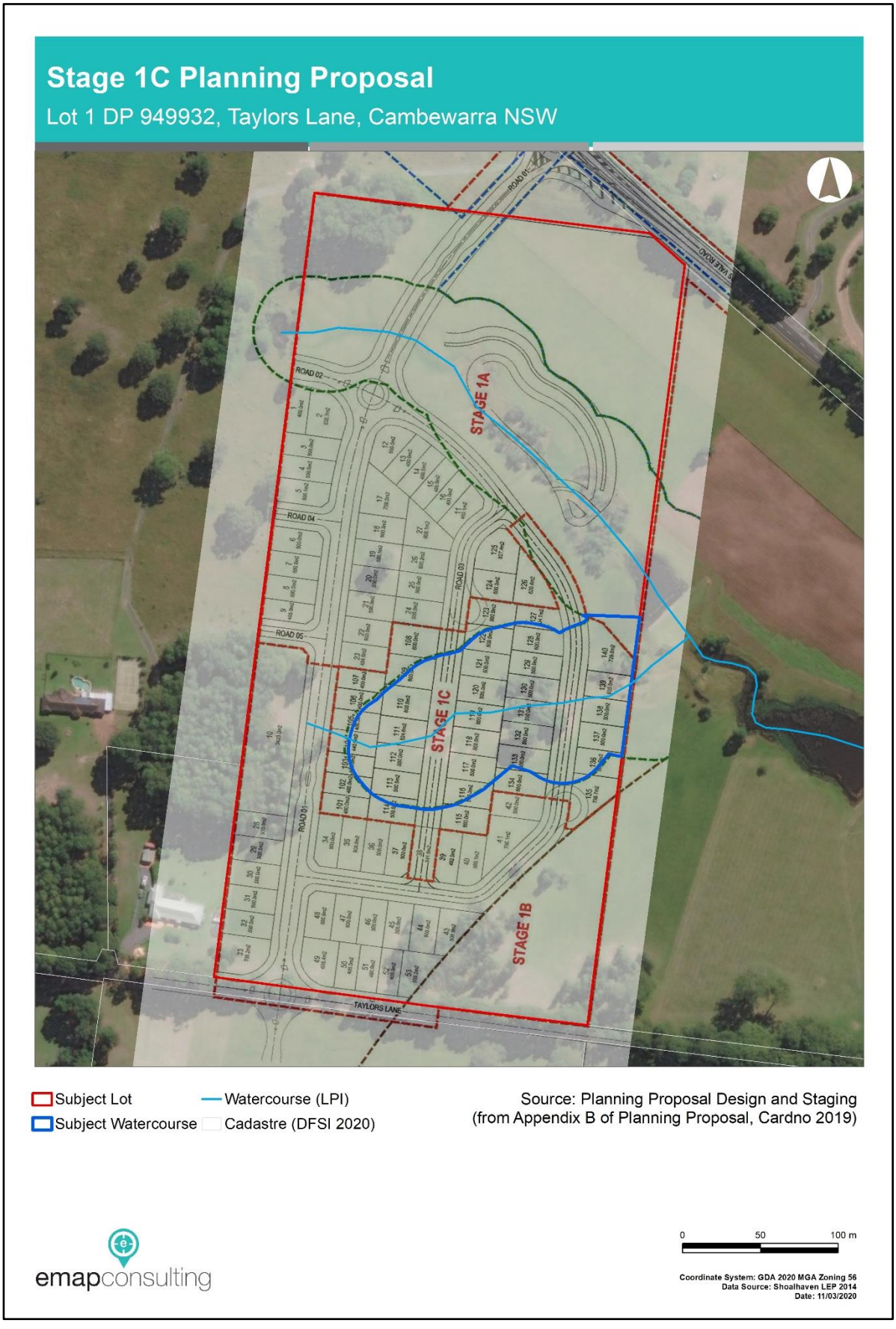


Figure 2: Planning Proposal for Stage 1C, as per Cardno (2019)

2. Statutory Considerations

2.1 State Legislation

2.1.1 Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the protection, conservation and ecologically sustainable development of waterways. It controls the carrying out of activities in or near waterways, their ecosystems, ecological processes, biological diversity and water quality.

Controlled activities carried out in, on or under waterfront land are regulated by the WM Act. The Natural Resource Access Regulator administers controlled activities under the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront as a consequence of carrying out the proposed work. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary.

2.1.2 Fisheries Management Act 1994

Threatened species, populations and ecological communities of fish and marine vegetation are addressed in the *Fisheries Management Act 1994* (FM Act). The degradation of riparian vegetation is listed as a Key Threatening Process under the FM Act. The objectives of the FM Act are to:

- Conserve biological diversity of fish and marine vegetation and promote ecologically sustainable development and activities.
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities of fish and marine vegetation.
- Protect the critical habitat of those threatened species, populations and ecological communities that are endangered.
- Eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities of fish and marine vegetation.
- Ensure that the impact of any action affecting threatened species, populations and ecological communities of fish and marine vegetation is properly assessed.
- Encourage the conservation of threatened species, populations and ecological communities of fish and marine vegetation by the adoption of measures involving co-operative management.

2.1.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) establishes a framework for protecting threatened species, populations and ecological communities and their habitats. Schedules 1 and 2 of the BC Act list terrestrial species, populations and ecological communities threatened in NSW.

2.1.4 Noxious Weeds Act 1993

The purpose of the *Noxious Weeds Act 1993* is to identify noxious weeds in respect of which particular control measures need to be taken, to specify those control measures, and to specify the duties of both public and private landholders with respect to the control of noxious weeds.

2.2 State Policies

2.2.1 State Rivers and Estuaries Policy

The objective of the policy is to manage the rivers and estuaries of NSW in ways which:

- Slow, halt or reverse the overall rate of degradation in their systems.

- Ensure the long term sustainability of their essential biophysical functions.
- Maintain the beneficial use of these resources.

2.2.2 State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017 (Vegetation SEPP)

The Vegetation SEPP (the SEPP) works together with the *Biodiversity Conservation Act 2016* and the *Local Land Services Amendment Act 2016* to create a framework for the regulation of clearing of native vegetation in NSW.

The SEPP will ensure the biodiversity offset scheme (established under the Land Management and Biodiversity reforms) will apply to all clearing of native vegetation that exceeds the offset thresholds in urban areas and environmental conservation zones that does not require development consent.

2.3 Local Legislation

2.3.1 Shoalhaven Local Environmental Plan (LEP) 2014

Zoning

The subject watercourse is currently zoned *E2 – Environmental Conservation* under the Shoalhaven LEP 2014.

Objectives of the E2 zone are:

- To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values.
- To prevent development that could destroy, damage or otherwise have an adverse effect on those values.
- To protect water quality and the ecological integrity of water supply catchments and other catchments and natural waterways.
- To protect the scenic, ecological, educational and recreational values of wetlands, rainforests, escarpment areas and fauna habitat linkages.
- To conserve and, where appropriate, restore natural vegetation in order to protect the erosion and slippage of steep slopes.

The current E2 zoning permits the development of dwelling houses. However, any development must demonstrate consistency with the zone objectives, including that it will "*protect, manage and restore areas of high ecological….value*" and "*conserve and, where appropriate, restore natural vegetation*". Further, the LEP restricts subdivision of the subject site, as the current minimum lot size is 40 ha.

The planning proposal seeks to rezone the subject watercourse from *E2 Environmental Conservation* to *R1 General Residential* and decrease the minimum lot size from 40 ha to 500 $m^2$with the potential to enact Clause 4.1H of SLEP 2014 in appropriate circumstances to allow minimum lot sizes of ≥300sqm.

Objectives of the R1 zone are:

- To provide for the housing needs of the community.
- To provide for a variety of housing types and densities.
- To enable other land uses that provide facilities or services to meet the day to day needs of residents.
- To identify land suitable for future urban expansion.

The R1 zone permits a wide range of residential development and associated facilities and services.

Riparian land and watercourses

The subject watercourse is identified as 'Watercourse Category 2' on the Riparian Lands and Watercourses Map. As such Clause 7.6 'Riparian land and watercourses' of Shoalhaven LEP 2014 applies.

The objective of Clause 7.6 is to protect and maintain:

- Water quality within watercourses.
- The stability of the bed and banks of watercourses.
- Aquatic and riparian habitats.
- Ecological processes within watercourses and riparian areas.

Clause 7.6 outlines a range of matters related to the clause objectives that the consent authority must consider prior to granting consent to any development subject to the clause. It also requires the consent authority to be satisfied that proposed development will avoid, minimise or mitigate any significant adverse environmental impact.

The PP seeks to remove the subject watercourse's classification as a watercourse on the Riparian Lands and Watercourses Map.

2.3.2 Shoalhaven Development Control Plan 2014 Chapter NB3: Moss Vale Road South Urban Release Area

Chapter NB3 of the Shoalhaven DCP 2014 was prepared to facilitate development of land in the Moss Vale Road South Urban Release Area (URA). The relationship of the Subject Lot and Subject Watercourse with respect to the Moss Vale South URA is illustrated in Figure 3.

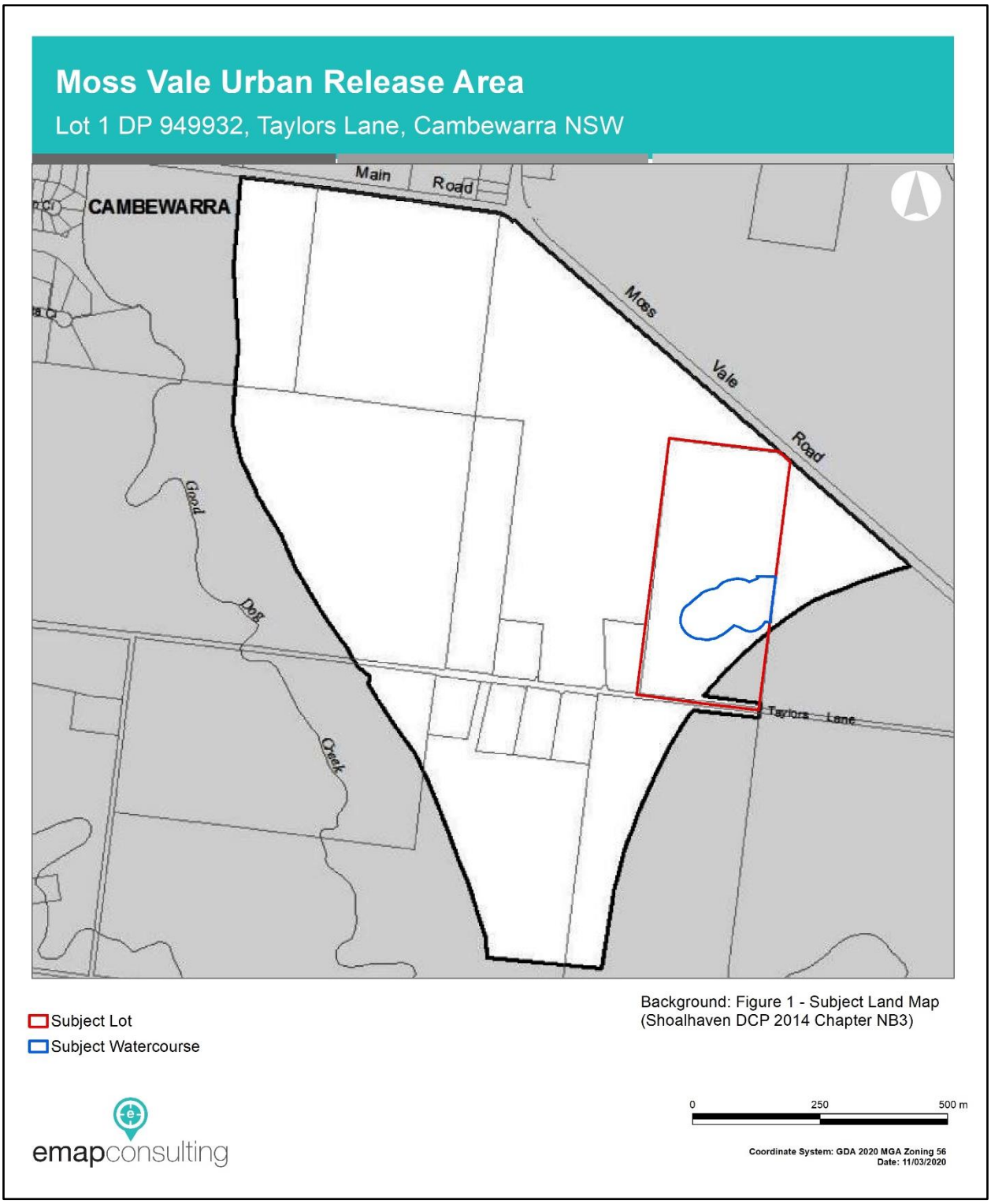


Figure 3: Location of Subject Lot and Subject Watercourse with respect to Moss Vale Road South URA (Shoalhaven DCP Chapter NB3)

The objectives of Chapter NB3 are to:

- Provide sound objectives and controls that build on sustainable living, economic vitality and community wellbeing principles.
- Promote neighbourhood design that achieves healthy, active and high quality urban design outcomes.
- Ensure that the environmentally sensitive development of the Moss Vale Road South URA occurs in an integrated and efficient manner.

Nowra Bomaderry Structure Plan (SCC 2008)

The Nowra Bomaderry Structure Plan was adopted by Shoalhaven City Council in 2008 and was prepared by Council to set the development-conservation agenda for the Nowra Bomaderry Region for the next 20-30 years. The Structure Plan identified the Moss Vale Road South (MVRS) Urban Release Area (URA) for low and medium density residential development. The urban structure outlined in the Nowra Bomaderry Structure Plan at the location of the Subject Site and Subject Watercourse is illustrated in Figure 4.

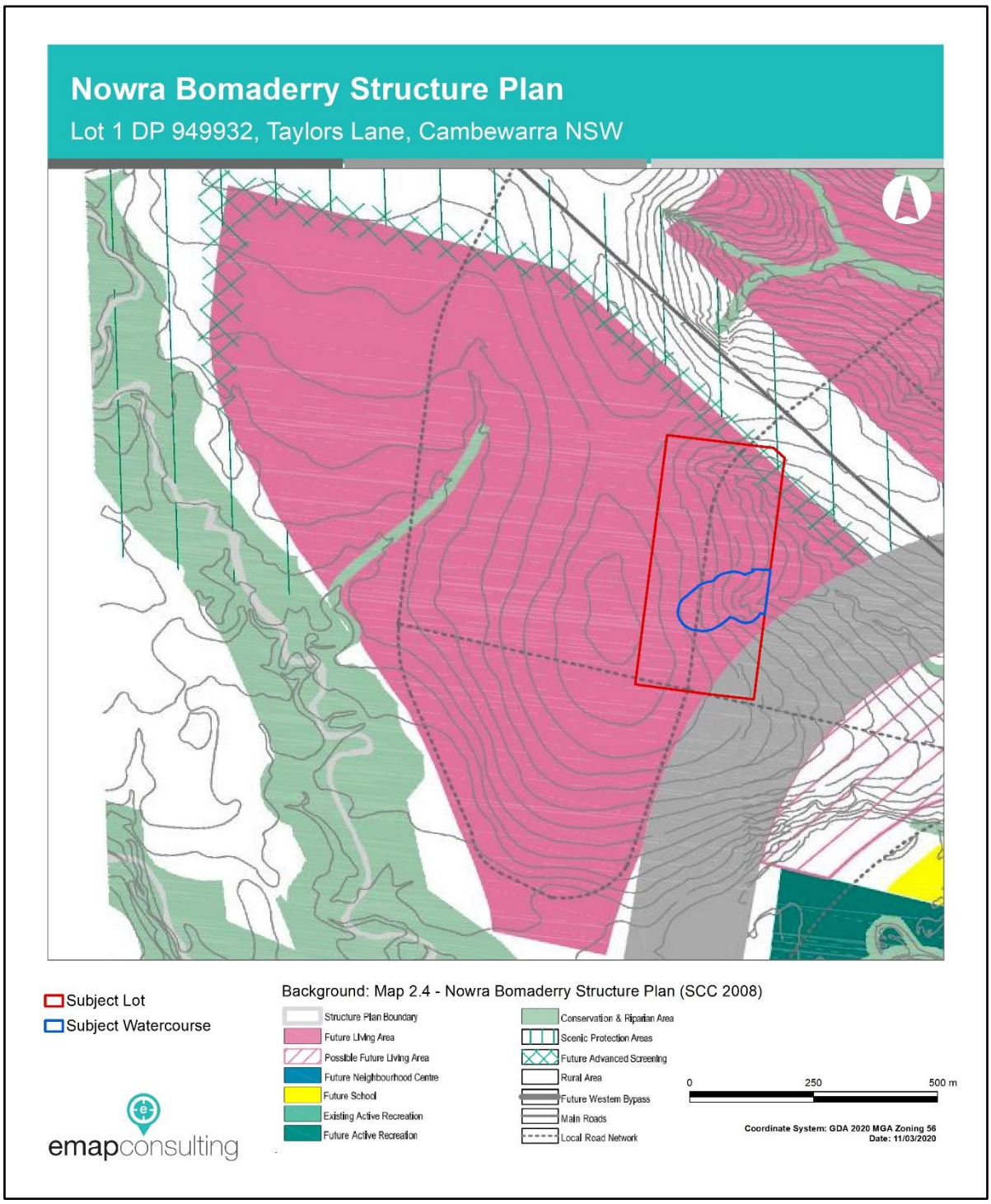


Figure 4: Location of Subject Lot with respect to Nowra Bomaderry Structure Plan.

3. A review of previous methods applied to mapping riparian land in the Subject Watercourse

There have been a number of approaches to mapping riparian land at the Subject Lot and Subject Watercourse, which have led to different findings with respect to the classification of the subject watercourse and hence this Riparian Lands Study has been sought.

The methods that have been previously applied by various studies to map riparian land at the Subject Watercourse are reviewed here.

3.1 Objective Setting

One method for mapping riparian land is to assess the stream in terms of its long-term riparian objectives. This approach was taken by Department of Infrastructure Planning and Natural Resources DIPNR (2004) in its Riparian Corridor Objective Setting (RCOS) for selected streams in Nowra-Bomaderry.

Riparian objectives provide aims for the protection and/or restoration of individual watercourses and their vegetated buffer zones, according to their relative importance and future function within a catchment.

Riparian corridor widths are determined by the category and associated objectives. The corridor comprises:

- A Core Riparian Zone (CRZ) which is the area of land within and adjacent to the channel. The CRZ is to remain or become fully vegetated with local provenance native vegetation (including aquatic ground covers, shrubs and other species) to a minimum width from the banks of the river. The minimum width is determined by the stream category.
- A Vegetated Buffer (VB) is required to protect the environmental integrity of the CRZ from edge effects from adjacent lands, such as weed invasion, litter, trampling and pollution. The minimum width from the CRZ is 10 m but is dependent on merit issues (eg extra widths of vegetation exists). Asset Protection Zones (APZs) required for bushfire protection purposes are to be located outside of the CRZ and VB.

Table 1 outlines categories of riparian corridors and their overarching objectives.

Table 1: Riparian Corridor Objectives and recommended riparian corridor widths (DIPNR 2004)

Category	Objectives	Minimum Core Riparian Zone (CRZ)	Additional Vegetated Buffer
Category 1 Environmental Corridor	The overarching objective is to provide biodiversity linkages by maintaining connectivity for the movement of aquatic and terrestrial species along the riparian corridor and between key destinations.	40 m from top of bank	10 m
Category 2 Terrestrial and aquatic habitat	The overarching objective is to provide basic habitat and preserve or emulate as much as possible a naturally functioning stream (not necessarily linking key destinations). While accepting the width of the riparian corridor will not fully satisfy the requirements of a Category 1, the width must still be sufficient to provide long term robust habitat and refuge for native fauna.	20 m from top of bank	10 m
Category 3 Bank stability and water quality	The overarching objectives are to prevent accelerated rates of soil erosion and to enhance water quality. This Category may	Usually 10m from the bank	Generally not required

	have limited habitat value but contributes to the overall basic health of the catchment. While an open watercourse emulating some natural stream function is the preferred option, it is recognised that the practicality and economics of developing urban land may make this difficult. It is this Category of watercourse where it may be possible to negotiate trade-offs.		

DIPNR (2004) undertook a desktop assessment of streams mapped on 1:25,000 topographic maps. Riparian Corridors were mapped according to desktop mapping of stream location in relation to any remnant vegetation, land tenure, and significance of the stream in relation to the whole catchment, as determined by aerial photo interpretation. Field verification followed, with a focus on streams in areas having the potential for urban development.

The Moss Vale Road South Catchment was described by DIPNR (2004) as

> *"almost entirely cleared for agricultural purposes. There are no substantial waterways within the immediate areas of the proposed urban areas".*

Riparian objective classifications for streams in this catchment were:

- Bomaderry Creek: Category 1
- All other streams: Category 3.

Upon viewing the map for the subject watercourse in DIPNR (2004), no riparian corridor has been mapped at this location (see Plate 1 below). It is believed that the reason for this is that the stream was not included within the 1:25,000 topographic map used as the basis for this mapping.

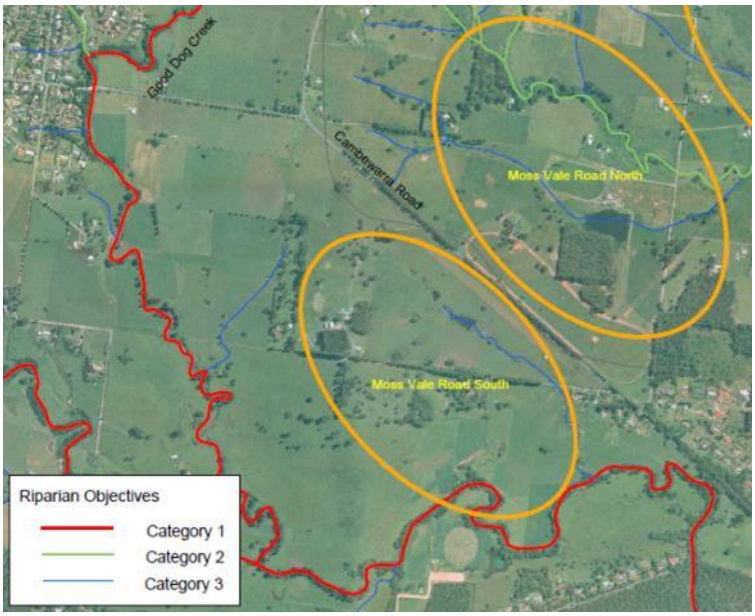


Plate 1: DIPNR (2004) Riparian Corridor Mapping at the subject watercourse

GHD (2008) also applied the RCOS method of mapping riparian land for the subject watercourse. This study classified the subject watercourse as a Category 2- Terrestrial and aquatic habitat (see Plate 2 below). The report describes the basis for the reclassification of the adjacent watercourse (which flows south-east to Bomaderry Creek) from a Category 3 to a Category 2 as *"based on the importance of this particular watercourse to provide basic habitat and preserve or emulate as much as possible a naturally functioning stream".* The report does not describe the basis of the classification of the subject watercourse as a Category 2.

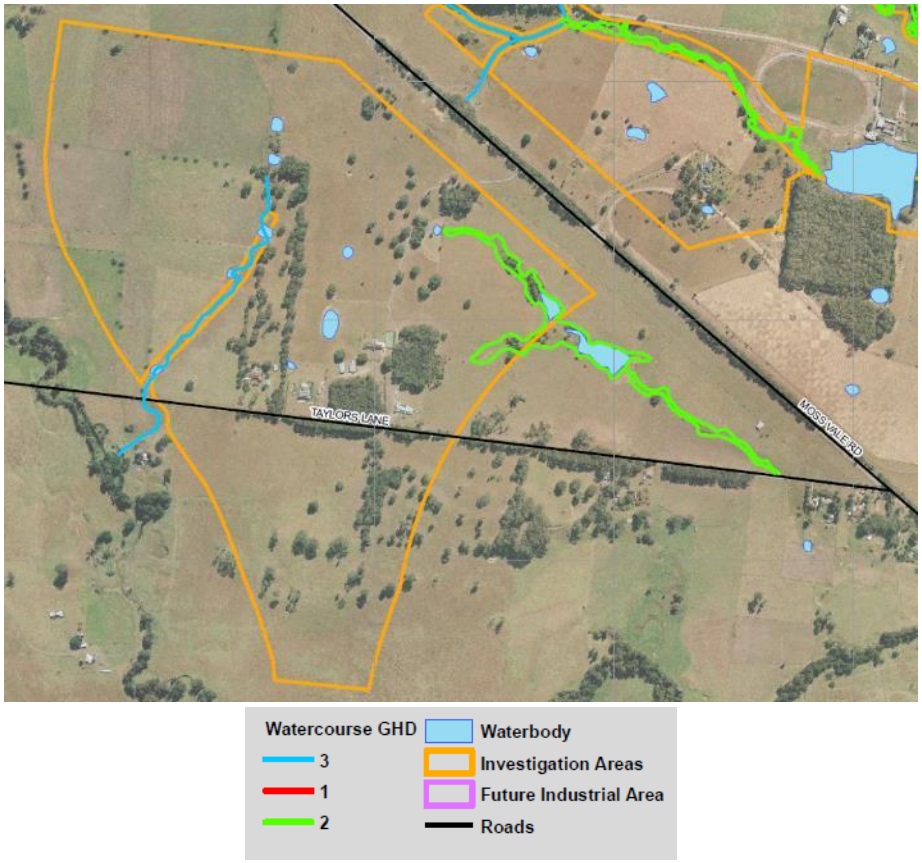


Plate 2: GHD (2008) mapping of riparian extent at the subject watercourse

Methods used by GHD (2008) to map the extent of riparian land at the subject watercourse included desktop mapping exercises and field survey to determine top of bank. Desktop mapping included preparation of a Digital Elevation Model prepared using 2m and 10m contour lines as inputs, and a hydrological model using ArcGIS Spatial Analyst tools. Field survey was conducted to ground truth the location of the "top of bank" and riparian land categorisations. Riparian Condition Assessments using the "River Score" method were also undertaken.

The discrepancy between DIPNR (2004) and GHD (2008) mapping of riparian land at the subject watercourse, despite both applying the RCOS method, can be based on:

- The assumption by GHD (2008) that the subject watercourse is indeed a watercourse, whilst DIPNR (2004) did not consider the subject watercourse in its mapping as the stream was not mapped in the 1:25,0000 topographic maps used as the basis of their study.
- Interpretation of "top of bank" by GHD (2008) in their field survey. Whilst top of bank can be defined in theory, often in practice it is difficult to locate, particularly in areas like the subject watercourse which is not well defined and is highly disturbed.

3.2 Strahler Stream Order

The Natural Resource Access Regulator (NRAR) Guidelines for riparian corridors on waterfront land defines a Riparian Corridor as *"a transition zone between the land, also known as the terrestrial environment, and the river or watercourse or aquatic environment".*

As per NRAR's *"Guidelines for riparian corridors on waterfront land",* the riparian corridor consists of:

- The channel which comprises the bed and banks of the watercourse (to the highest bank).
- The vegetated riparian zone (VRZ) adjoining the channel.

This is illustrated in Plate 3 below.

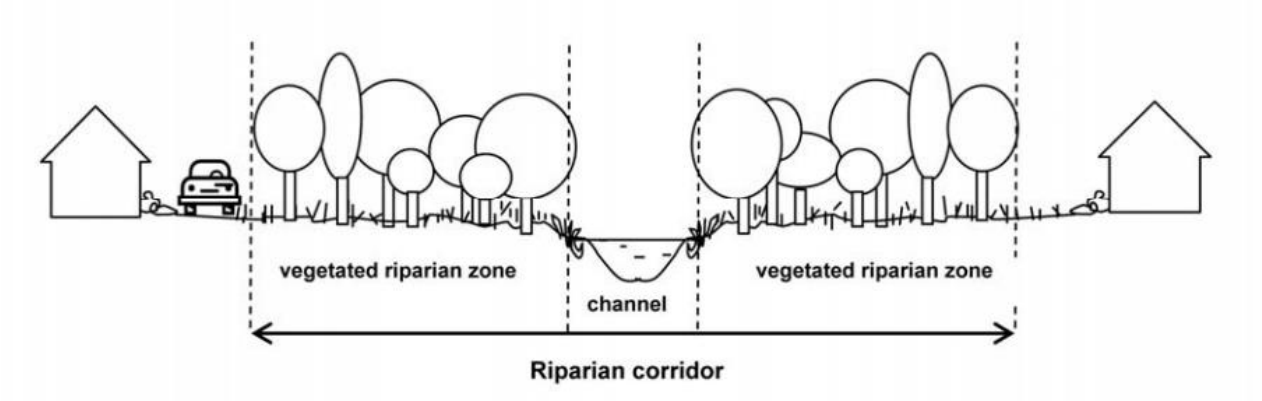


Plate 3: The riparian corridor (from NRAR Guidelines)

NRAR recommends a VRZ width based on the Strahler Stream Order of the Watercourse as per Table 2 below.

Table 2: NRAR's recommended riparian corridor widths

Watercourse Strahler Stream Order	VRZ width (each side of watercourse)	Total width of riparian corridor
1st order	10 metres	20m + Channel width
2nd order	20 metres	40 m + channel width
3rd order	30 metres	60 m + channel width
4th order and greater	40 metres	80 m + channel width

The Guidelines outline the following principles for determining the environmental functions of riparian corridors:

- Identify *whether or not there is a watercourse present* and determine its order in accordance with the Strahler System.
- If a watercourse is present, define the RC/VRZ on a map in accordance with Table 2.
- Seek to maintain or rehabilitate a RC/VRZ with fully structured native vegetation in accordance with Table 2.
- Seek to minimise disturbance and harm to the recommended RC/VRZ.
- Minimise the number of creek crossings and provide perimeter road separating development from the RC/VRZ.
- Locate services and infrastructure outside of the RC/VRZ. Within the RC/VRZ provide multiple service easements and/or utilise road crossings where possible.
- Treat stormwater run-off before discharging into the RC/VRZ.

The Flora and Fauna Assessment undertaken by Ecoplanning (2019) for the subject site as part of the proponent's planning proposal documentation, states that the subject watercourse is a first order stream and that a 10m buffer is therefore required on either side of the channel as per requirements of the WM Act. It also recommends that a Vegetation Management Plan be prepared for the Vegetated Riparian Zone (VRZ) around retained first order streams. It was beyond the scope of this study to validate mapping of the stream in the subject watercourse. It is also noted that the lot layout assessed by EcoPlanning (2019) differs to the lot layout assessed in the planning proposal document.

3.3 The Averaging Rule

According to NRAR *"Guidelines for riparian corridors on waterfront land"*, non riparian corridor works and activities can be authorised within the outer riparian corridor, so long as the average width of the vegetated riparian zone can be achieved over the length of the watercourse within the development site. That is, where appropriate 50 per cent of the outer vegetated riparian zone width may be used for non-riparian uses including asset protection zones, recreational areas, roads, development lots and infrastructure. However, an equivalent area connected to the riparian corridor must be offset on the site (see Plate 4) and the inner 50 per cent of the vegetated riparian zone must be fully protected and vegetated with native endemic riparian plant species.

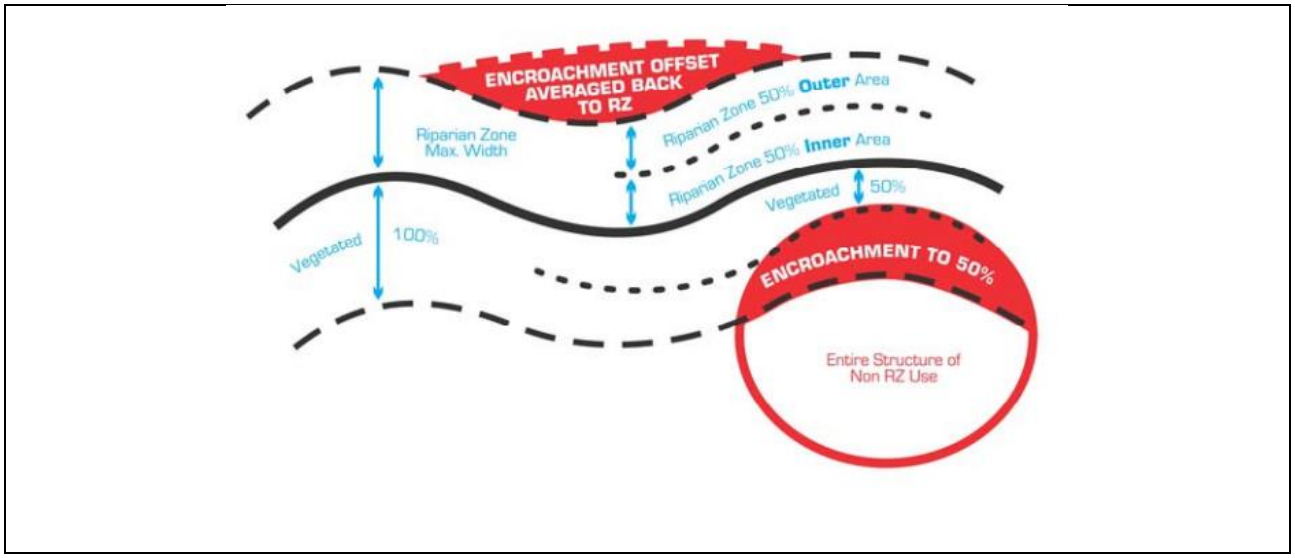


Plate 4: The Averaging Rule

The averaging rule provides more flexibility in how riparian corridors can be used and making it easier for applicants to determine the NRAR's controlled activity approval requirements.

4. Methods

4.1 Desktop Mapping

4.1.1 Data Audit and review

Spatial data layers were sourced to identify the subject site as follows:

- Cadastre data (sourced from NSW Digital Cadastral Database 2020).
- Watercourse centreline data (sourced from NSW Digital Topographic Database 2020).
- Biometric Vegetation Communities (sourced from OEH 2013).
- LEP Zoning (sourced from DPIE 2020).
- LEP Minimum Lot Size (sourced from DPIE 2020).
- Light Detection and Ranging (LiDAR) data sourced from Geoscience Australia, 2020.
- Nearmap imagery.

The following maps were sourced from the existing literature, and then georeferenced in ArcGIS to assess the relevance of each report to the Subject Site and Subject Watercourse:

- Shoalhaven DCP 2014 Chapter NB3- Figure 1.
- Nowra Bomaderry Structure Plan Map 2.4.
- Riparian Lands Report (GHD 2008) Figure 5.1-2.

4.1.2 Spatial Analysis

A desktop mapping exercise was undertaken in ArcGIS to delineate the riparian corridor for the subject watercourse based on analysis of available LiDAR data.

The procedures were as follows:

- Raw LiDAR data files sourced from Geoscience Australia's Elevation Data Portal for the Subject Site and surrounds.
- Raw LiDAR data was filtered to ground points only (ie filtering out tree canopy, buildings, fences, powerlines etc) using ArcGIS LAS Toolset.
- A Raster format Digital Surface Model (DSM) was created as a 3D model of the Subject Site.
- 3D Analyst was used to create a slope model of the DSM.
- "Break of Slope" was mapped for the subject watercourse based on the slope model. This represented a starting point for mapping the riparian extent based on the "highest bank" method.

4.2 Field Survey

Field survey was undertaken by Matthew Russell (Senior Aquatic Ecologist) of Niche Environment and Heritage and Dr Emma McIntyre (GIS Specialist) of EMAP Consulting on 29th January 2020.

Matt and Emma collected 27 data points using Collector for ArcGIS and noted the location of the site and any hydrological and/or ecological functions of the site.

5. Results

5.1 Desktop Mapping

The result of desktop mapping of the “top of bank” (as indicative of riparian extent) identified in the Digital Surface Model (DSM) is illustrated in Figure 5.

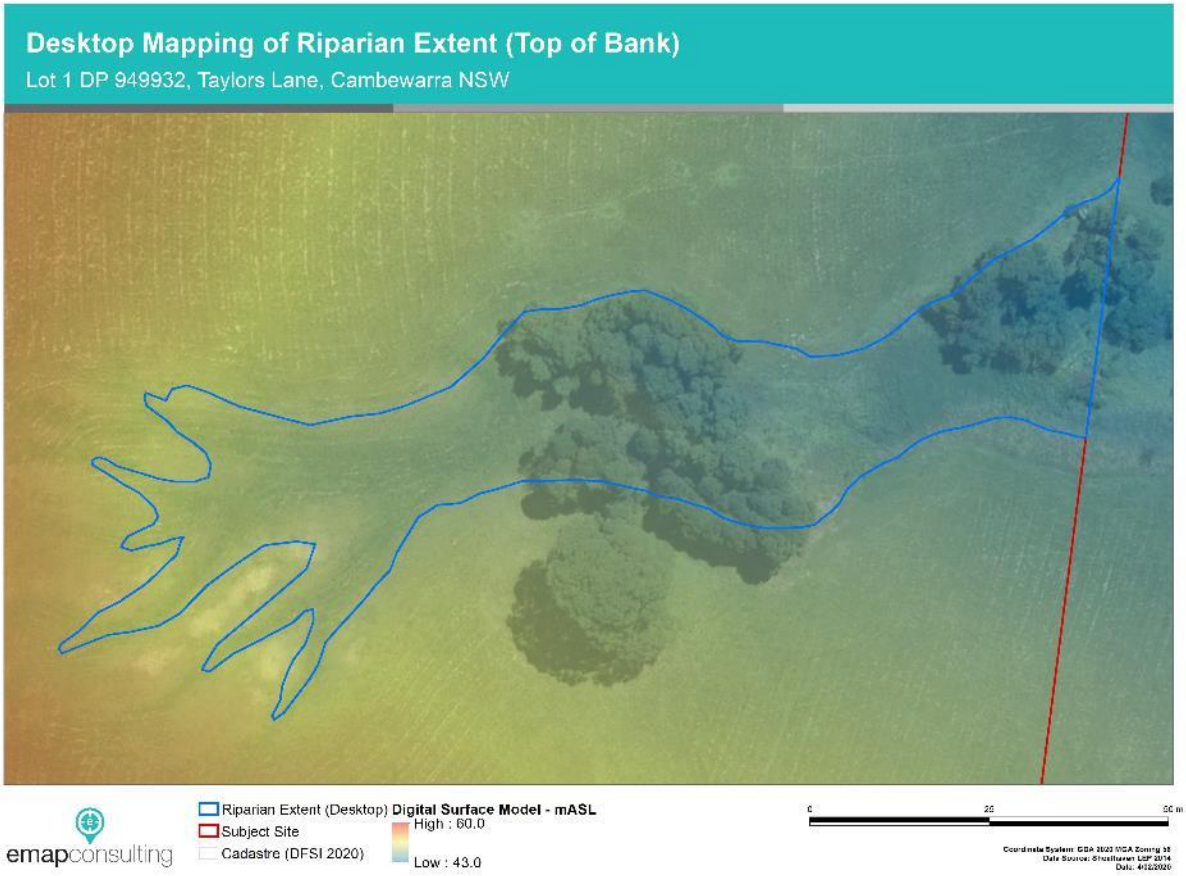


Figure 5 Desktop mapping of riparian extent

5.2 Field Survey

Figure 6 illustrates the location of field survey points recorded in Collector for ArcGIS, with respect to the desktop mapping conducted prior to field survey and the riparian extent mapped by GHD (2008).

Table 3 provides a summary of the data collected at each point, while a more detailed description including photos taken at each site is provided in Annex1.

Figure 6: Field Survey Data Collection Points

Table 3: Results of field survey

Site ID	Location Description	Riparian Function	Ecological Function
1	South side of watercourse, on western side of tree patch	High side of 'bank', although there is no clearly defined channel at this location	Exotic Grassland, upstream of tree canopy
2	Upstream end of drainage depression 1	Upstream end of a drainage depression, no clearly defined channel	Exotic grassland
3	Upstream end of drainage depression 2	Upstream end of a drainage depression, no clearly defined channel	Exotic grassland
4	Upstream end of drainage depression 1	Upstream end of a drainage depression, no clearly defined channel	Exotic grassland
5	Upstream end of drainage depression 3	Upstream end of a drainage depression, no clearly defined channel	Exotic grassland
6	Upstream end of drainage depression 3	Upstream end of a drainage depression, no clearly defined channel	Exotic grassland
7	Upstream end of drainage depression 3	Upstream end of a drainage depression, no clearly defined channel	Exotic grassland
8	Upstream end of drainage depression 4	Upstream end of a drainage depression, no clearly defined channel	Exotic grassland
9	Upstream end of drainage depression 5	Upstream end of a drainage depression, no clearly defined channel	Exotic grassland
10	North side of subject watercourse, upstream of vegetation patch	High side of bank, although there is no clearly defined channel at this location	Exotic Grassland, upstream of tree canopy
11	North side of subject watercourse, adjacent to vegetation patch	High side of bank, although there is no clearly defined channel,	Fauna habitat value – tree canopy and woody debris
12	North side of subject watercourse, adjacent to vegetation patch	High side of bank, although there is no clearly defined channel,	Fauna habitat value – tree canopy and woody debris
13	North side of subject watercourse	High side of bank, although there is no clearly defined channel	Fauna habitat value – tree canopy and woody debris
14	North side of subject watercourse	High side of bank, although there is no clearly defined channel	Fauna habitat value – tree canopy, fallen tree and woody debris

15	North side of subject watercourse	High side of bank, although there is no clearly defined channel	Fauna habitat value – tree canopy and woody debris
16	Outside Subject Site		
17			
18			
19	South side of subject watercourse, downstream end	High side of bank, although there is no clearly defined channel	Exotic grasslands
20	South side of subject watercourse, downstream end	High side of bank, although there is no clearly defined channel	Fauna habitat value – tree canopy, fallen tree and woody debris
21	South side of subject watercourse, between tree patches	High side of bank, although there is no clearly defined channel	Exotic grasslands, some patches of bare earth
22	South side of subject watercourse, tree canopy present	High side of bank, although there is no clearly defined channel	Exotic grasslands, some patches of bare earth, tree canopy, woody debris
23	South side of subject watercourse, tree canopy present	High side of bank, although there is no clearly defined channel	Exotic grasslands, some patches of bare earth, tree canopy, woody debris
24	South side of subject watercourse, tree canopy present	High side of bank, although there is no clearly defined channel	Exotic grasslands, some patches of bare earth, tree canopy, woody debris
25	Drainage centreline – upstream extent	Centre of drainage line	Exotic grasslands
26	Upstream end of drainage depression	Upstream end of drainage depression	Exotic grasslands, some patches of bare earth
27	South side of subject watercourse, high side of bank	High side of bank, although there is no clearly defined channel	Exotic grassland

6. Discussion and Recommendations

6.1 Recommended Riparian Extent

In order to determine the recommended riparian extent for the subject watercourse, the NRAR Guidelines as described in Section 3.2 were adopted as follows:

(i) Identify *whether or not there is a watercourse present*

During the field survey, it was determined that site 25 (see Figure 6 and Table 3) was the upstream extent of the defined watercourse at the subject site. Further upstream of site 25, there were several drainage depressions which clearly provided a drainage function for the subject lot, but there was no clearly defined watercourse present.

(ii) Determine the Strahler Stream Order

Strahler Stream Order classified the subject watercourse as a 1st order stream.

(iii) Define the RC/VRZ on a map in accordance with Table 2.

According to NRAR Guidelines for a 1st order stream, a riparian corridor of 10 m either side of the stream (total 20m width plus width of the channel) is recommended.

As such, the recommended **"Minimum Riparian Extent"** for the subject watercourse as mapped in Figure 8, represents the recommended riparian corridor in accordance with the WM Act and the NRAR Guidelines.

During field survey, it was also determined that the existing vegetation on the subject watercourse is of ecological value which could potentially be incorporated into an **"Ultimate Riparian Corridor".** By incorporating patches native vegetation identified and field validated by EcoPlanning (2019) as "Spotted Gum – Grey Ironbark – Woollybutt grassy open woodlands" and "Native plantings" (see Figure 7), the ecological value of the riparian corridor would be enhanced by retaining existing native vegetation and fauna habitat.

Figure 8 illustrates the recommended **Minimum Riparian Extent** and the **Ultimate Riparian Corridor** for the subject watercourse.

Figure 7: Validated Vegetation at the Subject Lot

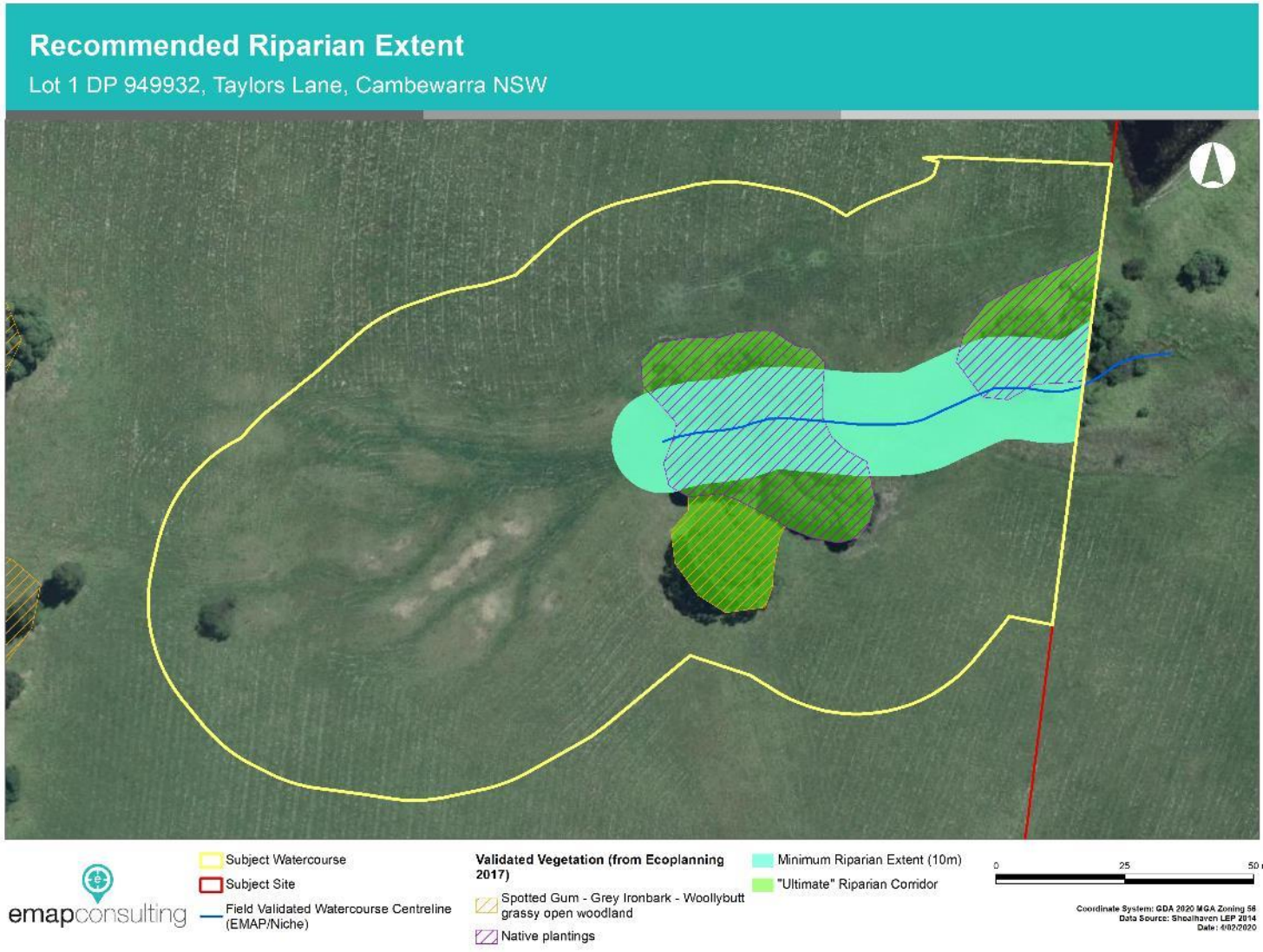


Figure 8: Recommended Riparian Extent

6.2 Implications for the Planning Proposal

An overlay of the Minimum Riparian Extent and the Ultimate Riparian Corridor as mapped in Figure 7, with the Planning Proposal Plan (Cardno, dated 3/3/19), has identified the proposed lots which were mapped within the area of the "Subject Watercourse" - See Figure 9. It has also identified the lots which will be affected, in whole or in part, by the recommended riparian extent for the subject watercourse. Both scenarios- the Minimum Riparian Extent and the Ultimate Riparian Corridor- were considered, and results are provided in Table 4.

Table 4: Proposed Lots affected by Recommended Riparian Corridor Extents

Riparian options	Total Number of Lots proposed in Stage 1c	Proposed Lot ID affected	Number of Proposed Lots affected
Minimum Riparian Extent	**37**	119,120,131,130,138,139, 140 (plus a section of proposed road)	**7**
Ultimate Riparian Corridor	**37**	119,120,121,133,132,131,130,129,138,139,140 (plus a section of proposed road)	**11**

Figure 9: Implications of the recommended riparian extent on the Planning Proposal

6.3 Potential impact to the environment

The planning proposal for the development (Cardno 2019) assessed potential environmental and other impacts of rezoning the subject watercourse to R1- General Residential, and subsequent residential development.

Cardno (2019) identified that the disturbed nature of the site and removal of vegetation as not significant and therefore should be rezoned. However, this implies that there is no defined riparian corridor under state or local government legislation and guidelines. After a review of riparian delineation methods (DIPNR 2004; GHD 2008), relevant legislation, data analysis and field survey, it is concluded that a portion of this area is riparian which is identified as Recommended Riparian Extent (Section 6.1). The recommended approach includes:

- Recategorisation of riparian corridor objectives from 2 to 1.
- The rezoning of a portion of the land (Figure 8) that is grassland and has undefined banks from environmental conservation to residential.
- Maintaining minimum buffer widths of 10m and potential for incorporation of existing vegetation into the riparian zone.
- Enhancing the riparian zone and buffers with local native species to improve the ecological functions of the watercourse.

This is a balanced approach that provides some additional development potential, protection and enhancement of the riparian corridor while being consistent with State and Local Government legislation and planning controls. It is recommended that development consider incorporating the natural features and be consistent with riparian management considerations identified in DCP Chapter NB3 (Table 5).

6.3.1 Conveyance and Water Quality

Cardno (2019) concluded that their assessment *"found that the conveyance and water quality function of the corridor is of limited value, with the corridor largely devoid of vegetation"*, and further that *"with the proposed development scheme including an area wide approach to stormwater management inclusive of water sensitive urban design that would improve water quality".*

These statements contradict the findings of GHD (2008) which identified that *"riparian lands are important for the maintenance of stream water quality and for providing opportunities for biodiversity connectivity"*, and the Structure Plan (2006) which states that *"riparian corridors are important for the maintenance of stream water quality and for providing opportunities for biodiversity connectivity"*.

NSW Department of Environment and Conservation's (2006) *"Local planning for healthy waterways using NSW Water Quality Objectives"* states that *"identifying buffer zones is one of the most significant contributions that strategic land use planning can make to support water quality objectives".*

Beesley *et al* (2017) has published the "Riparian Design Guidelines to Inform the Ecological Repair of Urban Waterways" for the Cooperative Research Centre for Water Sensitive Cities. The document identifies the ways in which riparian land protects water quality:

- Riparian land regulates nutrients and sediment of a stream. The gradual slope, dense groundcover, leaf litter and complex soil microtopographies of riparian land slow runoff and flood flows so that suspended sediments from the catchment or stream bed can deposit and nutrients can be processed.
- Riparian land vegetated with groundcover protects soil from erosion caused by surface runoff, and scour associated with high flows can be reduced by tree roots and woody debris.

- Riparian land plays a role in flood attenuation by absorbing runoff from the catchment and reducing flows into the stream. Vegetation in the riparian corridor increases flow resistance, slowing flows and reducing flood volumes downstream.

Beesley *et al* (2017) provides a thorough assessment of all the ways in which urban development can degrade ecological processes that support healthy waterway functioning. These are summarised below:

- Increased impervious surfaces:
  - Reduce infiltration causing the water table to fall and decline in the health of riparian vegetation.
  - Increase the temperature of runoff, undermining the ability of riparian vegetation to shade and cool the stream.
- Narrowing of riparian buffer:
  - Compromises the ability of vegetation to stabilise the stream bank.
  - Causes the loss of floodplain habitat, reducing the ability of riparian land to dampen flood peaks and provide important flora and fauna habitat.
  - Reduces the ability of the stream to act as a wildlife corridor.
- Stormwater management:
  - Efficiently transports runoff from impervious surfaces to the waterway, increasing flow volume, leading to localised bed and bank erosion.
  - High flows bypass riparian soils and vegetation preventing nutrient and sediment filtration.
  - In some areas, stormwater pipes lead to a fall in the height of the water table which impacts the ability of riparian soils to remove nitrogen and filter nutrients.
- Introduction of deciduous vegetation:
  - Often breaks down more rapidly than native vegetation, can increase input of nutrients to the stream that contribute to algal blooms.
- Introduction of weeds:
  - Outcompete and native plants and reduces native species diversity.
  - Can choke stream channels.
  - Can negatively affect aquatic and terrestrial fauna.

The conclusion of this assessment is that Cardno's (2019) statements regarding the conveyance and water quality function of the subject watercourse are not well founded.

Following our field survey, this assessment concluded that there is indeed a defined watercourse for the eastern portion (as mapped in Figure 8) of the subject watercourse that was assessed. This watercourse clearly plays an important function in conveyance of flows from higher up in the catchment on the subject lot.

Rainfall in the nearby town of Nowra ranges from a monthly average of 40.0mm in September to 138.8mm in February for the period from December 2000 to February 2020, as recorded at the "Nowra Boat Shed Gauge" (BOM 2020, Reference 58676144). Rainfall in the months preceding our field survey was a total of 35.0mm for October, 5.0mm in November, 1.0mm in December and 90.0mm in January. Whilst conditions were therefore drier than average, it was evident during our field survey that due to the slope of the western portion of the Subject Lot, and patterns in the existing riparian vegetation in the western portion of the subject watercourse, that the watercourse does have a conveyance function, from site 25 to the downstream farm dam.

Further, the existing vegetation in the subject watercourse and the existing vegetation plays a key role in soil stabilisation of the bed and banks. Whilst the implementation of water sensitive urban design practices

is desirable, it cannot replace the overall function of a riparian buffer to meet water quality objectives for this stream.

6.3.2 Biodiversity Value

In relation to biodiversity value, Cardno (2019) stated that *"the limited scale of native vegetation removal would be offset through extensive on site landscaping, which would improve the overall biodiversity value of the site. Consequently, the works would result in an improved level of ecology compared to the current situation".* The Flora and Fauna Assessment prepared by Ecoplanning (2017) identified the following direct impacts of the proposed development:

- Vegetation clearing:
  - Removal of 0.34 ha of native vegetation and upper section of a first order watercourse.
  - Remainder of site to be impacted (i.e. the Subject Lot *outside* of the Subject Watercourse) is exotic grassland.
- Loss of fauna habitat
  - Removal of potential foraging, roosting and nesting habitat including woodland, hollow bearing trees and grassland (a total of eight hollow bearing trees were identified on the Subject Lot *outside* of the Subject Watercourse).
  - The *Spotted Gum – Grey Ironbark – Woollybutt grassy open forest on coastal flats* (SGGIW) to be cleared is degraded, under-scrubbed and does not represent an area of high ecological value.

Indirect impacts described by Ecoplanning (2017) included erosion and reduced water quality in the farm dam and downstream environments during the construction phase of the development.

The Flora and Fauna Assessment recommended that a Vegetation Management Plan be developed and implemented for the "Vegetated Riparian Zone" for revegetation and management of the VRZ.

There appears to be some inconsistency in the findings of the Flora and Fauna Assessment as reported in Cardno's report. In section 4.7, Cardno (2017) reports that the Flora and Fauna Assessment *"found that the first order watercourse running through the site has been modified and lacked a defined channel. Furthermore, the majority of this land is exotic grassland".* However, as noted above, EcoPlanning (2017) describes the vegetation within the Subject Watercourse as "native vegetation" including a patch of *Spotted Gum – Grey Ironbark – Woollybutt grassy open forest on coastal flats* (SGGIW) as well as native plantings. It refers to the remainder of the site- i.e. outside the Subject Watercourse- as consisting of mostly exotic grassland. Furthermore, it is noted that the Flora and Fauna Assessment will need to be revised if the land is rezoned as any vegetation requiring removal in the corridor was not covered by the original assessment.

This assessment disagrees with Cardno's view that the planning proposal will improve the overall biodiversity value and ecology of the site. Whilst there is opportunity to incorporate native species in street tree plantings and the like, this is not likely to be an improvement in the biodiversity value of the site compared to maintaining the existing native vegetation in the vicinity of the subject watercourse, and improving the overall condition of this vegetation by managing it within a defined riparian buffer zone via a Vegetation Management Plan.

6.4 Recommendations

- The eastern portion of the Subject Watercourse as identified in Figure 8, is a 1st order watercourse. Functions of this section of the watercourse, and associated riparian land include conveyance of flows from upstream, and maintenance of water quality.
- Implementing the "Minimum Riparian Extent" will maintain conveyance and water quality functions of the watercourse.
- Implementing the wider "Ultimate Riparian Corridor" will maintain biodiversity value of existing native vegetation, and provide opportunities to enhance vegetation condition and habitat quality.
- Implementation of either the "Minimum Riparian Extent" or the "Ultimate Riparian Corridor" should be facilitated by development of a Vegetation Management Plan to maintain and enhance biodiversity value of the riparian corridor.

6.5 Recommended Management of the Riparian Corridor

A Vegetation Management Plan should be prepared for the adopted riparian extent, with consideration given to relevant performance criteria and acceptable solutions as provided in the Shoalhaven DCP Chapter NB3, and outlined in Table 5 below.

Table 5 Performance criteria and acceptable solutions for management of the riparian corridor

Performance Criteria	Acceptable Solutions
P15 Riparian Corridors are protected and improved	A15.1 Continuous riparian zones are provided along Bomaderry Creek, Good Dog Creek and unnamed Creek
	A15.2 Riparian zones and associated buffers are to be retained and enhanced using local native species to improve the ecological functions of the watercourse.
	A15.3 Buffers are vegetated to protect the integrity of the riparian zone from weed invasion, littering, sedimentation, erosion control pollution and impacts of climate change.
	A15.4 Fencing within riparian corridors are minimised and across watercourses is not permitted.
P17 Stormwater flows and quality is managed using Water Sensitive Urban Design (WSUD) principles	A17.1 Development Applications must be supported by a Concept Stormwater Management Plan which must demonstrate: WSUD principles (including on-site stormwater detention/retention) as per DCP Chapter G2: Sustainable Stormwater Management and Erosion and Sediment Control. Stormwater management primarily within the street network.
P20 Development of the site results in improved benefit from stormwater discharged into natural watercourses.	A20.1 Stormwater discharge is designed to achieve targeted reductions as per DCP Chapter G2: Sustainable Stormwater Management and Erosion and Sediment Control.

References

Beesley, LS., Middleton, J., Gwinn, DC., Pettit, N., Quinton, B. and Davies, PM. (2017). Riparian Design Guidelines to Inform the Ecological Repair of Urban Waterways. Cooperative Research Centre for Water Sensitive Cities, Monash University, Victoria. October 2017.

Cardno South Coast. (2019). Planning Proposal for Taylors Lane Stage 1c – Residential Subdivision. Prepared for Cambewarra Housing Company, 15 March 2019.

DEC (2006). Local Planning for Healthy Waterways Using NSW Water Quality Objectives. Department of Environment and Conservation NSW. December 2006.

DIPNR. (2004). Riparian Corridor Objective Setting for Selected Streams in Nowra and Bomaderry, Draft. Prepared by Department of Infrastructure, Planning and Natural Resources, November 2004.

GHD. (2008). Mapping of Riparian Lands Report for Shoalhaven City Council. April 2008.

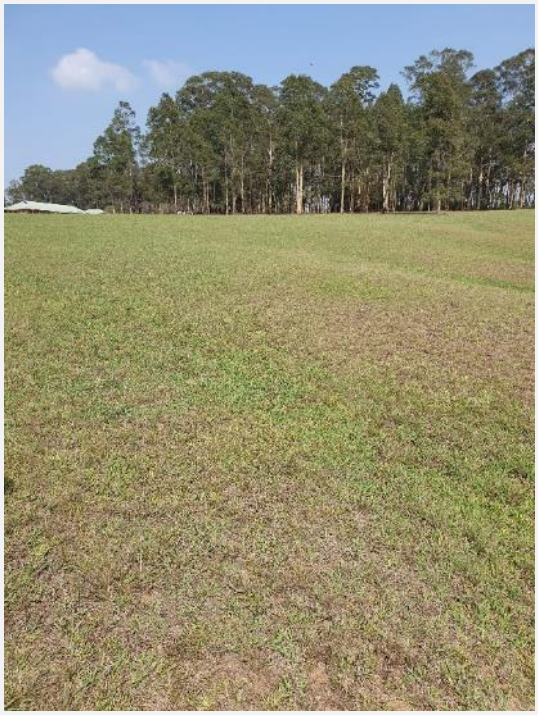
Natural Resource Access Regulator. (2018). Guidelines for controlled activities on waterfront land - Riparian corridors. Department of Industry.

Shoalhaven City Council. (2006). Nowra Bomaderry Structure Plan, Shoalhaven City Council. Adopted October 2006.

Shoalhaven City Council. (2014). Shoalhaven Development Control Plan Chapter NB3: Moss Vale Road South Urban Release Area, Shoalhaven City Council.

Annex 1

Site ID on Figure 6	1
Location Description	South side of watercourse, on western side of tree patch
Hydrological Description	High side of 'bank', although there is no clearly defined channel at this location
Ecological Description	Exotic Grassland, upstream of tree canopy
Photos	
 Facing Upstream of site	 Facing north, across channel towards Cambewarra Mountain
Recommendation: This site is not indicative of riparian land. Although this site can be described as the high side of the bank, it is adjacent to a drainage depression rather than a defined stream or watercourse. The site clearly performs a drainage function due to the slope, however there is no defined channel and no ecological values present at this site.	

Site ID on Figure 6	2
Location Description	Upstream end of drainage depression 1
Hydrological Description	Upstream end of a drainage depression, no clearly defined channel
Ecological Description	Exotic grassland
Photos	
 Facing Upstream of site	 Facing downstream of site
Recommendation: This site is upstream of a small drainage depression, and is not indicative of riparian land. The site performs a drainage function due to the slope, however there is no defined channel and no ecological values present at this site.	

Site ID on Figure 6	3
Location Description	Upstream end of drainage depression 2
Hydrological Description	Upstream end of a drainage depression, no clearly defined channel
Ecological Description	Exotic grassland
Photos	
 Facing upstream of site	 Facing downstream of site
Recommendation: This site is upstream of a small drainage depression, and is not indicative of riparian land. The site performs a drainage function due to the slope, however there is no defined channel and no ecological values present at this site.	

Site ID on Figure 6	4
Location Description	Upstream end of drainage depression 1
Hydrological Description	Upstream end of a drainage depression, no clearly defined channel
Ecological Description	Exotic grassland
Photos	

Facing downstream of site

Recommendation: This site is upstream of a small drainage depression, and is not indicative of riparian land. The site performs a drainage function due to the slope, however there is no defined channel and no ecological values present at this site.

Site ID on Figure 6	5, 6, 7
Location Description	Upstream end of drainage depression 3
Hydrological Description	Upstream end of a drainage depression, no clearly defined channel
Ecological Description	Exotic grassland
Photos	
 Facing Upstream of site	 Facing downstream of site
Recommendation: This site is upstream of a small drainage depression, and is not indicative of riparian land. The site performs a drainage function due to the slope, however there is no defined channel and no ecological values present at this site.	

Site ID on Figure 6	8
Location Description	Upstream end of drainage depression 4
Hydrological Description	Upstream end of a drainage depression, no clearly defined channel
Ecological Description	Exotic grassland
Photos	

Facing downstream of site

Recommendation: This site is upstream of a small drainage depression, and is not indicative of riparian land. The site performs a drainage function due to the slope, however there is no defined channel and no ecological values present at this site.

Site ID on Figure 6	9
Location Description	Upstream end of drainage depression 5
Hydrological Description	Upstream end of a drainage depression, no clearly defined channel
Ecological Description	Exotic grassland
Photos	

Facing Upstream of site

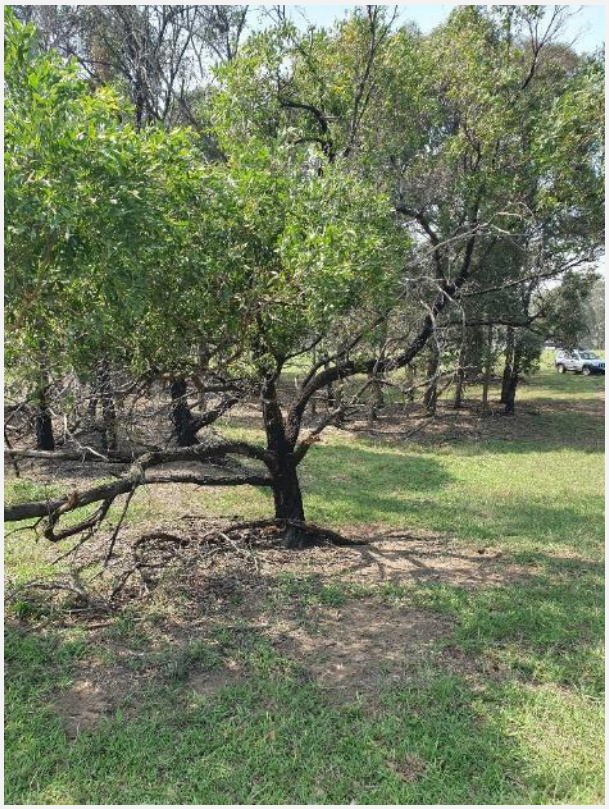
Facing downstream of site

Recommendation: This site is upstream of a small drainage depression, and is not indicative of riparian land. The site performs a drainage function due to the slope, however there is no defined channel and no ecological values present at this site.

Site ID on Figure 6	10
Location Description	North side of subject watercourse, upstream of vegetation patch
Hydrological Description	High side of bank, although there is no clearly defined channel at this location
Ecological Description	Exotic Grassland, upstream of tree canopy
Photos	
 Facing Upstream of site	 Facing downstream of site
Recommendation: This site is not indicative of riparian land. Although this site can be described as the high side of the bank, it is adjacent to a drainage depression rather than a defined stream or watercourse. The site clearly performs a drainage function due to the slope, however there is no defined channel and no ecological values present at this site.	

Site ID on Figure 6	11
Location Description	North side of subject watercourse, adjacent to vegetation patch
Hydrological Description	High side of bank, although there is no clearly defined channel,
Ecological Description	Fauna habitat value – tree canopy and woody debris
Photos	

Facing Upstream of site



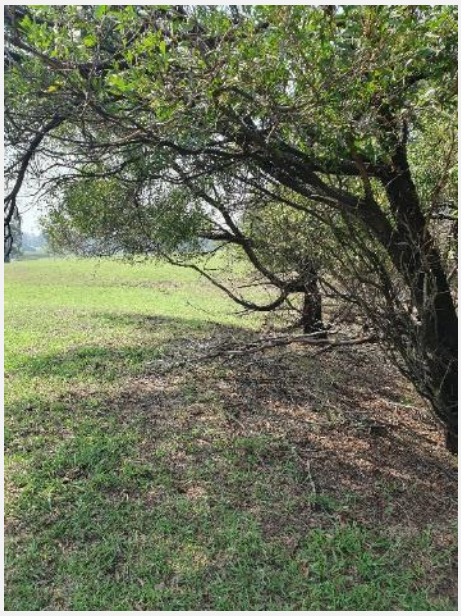
Facing across site

Facing downstream of site

Recommendation: This site is not indicative of riparian land. Although this site can be described as the high side of the bank, there is no clearly defined channel. The site clearly performs a drainage function due to the slope, however there is no defined channel. Ecological values include fauna habitat in the form of tree canopy and woody debris.

Site ID on Figure 6	12
Location Description	North side of subject watercourse, adjacent to vegetation patch
Hydrological Description	High side of bank, although there is no clearly defined channel,
Ecological Description	Fauna habitat value – tree canopy and woody debris
Photos	

Facing Upstream of site



Facing downstream of site

Facing across site

Recommendation: This site is not indicative of riparian land. Although this site can be described as the high side of the bank, there is no clearly defined channel. The site clearly performs a drainage function due to the slope, however there is no defined channel. Ecological values include fauna habitat in the form of tree canopy and woody debris.

Site ID on Figure 6	13
Location Description	North side of subject watercourse
Hydrological Description	High side of bank, although there is no clearly defined channel
Ecological Description	Fauna habitat value – tree canopy and woody debris
Photos	

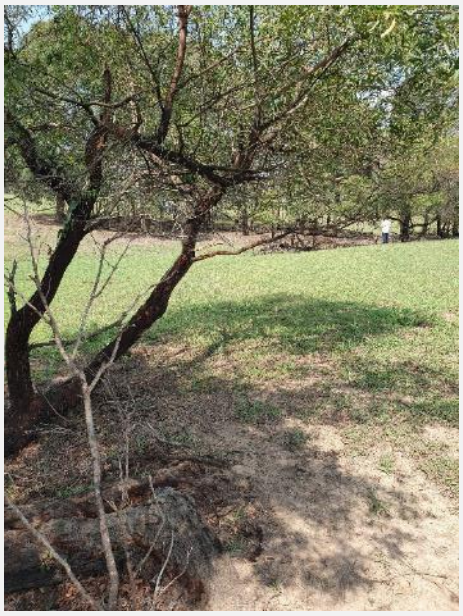
Facing Upstream of site

Facing downstream of site

Facing across site

Recommendation: This site is not indicative of riparian land. Although this site can be described as the high side of the bank, there is no clearly defined channel. The site clearly performs a drainage function due to the slope, however there is no defined channel. Ecological values include fauna habitat in the form of tree canopy and woody debris.

Site ID on Figure 6	14,15
Location Description	North side of subject watercourse
Hydrological Description	High side of bank, although there is no clearly defined channel
Ecological Description	Fauna habitat value – tree canopy, fallen tree and woody debris
Photos	



Facing Upstream of site

Facing downstream of site

Facing across site

Facing north

Recommendation: This site is indicative of riparian land. Although the watercourse is not well defined, it clearly performs an important drainage function for the subject site and has some ecological value in terms of fauna habitat and woody debris.

Site ID on Figure 6	19
Location Description	South side of subject watercourse, downstream end
Hydrological Description	High side of bank, although there is no clearly defined channel
Ecological Description	Exotic grasslands
Photos	

Facing Upstream of site

Facing downstream of site

Facing across site

Recommendation: This site is indicative of riparian land. Although the watercourse is not well defined, it clearly performs an important drainage function for the subject site and has some ecological value in terms of fauna habitat and woody debris.

Site ID on Figure 6	20
Location Description	South side of subject watercourse, downstream end
Hydrological Description	High side of bank, although there is no clearly defined channel
Ecological Description	Fauna habitat value – tree canopy, fallen tree and woody debris
Photos	

Facing Upstream of site

Facing across site

Facing downstream of site

Recommendation: This site is indicative of riparian land. Although the watercourse is not well defined, it clearly performs an important drainage function for the subject site and has some ecological value in terms of fauna habitat and woody debris.

Site ID on Figure 6	21
Location Description	South side of subject watercourse, between tree patches
Hydrological Description	High side of bank, although there is no clearly defined channel
Ecological Description	Exotic grasslands, some patches of bare earth
Photos	

Facing Upstream of site

Facing across site

Facing downstream of site

Recommendation: This site is indicative of riparian land. Although the watercourse is not well defined, it clearly performs an important drainage function for the subject site and has some ecological value in terms of connecting patches of fauna habitat.

Site ID on Figure 6	22
Location Description	South side of subject watercourse, tree canopy present
Hydrological Description	High side of bank, although there is no clearly defined channel
Ecological Description	Exotic grasslands, some patches of bare earth, tree canopy, woody debris
Photos	

Facing Upstream of site

Facing downstream of site

Facing across site

Recommendation: This site is indicative of a vegetated buffer. Although the watercourse is not well defined, it clearly performs an important drainage function for the subject site and has some ecological value including fauna habitat features.

Site ID on Figure 6	23
Location Description	South side of subject watercourse, tree canopy present
Hydrological Description	High side of bank, although there is no clearly defined channel
Ecological Description	Exotic grasslands, some patches of bare earth, tree canopy, woody debris
Photos	

Facing Upstream of site

Facing across site

Facing downstream of site

Recommendation: This site is indicative of a vegetated buffer. Although the watercourse is not well defined, it clearly performs an important drainage function for the subject site and has some ecological value including fauna habitat features.

Site ID on Figure 6	24
Location Description	South side of subject watercourse, tree canopy present
Hydrological Description	High side of bank, although there is no clearly defined channel
Ecological Description	Exotic grasslands, some patches of bare earth, tree canopy, woody debris
Photos	

Facing Upstream of site

Facing downstream of site

Facing across site

Recommendation: This site is indicative of a vegetated buffer. Although the watercourse is not well defined, it clearly performs an important drainage function for the subject site and has some ecological value including fauna habitat features.

Site ID on Figure 6	25
Location Description	Drainage centreline – upstream extent
Hydrological Description	Centre of drainage line
Ecological Description	Exotic grasslands
Photos	

Facing Upstream of site

Facing downstream of site

Facing across site

Recommendation: This site indicates the upstream extent of the centre of the drainage line. Although dry at the time of field survey, and absence of clearly defined channel, the topography and grass species present indicate this site performs a drainage function.

Site ID on Figure 6	26
Location Description	Upstream end of drainage depression
Hydrological Description	Upstream end of drainage depression
Ecological Description	Exotic grasslands, some patches of bare earth
Photos	

Facing Upstream of site

Facing downstream of site

Recommendation: This site does not indicate riparian land. There is no clearly defined channel, no stream bed and no banks.

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Project management

Environmental offsetting
Offset strategy and assessment (NSW, QLD, Commonwealth)