Riparian Vegetation Management Plan

20-22 Macpherson St, Warriewood NSW 2102

By Ecological Consultants Australia Pty Ltd TA

Kingfisher Urban Ecology and Wetlands

November 2022

About this document

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Statement of Authorship

This study and report were undertaken by Ecological Consultants Australia for the client. The author of the report is Geraldene Dalby-Ball whose qualifications are BSc majoring in Ecology and Botany with over 25 years' experience in this field and specialising in projects within Sydney urban areas and Brooke Thompson whose qualifications are BSc majoring in Conservation Biology.

Limitations Statement

Information presented in this report is based on an objective study undertaken in response to the brief provided by the client. Any opinions expressed in this report are the professional, objective opinions of the authors and are not intended to advocate any particular proposal or pre-determined position.

Document Control Sheet	
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Executive Summary

Ecological Consultants Australia (ECA) trading as Kingfisher Urban Ecology and Wetlands has been contracted by Green Kingswood Pty Ltd c/o BMN Properties Pty Ltd to provide a Riparian Vegetation Management Plan (VMP) for vegetation within the subject site identified as 20-22 Macpherson St, Warriewood NSW 2102 identified as Lot 1 in DP 592091 within the Northern Beaches Council LGA.

This VMP was prepared for the proposed development at 20-22 Macpherson St, Warriewood NSW 2102 which includes a 53 lot subdivision of Lot 1 in DP 592091 for an integrated housing development.

Methods

- On-ground site inspection took place in November 2021 and March 2022 by Senior Ecologist Geraldene Dalby-Ball.
- Flora and fauna observations were recorded on-site using binoculars and physical examination. Notes, photos, and samples of flora species were taken, on-site and neighbouring sites, to assess the ecological health and value of the site.
- BioNet searches were performed for flora, fauna, endangered populations, and communities to identify if there were previous records of threatened species occurring within the local area using a 10km radius around the site.

Summary of findings

Key ecological values identified within the site include:

- The site contains vegetation mapped within PCT 1795 – Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, however the community is not in benchmark condition, native species planting and weed control are expected to improve the condition of the community onsite.
- The proposed development is restricted to the existing building footprint.
- Tree protection will be consistent with the Arborist report.
- No significant habitat features, values, or corridors will be impacted by the proposed development.
- No threatened species were observed/recorded during the site inspection or previously recorded via BioNet.

Conclusions

- The site borders an endangered ecological community (EEC) identified as Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.
- Vegetation on-site has been previously disturbed and this VMP aims to reinstate the vegetation community to reflect the natural conditions and ecological value of the Swamp Sclerophyll Forest community.
- Weed management must occur as per the schedule of works within the management zone to ensure exotic species do not establish.

- Planting of native species is recommended in this VMP to reinstate the condition of the site to that prior of clearing and disturbance. Once plantings become established, the site will add ecological value to the Swamp Sclerophyll Forest EEC and provide habitat (such as foraging habitat and potentially roosting habitat) for listed threatened species including Microbats.

Recommendations

Key recommendations of this VMP include:

- Planting locally native plants of local provenance stock,
- On-going weed management,
- Soil scarification,
- Erosion management,
- Reporting and monitoring as per schedule,
- Recommendations have been costed for a 5-year VMP.

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Glossary

- **Biodiversity Conservation Trust**: Guideline for Biodiversity Stewardship Sites

  Biodiversity Conservation Trust Guideline for Biodiversity Stewardship Sites August 2019

- **Biodiversity Stewardship Agreements**: Biodiversity Stewardship Agreements are in-perpetuity agreements registered on title. The land is protected and managed to achieve a gain in biodiversity values. This generates 'biodiversity credits' which can be used to offset the impacts of approved developments elsewhere.

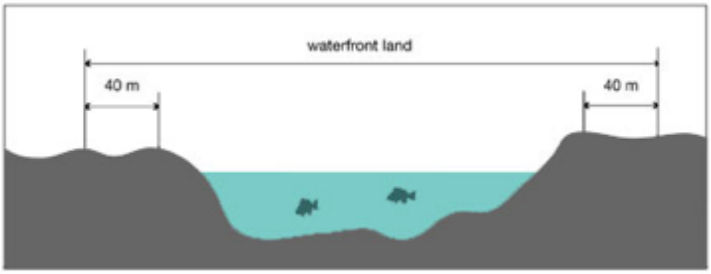
- **Biobank Land:** land managed for conservation purposes as per an agreement with the Biodiversity Conservation Trust (BCT).

- **Biodiversity Conservation Trust (BCT) Guidelines**: BCT guidelines for Biodiversity Stewardship Sites is limited to tracks, trails and other exclusions https://www.bct.nsw.gov.au/sites/default/files/2019-08/Guidelines%20for%20BSA%20Sites%20%28tracks%20and%20trails%29.pdf

- **BC Act** means the *Biodiversity Conservation Act 2016 (NSW).*

- **Controlled activity:** Controlled activities are certain types of activities which are
  i) carried out on waterfront land, and
  ii) defined as a controlled activity in the Water Management Act 2000.

  'Waterfront land' as per the Water Management Act definition means the bed of any river, lake or estuary, and the land within 40 metres of the river banks, lake shore or estuary mean high water mark.



  Examples of controlled activities relevant to this VMP and Riparian Plan include:
  i) modifications to a watercourse, such as erosion control works
  ii) construction of stormwater management devices, outlets, and spillways

- **Controlled activity approval**: A controlled activity approval confers a right on its holder to carry out a specified controlled activity at a specified location in, on or under waterfront land. Waterfront land as defined in the Water Management Act 2000. A controlled activity approval is as per Chapter 3, Part 3, Division 1, Section 91. There are two kinds of activity approvals, namely, controlled activity approvals (for works in 40m of a waterway) and aquifer interference approvals (not relevant here). https://www.dpie.nsw.gov.au/water/licensing-and-trade/approvals/controlled-activity-approvals/what/how-to-apply

- **Cycleways and paths:** Cycleways or paths no wider than four metres total disturbance footprint can be built in the outer 50 per cent of the VRZ.

- **Detention basins:** As per the Guidelines detention basins can be built in the outer 50 per cent of the VRZ or online where indicated. Refer to the Office of Water's Controlled activities. Guidelines are that basins are to:

  - be dry and vegetated
  - be for temporary flood detention only with no permanent water holding

- have an equivalent VRZ for the corresponding watercourse order
- not be used for water quality treatment purposes.

DPE: NSW Dept of Planning and Environment –for Controlled Activity Approvals (work in waterfront land).

- **Guidelines for Riparian Corridors**

  https://www.industry.nsw.gov.au/__data/assets/pdf_file/0003/160464/licensing_approvals_controlled_activities_riparian_corridors.pdf

- **Guidelines for Vegetation Management Plans**

  https://www.industry.nsw.gov.au/__data/assets/pdf_file/0006/160467/licensing_approvals_controlled_activities_veg_mgt_plans.pdf

- **Guidelines for instream works on waterfront land**

  https://www.industry.nsw.gov.au/__data/assets/pdf_file/0018/160461/licensing_approvals_controlled_activities_instream_works.pdf

- **Guidelines for outlet structures on waterfront land**

  https://www.industry.nsw.gov.au/__data/assets/pdf_file/0020/160463/licensing_approvals_controlled_activities_outlet_structures.pdf

- **Guide to preparing a Vegetation Management Plan within the Campbelltown Local Government Area**

  file:///C:/Users/Kingfisher/Downloads/MRVegetationManagementPlan.pdf

- **Riparian:** terrestrial land alongside a waterway
- **Vegetation Management Plan:** A VMP is intended to assist land managers and/or owners in managing the impacts of development (planned, previous or existing), in order to protect existing bushland and habitat from disturbance and/or remediate impacts from development activities. A VMP outlines the objectives, techniques and actions specific to the management of vegetation on site.
- **Water Management Act 2000:** The name of the legislation (Act) governing water management in NSW with the current version being 1 November 2019.
  https://legislation.nsw.gov.au/#/view/act/2000/92
- **Stream order:** The watercourse order as classified under the Strahler System based on 1:25,000, 1:50,000 or 1:100,000 topographic maps whichever is the smallest scale available. See extract from the Water Management Act (2012) below.

Riparian corridor widths

The Officer of Water recommends a VRZ width based on watercourse order as classified under the Strahler System of ordering watercourses and using current 1:25 000 topographic maps (see Figure 2 and Table 1). The width of the VRZ should be measured from the top of the highest bank on both sides of the watercourse.

Figure 2. The Strahler System

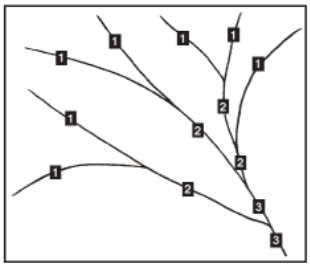


Table 1. Recommended riparian corridor (RC) widths

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

- **Suitably Qualified person:** the definition from DPE and Campbelltown City Council are covered by the following minimum requirements: i) a tertiary degree in Natural Sciences and/or a Certificate IV in Conservation and Land Management ii) a minimum of 500 hours practical bushland regeneration. Brief CVs of authors are provided with this Plan.
- **Vegetated riparian zone (VRZ):** The required width of the VRZ measured from the top of the high bank on each side of the watercourse.
- **Riparian corridor (RC) off-setting for non-RC uses:** non-riparian uses, such as Asset Protection Zones are allowed within the outer 50 per cent of the VRZ, so long as offsets are provided in accordance with the averaging rule as seen in Figure 2-7.
- **Subject site**: General term for 20-22 Macpherson St, Warriewood which the riparian works will occur.
- **Stormwater outlet structures and essential services:** Stormwater outlets or essential services are allowed in the RC. Works for essential services on a fourth order or greater stream are to be undertaken by directional drilling or tied to existing crossings. Refer to the Office of Water's Controlled activities. *Guidelines for laying pipes and cables in watercourses* and *Controlled activities. Guidelines for outlet structures.*
- **Stream realignment:** Indicates that a watercourse may be realigned. Refer to the Office of Water's

  Controlled activities. Guidelines for instream works.
- **Road crossings:** Indicates permitted road crossing methods. Refer to the Office of Water's *Controlled activities. Guidelines for watercourse crossings* and NSW DPI policy and guidelines for fish friendly waterway crossings for Class 1 and 2 waterways

1 Introduction

1.1 Riparian Vegetation Management Plan Preparation

This Riparian Vegetation Management Plan (VMP) applies to the site identified as 20-22 Macpherson St, Warriewood NSW 2102. This Riparian VMP has been prepared to satisfy the NSW Department of Primary Industries (DPI) Office of Water guidelines, including but not limited to:

- *Guidelines for vegetation management plans on waterfront land* 2012,
- *Guidelines for riparian corridors on waterfront land* 2012, and
- *Guidelines for controlled activities on waterfront land* 2018.

The guidelines for vegetation management plans on waterfront land and the associated section in this report are outlined in Table 1.1.

Table 1.1 Guidelines for a VMP. Source: *Guidelines for vegetation management plans on waterfront land* (DPI Office of Water 2012).

Criteria	Section
An appropriate width for the riparian corridor should be identified by consulting either the development consent, the relevant environmental planning instrument or the NSW Office of Water guidelines for riparian corridors. The VMP should consider the full width of the riparian corridor and its functions including accommodating fully structured native vegetation.	2.3
Maps or diagrams which clearly identify the riparian corridor; the existing vegetation; the vegetation to be retained; the vegetation to be cleared; the footprint of construction activities; and areas of proposed revegetation etc. should be prepared.	4.1
The location of the bed and banks or foreshore of waterfront land and the footprint of the riparian corridor should be clearly identified. Vegetated riparian zones must be indicated.	4.1
Photographs of the site should be supplied and photo points should be identified. To assist with future monitoring and reporting requirements, the photo points should be identified by GPS coordinates or by survey. This is particularly important for large scale earthworks or extractive industries.	3.5
Measures for controlling long term access and encroachments (bollards, fences, etc.) into the riparian corridor should be identified.	4.2
Vegetation species composition, planting layout and densities should be identified. The required mix of plant species relates to the actual community to be emulated and the size of the area or areas to be rehabilitated but mature vegetation communities are generally well structured, comprising trees, shrubs and groundcovers species.	5.1

Planting densities should achieve quick vegetative cover and root mass to maximise bed and bank stability along the subject watercourse.	
Costs associated with high density planting will be recovered through reduced maintenance costs for weeding or replacement planting in the maintenance period specified in the controlled activity approval (CAA).	4.2.4/7
Seed or plant sources should be identified. Where possible, native plants and seed sources of local provenance should be used.	Appendix V
Exotic vegetation should be avoided. The use of exotic species for temporary soil stabilisation is permitted provided they are sterile, non-invasive and easily eradicated when permanent vegetation is established.	4.2.2/4.2.3
Details of the planting program, rehabilitation methods and staging should be provided. Techniques such as hydro-seeding, direct seeding, brush matting or assisted natural regeneration may be considered.	4.2
Maintenance requirements should extend for a minimum of two years after the completion of works or until such time as a minimum 80 per cent survival rate of each species planted and a maximum 5 per cent weed cover for the treated riparian corridor controlled activity is achieved.	4.2/6
Project tasks should be defined and described, including a schedule detailing the sequence and duration of works necessary for the implementation of the VMP.	4.2/4.2.14/6
Costings for the implementation of all components and stages of the work including materials, labour, watering, maintenance which includes plant replacement, monitoring and reporting should be prepared.	7
Processes for monitoring and review, including a method of performance evaluation should be identified. This should include replacing plant losses, addressing deficiencies, problems, climatic conditions and successful completion of works.	5
Regular reporting on the implementation and status of works covering progress, success or failures and completion should be provided. The number and duration of reporting periods will be identified in the CAA. Works as executed plans and reports detailing how the components of the VMP have been implemented will be required prior to the release of any security held by the NSW Office of Water.	5.2
Security such as bank guarantees may be required before a controlled activity involving the implementation of a VMP is commenced. The amount of security is usually based on the costings provided.	N/A

1.2 Aims and objectives

The aim for this Riparian VMP is to provide a working document that will successfully protect, maintain and enhance the riparian vegetation onsite both for immediate restoration and rehabilitation purposes and for maintenance of the riparian corridor long-term. This VMP details recommendations relating to site restoration and rehabilitation fulfilling the requirements of the guidelines outlined by the DPI Office of Water.

The riparian vegetation on the site identified as 20-22 Macpherson St, Warriewood NSW 2102 is covered by this VMP. The authors Geraldene Dalby-Ball and Brooke Thompson have over 25 years' experience in ecology projects and large-scale environmental restoration activities in Sydney and are familiar with the requirements of a VMP.

The objectives of the VMP are to ensure that biodiversity values onsite are improved and maintained. The overarching objectives of this VMP include, but are not limited to:

- conserve and preserve the existing native vegetation,
- undertake rehabilitation activities in the riparian zone,
- undertake native vegetation protection measures,
- restore native vegetation such that the vegetation onsite reflects the cover, diversity and density of the Indigenous vegetation, and
- provide education material to promote responsible management of the riparian corridor.

The information in the following sections ensure that the objectives of the VMP are achieved.

1.3 Legislation and policies

The implications for the VMP are assessed in relation to key biodiversity legislation, policy and guidelines and include the following:

- *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act),
- *Environmental Planning and Assessment Act* 1979 (EP&A Act),
- *Biodiversity Conservation Act* 2016 (BC Act),
- *Local Land Service Act* 2013 (LLS Act),
- *Biosecurity Act* 2015,
- *Planning for Bush Fire Protection* 2016 (NSW RFS),
- *Guidelines for vegetation management plans on waterfront land* 2012,
- *Guidelines for riparian corridors on waterfront land* 2012, and
- *Guidelines for controlled activities on waterfront land* 2018.

2 Site description

2.1 Identification and description of the site and surrounds

The Subject Site (the "Site") is identified as 20-22 Macpherson St, Warriewood NSW 2102 (Lot 1 in DP 592091) within the Northern Beaches Council LGA, 30.4 kilometres north of the Sydney CBD. The site fronts Macpherson Street. The primary land use of the site is residential.

Refer to Figure 2.1 and 2.2.

Table 2.1 Site administrative information

Category	Details
Title reference (Lot/DP)	1/DP592091
Area (ha)	2.05
Street address	20-22 MacPherson St, Warriewood NSW 2102
LGA	Northern Beaches Council
Land zoning	R3 – Medium Density Residential

Figure 2.1 Site map showing the site boundary (red outline). Source: Nearmap 2022.

Figure 2.2 Location of the site (red outline) relative to surrounding areas. Source: Nearmap 2022.

2.2 Site context

The site consists of a Flower Power Garden Centre and carpark.

2.3 Catchment context

Narrabeen Creek (2nd order creek) runs adjacent to the northeast boundary of the site (Refer to Figure 2.3) and runs south to enter Mullet Creek (1st order creek) that leads to South Creek (4th order creek) also known as Narrabeen Lagoon.

The vegetated riparian zone width, as per the DPI Office of Water, for 2nd order watercourses is 20 metres on each side of the watercourse, therefore the riparian corridor width for the site is 20 metres. Refer to Figure 2.4.

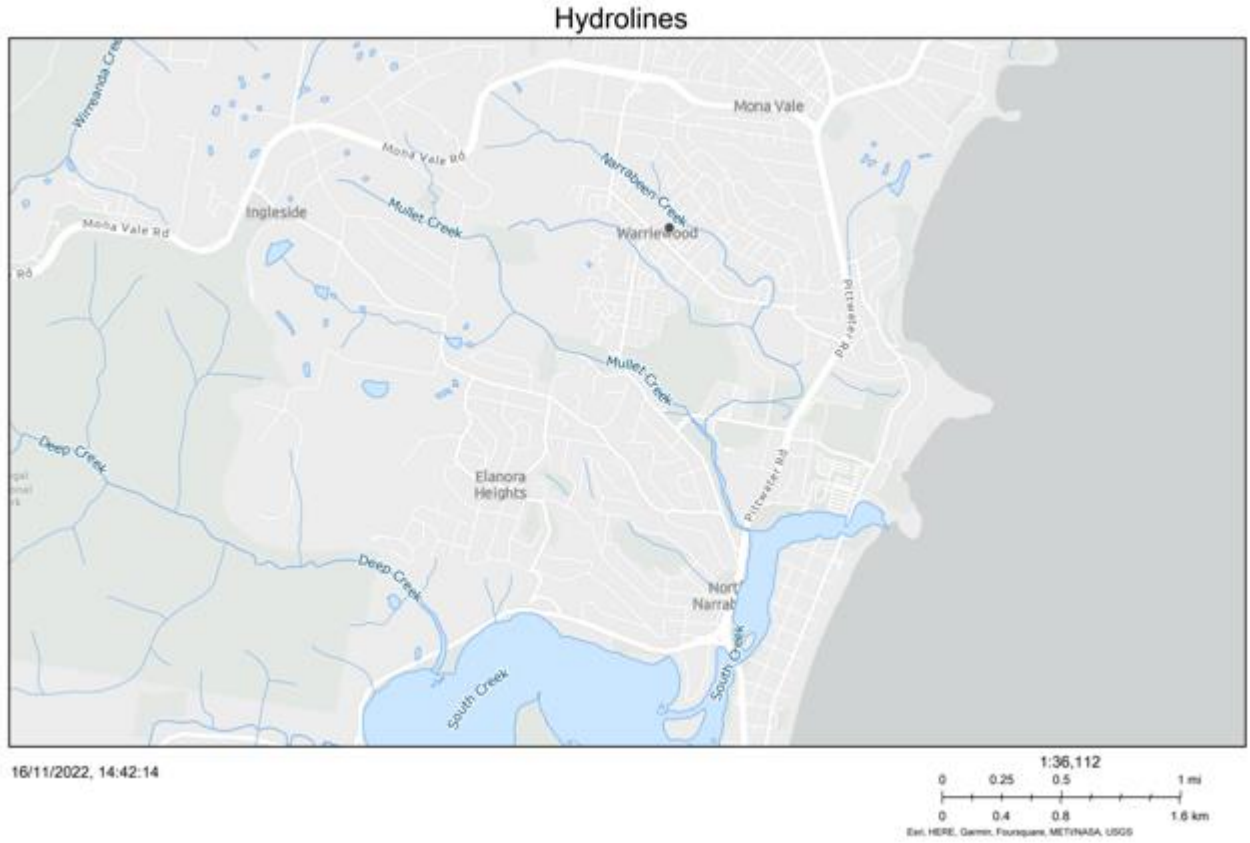
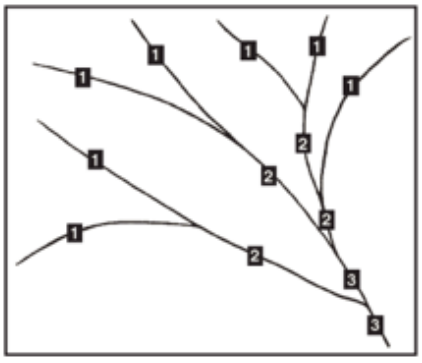


Figure 2.3 Hydrolines surrounding the site (black dot). Source: Water Management (General) Regulation 2018 Hydro Line spatial data.

Figure 2. The Strahler System



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4th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80 m + channel width

Figure 2.4 Strahler system and recommended riparian corridor width. Source: *Guidelines for riparian corridors on waterfront land* – Department of Primary Industries Office of Water July 2012.

2.4 Vegetation context

The site is largely cleared with few scattered Swamp Oak (*Casuarina glauca*) lining the creek. The creek is dominated by exotic species, most common being *Ludwigia peruviana*. The rear of the site descends into a soak area adjacent to the creek. This area consists of a variety of grass and sedge species containing both native and exotic species due to its high water content. Habitat and vegetation condition remains poor with the presence of high threat exotic (HTE) weeds.

The existing habitat and vegetation do not meet the required benchmark conditions of the vegetation community onsite. It is expected that the removal and management of weed species and planting of native vegetation will increase the ecological values of the site.

The vegetation onsite makes up part of the riparian vegetation/habitat corridor lining Narrabeen Creek and adjoining vegetation in surrounding areas. Refer to Figure 2.5.

Figure 2.5 Vegetation/habitat corridors surrounding the site (red outline). Source: Nearmap 2022.

3 Site assessment

3.1 Vegetation

A review of the most up-to-date vegetation mapping, SEED The Native Vegetation of the Sydney Metropolitan Area – Version 3.1 (OEH, 2016) VIS_ID 4489, identified one (1) plant community type (PCT) occurring on the site. The PCT is identified as PCT 1795 – *Swamp Mahogany/Cabbage Tree Palm – Cheese Tree – Swamp Oak tall open forest on poorly drained coastal alluvium in the Sydney basin*. Refer to Figure 3.1.

Table 3.1 Vegetation community synonyms as per NSW and Commonwealth legislation

PCT Code	PCT Name	BC Act 2016	EPBC Act 1999
1795	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered Ecological Community (EEC)	No associated TEC

The species selected from PCT 1795 are considered suitable for revegetation activities and a recommended planting list is included in Appendix V. The site represents a swamp forest coastal alluvium community and species should be selected appropriately to ensure maximum recruitment.

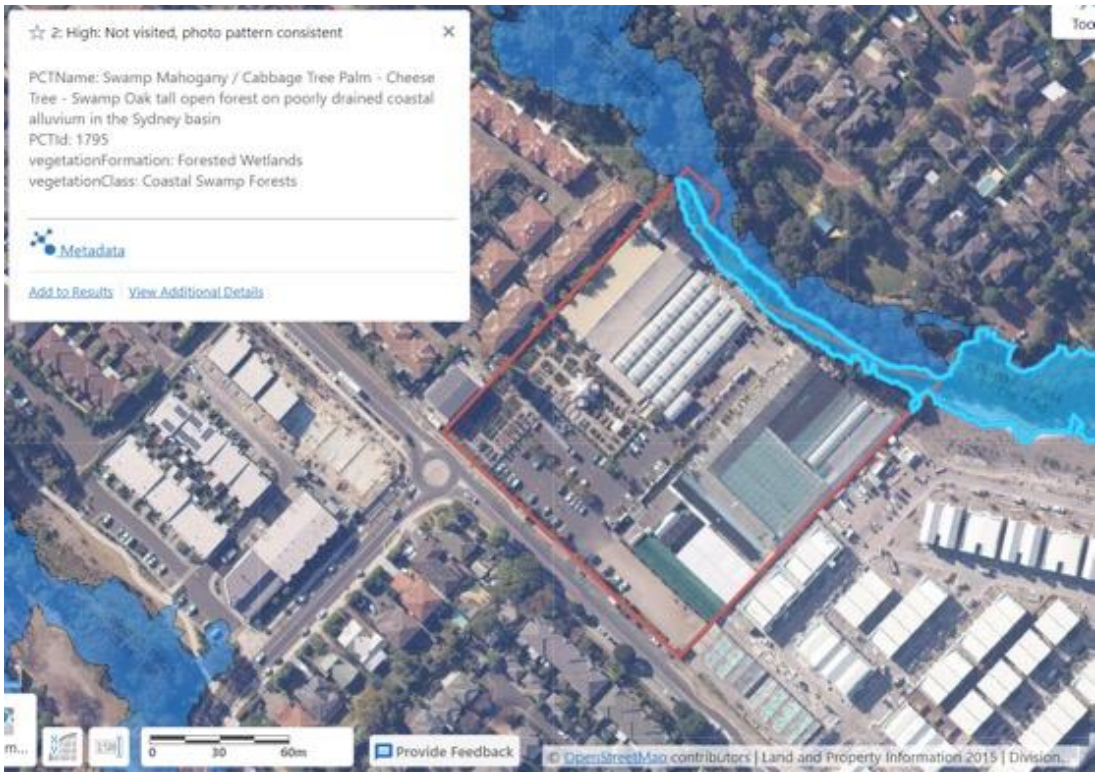


Figure 3.1 PCTs mapped on the site (red outline). Source: SEED The Native Vegetation of the Sydney Metropolitan Area – Version 3.1 (OEH, 2016) VIS_ID 4489.

3.2 Current condition

The site shows evidence of disturbance due to the high presence of weed species. The depressed area at the rear of the site holds a high water content, and as a result, contains a mix of largely exotic grass and sedge species with some native species present. Habitat and vegetation condition remains poor with the presence of high threat exotic (HTE) weeds.

Weed invasion and sediment transport are the primary threats at the site, due to the existing presence of some weed species and the slope of the site which includes the creek that runs behind the site. The mitigation measures outlined in this report will be implemented to reduce the likelihood of these factors causing further degradation to the site.

3.3 Weeds

The following weeds of significant importance were identified onsite and in surrounding areas during the site assessment. Weeds must be controlled as required under the Biosecurity Act 2015. Refer to Table 3.2.

Table 3.2 Weeds present with the potential to spread – species onsite highlighted bold

Scientific name	Common name	Legal requirements under the Biosecurity Act 2015
Asparagus asparagoides	Bridal Creeper	The plant must not be sold, propagated, or knowingly distributed
Asparagus aethiopicus	Asparagus fern	The plant must not be sold, propagated, or knowingly distributed
Cestrum parqui	**Green Cestrum**	**The plant must not be sold, propagated, or knowingly distributed**
Cortaderia sp.	Pampas grass	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread
Lantana camera	**Lantana**	**The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread**
Ludwigia peruviana	**Peruvian Primrose**	**The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread**
Ligustrum lucidum	Broad-leaf Privet	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread

Ligustrum sinense	Small-leaf Privet	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread
Ipomoea purpurea	Morning Glory	Environmental Weed
Opuntia sp.	**Prickly Pear**	**The plant must not be sold, propagated, or knowingly distributed**

3.4 Fauna sightings and habitat

Fauna sightings

A number of faunae were identified during the site assessment including:

- Noisy Minor (*Manorina melanocephala*);
- Blue Wren (Malurus cyaneus);
- Willie Wagtail (*Ripidura leucophrys);*
- Black-faced Cuckooshrike (C*oracina novaehollandiae*);
- Eastern Whipbird (*Psophodes olivaceus*); and
- Striped Marsh Frog (*Limnodynastes peronii*).

No reptiles or mammals were identified during the site assessment. No threatened fauna listed under the BC Act 2016 or EPBC Act 1999 were identified during the site assessment.

Fauna habitat

Several potential habitat features were identified during the site assessment including:

- Grass and sedge soak provide habitat for amphibian species including the threatened Green and Golden Bell Frog (*Litoria aurea*) and potential foraging habitat for the threatened Southern Myotis (*Myotis aelleni*).
- Casuarina species provide potential foraging habitat for the threatened Glossy Black Cockatoo (*Calyptorhynchus lathami*).

3.5 Site photos

The following photos were taken during the November 2021 and March 2022 site inspections. Plates display the vegetation condition on the site.

Plate 1. Rear of the site.

Plate 2. Planted areas immediately upstream of the site.

Plate 3. Creek side vegetation.

Plate 4. *L. peruviana* present on the site.

Plate 5. Creek line upstream of the site.

Plate 6. *L. peruviana* common in catchment.

Plate 7. Creek side vegetation downstream from the site – representative of vegetation along the water edge on the site.

Plate 8. Weed dominated with few Swamp Oak (*Casuarina glauca*).

4 Management Zones

4.1 Proposed riparian management zones

One (1) riparian management zone (RMZ) has been identified based on the recommended riparian corridor widths set by the DPI Office of Water for 2nd order watercourses. Narrabeen Creek is a 2nd order watercourse type and therefore the vegetated riparian zone width is 20 metres on each side of the watercourse.

The RMZ extends from the top of the bank (boundary line of the site) 20 metres toward Macpherson Street (Refer to Figure 4.1). The primary objective of the RMZ is to restore the native vegetation community to an appropriate level that reflects the original condition prior to clearing and disturbance.

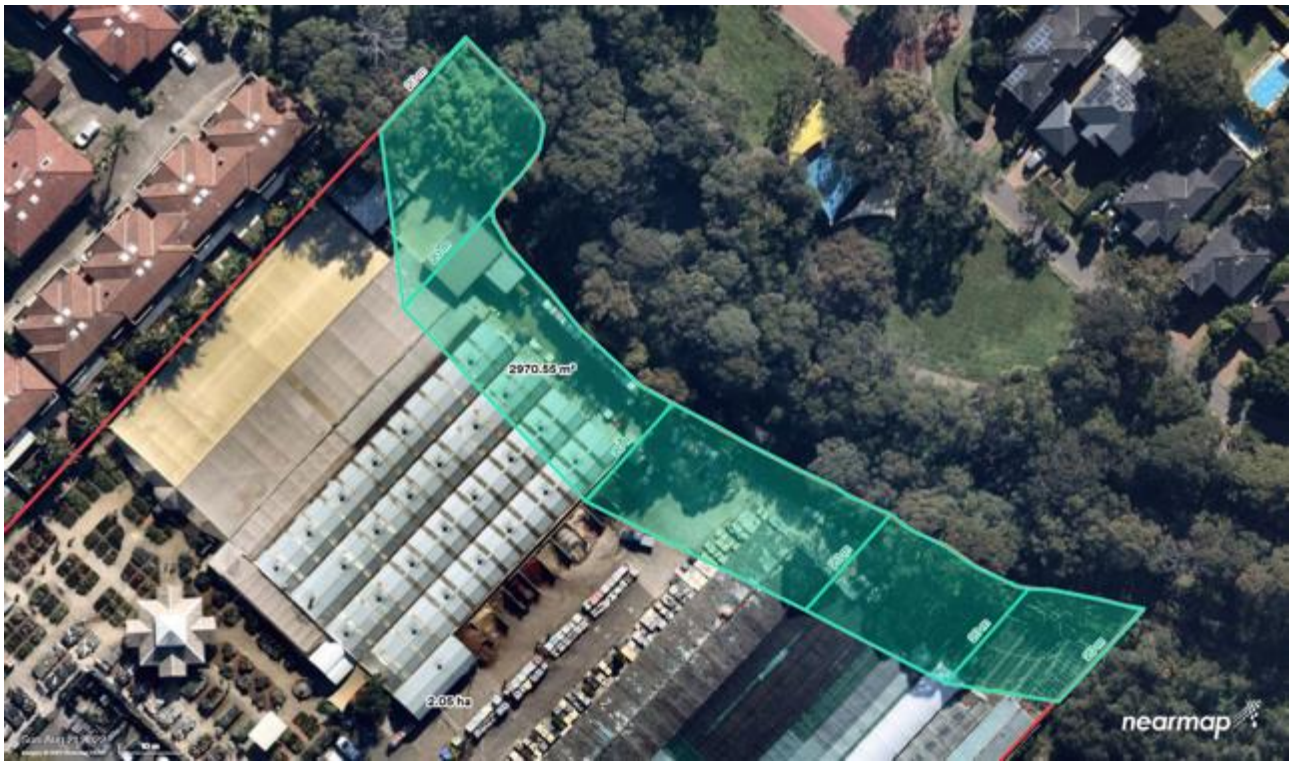


Figure 4.1 Riparian management zone for the site shown in green. Source: Nearmap 2022.

4.2 Proposed tasks

Proposed riparian management tasks have been guided by the *Guidelines for riparian corridors on waterfront land – Department of Primary Industries Office of Water July 2012*.

4.2.1 Delineation of Work Areas

During the construction, impact to the site and the adjacent vegetation should be reduced by the delineation of work zone areas. The access to the site would be best restricted to the development footprint only. An exclusion zone should be established for the vegetation outside the work areas.

4.2.2 Primary Weed Removal

Weed species are present within the management zone. Most weeds on-site are woody or fleshy in nature. It is recommended that larger woody weeds are poisoned via cut and scrape techniques before their removal, while small weeds can be sprayed with a combination of non-selective and selective herbicides prior to planting. The appropriate control methods for several different weed types are species in Table 4.1.

There must be ongoing maintenance of the management zone, otherwise it may result in increased weed growth within the site. All bush regeneration activities requiring the use of chemicals must be performed in accordance with the *NSW Pesticides Act 1999*. Herbicides must not be applied whilst exotic plants are setting seed. The weed removal program aims to be broad in approach and sustained in application to provide the best possible conditions for natural regeneration and to control weeds within the site.

Performance targets for weed species include:

- A reduction in noxious weed density to 5% or less in the management zone; and
- A reduction in all other weed density to 10% or less in the management zone.

Although soil borne pathogens have not been identified as a Key Threatening Process, accidental spread of pathogens can occur at any time. To prevent the introduction of pathogens, Bushland Hygiene Protocols outlined in Appendix II must be followed. Hydrological conditions may promote the spread of Phytophthora (a group of fungus-like diseases affecting plants) due to moist soil and proximity to water. It is recommended that Bushland Hygiene Protocols be followed closely.

4.2.3 Weed Removal Methods

As part of the VMP, weed removal methods have been provided and tailored specifically to the site. Along with traditional bush regeneration techniques, thermal weeding has been recommended in controlling non-seeding annuals and grasses. Thermal weeding may stimulate natural regeneration and germination of native species as well as achieving ecological burns. Refer to Table 4.1.

Table 4.1 Weed removal methods

Weed type	Primary control treatment	Follow up control	Maintenance weeding post-planting (revegetation)	Disposal
Woody weeds (e.g., shrubs and trees)	Cut/scrape and paint with herbicide for small shrubs[1]. Large trees greater than four metres high and diameter > 10 cm drill and inject with registered herbicide[2].	Retain dead trunks in or on ground has habitat. Continue to Cut/scrape and paint remaining weeds. Monitored monthly and controlled as required (and	Cut/scrape and paint germinating weeds. Monitored and carried out regularly for a period of five years from the date of final planting.	Raft and pile non-reproductive parts on site (for later pile burns or left as habitat) and bag flower heads, berries, and seeds.

		within a minimum of three months) and up until the date of final plantings.		
Climbing weeds (e.g., vines and scramblers)	Hand pull/ Dig juvenile growths and bag. Bag seeds, pods and flowers then skirt vines out of the canopy and Scrape and paint for established growths. Scrape from the base up the stem covering 1 m length. Large infestations foliar spray using registered herbicides.	Scrape and paint and bag reproductive parts. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings.	Scrape and paint and bag reproductive parts. Monitored and carried out regularly for a period of five years from the date of final planting.	Bag and remove from site.
Herbaceous weeds	Spraying using a combination of non-selective and selective herbicides where damage to adjoining native vegetation can be avoided. Spray herbicide close to and before flowering.	Spray or hand pull seedlings. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings.	Spray or hand pull seedlings. Monitored and carried out regularly for a period of five years from the date of final planting.	Bag and remove from site.
Exotic grasses and broadleaf annuals around native grasses	Spray prep around natives. Low volume spot spraying of broadleaf selective and non-	Continue spray prep and spot spraying for re-established growths. Hand pull and bag weeds in amongst	Hand weed isolated patches. Monitored and carried out regularly for a period of five years from the	Bag and remove from site.

	selective herbicides. Flame (thermal) weed in areas of large infestation of grasses and annuals.	natives. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings.	date of final planting.	
Weeds and seedlings in close proximity to protected native vegetation	Spray prep around natives and Spot spray. Hand weeding.	Spray prep around natives and Spot spray. Where possible hand weed. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings.	Monitored and carried out regularly for a period of five years from the date of final planting.	Bag and remove from site.
Bulbous and succulent weeds	Hand pull/dig, bagging all plant parts and removing from site[3].	Foliar spray and/or Cut and Paint.	Monitored and carried out regularly for a period of five years from the date of final planting.	Bag and remove from site.
Aquatic weeds	Hand dig/pull juvenile plants. Contact your local weed officer if you require a permit to spray near water.	Hand pull.	Monitored and carried out regularly for a period of five years from the date of final planting.	Bag and remove from site.

Note: [1] Some weeds will have different treatment requirements i.e., *Ochna serrulata* requires scrape and paint on one side with stem width less than 2 cm thick, scrape and paint both sides from root to 2/3 up the stem >2 cm thick. *Ligustrum s*pp. and Lantana are treated with cut and paint.

[2] After drill and inject treatment, the plant usually will drop its leaves within six weeks and dies within a few months. Monitor the plant and if it re-sprouts, the process will need to be repeated. Drill around the base of the tree and on exposed lignotubers less than 20mm apart and as deep as possible.

[3] If hand pulling/dig, ensure all reproductive parts of the plant e.g., corms, tubers and rhizomes are removed.

Refer to Appendix I for more details on Bush Regeneration Techniques.

4.2.4 Revegetation Activities

The desired outcome within the management zone is to reinstate the condition of the site to that prior of clearing and disturbance, or to its neighbouring PCT. The restoration activities should aim to establish a community which reflects that of a Coastal Flats Swamp Mahogany Forest/ Coastal Freshwater Swamp Forest community. The management zone should be planted with local wetland species that are suitable to tolerate the saturated conditions on the site to ensure maximum recruitment. This should include a mix of canopy, shrubs, and clumping grasses/ groundcover species. Planting is to occur during the Spring, if possible, with Autumn planting reserved as backup. Restoration planting should only occur once all weed species are removed.

Refer to Appendix V for the Recommended Planting List for the site.

The management zone covers an area of approximately 2,970m^2. Restoration plantings should aim to cover approximately 70% of the management area (2,079m^2). The other 30% of the management zone can be maintained as grassy understorey as this reflects the natural attributes of the site prior to unauthorised clearing. Planting density for the vegetation community on-site has been calculated as 1 plant per 2.5 m^2. Estimated number of tube stock required is 900. Plantings should be planted in an irregular pattern to mimic a natural bushland configuration. This can be achieved via tube stock plantings and strategic bush regeneration activities to promote natural regeneration over the duration of the VMP, thus reducing the cost of planting for the project. It is expected that natural recruitment of native species will occur within the management zone after 1-3 years.

***Locally Native**: Locally native (local provenance stock) refers to the area the stock is collected from, i.e., being within the area that the natural pollinators and / or natural dispersal agents would be expected to move in usual circumstances.*

***Stock:** Nurseries supplying locally native plants have been included in Appendix III.*

***Diversity:** Plants recommended here include a wider diversity than expected. A wide range has been provided to ensure a diversity of locally native plants is available and then established in the restoration area. Table 3 summarises the minimum diversity (number of different species) of each plant type (ground, vines, shrubs, & trees).*

***Size:** All plants can be Hikos (50mm) and or Forestry tubes (75mm).*

***Bushfire Protection:** Planting densities should adhere to any Bushfire Protection requirements for the site. This may result in lower planting densities or modified planting schedules in areas which are identified as Asset Protection Zones.*

4.2.5 Soil Scarification

The management zone consists of dense saturated soil with a high water content. To ensure successful plant recruitment within the management zone, it is recommended that soil scarification is undertaken prior to tube stock plantings.

Soil scarification can be implemented by light mechanical tillage of the ground surface, via a rotary hoe or ripper implement on a tractor. Soil should be ripped to a depth of 20 to 50 cm. Where the ground is sloping, the rip lines should follow the bank contour to prevent erosion. Soil scarification of the soil is likely to stimulate weed growth, and this should be monitored and treated as part of the maintenance program.

4.2.6 Mulching

All planted tube stock should be mulched post planting. This will ensure successful plant recruitment and prevent exotic species from establishing. Mulch stockpiles must be kept under 1m in height, must be monitored for the presence of weeds and turned frequently to avoid spoilage. If the site does not contain enough mulch in situ, a native composition mulch may be imported to the site. Mulch may be used to supress weeds within planting areas.

4.2.7 Sediment Controls

Sediment controls are required immediately after soil scarification to prevent sediment transport. The management zone is gently sloped towards the western boundary of the property which continues into Narrabeen Creek. Due to the slope, immediate measures to stabilise the soil and reduce erosion risk may include slitted jute matting, coir log baffles, and sediment fencing. Thick jute matting will be implemented to stabilise the soil on the bank with the additional benefit of suppressing weed growth. Additional sediment controls may be required throughout the site post primary weeding and soil scarification. The installation of additional soil stabilisation apparatuses (slitted jute matting, coir log baffles, and sediment fencing) will be performed at the discretion of the property owner and/or bush regeneration contractor if necessary.

Sediment and erosion control measures must ensure that no settlement of sediment or silt is to occur within areas of vegetation to be retained. All sediment fences should be retained for as long as practical. If removed, then monitoring is required to ensure flows do not concentrate and cause further erosion. If concentrated flows do occur and/or erosion gullies develop then coir logs baffles are required across the slope.

Table 4.2 Sediment control methods

Sediment control method	Recommendations	Examples of appropriate sediment control method
Slitted jute matting	Slitted jute matting should be place on the bank to stabilise the soil and reduce the likelihood of erosion or sediment transport.	
Coir log baffles	Coir log baffles should be installed where run off water may increase erosion or sediment transport. Baffles are recommended to be constructed with coir logs that have been staked into the soil. This method will ensure soil is not disturbed and the baffles are secure.	
Sediment fence	Sediment fencing should be installed around any areas of exposed or disturbed soil. Any excavated or cleared areas must be stabilised or covered to minimise the risk of sediment transport occurring.	

4.2.8 Secondary Weed Removal

Secondary weed removal should occur quarterly, considering the life cycles of targeted weed species, with greater effort required in the warmer months when weed growth will be greater. Secondary weed removal will follow the protocols outlined for primary weed removal, with more of a focus on controlling new weed growth in their early stages to prevent future release of propagules.

4.2.9 Natural Regeneration Areas

Natural regeneration on the site will be suitable once initial tube stock plantings become established and weeds are being consistently maintained. Natural regeneration must only be encourage in the areas where

vegetation is displaying medium to high resilience. Two methods of natural regeneration are expected to be implemented including assisted and unassisted natural regeneration.

Assisted

During the initial planting phase, soil scarification should be implemented. Disturbing the soil via soil scarification or ploughing encourages native seed germination and is a key factor to ensure successful plant recruitment. Soil scarification is expected to increase the survival rate of tube stock and encourage natural regeneration in the later stages of the VMP. Natural regeneration areas should be continually monitored for the presence of exotic flora species and sediment transport. Soil scarification should be supervised by qualified bush regeneration contractors to ensure areas of existing native vegetation and plantings remain unaffected.

Unassisted

Unassisted natural regeneration may be applicable in the final stages of the VMP (4-5 years). Unassisted natural regeneration should only be implemented where bushland is expected to recover naturally once exotic species are removed. Weed removal techniques including thermal weeding, cut and paint, spot spraying, and hand pulling should be used to remove exotics and encourage native seed germination.

4.2.10 Plant Replacement

Plant replacement must account for the 10-20% of planted vegetation that is expected to fail. Any plants that fail are to be replaced by another individual of the same species, except for the case that an entire species displays low success rates. In this case, individuals from the same growth form may be substituted. Plant replacement must occur within three months following the death of a plant.

4.2.11 Watering

Within two hours of planting, each plant will require 10L of water if the soil profile is moist and 20L of water if the soil profile is dry. It is recommended that an irrigation system is be established within the planting areas. The irrigation system is to be established within each planting area for a total duration of 6 weeks to ensure adequate watering of establishing plants and to reduce the risk of plant loss.

4.2.12 Habitat supplementation

Although not critical, the installation of a single nest box designed for microbats should be added to the management zone to replace the potential loss of roosting habitat. Other significant habitat features including rocks, logs, and leaf litter should remain within the management zone. This will encourage native animals to use the area including amphibians and reptiles.

4.2.13 Maintenance Inspections

Maintenance inspections will be required to determine how the management zone is responding to rehabilitation works, and whether the performance criteria are being met. Maintenance inspections will be performed by comparing the objectives of the VMP to the maintenance information recorded by the property owner and/or bush regeneration contractors. Maintenance inspections must be performed quarterly during the restoration phase, reduced to bi-annually during the post-restoration phase if performance criteria are consistently being met.

Quarterly maintenance inspections at the time of monitoring will including the following:

- **Weeds**: Weeds must be assessed in terms of total weed cover per management zone with average densities of each species provided and updates to treatment recommendations.
- **Pests and disease**: Regenerating areas within the management zone must be monitored for herbivory by exotic and native fauna and the presence of any other disease or infection. The species being impacted must be recorded in addition to the type of pest or disease, proportion of the total individuals being impacted and treatment recommendations.
- **Sedimentation and erosion**: Regenerating areas within the management zone must be monitored for sedimentation and erosion.

4.2.14 Management and mitigation measures

All managed areas should be maintained and monitored for at least five years after last planting completed. Table 4.3 provides a summary of mitigation measures to be implemented with each year of operation of the restoration plan. Mitigation measures or other activities have been divided into three broad phases:

- Pre-restoration works
- Restoration phase
- Post-restoration works

Table 4.3 Summary of mitigation activities associated with each year of operation of the restoration plan

Mitigation Measure	Timing			Frequency	Management Zone	Responsibility
	Pre-restoration	Restoration phase	Post-restoration			
Biodiversity Management						
Define work areas and access paths	✓			Prior to commencement of works and continually maintained	✓	Property owner and/or bush regeneration contractor
Any surplus woody debris to be mulched and reused within the site where appropriate		✓		Throughout all activities	✓	Property owner and/or bush regeneration contractor
Restoration Activities						

Tube stock plantings		✓		Spring plantings recommended	✓	Property owner and/or bush regeneration contractor
Soil scarification	✓			Once	✓	Property owner and/or bush regeneration contractor
Installation of a 75 mm layer of mulch to planted areas and/or in cleared areas to suppress weeds	✓	✓		With plantings or as weed suppression	✓	Property owner and/or bush regeneration contractor
Sediment and Erosion Control						
Implementation of sediment, soil, or water controls	✓	✓	✓	Applied continually and daily	✓	Property owner and/or bush regeneration contractor
Bush Regeneration						
Primary weeding	✓			Once	✓	Property owner and/or bush regeneration contractor
Secondary weeding		✓		Quarterly	✓	Property owner and/or bush regeneration contractor
Weed inspections	✓	✓	✓	Quarterly	✓	Property owner and/or bush regeneration contractor

Maintenance Activities						
Pest and disease monitoring	✓	✓	✓	Quarterly	✓	Property owner and/or bush regeneration contractor
Maintenance weeding		✓	✓	Quarterly	✓	Property owner and/or bush regeneration contractor
Maintenance watering		✓	✓	Initially after planting followed by quarterly deep watering	✓	Property owner and/or bush regeneration contractor
Replacement plantings		✓	✓	Approximately 6 months following initial planting	✓	Property owner and/or bush regeneration contractor
Maintenance inspections		✓	✓	Quarterly	✓	Property owner and/or bush regeneration contractor
Reporting		✓	✓	Annually throughout the implementation of the restoration plan	✓	Ecologist / bush regeneration contractor
Confirmation of completion of key performance indicators			✓	Once all performance criteria have been met including: Reduction in noxious weed density to 5% or	✓	Ecologist / bush regeneration contractor

				less in all management zones. Reduction in all other weed density to 10% or less in all management zones. Native vegetation displays a diversity of species resembling Blue Gum High Forest. Evidence of gradual expansion of native plant cover. Appropriate erosion and sediment control throughout the project.		
Bushland Management Plan						
Development of a bushland management plan as a continual management tool reflecting the aims and objectives of the VMP			✓	Post-maintenance certification	✓	Ecologist

5 Monitoring and Reporting

5.1 Performance criteria

In order to provide an effective method of assessing the success of the VMP, performance evaluation targets such as the following must be provided. Table 5.1 provides a summary of the outcomes to be achieved each year.

Table 5.1 Summary of the outcomes to be achieved each year

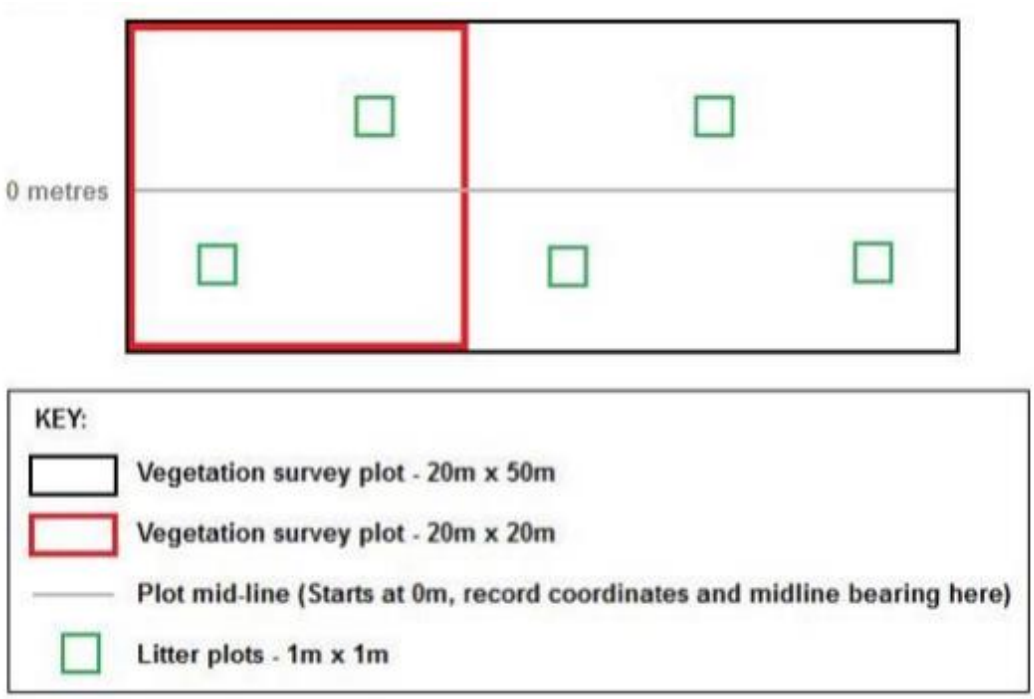
Time	Native Plant Species Diversity	Native Plant Cover	Weed Cover
6 months	At least 10 species of native plants included in the plantings. – At least **7** different species from herbs, grasses, and groundcovers, with no more than 25% of any 1 species. – At least **1** different shrub species and no more than 25% of any 1 species. – At least **2** different tree species and no more than 25% of any 1 species.	5-10% tree cover 5-10% shrub cover 15% ground cover	<10%
12 months	At least 10 species of native plants included in the plantings. – At least **7** different species from herbs, grasses, and groundcovers, with no more than 25% of any 1 species. – At least **1** different shrub species and no more than 25% of any 1 species. – At least **2** different tree species and no more than 25% of any 1 species.	10-20% tree cover 10-20% shrub cover 20% ground cover	<10%
30 months	At least 10 species of native plants included in the plantings. – At least **7** different species from herbs, grasses, and groundcovers, with no more than 25% of any 1 species. – At least **1** different shrub species and no more than 25% of any 1 species. – At least **2** different tree species and no more than 25% of any 1 species.	10-30% tree cover 10-20% shrub cover 20-30% ground cover	<10%
Final Criteria	At least 10 species of native plants included in the plantings.	20-40% tree cover 20-30% shrub cover	<5%

Time	Native Plant Species Diversity	Native Plant Cover	Weed Cover
(60 months)	– At least **7** different species from herbs, grasses, and groundcovers, with no more than 25% of any 1 species. – At least **1** different shrub species and no more than 25% of any 1 species. – At least **2** different tree species and no more than 25% of any 1 species. – Unassisted natural regeneration present. – Overall density of 5 plants per m^2 made up of groundcovers, shrub, and tree species. – Groundcovers average 4 per m^2. – Shrubs average 4 per m^2. – Trees average 1 per $16m^2$. – Site displaying signs of Coastal Flats Swamp Mahogany Forest/ Coastal Freshwater Swamp Forest community.	30-50% ground cover >15 large shrubs /trees	

A suitability qualified Ecologist should monitor and report on the condition of the site on an annual basis. The Ecologist should use the Biodiversity Assessment Method (BAM) to monitor vegetation condition on site. The location of BAM plots and photo monitoring points should be identified via aerial imagery and included within the first monitoring report.

The BAM methodology is as follows: 20 x 20 plot ($400m^2$) for assessing structure and composition with a centre line extending 50m to create a 20 x 50 plot ($1000m^2$) to assess function. See Biodiversity Assessment Method Operational Manual – Stage 1 (OEH, 2018) page 26-28 for methods.

https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/biodiversity-assessment-method-operational-manual-stage-1-180276.pdf



- Ongoing maintenance will be required to ensure that ratios and performance targets are maintained in the long-term.
- Reduction in noxious weed density to 5% or less in all management zones and a reduction in all other weed density to 10% or less in all management zones at the end of the maintenance period.
- Plant replacement must account for the 10-20% of planted vegetation that is expected to fail. Any plants that fail are to be replaced by another individual of the same species, except for the case that an entire species displays low success rates. In this case, individuals from the same growth form may be substituted. Plant replacement must occur within three months following the death of a plant.

5.2 Reporting

To assess the success of the VMP against the established performance evaluation targets, subsequent reporting will be required. This is to include:

- Demonstrated compliance with performance evaluation targets.
- Identification of deficiencies and corrective actions taken to ensure targets are met.
- A photographic record before, during, and after works is to be provided with the final compliance certification.
- Copies of annual reports are to be provided to the Environmental Compliance Officer at Northern Beaches Council.
- Reporting at the completion of the first year should be provided to Council to enable a review and consideration in the development of actions and objectives for the following year. This first-year report also enables an early assessment of the works and suitability of performance criteria.
- Monitoring to be performed by a suitably experienced Ecologist on an annual basis, in consultation and collaboration with the property owner and/or project bush regeneration contractor. Reporting

must be performed in association with maintenance inspections to form the primary source of information for monitoring and review reports. Monitoring by the property owner and/or project bush regeneration contractor must occur quarterly during the restoration phase and bi-annually in the post- restoration phase if adequate progress towards performance criteria is achieved. A primary goal of monitoring and reporting will be to provide recommendations to improve compliance.

6 Schedule of Works

The schedule of works will commence on the day of approval from the consent authority. Refer to Figure 6 Schedule of Works.

The VMP is to be implemented for a period of 5 years from date of commencement. Council is to be consulted in the initial review after 12 months on receiving the first annual report.

			Year 1												Years 2-5											
			Month												Month											
Section	**Management Task**	**Frequency**	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
4.1.1.1	Exclusion Zone	Once and Ongoing																								
4.1.1.3	Primary Weed Removal	Once																								
4.1.1.6	Soil Scarification	Once																								
4.1.1.8	Sediment Controls	Once and Ongoing																								
4.1.1.5	Revegetation Activities	Once																								
4.1.1.7	Mulching	Once																								
4.1.1.10	Watering	6 weeks																								
4.1.1.13	Habitat Supplementation	Once																								
4.1.1.9	Secondary Weed Removal	Quarterly and Bi-annually																								
4.1.1.11	Plant Replacement	Quarterly and Bi-annually																								
4.1.1.14	Maintenance Inspections	Quarterly and Bi-annually																								
Legend																										
	Pre-restoration Phase																									
	Restoration Phase																									
	Post-restoration Phase																									

Figure 6.1 Schedule of works for the VMP at 53A Warriewood Rd, Warriewood NSW 2102. Kingfisher 2022.

7 Estimate Costs

The following cost estimates have been provided by a bush regeneration company based on a management period of five years. This estimate provides an indication of the costs associated with the bush regeneration aspects of the implementation of the VMP. This estimate of cost does not include construction related items such as fencing, signage, or the production of mulch in situ. Estimates are indicative only, final costs should be expected to vary. A formal quote from a bush regeneration company would be required to refine these estimates. Table 7.1 provides a detailed breakdown of estimated costs.

Table 7.1 Cost indication summary

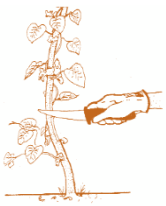
Item	Cost excl. GST
Primary Weeding	$10,000
Planting, mulching and irrigation	$25,000
Year 1 Maintenance	$15,000
Year 2 Maintenance	$15,000
Year 3 Maintenance	$10,000
Year 4 Maintenance	$5,000
Year 5 Maintenance and confirmation of compliance with performance criteria	$5,000
Total excl. GST	$80,000

8 Appendices

Appendix I – Key Weed Removal Methods

Physical removal

Technique	Method	Equipment
Hand Removal 	Seedlings and smaller weed species where appropriate will be pulled out by hand, without risk of injury to workers. The size that this can occur varies throughout the treatment area. Generally, it ranges from post seed to approximately 300mm in height. Rolling and raking is suitable for larger infestations of Wandering Jew. The weed can be raked, and stems and plant parts rolled. The clump of weed material can then be bagged and removed from site.	Tools: gloves, rakes, knife, and weed bags
Crowning 	Plants that possess rhizomes or bulbs might not respond to various removal techniques and may need to be treated with crowning. A knife, mattock, or trowel is to be driven into the soil surrounding the bulb or rhizome at an angle of approximately 45 degrees, to cut any roots that may be running off. This is to occur in 360 degrees around the bulb/rhizome. The rhizome or bulb is to be bagged and removed from the site and disposed of at an appropriate waste recycling facility. Soil disturbance is to be kept to a minimum when using this technique.	Tools: knife, mattock, trowel, impervious gloves, and all other required PPE
Cut and Paint Stems 	Weed species deemed unsuitable for hand removal shall but cut. Those that have persistent vigorous growth will be cut and painted with Roundup® Biactive Herbicide or equivalent. Juvenile and smaller weed species will be cut with secateurs at base of plant, and herbicide applied via applicator bottle. Stem to be cut horizontally as close to the ground as possible, using secateurs, loppers, or a pruning saw. Horizontal cuts to be made on top of stem to prevent the herbicide running off the stump.	Tools: loppers, secateurs, pruning saw, herbicide applicator/sprayer, impervious gloves, Roundup® Biactive

	Apply herbicide to the cut stem immediately, within 10-20 seconds, before the plant cells close and the translocation of herbicide is limited. Herbicide is not to reach sediment or surrounding non-target plants.	Herbicide and all other required PPE
Scrape and Painting 	More resilient weed species, where other techniques are less reliable are to be scraped with a knife or chisel and painted with undiluted Roundup® Biactive Herbicide. Works to be carried out by a contractor with a current herbicide license. Weed species will be scrapped with a knife or chisel up the length of the trunk, and herbicide applied via applicator bottle. Scrape the trunk from as close to the ground as possible to approximately ¾ of the plants height. Where trunk diameters exceed approximately 5cm a second scrape shall be made on the other side of the trunk. Apple undiluted herbicide to the cut trunk immediately, within 10-20 seconds, before the plant cells close and the translocation of herbicide is limited. Herbicide is not to reach sediment or surrounding non-target plants. Follow up treatment may be required. If plants resprout, scrape and paint the shoots using the same method after sufficient regrowth has occurred.	Tools: knife, chisel, protective clothing, safety glass, herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide, and all other required PPE
Cut with a Chainsaw and Paint 	Larger size weed species, too large for cutting with hand tools, shall be cut with a chainsaw, and painted with undiluted Roundup® Biactive Herbicide. Works to be carried out by a contractor with a current chainsaw and herbicide license. Larger weed species will be cut with a chainsaw at base of plant, and herbicide applied via applicator bottle. Cut the stem horizontally as close to the ground as possible, using the chainsaw. Remove upper branches to reduce bulk of plant. If cutting at the base is impractical, cut higher to get rid of the bulk of the weed, then cut again at the base and apply herbicide. Make cuts horizontal to prevent the herbicide running off the stump. Apply undiluted herbicide to the cut trunk immediately, within 10-20 seconds, before the plant cells close and the translocation of herbicide is limited. Herbicide is not to reach sediment or surrounding non-target plants. Follow up treatment may be required. If plants resprout, scrape and paint the shoots using the same method after sufficient regrowth has occurred.	Tools: chainsaw, earmuffs, protective clothing, safety glasses herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide, and all other required PPE

Spot Spraying	Spot spraying involves spraying non-seeding annuals and grasses, and for regrowth of weeds once an area has been cleared or brush cut. Works to be carried out by a contractor with a current herbicide license. Herbicide will be mixed up according to the manufacturer's directions for the weed species being targeted. Mixed herbicide shall be applied to the targeted weed species with a backpack sprayer. All care must be taken by the contractor not to spill herbicide onto sediment or surrounding non-targeting plants.	Tools: protective clothing, safety glasses, herbicide sprayer, impervious gloves, Herbicide, and all other required PPE

Flame Weeding

Thermal (flame) weeding is a method where high temperatures are applied to weeds, causing the plant to die. Thermal weeding is particularly useful in situations where conservation or health considerations are high and weed density is low such as waterways where herbicide use is not permitted.

For native vegetation areas, thermal weeding, with a flame weeder, has been shown to stimulate germination of native plants while killing the seeds of annual weeds such as Devils Pitchfork, *Bidens pilosa*. Flame weeding is also effective in killing persistent weeds like Mother of Millions.
Best results are obtained when follow up weed control is undertaken 4-6 weeks after treatment. In addition, weed control should be conducted periodically after that for example to control weeds over a period of a year it is likely that between 3-5 applications will be necessary, depending on rainfall and the extent of the weed seed bank. This method is most effective on young annual weeds and least effective on older perennial weeds. In some cases, control of perennial weeds will be ineffective however this depends on the species present and its age.

Images provided by Dragonfly Environmental

Flame weeding should be undertaken outside of the fire seasons. Flame weeding allows for the mimicking of a burn in areas where a control burn could not be undertaken. Find native plants regenerating after flame weeding.

Appendix II – Bushland Hygiene Protocols for Phytophthora (Hornsby Council Recommendations)

- Always assume that the area you are about to work in is free of the disease and therefore needs to be protected against infection.
- And always assume that the activity you are about to undertake has the potential to introduce the disease.
- Arrive at the site with clean shoes, i.e., no dirt encrusted on them.
- If you arrive with shoes that are encrusted with dirt, they will have to be completely soaked in methylated spirit or disinfectant and allow a few minutes to completely soak in. NEVER scrape untreated dirt off your shoes onto the ground.
- Before you move onto the site spray the bottom of your shoes with 70% methylated spirit. Bleach solution (1% strength) or household/commercial disinfectant (as per label) are also suitable.
- Check all tools and equipment that come in contact with soil are clean before entering the area (they should have been cleaned on-site at the end of the previous work session). If there is any dirt on them, spray them with 70% methylated spirit.
- Clean all tools at the end of each work session while still on site ensuring this is done away from drainage lines and adjacent work areas. Knock or brush off encrusted dirt and completely spray with 70 % methylated spirit. Replace in storage/transport containers.
- Preferably compost all weed material on site.
- Never drag vegetation with exposed roots and soil through bushland.
- When removing weeds from the site, remove as much soil as possible from them in the immediate work area and carefully place vegetative material into plastic bags.
- Try not to get the bag itself dirty; don't put it on/in a muddy area.
- Always work from the lower part of a slope to the upper part.
- Always work in areas known to be free of the pathogen before working in infected areas.
- Minimise activities wherever possible when the soil is very wet.
- Vehicles should not be driven off track or into reserves (unless vehicle decontamination is carried out before and after entering a single work site)
- Only accredited supplies of plants/mulch are to be used.

Kit contents: 1 bucket, 1 scrubbing brush, 1 spray bottle (methylated spirit 70% solution), 1 bottle of tap water, and 1 bottle of methylated spirits.

Facts about Phytophthora

Phytophthora cinnamomi (Phytophthora) is a microscopic, soil-borne, water-mould that has been implicated in the death of remnant trees and other plants in Australian bushland. Phytophthora is not native to Australia. It is believed to have been introduced sometime after European settlement. Phytophthora is a national problem and is listed as a key threatening process under the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999*.

Symptoms including Dieback

"Dieback" simply means dying or dead plants. There are many causes of dieback; Phytophthora is just one of them. Often dieback is the result of a combination of factors such as changed drainage patterns and nutrient loads (e.g., increased stormwater run-off) or changed soil conditions (e.g., dumped fill or excavation of/near root zone). Plants that are stressed are more vulnerable to Phytophthora.

Initial symptoms of Phytophthora include wilting, yellowing and retention of dried foliage, loss of canopy and dieback. Infected roots blacken and rot and are therefore unable to take-up water and nutrients. Severely infected plants will eventually die. Symptoms can be more obvious in summer when plants may be stressed by drought. If you suspect that Phytophthora is on your site, please contact the Bushcare team to collect a soil sample to be lab tested. This is usually done in the warmer months where conditions are optimum for the disease.

Infection

There is no way of visually telling if Phytophthora is present in the soil as its structures and spores are microscopic (invisible to the naked eye). Phytophthora requires moist soil conditions and warm temperatures for infection, growth, and reproduction. Spores travel through moist soil and attach to plant roots. Once Phytophthora has infected a host plant it can grow inside plant root tissue independent of external soil moisture conditions. After infection, Phytophthora grows through the root destroying the tissue which is then unable to absorb water and nutrients.

Appendix III – Native Plant Nurseries

Wirreanda Nursery Ingleside NSW 2101

(02) 9450 1400

wirreandanursery.com.au/

Kulgoa Nursery Terrey Hills NSW 2084

(02) 9450 1217

kulgoa.com.au/

Indigo Native Nursery Ingleside NSW 2101

(02) 9970 8709

indigonursey.com.au/

New Leaf Nursery Ingleside NSW 2101

(02) 9913 3709

newleafnursery.com.au/

Harvest Seeds & Native Plants Nursery Terrey Hills NSW 2084

(02) 9450 2699

harvestseeds-nativeplants.com.au/

Ingleside Plant Growers Ingleside NSW 2101

(02) 9912 1028

Avalon Aquatics Ingleside NSW 2101

(02) 9918 4486 or sales@dragonflyenv.com.au for enquiries

Wildflower Nursery Ku-ring-gai

(02) 9423 0353 or kwg@krg.nsw.gov.au for enquiries

Appendix IV – Checklists

The following checklists have been included as a simple guide to ensure management measures within each stage of restoration are implemented.

Pre-restoration Checklist

Management Measure	Details
1. Soil and Water Management	• Bushland Hygiene Protocols outlined in Appendix II must be followed. The hydrological conditions of the site may promote the spread of Phytophthora. • Sediment controls may be implemented following weed removal and are to remain implemented throughout the restoration period.
2. Access Controls	• Parking, access/egress routes, stockpiles and materials storage areas must be identified and mapped outside the protected vegetation areas.
3. Biodiversity Protection	• Fencing must be erected to protect the native flora and fauna within the site. An exclusion zone will be established for bushland.
4. Weed Control	• Weeds must be managed, to a small degree in areas of earthworks, prior to commencement of works. Weed propagules must be disposed of within the site waste streams.

Restoration Phase Checklist

Management Measure	Details
1. Soil and Water Management	• Bushland Hygiene Protocols outlined in Appendix II must be followed. The hydrological conditions of the site may promote the spread of Phytophthora. • Sediment controls may be implemented following weed removal and are to remain implemented throughout the restoration period.
2. Access Controls	• Parking, access/egress routes, stockpiles and materials storage areas must be identified and mapped outside the protected vegetation areas.
3. Biodiversity Protection	• Fencing must be erected to protect the native flora and fauna within the site. An exclusion zone will be established for bushland.

4. Planting	• Planting is to occur during Spring, if possible, with Autumn planting reserved as a backup.
5. Bush Regeneration	• Primary weeding is to commence throughout the site to facilitate rehabilitation of native vegetation.
6. Reporting	• Reporting is to occur yearly (Ecologist) including the results of quarterly maintenance inspections and whether performance criteria are being met.

Post- restoration Phase

Management Measure	Details
1. Soil and Water Management	• Soil, sedimentation, erosion, and water management strategies implemented in earlier phases are to be retained where appropriate to continue to protect native vegetation zones from additional minor works and impacts arising from site operation.
2. Access Controls	• Parking, access/egress routes, stockpiles and materials storage areas must be identified and mapped outside of biodiversity protection exclusion zones.
3. Biodiversity Protection	• Fencing must be erected to protect the native flora and fauna within the site. An exclusion zone will be established for bushland.
4. Bush regeneration	• Maintenance weeding is to commence throughout the site to facilitate rehabilitation of native vegetation. • The soil seedbank is to be triggered to encourage natural regeneration in areas of medium to high resilience or where appropriate at the discretion of the bush regeneration contractors.
5. Planting	• Planting is to commence once performance criteria are on track to being met and there is little risk of plantings being outcompeted by exotics.
6. Reporting	• Reporting is to occur yearly (Ecologist) including the results of quarterly maintenance inspections and whether performance criteria are being met.

Appendix V – Recommended Planting List for the Site

Plant species have been selected from the *Warriewood and Nareen Wetlands Plan of Management*, Appendix E: Species suitable for revegetation (Eco Logical Australia Pty Ltd, Pittwater Council, 2010).

Scientific name	Common name
Trees	
Casuarina glauca	Swamp Oak
Glochidion ferdinandi	Cheese Tree
Eucalyptus botryoides	Bangalay
Eucalyptus robusta	Swamp Mahogany
Livistona Australia	Cabbage Palm
Cyathea cooperi	Straw Tree-fern
Shrubs	
Acmena smithii	Lilly-pilly
Viminaria juncea	Native Broom
Acacia elongata	Swamp Wattle
Acacia floribunda	White Sally
Callistemon citrinus	Scarlet Bottlebrush
Callistemon linearis	Narrow-leaved Bottlebrush
Leptospermum juniperinum	Prickly Tea-tree
Melaleuca ericifolia	Swamp Paperbark
Melaleuca linariifolia	Flax-leaved Paperbark
Groundcovers	
Blechnum camfieldii	Water Fern
Blechnum indicum	Swamp Water Fern
Entolasia marginata	Bordered Panic

Hemarthria uncinata	Mat Grass
Isachne globosa	Swamp Millet
Oplismenus aemulus	Broad-leaved Basket Grass
Paspalum distichum	Water Couch Grass
Alternanthera denticulata	Common Joyweed
Ludwigia peploides subsp. montevidensis	Water Primrose
Viola hederacea	Native Violet
Alisma plantago-aquatica	Water-plantain
Alocasia brisbanensis	
Commelina cyanea	Blue Spiderwort
Triglochin microtuberosum	
Triglochin procerum	Water Ribbons
Lomandra longifolia	Spiny-headed Mat-rush
Philydrum lanuginosum	Woolly Waterlily
Dianella caerulea	Blue Flax-lily
Dianella caerulea var. producta	
Baumea articulata	Jointed Twig-rush
Baumea juncea	Bare Twig-rush
Baumea rubiginosa	Soft Twig-rush
Bolboschoenus fluviatilis	Club-rush
Carex appressa	Tall Sedge
Cladium procerum	
Cyperus exaltatus	Giant Sedge
Eleocharis equisetina	

Eleocharis sphacelata	Tall Spike-rush
Ficinia nodosa	Knobby Club-rush
Gahnia sieberiana	Red-fruited Saw-sedge
Schoenoplectus mucronatus	
Schoenoplectus validus	River Club-rush
Juncus kraussii subsp. australiensis	Sea Rush
Juncus polyanthemus	Tussock Rush
Juncus usitatus	
Baloskion tetraphyllum	Tassel Cord-rush
Leptocarpus tenax	

9 Expertise of Authors

With over 25 years wetland and urban ecology experience, a great passion for what she does, and extensive technical and on-ground knowledge make Mia a valuable contribution to any project.

Geraldene has over 8 years local government experience as manager of environment and education for Pittwater Council. Geraldene presented papers on the topic at the NSW Coastal Conference, Sydney CMA and Hawkesbury Nepean forums. Geraldene is a Technical Advisor Sydney Olympic Park Wetland Education and Training (WET) panel.

Geraldene has up to date knowledge of environmental policies and frequently provides input to such works. Mia was a key contributor to the recent set of Guidelines commissioned by Southeast Queensland Healthy Waterways Water Sensitive Urban Design Guidelines. Geraldene's role included significant contributions and review of the Guideline for Maintaining WSUD Assets and the Guideline for Rectifying WSUD Assets.

Geraldene is a frequent contributor to many community and professional workshops on ecological matters particularly relating to environmental management. She is an excellent Project Manager.

Geraldene is a joint author on the popular book Burnum Burnum's Wildthings published by Sainty and Associates. Author of the Saltmarsh Restoration Chapter Estuary Plants of East Coast Australia published by Sainty and Associates (2013). Geraldene's early work included 5 years with Wetland Expert Geoff Sainty of Sainty and Associates. Geraldene is an expert in creating and enhancing urban biodiversity habitat and linking People with Place.

Geraldene Dalby-Ball

DIRECTOR

SPECIALISATIONS

- Urban Ecology – and habitat rehabilitation and re-creation.
- Urban waterway management – assessing, designing, and supervising rehabilitation works
- Saltmarsh and Wetland re-creation and restoration – assessment, design, and monitoring
- Engaging others in the area of environmental care and connection
- Technical Advisor – environmental design, guidelines, and policies
- Sound knowledge and practical application of experimental design and statistics
- Project management and supervision
- Grant writing and grant assessment
- Budget estimates and tender selection
- Expert witness in the Land and Environment Court

CAREER SUMMARY

- **Director and Ecologist**, Ecological Consultants Australia. 2014-*present*
- **Director and Ecologist**, Dragonfly Environmental. 1998-*present*
- **Manager** Natural Resources and Education, Pittwater Council 2002-2010
- **Wetland Ecologist** Sainty and Associates 1995-2002

QUALIFICATIONS AND MEMBERSHIPS

- **Bachelor of Science with 1st Class Honors**, Sydney University.
- WorkCover WHS General Induction of Construction Industry NSW White Card.
- Senior First Aid Certificate.

Practicing member and vice president Ecological Consultants Association of NSW

Brooke Thompson

ECOLOGIST

Brooke is an ecologist with valuable on-ground experience working on bush regeneration projects throughout the Sydney region, including revegetation and weed management projects. Brooke is passionate about conserving and restoring natural areas for native species to thrive.

Brooke completed her undergraduate Bachelor of Science degree majoring in Conservation Biology. Brooke has knowledge of experimental design and analysis, research and reports, geographic information systems (GIS), environmental legislation, and flora identification.

Brooke has experience working with conservation organisations, including Sea Shepherd Australia, helping to raise awareness around the destruction of habitats in the world's oceans. She has participated in the organisation and delivery of fundraising events around Sydney.

Brooke has exceptional communication and customer service skills and an extended client relations history.

SPECIALISATIONS

- Urban and Landscape Ecology
- Fauna and Flora Assessments
- Vegetation Management
- Habitat Tree Assessment, Marking and Mapping

CAREER SUMMARY

- **Ecologist**, Ecological Consultants Australia. 2022-*present*
- **Natural Area Specialist**, Dragonfly Environmental. 2022

QUALIFICATIONS AND MEMBERSHIPS

- **BSc Conservation Biology**, University of Wollongong.
- WorkCover WHS General Induction of Construction Industry NSW White Card.