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Vegetation Management Plan



Lot 1 DP // 1069961, 14 Hamilton Road, Albion Park, NSW

Prepared for: 14 Hamilton Road Pty Ltd

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Glossary and abbreviations

Acronym	Description
*	Denotes exotic species
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
DA	Development Application
DCP	Development Control Plan
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ha	Hectares
LGA	Local Government Area
MZ	Management Zone
NRAR	NSW Natural Resources Access Regulator
ToB	Top of Bank
VMP	Vegetation Management Plan
VRZ	Vegetation Riparian Zone
SLEP	Shellharbour Local Environmental Plan 2013
WoNS	Weeds of National Significance

1 Introduction

1.1 Description of project and purpose of Vegetation Management Plan

This Vegetation Management Plan (VMP) has been prepared to guide the management and restoration of a Vegetated Riparian Zone (VRZ) along a section of the Macquarie Rivulet which lies north and adjacent to 14 Hamilton Road, (Lot 1 // DP 1069961), Albion Park NSW. It has been instigated following recommendations of a Flora and Fauna Assessment (FFA) (Ecoplanning 2020) that has been prepared to accompany a development application (DA) for a 'Seniors Living' development within Lot 1. The proposal consists of 39 self-contained dwellings, new access roads, sewage, Asset Protection Zone (APZ) for bushfire protection and drainage infrastructure.

Part of the proposed development is on waterfront land (**Figure 1.1**), and thus a controlled activity approval is required from the NSW Natural Resources Asset Regulator (NRAR). This VMP addresses NRAR's recommendation for a VRZ. The VRZ is referred to as the '**study area**' for this VMP and includes the northern part of Lot 1 (**Figure 1.2**).

All of the study area is also mapped as 'Environmentally Sensitive Land' on the Terrestrial Biodiversity map in Part 6.5 in the Shellharbour Local Environmental Plan (SLEP) (2013) (**Figure 1.3**). The objective of this clause is to maintain terrestrial biodiversity by—

- protecting native fauna and flora, and
- protecting the ecological processes necessary for their continued existence, and
- encouraging the conservation and recovery of native fauna and flora and their habitats.

Given that the study area is highly disturbed and infested by exotic plants and weeds, a finding that is supported by a site assessment (**Section 2**) and Ecoplanning (2020), this VMP will enhance the ecological condition of the degraded riparian corridor, thereby making contributions towards meeting the above three objectives of the Shellharbour LEP (2013).

This VMP outlines management methods for the restoration and stabilisation of the vegetation within the VRZ. Revegetation of the cleared areas of the VRZ and primary woody-weed removal will be implemented to achieve this VMPs primary objectives, which include:

- reduction of the abundance and cover of all exotic species, particularly exotic grasses, and herbaceous weeds
- creation of a vegetated riparian zone to buffer the 5th order watercourse from the impacts of the surrounding land use (e.g. nutrient enriched runoff), which will contribute to the health of these watercourses and of the overall catchment
- incorporation of the objectives of the APZ in some parts of the VRZ
- revegetation of the VRZ with a combination of ground layer and overstorey species to reduce roughness and eliminate any increases in flood levels
- improvement of the soil stability of the VRZ through the revegetation of appropriate native species

This report includes a site assessment, and proposal for staging of works to guide the weed management, revegetation, and general restoration of the subject site by a qualified bush regeneration company. This VMP is intended to be implemented over a 5-year period.



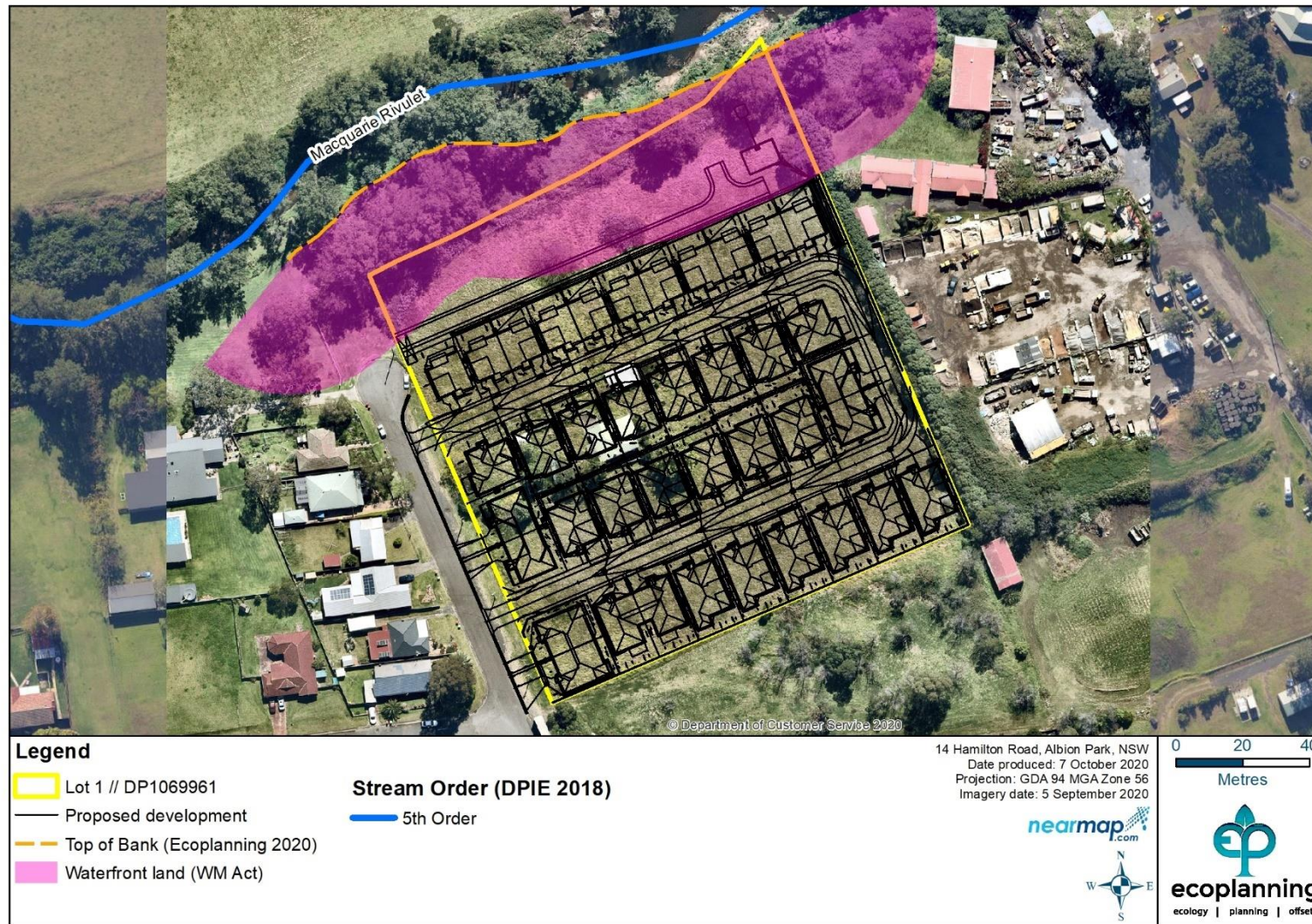


Figure 1.1: Proposed development in relation to waterfront land

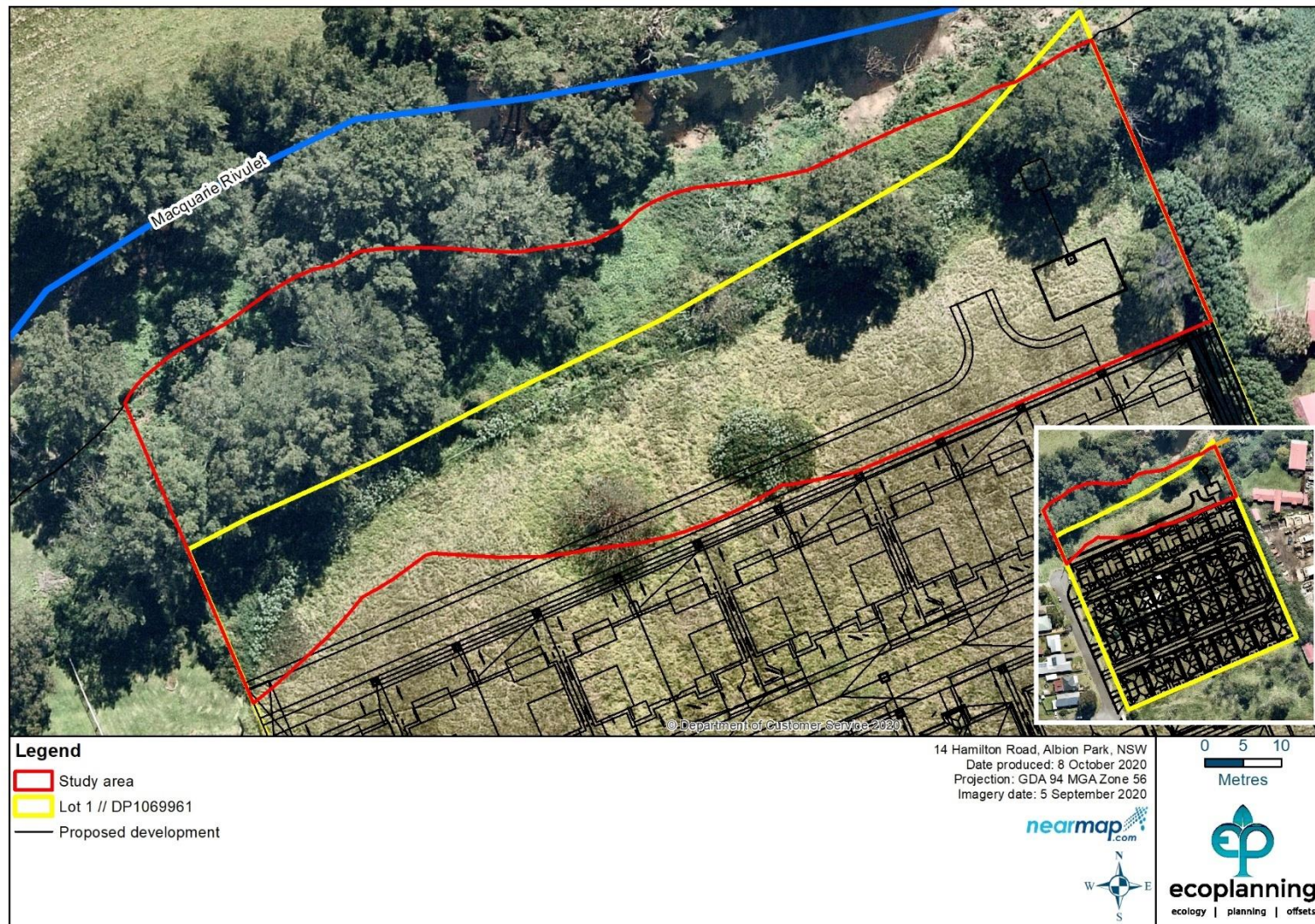


Figure 1.2: Study area

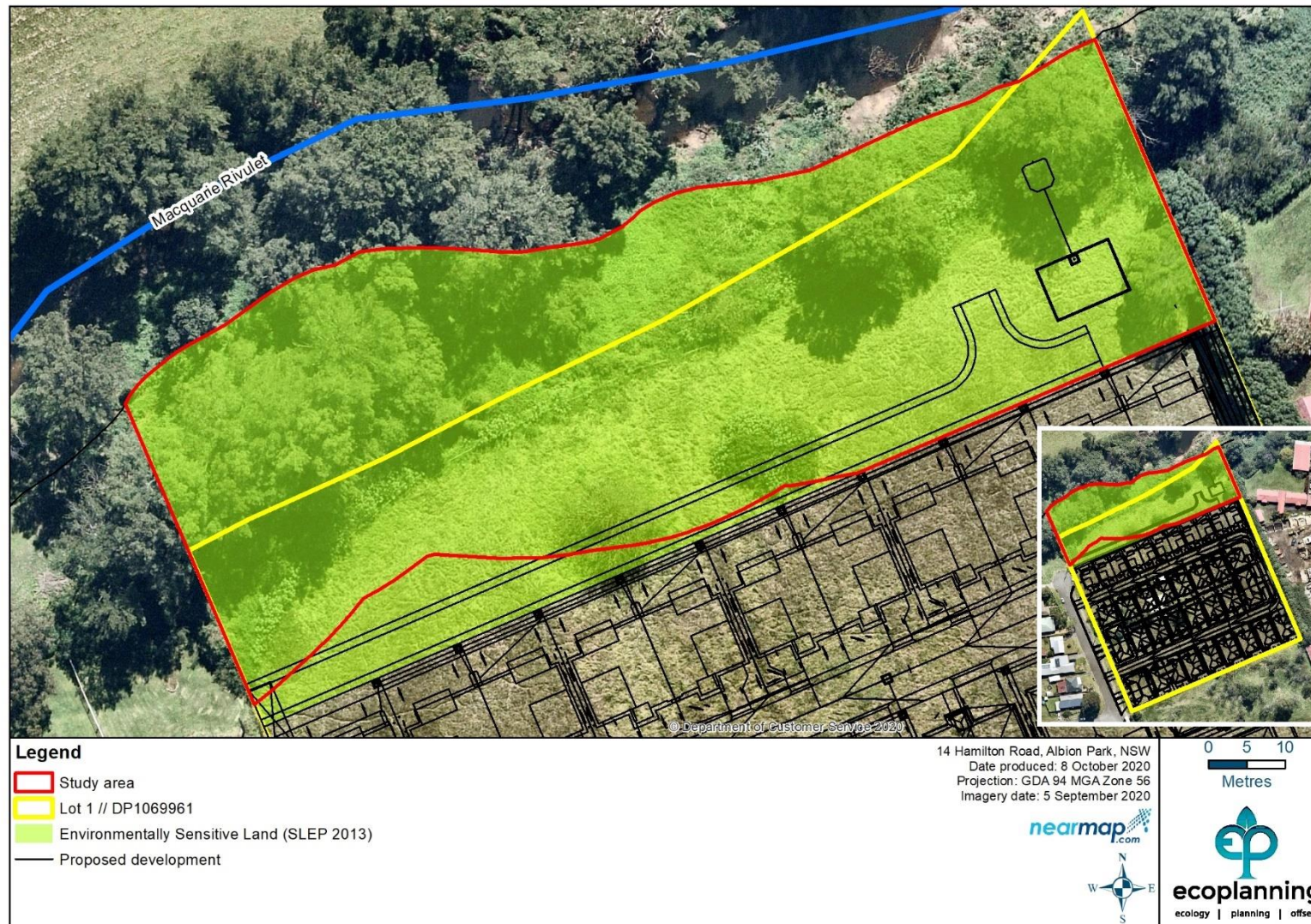


Figure 1.3: Environmentally Sensitive Land (Shellharbour Local Environmental Plan 2013).

1.2 Site description

The study area is in Albion Park, a suburb within the Shellharbour Local Government Area (LGA) on the coastal plain east of the Illawarra Escarpment. Lake Illawarra is located approximately 2.6 km to the northeast of the study area (**Figure 1.4**). The rural residential Lot 1, of which the study area is part of, is zoned *RU6 - Transition*, while the land north of Lot 1, which includes the Macquarie Rivulet, is zoned as *RU1 - Primary Production* (**Figure 1.5**).

The study area includes both heavily degraded cleared land as well as weed-infested riparian woodland along the Macquarie Rivulet. According to the *Water Management (General) Regulation 2018 Hydro Line spatial data*, the Macquarie Rivulet is a 5th-order Strahler stream. The width of the study area is based on *Guidelines for controlled activities on waterfront land Riparian Corridors* (NRAR 2018) which stipulate a 40 m buffer from 'top of bank' (ToB) for 4th-order streams and greater. The ToB has been mapped by Ecoplanning (2020) and the 40 m buffer has been identified from this ToB. The study area therefore includes all the land within the 40 m buffer and up to the boundary of the proposed dwellings. An access track and detention basin with stormwater discharge are also considered part of the study area (**Figure 1.6**).

Portions of the study area have been mapped as containing cleared land and Riparian River Oak Forest (MU37) (DPIE 2010) (**Figure 1.7**). More recent native vegetation mapping (DPIE 2015) using Plant Community Types (PCT) show areas of Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion (PCT1234), which is a component of Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, an Endangered Ecological Community under the BC Act (**Figure 1.8**).

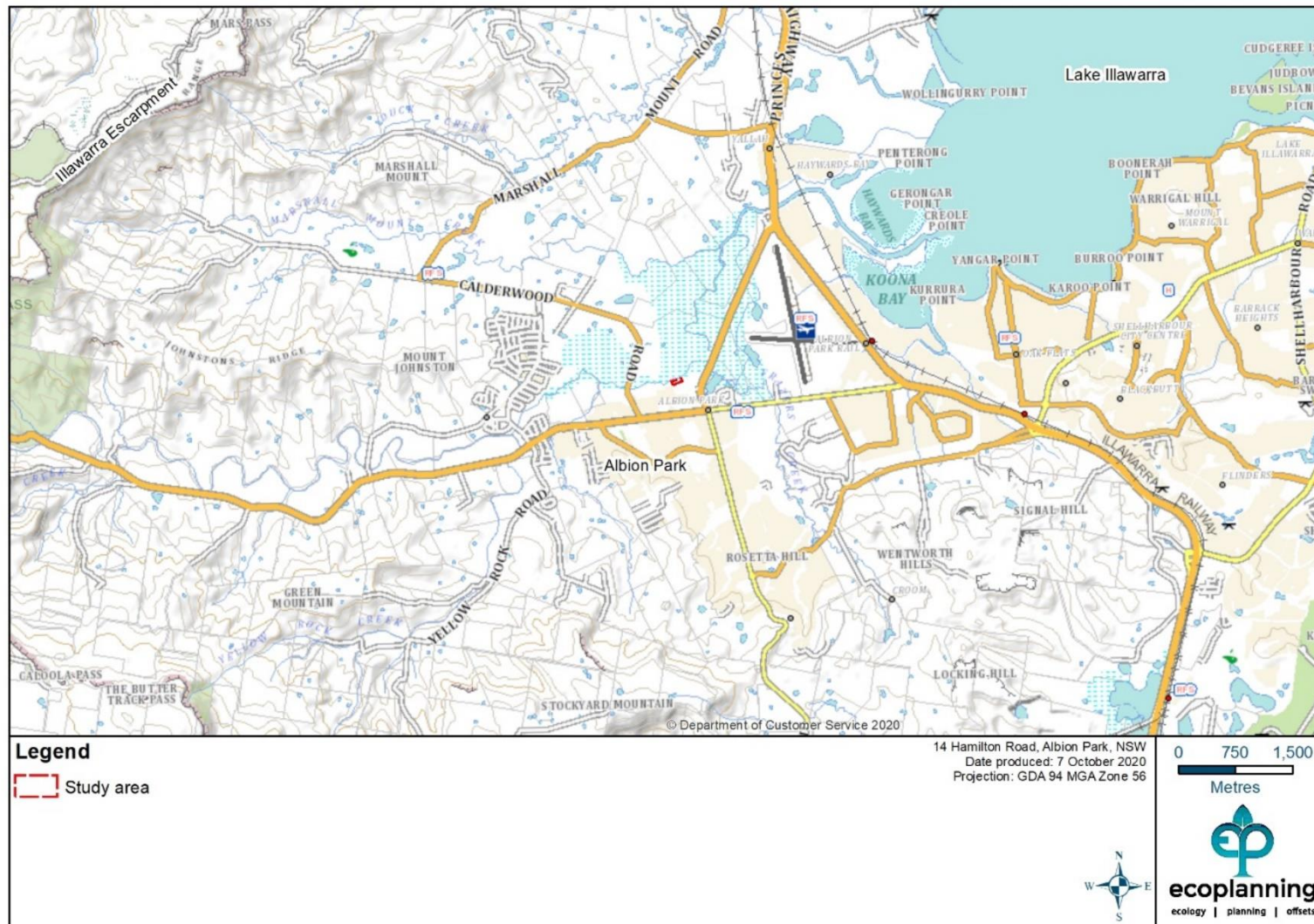


Figure 1.4: Locality of the study area, depicting surround suburbs and landscape features

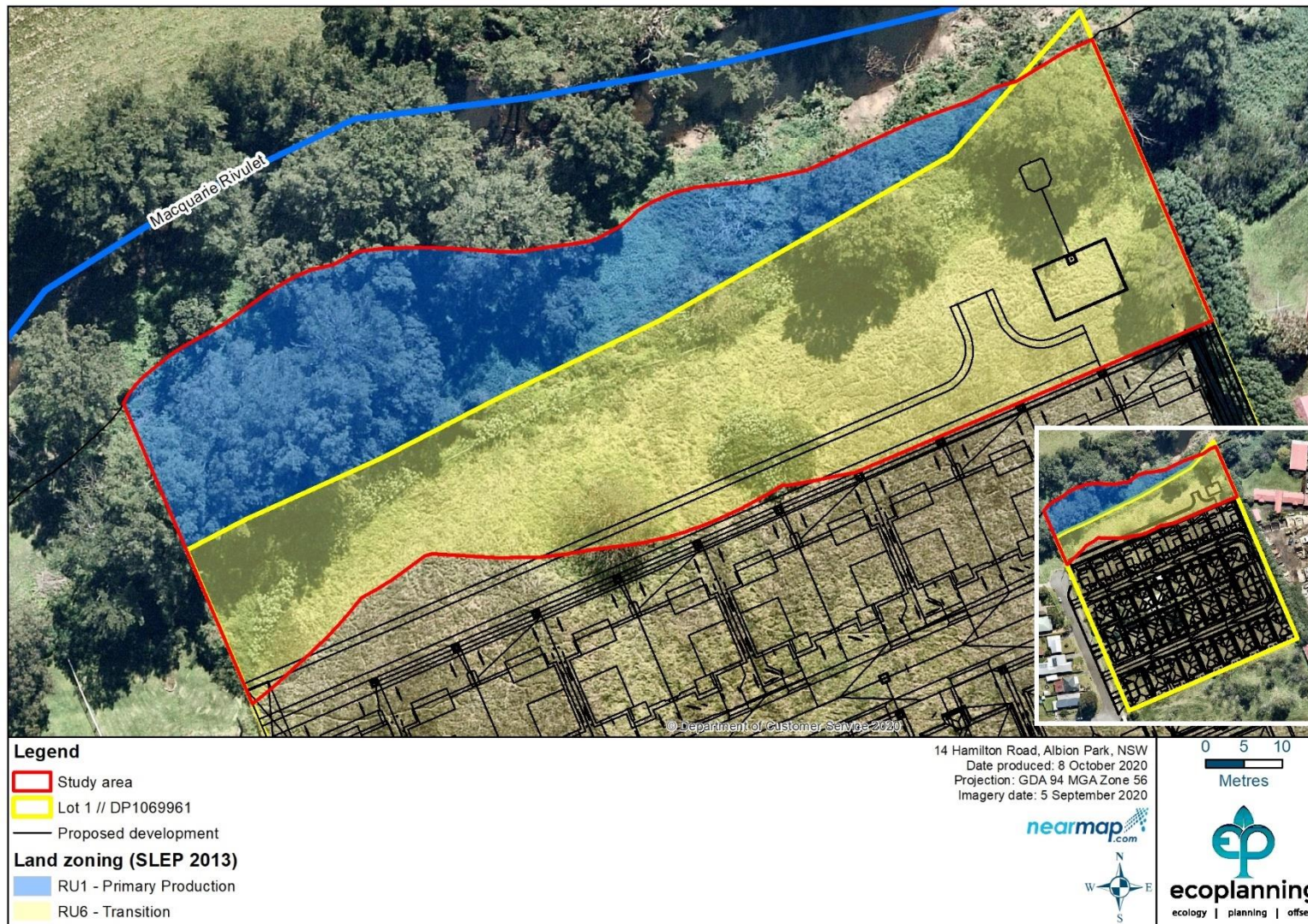


Figure 1.5: Land zoning (Shellharbour LEP 2013)

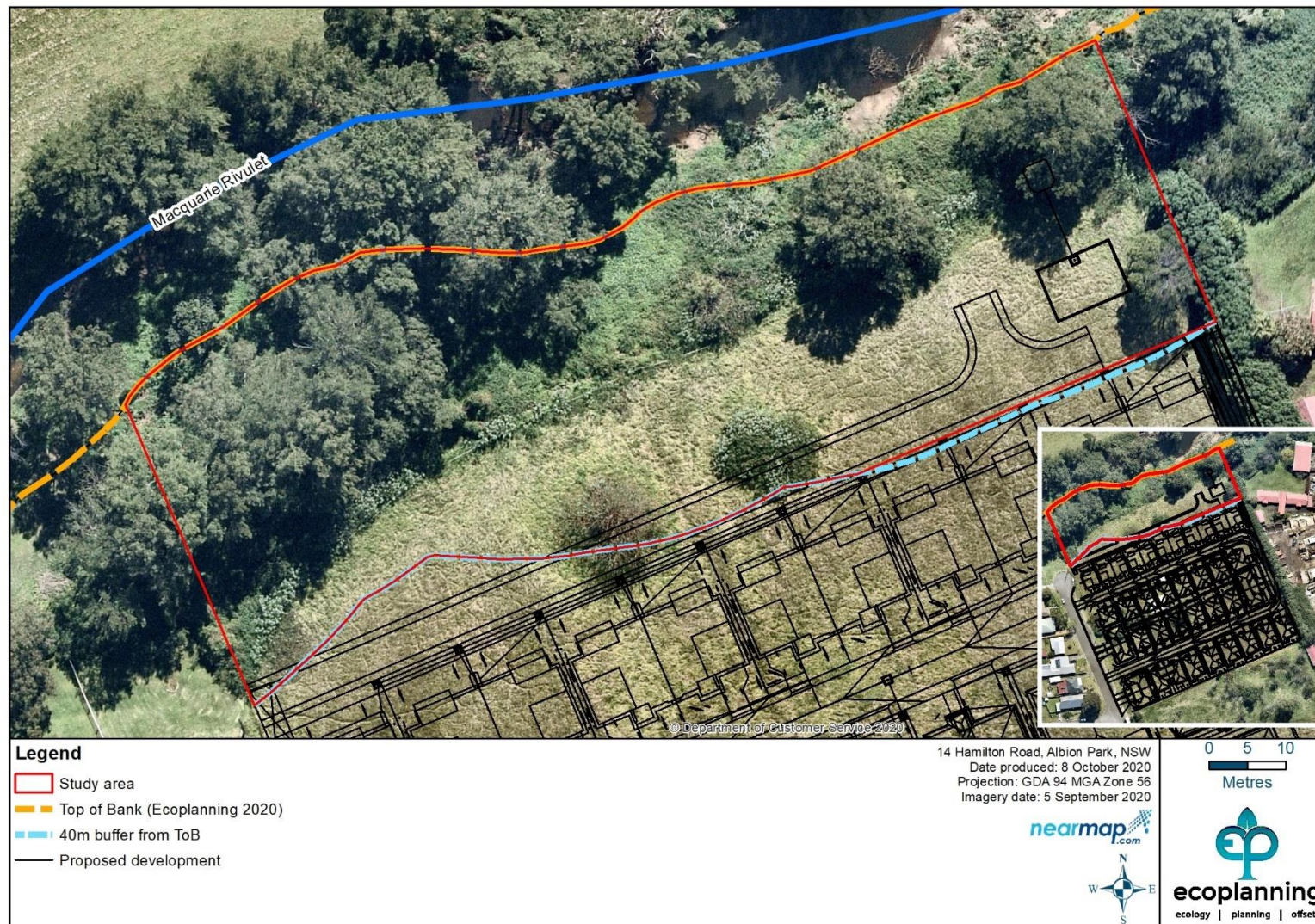


Figure 1.6: Top of Bank with 40m buffer

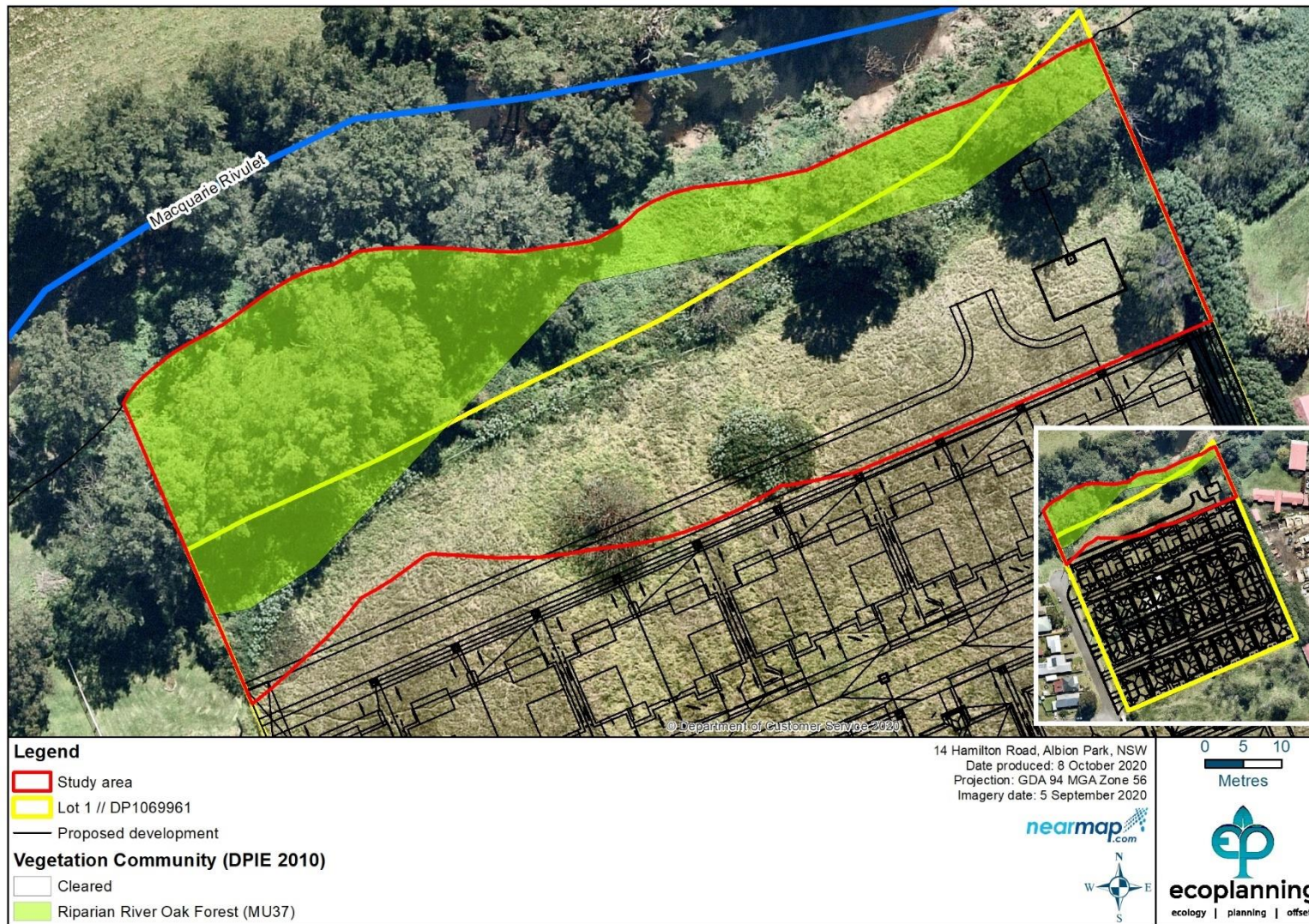


Figure 1.7: Vegetation mapping (DPIE 2010)

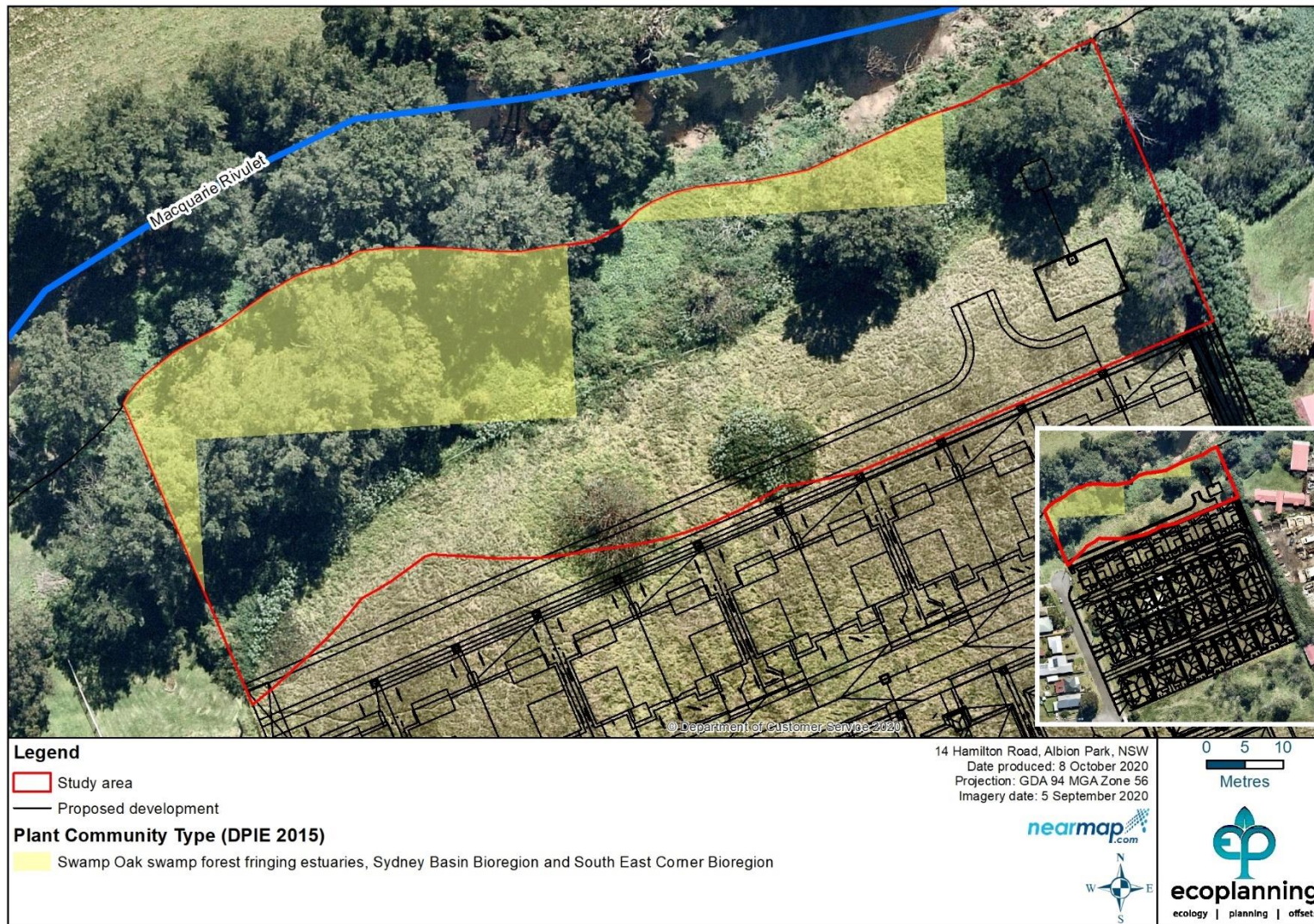


Figure 1.8: Vegetation mapping (DPIE 2015)

2 Site Assessment

2.1 Methods

A field survey was undertaken on 23 September 2020 by Dr John Gollan (Senior Ecologist, Ecoplanning) and Joel Nicholson (Ecologist, Ecoplanning). This survey included a general flora and fauna habitat and vegetation community assessment. Weather conditions during the site assessment were warm and overcast, with rainfall occurring in the prior 24 hours (**Table 2.1**)

Table 2.1: Daily weather observations (BoM 2020).

Date	Temp (°C)		Rainfall (mm)	Max wind gust	
	Min	Max		Direction	Speed (km/h)
23/09/2020	11.8	22.3	0	WSW	63

The field assessment aimed to determine the overall resilience of the subject site, and thus its capacity to respond to regeneration works.

Appropriate management methods were considered, with the aim of identifying areas of the site requiring revegetation, as opposed to assisted natural regeneration. The site was surveyed to determine the problematic exotic species present and aimed to identify all priority weeds and Weeds of National Significance (WoNS). During the survey, appropriate weed control techniques were considered for the dominant exotic species within the subject site.

All vegetation patches within the VMP study area were assessed to determine their location, extent, structure, and floristics.

Field survey was also undertaken to validate the regional vegetation mapping of DPIE (2010, 2015). Vegetation communities were checked against described Threatened Ecological Communities (TEC) listed under either the EPBC Act or the BC Act.

2.2 Results

2.2.1 Native vegetation communities

Regional vegetation mapping by NPWS (DPIE 2010, 2015) (**Figure 1.7** and **Figure 1.8**) and plant profiles for the mapped communities were reviewed, and following field survey, the following native vegetation community was found to be present in the VMP study area:

- *River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion* (PCT1105).

This PCT was assigned due to the presence of a canopy of *Casuarina cunninghamiana* (River Oak) and the occasional Sandpaper Fig (*Ficus coronata*). *Casuarina glauca* (Swamp

Oak) was not present, which refutes the presence of Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion (PCT1234) as mapped in DPIE (2015)

The understory and ground layer vegetation could not assist in assigning a vegetation community as it was infested with weeds such as *Lantana camara**, *Solanum mauritianum** (Wild Tobacco) and *Ricinus communis** (Castor Oil Plant). Much of the canopy and mid story was also choked with the exotic climber, *Cardiospermum grandiflora** (Balloon Vine). For this reason, the community was assigned to a 'disturbed' condition (**Figure 2.2**). Plant Community Type 1105 does not form part of any TEC listed under the BC Act or the EPBC Act.

2.2.2 Other vegetation

Woody weeds and exotics

This vegetation type occurs within the riparian corridor and does not support canopy species. These areas are infested with the exotic vine, *Cardiospermum grandiflorum** (Balloon Vine), and other exotic shrubs and herbs including *Ricinus communis** (Castor Oil Plant), *Lantana camara** (Lantana), *Solanum mauritianum** (Wild Tobacco Bush), *Tropaeolum majus** (Nasturtium), *Bidens pilosa** (Cobblers Pegs) and *Tradescantia fluminensis** (Trad) (**Figure 2.2**).

Cleared land

This vegetation type occurs along the south eastern half of the VMP study area and consists of a paddock was dominated by a variety of lawn and pasture grasses and weeds including *Anthoxanthum odoratum** (Sweet Vernal Grass), *Ehrharta erecta** (Panic Veldtgrass), *Hypochaeris radicata** (Catsear), *Bromus cartharticus** and *Plantago lanceolata** (Lamb's Tongues). *Cenchrus clandestinus** (Kikuyu) was the most dominant, accounting for around 95% of the cover (**Figure 2.4**).

A validated vegetation map is showing these three vegetation zones is shown in **Figure 2.1**.

2.2.3 Site resilience

Field assessment determined that, in general, the VMP study area has a low capacity for natural regeneration to occur. The VRZ is heavily degraded due to past grazing, vegetation clearing and weed infestation. A rapid riparian assessment found that the riparian corridor was in a 'Poor' condition, scoring a score of 11 out of a possible 60 (see Ecoplanning 2020). The VRZ will require substantial intervention for restoration to be successful, including primary woody-weed removal, revegetation and ongoing secondary and maintenance works.

The cleared land is dominated by herbaceous weeds and exotic grasses and does not contain native ground layer species. They therefore have minimal capacity to respond to assisted natural regeneration. However, the exotic grasses will be cleared, and native grasses, herbs and forbs will be planted.

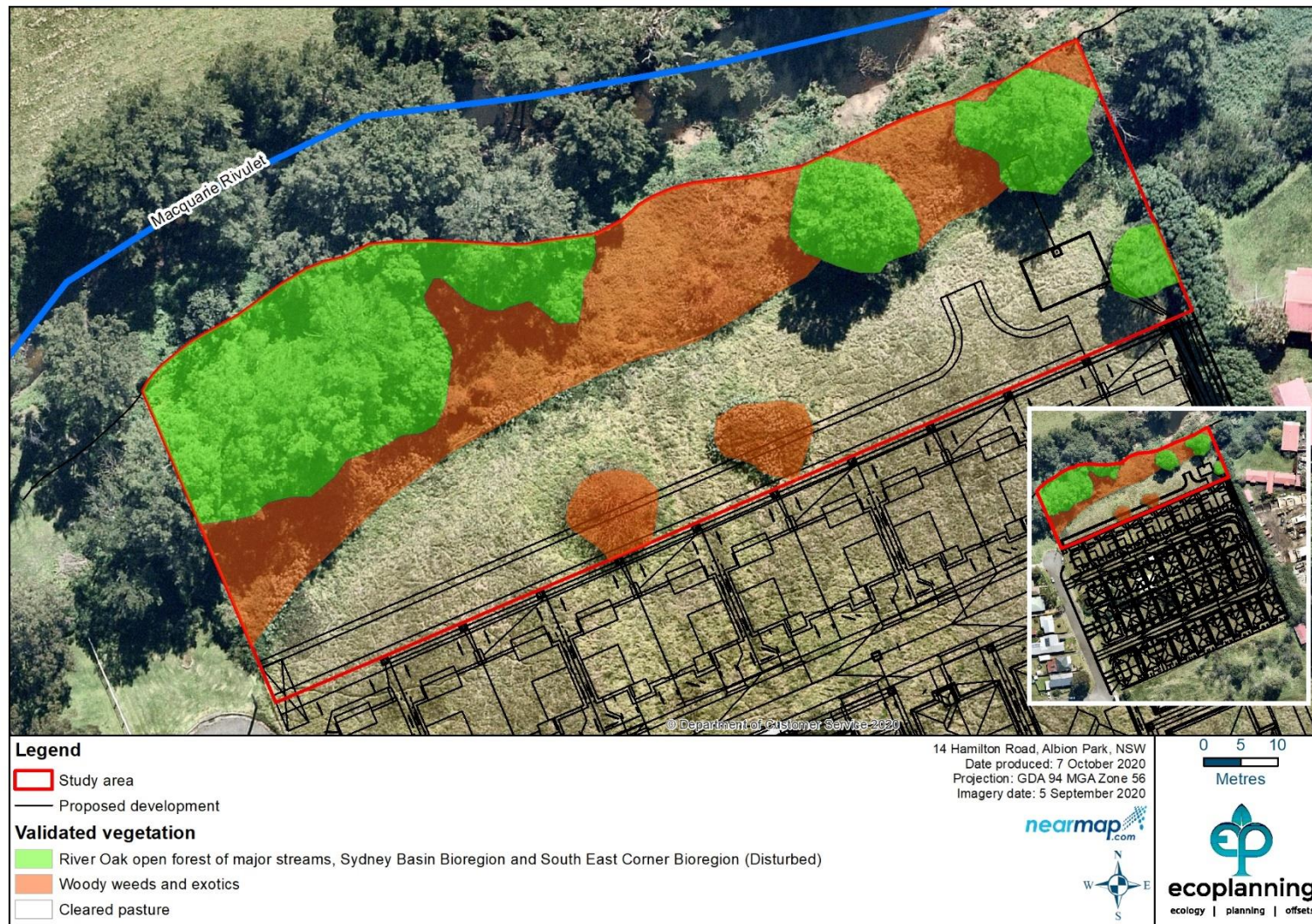


Figure 2.1: Validated vegetation in the VMP study area



Figure 2.2: River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (Disturbed)

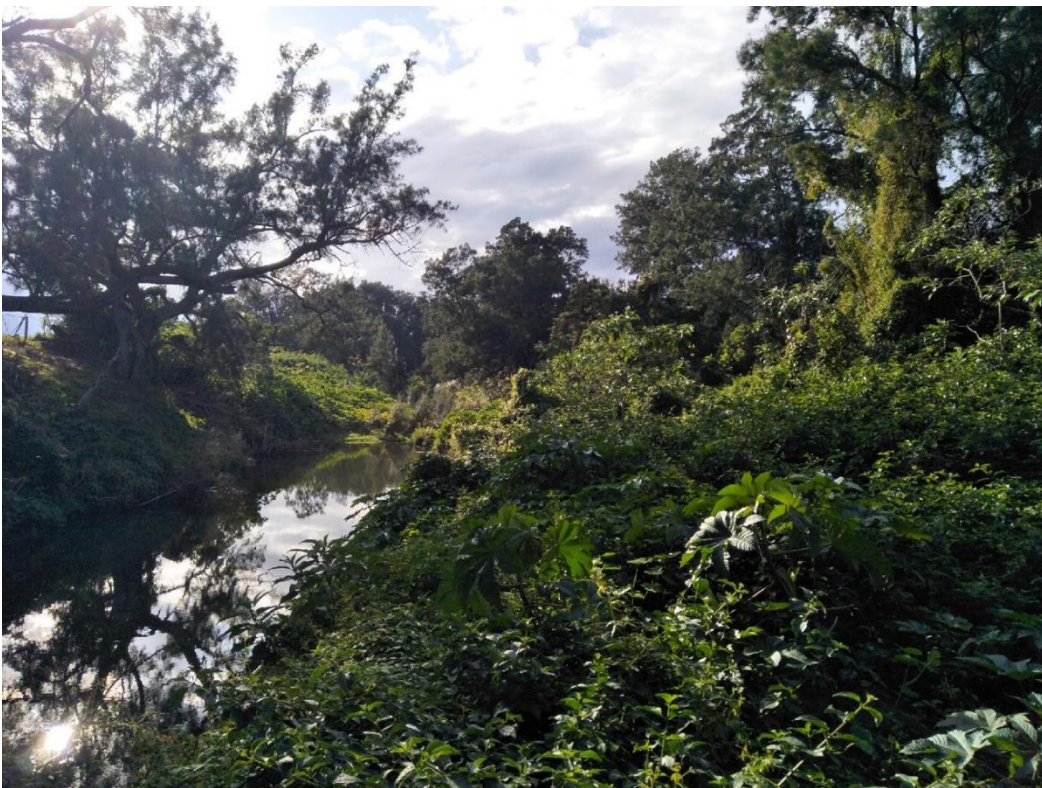


Figure 2.3: Woody weeds and exotics



Figure 2.4: Cleared pasture

Flora species

A total of 37 flora species were identified within the study area during the field investigation, of which 32 are exotic or introduced species (**Appendix B**). Three priority weeds listed under the NSW *Biosecurity Act 2015* for Shellharbour were recorded in the study area, all of which are Weeds of National Significance (WoNS) (**Table 2.2**).

Table 2.2: Priority weeds and Weeds of National Significance (WONS).

Common name	Scientific name	WoNS ¹	Duty
Lantana	<i>Lantana camara</i>	Y	Mandatory Measure Must not be imported into the State or sold
Blackberry	<i>Rubus fruticosus</i> spp. agg.	Y	
Fireweed	<i>Senecio madagascariensis</i>	Y	

¹ <http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>

No threatened flora species listed under the *Biodiversity Conservation Act 2016* (BC Act) or *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) were recorded in the VMP study area.

3 VMP weed management and revegetation

Regeneration of the VRZ will require woody-weed removal, spray preparation, revegetation and ongoing secondary and maintenance works to ensure the successful establishment of planted native vegetation. Management actions required for the restoration of the VMP subject site are discussed further in **Sections 3.1 to 3.6** and in **Appendix C**.

It is recommended that weed management begin prior to subdivision of the study area. A suitably qualified and experienced bush regeneration contractor (as per **Section 4.3**) must be engaged to carry out vegetation management works.

Weed management and revegetation will also be undertaken to meet the objectives of reducing flood impacts and management of the Asset Protection Zone (APZ) (Peterson 2020).

3.1 Preliminary works

Seed collection

Seed collection from the local area is recommended to ensure indigenous species are available for revegetation works; species identified for revegetation are outlined in **Appendix B**. All plantings should be of local provenance and collected from adjacent patches of vegetation. However, nurseries that supply indigenous seedling stock, (not horticultural varieties), may also be used to supplement the plantings.

Seed collection zones can extend within a radius of 3 km for groundcover, shrubs and trees. The collection site should reflect the natural conditions that exist for the area being regenerated.

Record keeping of seed collection and planting locations is to be as per the Flora Bank guidelines (Mortlock 2000), the bush regeneration contractor is responsible for recording this information. A Section 132C licence under the NSW *National Parks and Wildlife Act 1974* will be required to undertake seed collection works.

Fencing

Fencing is recommended along the boundary of the VRZ to discourage access by feral deer and people. The fencing should be of star picket and strained wire construction and will not include barbed wire as no stock are present within the study area. The fencing, as required for bushfire protection that runs the length of the boundary between the dwellings and the VRZ, is to be made of a non-combustible material (e.g. Colorbond®) and a minimum 1.8 m high (Peterson 2020). Star picket/wire fencing is not necessary along this boundary as the bushfire protection fencing will be dual purpose. Fencing should be installed prior to the initiation of the contract, particularly prior to revegetation works being undertaken. If the fencing for bushfire protection cannot be installed prior, then temporary fencing should be erected.

Signage

Signage in accordance with Shellharbour City Council (SCC) standardised signs for the VRZ will be installed at select locations along the perimeter of the VRZ. The exact information

and location of these signs will be determined during implementation of the works in accordance with the VMP. At a minimum, the signage should be positioned at all main access points or visual areas within the study area and should state that the VRZ are being managed for regeneration purposes.

3.2 Weed management techniques

Weed management will be carried out using primary and secondary weed control followed by ongoing maintenance. Weed control will include mechanical removal techniques, herbicide application and natural shading techniques. Disturbance of the soil during the weed management process should always be minimised (see Buchanan 2000, Bradley 2002). Weed control objectives and treatment techniques are outlined below (**Appendix C**) in accordance with weed type.

Primary Weed Control

Primary weed control is the initial removal of weed species. Mechanical removal techniques relevant to the weed being removed (Buchanan 2000; Bradley 2002; DPI 2015) should be used for all woody weeds and herbaceous plants. Herbicide application, such as backpack spraying should be avoided where off target loss of native species is likely to occur.

Secondary Weed Control

Secondary weed control involves follow-up weed control to remove seedlings that have emerged after primary control and treatment of any existing plants that reshoot. Any new weed infestation areas identified must also be treated.

Maintenance

Maintenance is the long-term management of a site to prevent weeds from becoming re-established after primary and secondary work. Substantial effort should be focussed on reducing the weed seed bank, eradicating problematic weeds and supporting the growth of native vegetation. Areas of high resilience should be the focus of intensive maintenance works, which will include fine hand-weeding. A structured maintenance regime following primary and secondary work will reduce the time taken for the site to reach a reasonable level of stability.

Weed Disposal

All seeding herbaceous/grass material and tubers should be bagged, removed from site and disposed of at an appropriate green-waste facility. Woody weeds, such as *Lantana camara** should be removed offsite. However, small piles of woody weeds may be stored onsite for fauna habitat if not be located within the flooding extent of the watercourses, or in a position that will make the future treatment of exotic grasses and herbaceous weeds difficult.

3.3 Vegetation management zones

The VMP subject site has been categorised into four management zones (MZs), based on the different management actions required to manage the vegetation within the study area. A fifth MZ that incorporates the access track has been included even though planting is not

required. However, it is within the VRZ and will require maintenance to ensure it remains an 'all weather' track.

Figure 3.1 shows the five management zones followed by a description of each zone. It is noted here that the MZs have been designed to consider advice on the VRZ from NRAR (Jeremy Morice, Water Regulation Officer NRAR in email correspondence to Dijana Harrison dated 31 August 2020; **Appendix D**). The advice was that:

- Existing flood constraints of the site will limit the ability to significantly increase Mannings roughness by revegetating the full width of the 40m riparian corridor with fully structured vegetation.
- The flood constraints will likely result in the outer areas of the 40m riparian corridor being grass and therefore compatible with meeting bushfire APZ requirements. This outcome would be acceptable to NRAR based on merit.

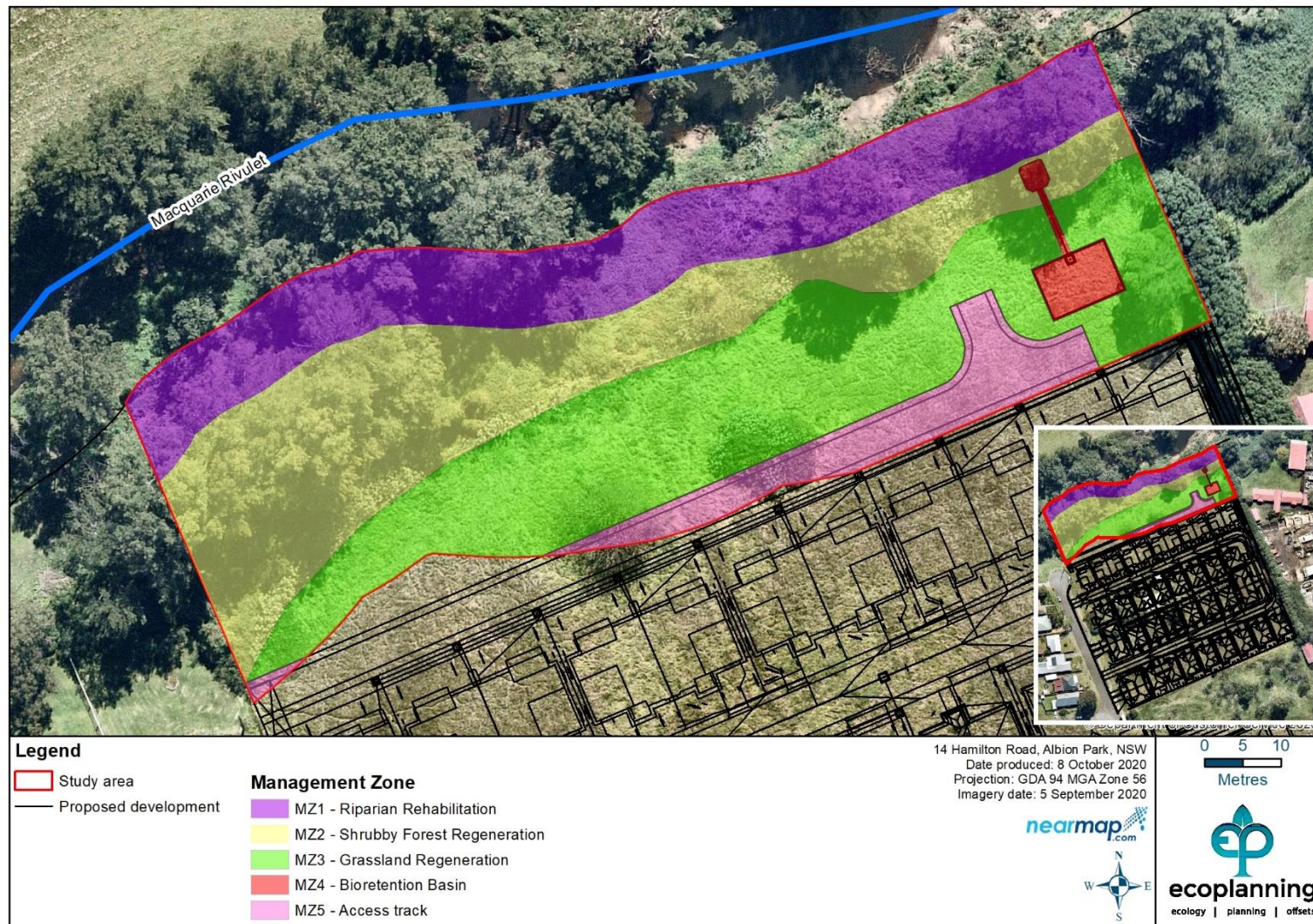


Figure 3.1: Management zones

Management Zone 1 - Riparian Rehabilitation

Management Zone 1 (MZ1) (0.13 ha) includes a 10m wide strip from the ToB. The purpose of this zone is to reduce weed cover and regenerate the existing native riparian vegetation along the Macquarie Rivulet to improve and provide bed and bank stability, protect water quality and provide riparian habitat. The existing native canopy trees are therefore not to be removed.

To avoid instability of the bank below, the broad-scale removal of exotic grasses should be avoided. All annual and perennial weed species along the watercourse should be hand-weeded, with any regrowth sprayed with herbicide suitable for use around waterways. Removal of riparian weeds and revegetation needs to be carefully implemented to avoid erosion to the bank and prevent bank collapse. Installation of jute matting may be required for revegetation along areas of the existing bank. Machinery such as Bobcats, excavators etc. should not be used to avoid causing instability of the soil.

Following primary and secondary weed treatment, this zone will be revegetated and managed. Planting should be undertaken with native tree, shrub, grass, sedge and forb species, in order to achieve natural plant understorey densities for *River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion* (PCT 1105). This zone should be planted out with a mix of species outlined in **Appendix B** and based on the planting densities outlined in **Section 3.4**.

Management Zone 2 - Shrubby Forest Regeneration

Management Zone 2 (MZ2) (0.17 ha) includes the area not covered by MZ1 and that is currently covered by woody weeds and exotics. The purpose of this zone is to reduce woody and herbaceous weed cover, regenerate the existing native canopy species, provide habitat that is a natural buffer to the riparian habitat within MZ1 and enhance connectivity of habitat upstream and downstream along the Macquarie Rivulet. The existing native canopy trees are therefore not to be removed.

All annual and perennial weed species within MZ2 should be hand-weeded or removed by hand-operated mechanical tools e.g. brushcutters, with any regrowth sprayed with herbicide suitable for use around waterways. As there is a buffer between the banks of the Macquarie Rivulet and this zone i.e. MZ1, it is unlikely that jute matting would be needed to stabilise the soil. However, this would need to be assessed once work has been initiated. Machinery such as Bobcats, excavators etc. should not be allowed to enter this zone in order to avoid causing instability of the soil. However, they may be used if the reach of the slasher, buckler etc. can be obtained from within MZ3.

Planting should be undertaken with native shrub, grass, sedge and forb species only, in order to achieve natural plant understorey densities for *River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion* (PCT 1105). This zone should be planted out with a mix of native midstorey species outlined in **Appendix B** based on the planting densities outlined in **Section 3.4**.

Management Zone 3 – Grassland Regeneration

Management Zone 3 (MZ3) (0.19 ha) includes the area not covered by MZ4 and MZ5 and that is currently covered by cleared pasture. The purpose of this zone is to reduce weed and

exotic grass cover and maintain a low ground cover of native species in order to meet the objectives of flood control and Asset Protection Zone. The native ground layer will help to enhance the natural buffer to the riparian habitat connectivity of habitat upstream and downstream along the Macquarie Rivulet.

Broad-scale removal of exotic grasses is allowable, in this zone, however, a cover of native plants is to be established soon after removal to reduce the risk of erosion. Mechanical removal with machinery is allowable, but every effort should be made to reinstate a cover as quickly as possible. The removal and monitoring of weeds together with natural regeneration within and outside of this MZ will help to re-establish ground-layer vegetation dominated by native species.

Planting should be undertaken with native species in order to achieve natural ground layer plant densities for River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (PCT1105) (see **Appendix B** and **Section 3.4**).

Management Zone 4 – Bioretention Basin

A bioretention basin (0.01 ha) is proposed and it should be managed generally in accordance with Chapter 4.5.4 of Book 9 Australia Rainfall & Runoff (AR&R) 2016 and the Healthy Waterways Water Sensitive Urban Design Technical Design Guidelines for South East Queensland as noted in the Shellharbour Drainage Design Handbook (Shellharbour City Council 2019). Indigenous species that suit the water regime should be used. Sedge species of River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (PCT1105) (see **Appendix B** and **Section 3.4**) are to be preferred, although other sedge species associated with PCT1234 could also be considered. Densities should follow the guidelines mentioned above.

Management Zone 5 – All Weather Access Track

The proposed access track (0.04 ha) has been designed to:

1. Provide access for firefighting equipment and thus protection against bushfire
2. Provide access for the maintenance of the VMP, including the bioretention basin

It is understood that the access track will not be sealed, and thus it may be prone to seeds germinating in cracks, crevices etc. of the pavement. Period maintenance should aim to remove any vegetation that may begin to establish.

3.4 Revegetation

Revegetation of the VRZ in the study area, and with the exception of MZ5, will be necessary to achieve a reasonable restoration outcome. The densities for revegetation have been calculated based on the modified condition of the study area and the moderate likelihood of native species recruiting following restoration works.

3.4.1 Staging and logic

Management Zone 1

This MZ is highly degraded, and thus will require revegetation, as opposed to assisted natural regeneration. MZ1 reflects the location of *River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion* (PCT1105) and will be revegetated to reflect this native vegetation community.

Exotic vines and woody weeds, particularly *Delairea odorata* (Cape Ivy), *Cardiospermum grandiflorum* (Balloon Vine), *Lantana camara* (Lantana), *Ricinus communis* (Castor Oil Plant) and Wild Tobacco (*Solanum mauritianum*) are currently stabilising the existing riparian zone. The abrupt removal of all the established exotic woody weeds will likely increase the erosive potential of the watercourse and result in an influx in herbaceous weeds.

Therefore, revegetation in MZ1 should commence with the establishment of 50 cm diameter weed free zones, where native midstorey and canopy tubestock will be installed. This will be achieved using herbicides, such as Roundup Biactive® at a solution suitable for the target species and will be conducted within the first 6 months of the contract. The extent of Balloon Vine and other exotic woody weeds will gradually be reduced, as the midstorey and canopy species become established. This will coincide with the installation of native groundlayer species.

Two planting events of native groundlayer species have been scheduled, one mid-way through the second year of the contract and one mid-way through the third year of the contract. The timing of groundlayer species revegetation can differ from these recommendations, so long as the recommended number of plants are installed through the zones. Supplementary planting is recommended for the end of the third year of the contract and will account for a 10% attenuation rate of all plantings conducted in these MZs.

Management Zone 2

This management zone is also degraded and similar to MZ1 and will be weeded and planted with the same staging. However, the planting regime will include low-growing shrubs, grasses, herbs and ground layer species only.

Management Zone 3

Weeds in MZ3 will be removed with similar staging to MZ1 and MZ2. Planting of ground layer grasses, herbs and forbs will be undertaken. This zone will be managed in accordance with APZ requirements (Peterson 2020).

Management Zone 4

As above, MZ4 should be installed and managed generally in accordance with Chapter 4.5.4 of Book 9 Australia Rainfall & Runoff (AR&R) 2016 and the Healthy Waterways Water Sensitive

Urban Design Technical Design Guidelines for South East Queensland as noted in the Shellharbour Drainage Design Handbook (SCC 2019).

Management Zone 5

Periodic maintenance should aim to remove any vegetation that may begin to establish. This will maintain integrity of the pavement and ensure the track remains as an 'all weather' access track.

3.4.2 Planting densities and species

Plantings will be installed at a density resembling the vegetation community indicated by the management zone. Revegetation should aim to recreate the densities of the original community in an 'unmodified' condition and take into consideration the proposed flooding capacity. The native species used for revegetation should be consistent with the planting palette provided (**Appendix B**). Planting densities for each MZ based are as follows:

Management Zone 1:

- 1 tree species per 25 m²
- 1 shrub species per 10 m²
- 3 groundcover (grass, fern, forb or sedge) per 1 m²

Management Zone 2:

- 1 shrub species per 10 m²
- 3 groundcover (grass, fern, forb or sedge) per 1 m²

Management Zone 3:

- 3 groundcover (grass, fern, forb or sedge) per 1 m²

Management Zone 4:

- As per guidelines

Management Zone 5:

- Not applicable

Planting densities for revegetation works for management zones are provided in **Table 3.1**.

Table 3.1: Planting density table for revegetation works.

Zone	Area (m ²)	Revegetation densities (m ²)			Zone total
		Canopy	Shrub	Groundcover	
MZ1	1394	0.04	0.1	3	56 canopy plants 139 midstory shrubs 4182 groundcover plants
MZ2	1713	0	0.1	3	171 midstory shrubs 5139 groundcover plants
MZ3	1882	0	0	3	5646 groundcover plants

Zone	Area (m ²)	Revegetation densities (m ²)			Zone total
		Canopy	Shrub	Groundcover	
MZ4	99	0	0	To be determined based on adopted guidelines	To be determined based on adopted guidelines
MZ5	442	0	0	0	0

3.4.3 Equipment, installation and timing

Prior to commencing planting, fencing should be installed to protect new vegetation. Plantings should be planned for late winter leading up to spring when regular rainfall is naturally occurring, and growth conditions are ideal. Planting of tube-stock (tree and shrub species) and Hiko or Viro cells (grasses and other groundcover species) will be favoured over broad-scale seed application, such as direct seeding or brush matting.

A water retaining and fertilising product (e.g. Terraform™) should be applied to each hole, to assist in the establishment of the plants. Each plant should be sufficiently watered on the same day as installation and regular watering should continue *in lieu* of rainfall for a period of 6 weeks, or until plantings have taken.

3.5 Concurrent works

If vegetation management works is carried out concurrently with civil construction works, planning between the bush regeneration contractor and civil works supervisor must be undertaken.

The civil works team will install environmental management controls across the site including exclusion zone fencing and erosion and sediment control. It is the responsibility of the bush regeneration contractor not to damage these controls and if any damage is observed or inadvertently caused it must be notified to the civil works supervisor immediately.

3.6 Maintenance

The maintenance phase must continue for 3 years, following 1 year of primary and 1 year of secondary works. Regular inspections of site condition will be conducted, including general site monitoring for potential new infestation areas and subsequent weed control of any identified weed species. Inspections and site monitoring must occur every 3 months during winter and autumn and every 1-month during summer and spring. This schedule could be revised depending on performance criteria recorded.

Weed maintenance works will include:

- Removal of all herbaceous weeds prior to establishment and seeding, which will be achieved by hand-weeding near plantings or the riparian zone. A broad-leaf selective herbicide (i.e. Starane Advanced), may be used to treat herbaceous weeds away from the watercourse and planted native vegetation
- Careful spot spraying of exotic grasses and herbaceous weeds amongst plantings in all management zones

- Gradual removal of exotic grasses, such as *Cenchrus clandestinus** (Kikuyu) in response to the spread and growth of planted vegetation
- Regular sweeps for woody weeds, which will be cut and painted with neat Roundup Biactive® prior to establishment

Supplementary planting and maintenance works will include:

- replacement of poorly growing or diseased individuals consistent with the prescribed planting,
- management of insect damage, if necessary,
- watering during dry periods,
- augmenting past planting areas where attenuation has occurred.

3.7 Cost of implementation

The costing for the VMP has been calculated over a five-year period and is estimated at a total of \$81,270 (**Table 3.2**), including the cost of monthly and annual reporting. This figure reflects a first-year cost of \$56,725, second year costs of \$10,497, third year costs of \$7,048, fourth year costs of \$3,500 and fifth year costs of \$3,500. Monthly and annual reporting costs over the five-year period add up to a total of \$1,500. The costs have been calculated based on the employment of trained bush regenerators at a rate of \$480 pp/day (\$60 pp/hr for an 8-hour working day), which covers crew and supervisor wages, equipment, herbicides, and all other associated business costs. The cost of weed control is slightly higher in the third, fourth and fifth years of the contract (@\$640 pp/day). This amount factors in the likely reduction in herbicide application and increase in hand-weeding methods, as a result of the establishment of plantings, particularly groundlayer species, which will ideally have substantially increased in cover and abundance by the third year of the contract.

The costing indicates how many crew members are required to attend the site over the five-year contract, based on the size of the site, extent of weed infestation and expected timeframes for the completion of primary, secondary works and initiation of maintenance works. The costs are indicative of commercial bush regeneration charge-out rates, and some variation is expected depending on the bush regeneration company used and their associated charge-out rates.

Plantings

The cost of revegetation was based on \$3.00 per tree and shrub and \$2.25 per groundcover/grass, including purchasing and installation costs (watering, plant guards (for shrubs and canopy species etc.)). Supplementary plantings in Year 2 and 3 have been calculated based on a 10% attenuation rate from original installation numbers.

Table 3.2: Cost of VMP implementation over the 5-year contract period*

Timing	Task	Cost
Year 1	<u>Primary and secondary weed control</u> based on a cost of employing a team of 2 bush regenerators at \$480 (\$60 per hour for 8 hours) per day to attend the site for 30 days.	\$14,400
Year 1	Revegetation of MZ1, MZ2, and MZ3 totalling 14,967 ground cover, 311 midstorey and 56 canopy plants (see Table 3.1).	\$34,775
Reporting	Cost of 12-monthly report. The report should consist of a one to two-page report detailing the works conducted on site (\$300 per report).	\$300
Fencing	360m at \$20/m	\$7,200
Signs	2 at \$25 each	\$50
	Year 1 total	\$56,725
Year 2	<u>Secondary weed control</u> based on the cost of employing two bush regenerators at \$480 (\$60 per hour for 8 hours) per day to attend site for 14 days.	\$6,720
Year 2	Supplementary planting of MZ1, MZ2, and MZ3 totalling 1,497 ground cover, 31 midstorey and 6 canopy plants	\$3,477
Reporting	Cost of 12-monthly report. Report should consist of a one to two-page report detailing the works conducted on site (\$300 per report).	\$300
	Year 2 total	\$10,497
Year 3	<u>Maintenance weed control</u> based on the cost of employing two bush regenerators at \$640 (\$80 per hour for 8 hours) per day to attend site for 10 days.	\$6,400
Year 3	Supplementary planting of MZ1, MZ2, and MZ3 totalling 150 ground cover, 3 midstorey and 2 canopy plants	\$348
Reporting	Cost of 12-monthly report. Report should consist of a one to two-page report detailing the works conducted on site (\$300 per report).	\$300
	Year 3 total	\$7,048

Timing	Task	Cost
Year 4	<u>Maintenance weed control</u> based on the cost of employing two bush regenerators at \$640 (\$80 per hour for 8 hours) per day to attend site for five days.	\$3,200
Reporting	Cost of 12-monthly report. Report should consist of a one to two-page report detailing the works conducted on site (\$300 per report).	\$300
	Year 4 total	\$3,500
Year 5	<u>Maintenance weed control</u> based on the cost of employing two bush regenerators at \$640 (\$80 per hour for 8 hours) per day to attend site for five days.	\$3,200
Reporting	Cost of 12-monthly report. Report should consist of a one to two-page report detailing the works conducted on site (\$300 per report).	\$300
	Year 5 total	\$3,500
	TOTAL	\$81,270

*MZ4 and MZ5 have not been incorporated into the cost estimate.

4 Performance criteria and monitoring

4.1 Performance criteria

The progress of and compliance with the VMP will be monitored and reviewed annually. This process will involve the bush regeneration contractor and land manager. The performance criteria listed in **Table 4.1** below are considered to be best practice and are not linked with any specific legislation. A photo monitoring point in each MZ has been established to assist with monitoring and review. The location and direction of the photo points are shown in **Figure 4.1**. The geographic coordinates for the points are shown in **Table 4.2**.

The bush regeneration contractor, in consultation with Shellharbour City Council, can adapt these criteria as required in response to the success of restoration works. Based on the success of the management works, further performance criteria may need to be developed for the maintenance phase. It should also be noted that performance criteria MZ4 may need to be reviewed depending on the desired outcomes of the bioretention basin.

Table 4.1: Revegetation performance monitoring criteria

Treatment Zones	Year 1	Year 2	Year 3	Year 4	Year 5
MZ1-4	Commencement of all tasks outlined in the VMP or evidence of planning for their implementation.				
	A demonstrated increase in native cover and diversity and a demonstrated decrease in exotic species cover and diversity by the end of the 3 rd year.				
	A minimum of 90% survival rate of all revegetation.				
	A visible improvement of soil stability along the riparian zone.				
	No exotic vines >5 cm in length with low abundance and cover (<5%) throughout the site.				
	A 20% reduction in exotic grass cover.	A 40% reduction in exotic grass cover.	A 60% reduction in exotic grass cover.	A 70% - 80% reduction in exotic grass cover.	Exotic grasses maintained at <5% cover.
	A 20% reduction in herbaceous weed cover.	A 40% reduction in herbaceous weed cover.	A 60% reduction in herbaceous weed cover.	A 70% - 80% reduction in herbaceous weed cover.	Herbaceous weed cover maintained at <5% cover.
	A 90% reduction in woody weed cover.	No woody weeds >10 cm in height remaining, with low cover (<5%) and abundance throughout the site.			
MZ5	0% establishment of any plant				

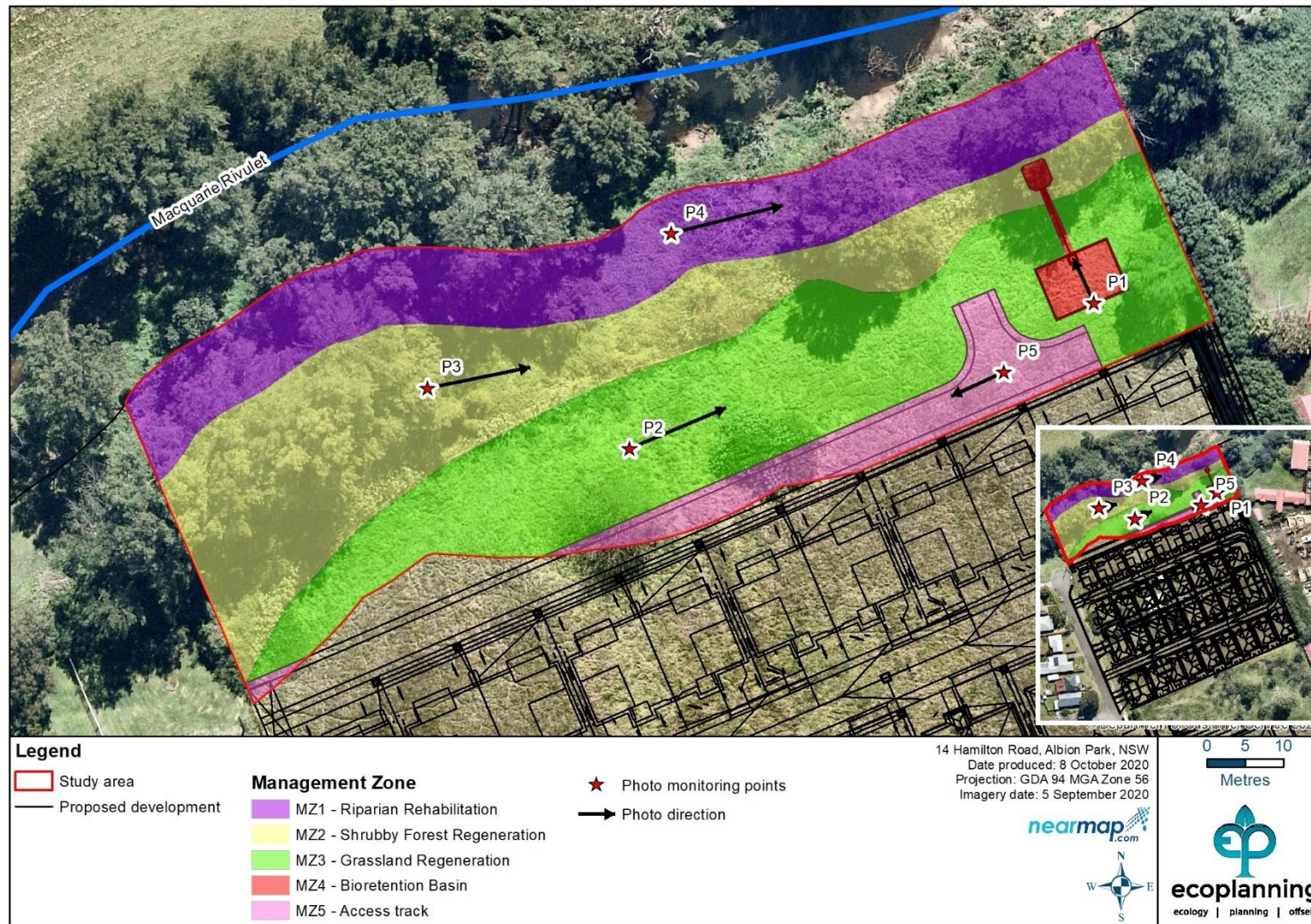


Figure 4.1: Photo monitoring points

Table 4.2: Photo monitoring points locations in GDA 94 zone 56

Photo Point	Easting	Northing
P1	295532	6172700
P2	295471	6172680
P3	295445	6172690
P4	295477	6172710
P5	295520	6172690

4.2 Monitoring reports

A monitoring report will be provided to Shellharbour Council every six (6) months (or at frequency that is stipulated by Council), which will shortly be followed by an inspection of the subject site with relevant Council staff (i.e. Natural Areas Coordinator) and the contractor(s) implementing the VMP. The aim of the inspection will be to ensure that reporting is consistent with the on-ground implementation of the VMP and to revise the costings accordingly. An example report is detailed in **Table 4.3**, the report should include:

- Works carried out, including weed species targeted and their location
- An approximation of the time spent on each task
- Any observations, such as the occurrence of new weed species
- Results from photo monitoring points
- Rates of regeneration and herbivory of native species
- A description of any problems encountered and how they were overcome
- A summary of how the site-specific objectives have been met (or not)
- Herbicide and other chemicals used, including quantity, dilution rate and other relevant information
- Weed control mechanisms used during the period
- Climatic conditions which may have influenced weed germination and growth
- Performance criteria and success
- If required, maps of weed distribution and density.

4.3 Bush regeneration contractors

Suitably qualified and experienced bush regeneration contractors that are members of the Australian Association of Bush Regenerators or fulfil the membership criteria must undertake all vegetation management works. In addition to this, team leaders should hold a Certificate III in Conservation & Land Management or possess equivalent field experience and certification. The contractor should carry out best practice bush regeneration techniques as described by Buchanan (2000).

Table 4.3. Example monitoring report template.

Date			
Name of Contractor:			
Hours worked on site since last monitoring report:			
Site Condition:	Zone		
	Weed cover %		
	Seedling survival %		
	Planting numbers		
	Herbicide used (in Litres)		
	Other		
Describe relevant weed management techniques:			
Describe problems; e.g. weed invasions, damage to planted material, etc.:			
Photographic evidence:			
Planned work before next monitoring report:			

5 References

- Bradley, J. (2002) Bringing back the bush. The Bradley Method of Bush Regeneration. New Holland Publishers, Sydney
- Brodie L (1999) The National Trust Bush Regenerators Handbook. National Trust of Australia (NSW)
- Buchanan R.A (2000) Bush regeneration: recovering Australian landscapes. 2nd edn, TAFE NSW, Sydney
- Ecoplanning (2020). Flora and Fauna Assessment – Lot 1 DP // 1069961, 14 Hamilton Road, Albion Park, NSW. Prepared for Stiletto Homes
- Gellie, N.J.H. (2005) Native vegetation of the Southern Forests: South-east Highlands, Australian Alps, South-west Slopes and SE Corner bioregions. *Cunninghamia* 9(2): 219-254
- Mortlock, W. (2000) The Hawkesbury-Nepean Catchment Management Authority (2000) Florabank Guideline 10: Seed collection ranges for revegetation. <http://www.florabank.org.au/> Florabank, Yarralumla, ACT [20 August 2001]
- NSW Department of Planning, Industry and Environment (DPIE) (2010). Southeast NSW Native Vegetation Classification and Mapping - SCIVI. VIS_ID 2230. Accessed at: https://datasets.seed.nsw.gov.au/dataset/southeast-nsw-native-vegetation-classification-and-mapping-scivi-vis_id-223006f8a
- NSW Dept. of Planning and Environment (DPE) (2015) NSW Planning Viewer Beta. NSW Government. Accessed at: <https://maps.planningportal.nsw.gov.au/Terms>
- NSW NPWS (2002) Native Vegetation of the Illawarra Escarpment and Coastal Plain. NSW NPWS, Hurstville
- NSW Natural Resource Access Regulator (NRAR) 2018). Guidelines for controlled activities on waterfront land. Riparian Corridors. Accessed at: https://www.industry.nsw.gov.au/_data/assets/pdf_file/0004/156865/NRAR-Guidelines-for-controlled-activities-on-waterfront-land-Riparian-corridors.pdf
- Peterson Bushfire (2020). Bushfire constraints analysis – 14 Hamilton Road, Albion Park. Letter report addressed to Dijana Harrison, Landteam. Dated 31 July 2020
- Shellharbour City Council (SCC) (2019) Shellharbour Drainage Design Handbook. Available at: https://cdn.shellharbour.nsw.gov.au/sites/default/files/Plan_and_build_documents/shellharbourdrainagedesignhandbook_6.pdf

Appendix A Flora inventory

Family	Scientific Name	Common name	Native/Exotic
Amygdalaceae	<i>Prunus</i> sp.		Exotic
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	Exotic
Apocynaceae	<i>Araujia sericifera</i>	Moth Vine	Exotic
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs	Exotic
Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	Exotic
Asteraceae	<i>Delairea odorata</i>	Cape Ivy	Exotic
Asteraceae	<i>Hypochaeris radicata</i>	Catsear	Exotic
Asteraceae	<i>Lactuca serriola</i>	Prickly Lettuce	Exotic
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	Exotic
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	Exotic
Casuarinaceae	<i>Casuarina cunninghamiana</i>	River Oak	Native
Commelinaceae	<i>Tradescantia fluminensis</i>	Wandering Jew	Exotic
Euphorbiaceae	<i>Ricinus communis</i>	Castor Oil Plant	Exotic
Fabaceae (Caesalpinioideae)	<i>Senna pendula</i> var. <i>glabrata</i>	Easter Cassia	Exotic
Fabaceae (Faboideae)	<i>Erythrina x sykesii</i>	Coral tree	Exotic
Fabaceae (Faboideae)	<i>Medicago minima</i>	Woolly Burr Medic	Exotic
Fabaceae (Faboideae)	<i>Trifolium repens</i>	White Clover	Exotic
Fabaceae (Faboideae)	<i>Vicia sativa</i>	Vetch	Exotic
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>	Black Wattle	Native
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow	Exotic
Moraceae	<i>Ficus coronata</i>	Creek Sandpaper Fig	Native
Oleaceae	<i>Ligustrum sinense</i>	Small-leaved Privet	Exotic
Onagraceae	<i>Persicaria decipiens</i>	Slender Knotweed	Native
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	Exotic

Family	Scientific Name	Common name	Native/Exotic
Poaceae	<i>Cynodon dactylon</i>	Couch	Exotic
Poaceae	<i>Poa annua</i>	Annual Poa	Exotic
Poaceae	<i>Bromus cartharticus</i>	A Brome	Exotic
Poaceae	<i>Cenchrus clandestinus</i>	Kikuyu Grass	Exotic
Poaceae	<i>Stenotaphrum secundatum</i>	Buffalo Grass	Exotic
Polygonaceae	<i>Rumex crispus</i>	Curled Dock	Exotic
Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash	Native
Rubiaceae	<i>Galium aparine</i>	Goosegrass	Exotic
Sapindaceae	<i>Cardiospermum grandiflorum</i>	Balloon Vine	Exotic
Solanaceae	<i>Solanum mauritianum</i>	Wild Tobacco Bush	Exotic
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade	Exotic
Verbenaceae	<i>Lantana camara</i>	Lantana	Exotic
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	Exotic

Appendix B Planting palette

River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (PCT1105)*

Scientific Name	Common Name
Tree	
<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>	River Oak
<i>Alphitonia excelsa</i>	Red Ash
<i>Pittosporum undulatum</i>	Sweet Daphne
<i>Ficus coronata</i>	Sandpaper Fig
<i>Eucalyptus tereticornis</i>	Forest Red Gum
Shrubs	
<i>Acacia floribunda</i>	White Sally
<i>Acacia mearnsii</i>	Black Wattle
<i>Acacia binervata</i>	Two-veined Hickory
<i>Hymenanthera dentata</i>	Tree Violet
Grasses, sedges and rushes	
<i>Lomandra longifolia</i>	Many-flowered Mat-rush
<i>Baumea juncea</i>	
<i>Myoporum parviflorum</i>	Creeping myoporum
<i>Machaerina juncea</i>	Bare Twig-rush
<i>Samolus repens</i>	Creeping Brookeweed
<i>Phragmites australis</i>	Common Reed
<i>Sporobolus virginicus</i>	Sand Couch
<i>Microlaena stipoides</i>	Weeping Grass
Groundcover species and vines/scramblers	
<i>Dichondra repens</i>	Kidney Weed
<i>Oplismenus aemulus</i>	Australian Basket Grass
<i>Pandorea pandorana</i>	Wonga Wonga Vine
<i>Stephania japonica</i>	Snake vine

*additions have been made to the community description by Gellie (2005) in order to increase the potential planting palette. Additional species are from MU37 Riparian River Oak Forest (NPWS 2002), which is the equivalent of PCT1105, and PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion, which is present further downstream.

Appendix C Weed treatment methods

Zone	Objective	Main Weeds	Method	Key Performance Indicators (KPI)
All	Control and suppress exotic grasses.	<ul style="list-style-type: none"> <i>Cenchrus clandestinus</i>, and <i>Stenotaphrum secundatum</i>. 	<ul style="list-style-type: none"> Primary and secondary works will consist of targeted removal of seeding annual and perennial exotic grasses, such as <i>Cenchrus clandestinus</i> and <i>Paspalum dilatatum</i>. This will be achieved using a combination of brush-cutting and regular spot spraying. Pasture and lawn grasses, including <i>Cenchrus clandestinus</i> and <i>Cynodon dactylon</i> will be targeted for removal in preparation for the revegetation of native midstorey, groundlayer and canopy species. This will be achieved by establishing 50 cm weed free zones, where all exotic species will be eradicated. The broadscale removal of <i>Cenchrus clandestinus</i>* should be avoided, given that it is likely suppressing an established herbaceous weed seed bank and assisting with soil stability along the riparian zone. The removal of <i>Cenchrus clandestinus</i>* will be gradual and will correspond with the expansion and consolidation of previously planted areas, particularly leading up to the installation of native groundlayer species. 	<ul style="list-style-type: none"> A 20% reduction in exotic grass cover by the end of year 1 A 40% reduction in exotic grass cover by the end of year 2. A 60% reduction in exotic grass cover by the end of year 3. A 70% - 80% reduction in exotic grass cover by the end of year 4. Exotic grasses maintained at <5% cover by the end of year 5.
	Control and suppress herbaceous weeds.	<ul style="list-style-type: none"> <i>Bidens pilosa</i>, <i>Hypochaeris radicata</i>, <i>Senecio madagascariensis</i>, <i>Solanum pseudocapsicum</i> and <i>Verbena bonariensis</i>. 	<ul style="list-style-type: none"> Primary and secondary works will consist of selective brush-cutting and spot spraying through the subject site. It is recommended that a broad-leaf selective herbicide (i.e. Starane Advanced) is used to prevent unwanted removal of large areas of <i>Cenchrus clandestinus</i>* in the early years of the contract. The uncontrolled removal of <i>Cenchrus clandestinus</i>* will likely result in the germination and establishment of herbaceous weeds. As such, it is recommended that <i>Cenchrus clandestinus</i>* is only removed in preparation for planting. This will be followed by a strict maintenance regime to suppress herbaceous weed growth and reduce the exotic weed seed bank. 	<ul style="list-style-type: none"> A 40% reduction in herbaceous weed cover by the end of year 1. A 60% reduction in herbaceous weed cover by the end of year 2 and 3. A 70% - 80% reduction in herbaceous weed cover by the end of year 4. Herbaceous weed cover maintained at <5% cover by the end of year 5.

Zone	Objective	Main Weeds	Method	Key Performance Indicators (KPI)
			<ul style="list-style-type: none"> Herbaceous weeds will be hand weeded or cut and painted with neat Roundup Biactive® when in close proximity to planted vegetation or watercourses in the subject site. Herbaceous weeds will be treated prior to seeding, bagged, removed from site and disposed at a licensed green waste facility. 	
	Treatment of all woody weeds.	<ul style="list-style-type: none"> <i>Erythrina x sykesii</i>, <i>Lantana camara</i>, <i>Ligustrum sinense</i>, <i>Ricinus communis</i>, <i>Rubus fruticosus</i> spp. agg. and <i>Solanum mauritianum</i>. 	<ul style="list-style-type: none"> Primary woody weed removal will be conducted in the first three months of the contract. Primary works will aim to eradicate all woody weed species. Stem injection should be utilised for the treatment of <i>Erythrina x sykesii</i> using neat Roundup Biactive®. All less well-established woody weeds (i.e. <i>Lantana camara</i>, <i>Ligustrum sinense</i> and <i>Solanum mauritianum</i>) will be treated by cut and painting with neat Roundup Biactive®. Secondary and maintenance woody removal will consist of sweeps through the VMP subject site to prevent woody weeds from becoming re-established. Maintenance works will be conducted regularly, with a focus on removing woody weeds before reaching >50 cm, or prior to seeding. It is recommended that all cut woody weed material is removed from site and disposed of at a licenced green waste facility. However, small habitat piles can be constructed out of woody weed material (i.e. <i>Lantana camara</i> and <i>Solanum mauritianum</i>). <i>Erythrina x sykesii</i> should not be retained and piled within the subject site, given the ability for offcuts to rapidly layer and re-establish. 	<ul style="list-style-type: none"> A 90% reduction in woody weed cover by the end of year 1. No woody weeds >10 cm in height remaining, with low cover (<5%) and abundance throughout the site from year 2 onwards.

Appendix D Email correspondence with NSW NRAR



Mon 31/08/2020 12:38 PM

Jeremy Morice <jeremy.morice@dpie.nsw.gov.au>

RE: 209139 - 14 Hamilton Rd Albion Park Riparian Zone

To:  Dijana Harrison

Hi Dijana,

As discussed today please see the below advice for the subject site.

- The required riparian corridor setback for the subject site is 40m.
- The existing flood constraints of the site will limit the ability to significantly increase Mannings roughness by revegetating the full width of the 40m riparian corridor with fully structured vegetation.
- The flood constraints will likely result in the outer areas of the 40m riparian corridor being grass and therefore compatible with meeting bushfire APZ requirements. This outcome would be acceptable to NRAR based on merit.
- Any future DA for the site must include a detailed flood sensitivity analysis to identify the maximum riparian corridor revegetation that can be achieved on the site.

The above advice is general and is based on the very limited information provided for the subject development proposal.

Regards,

Jeremy Morice | Water Regulation Officer

Natural Resource Access Regulator | Water Regulation East

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