Land Eco consulting

Biodiversity Management Plan

43, 45-49 Warriewood Road, Warriewood

Report prepared by
Land Eco Consulting
for
CPS c/- Lesryk Environmental
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Report Certification

Works for this report were undertaken by:

Name	Company / Position
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I, Kurtis Lindsay, certify that:

- This Biodiversity Management Plan has been prepared in accordance with the brief provided by the client
- The information presented in this report is a true and accurate record of the study findings in the opinion of the authors

Kurtis Lindsay
Principal Ecologist and Director
Land Eco Consulting

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Glossary

Abbreviation	Definition
°C	Degrees Celsius
APZ	Asset Protection Zone
ASL	Above Sea Level
BAAS	Biodiversity Assessors Accreditation System
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Calculator
BMP	Biodiversity Management Plan (this document). This term is interchangeable with Vegetation Management Plan.
BMP area	The proportion of the study area to be conserved and managed by this BMP specifically, the land from the south of the development area to the southern property boundary (**Figure 1**).
BC Act	NSW *Biodiversity Conservation Act 2016*
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offsets Scheme
Buffer Area	1500 m around the edge of the subject land
BVMTT	Biodiversity Values Map and Threshold Tool
CM Act	NSW *Coastal Management Act 2016*
CEEC	Critically Endangered Ecological Community
CFSF	Coastal Freshwater Swamp Forest
CPS	Creative Planning Solutions
DAWE	Department of Agriculture, Water and the Environment
DBH	Diameter at Breast Height (in reference to trees)
DE	Commonwealth Department of the Environment (now known as the Commonwealth Department of the Environment and Energy)
DEC	Department of Environment and Conservation
DECC	NSW Department of Environment and Climate Change (now known as the NSW Office of Environment and Heritage)
DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
EPA Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ha	hectare
IBRA	Interim Biogeographic Regionalisation for Australia
LEP	Local Environment Plan
LGA	Local Government Area
mm/cm/m/m²/km	Millimetres, centimetres, metres, square metres, kilometres
MZ	Management Zone
NSW	New South Wales
OEH	NSW Office of Environment and Heritage (now known as DPIE)
PCT	Plant Community Type
PMST	Protected Matters Search Tool
LEP	Local Environment Plan
SAII	Serious and Irreversible Impact
SEPP	State Environmental Planning Policy
Strahler Order	A stream ordering system used to classify streams under the WM Act. Streams mapped at the highest point of the catchment are 1st order streams. Streams mapped at the lowest point of the catchment are 4th order streams.
Subject Land	The maximum total extent of the proposed development footprint and associated direct impact.
Subject Property	43,45-49 Warriewood Road, Warriewood NSW (Lot 1 & 2 / DP 349085)
TOB	Top of Bank
TEC	Threatened Ecological Community
WM Act	NSW Water Management Act 2000
VI	Vegetation Integrity
VMP	Vegetation Management Plan (this document). This term is interchangeable with Biodiversity Management Plan.
WoNS	Weeds of National Significance
VRZ	The vegetated riparian zone adjoining the channel. The width ranges from 10m to 40m either side of the channel depending on the Strahler Order classification of the stream.

1. Introduction and Site description

1.1 Background and Project Proposal

Land Eco Consulting (Land Eco) was engaged by Lesryk Environmental on behalf of CPS to provide this Vegetation Management Plan (VMP) here forward referred to as a Biodiversity Management Plan (BMP). This BMP is to be lodged in conjunction with a Development Application (DA) for proposed development of 43, 45-49 Warriewood Road, Warriewood (Lot 1 & 2 / DP 349085) ('the subject property'). The subject of this report is the area covered by the BMP/BMP here after referred to as the 'subject site' or 'BMP area' (**Figure 1**).

The proposed works involve the demolition of existing dwellings and ancillary structures, and the partial clearing of both native and exotic vegetation for the construction of a residential development, road, footpath and stormwater detention basin within the Subject Site.

This site is located within the Northern Beaches Council (formerly Pittwater Council).

The DA is a 'Controlled Activity', as it will be carried out in, on or under waterfront land are regulated by the *Water Management Act* 2000 (WM Act). The Department of Primary Industries, - Water (DPI Water), previously the NSW Office of Water, administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. In this instance, 40m was measured from the centreline of Narrabeen Creek which flows adjacent to the southern boundary of the study area.

This BMP has been prepared to meet DPI Water requirements under the WM Act. This BMP has been prepared based on current best practice and is consistent with the DPI Water guidelines, including provision of indicative costs for management actions.

This report is based upon Pittwater Local Government Area (LGA) planning requirements for management of biodiversity under Pittwater Local Environment Plan 2011 (LEP) and Pittwater Development Control Plan 2011(DCP).

1.2 Objectives of the Biodiversity Management Plan

The overall objectives of the BMP are to:

- control the spread of priority and environmental weeds (especially woody weeds and climbers)
- establish native species cover and density by revegetation works (using locally indigenous species representative of Coastal Swamp Sclerophyll Forest) and to
- maintain healthy riparian vegetation which in turn will lead to a healthy catchment
- maintain habitat for threatened fauna species (including hollow-bearing trees, shelter and foraging habitat).

The maintenance period will run for five years or until the objectives and performance criteria outlined in this BMP are met.

This BMP is intended as a practical document to specify appropriate native vegetation management and rehabilitation field works in order to enhance the riparian corridor within the Subject Site and to guide vegetation maintenance into the future.

These aims of this BMP will be achieved through this document by:

- guiding site management and native vegetation establishment;
- specifying best-practice native vegetation rehabilitation works;
- specifying any required flora and fauna protections prior, during and post construction;
- directing the appropriate removal and handling of Priority Weeds;
- advising locally indigenous plant selection;
- detailing plant installation and maintenance; and,
- providing indicative costing for native vegetation management and rehabilitation works.

Figure 1. Location of the Subject Site, proposed development footprint and mapped riparian corridor

2. Site Description

2.1 General Site Description

The BMP area occurs to the south of the development site assessed in Lesryk (2020). The BMP area comprises an important patch of remnant vegetation in the Narrabeen Lagoon catchment, and one of the largest and most significant patches of Swamp Sclerophyll Forest in the Northern Beaches, outside of the Warriewood Wetlands.

It is a locally significant patch of vegetation and its management under this BMP will provide long-term biodiversity gains for the locality and region.

2.2 Existing Vegetation

Site Assessment conducted by Land Eco Consulting revealed that the native vegetation observed within the Subject Site was representative of a single vegetation community, *PCT 1795 Swamp Mahogany / Cabbage Tree Palm - Cheese Tree - Swamp Oak tall open forest on poorly drained coastal alluvium in the Sydney basin*.

The entire extent of native canopy trees and shrubs on the subject property corresponds to the threatened ecological community 'Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions' which is listed as an EEC under BC Act (NSW Scientific Committee 2005). It is therefore of high retention value.

The vegetation across the subject property is described in detail in the Biodiversity Development Assessment Report (Lesryk 2020).

Field validated vegetation communities within the Subject Site are mapped in **Figure 2.**

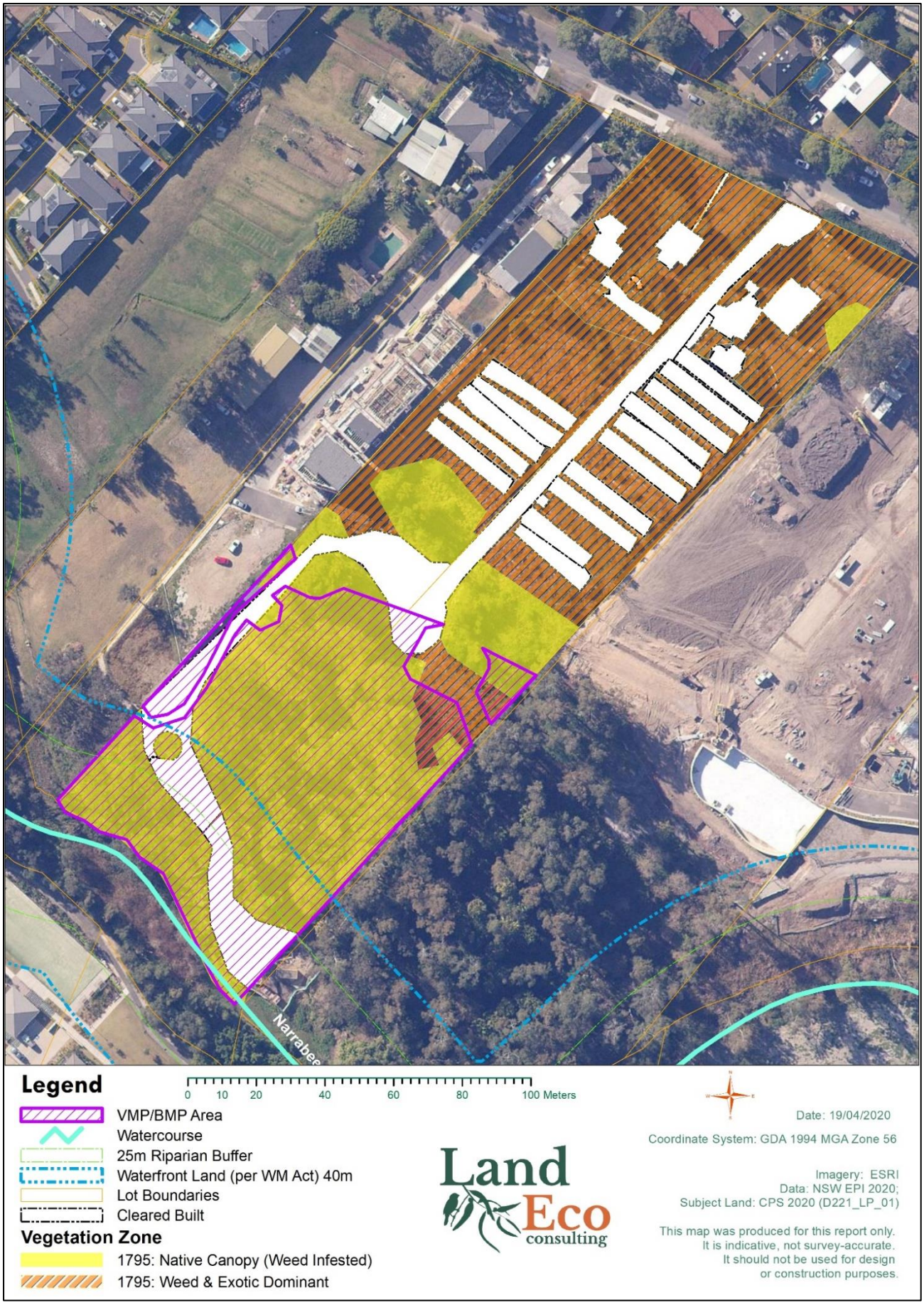

Figure 2. Proposed BMP Area Including Management Zones

2.3 Habitat Values

A thorough assessment of fauna habitat availability across the Subject Site was conducted. The habitat assessment provided an understanding of the fauna species (including threatened species) that may potentially occur on the Subject Site during part of their lifecycle. Abundant shelter, forage and breeding habitat for a wide range of local and mobile fauna was identified throughout the Subject Site. The high diversity of habitat reflects the importance of the vegetation in the BMP area.

Hollow-bearing trees may provide habitat for birds, reptiles, frogs, arboreal mammals and microchiropteran bats (microbats). Large hollows were identified in mature *Eucalyptus robusta* in the BMP area (**Plate 1**).

The subject site may be utilised by a number of threatened insectivorous microchiropteran bats for roosting and foraging. Multiple hollow-bearing trees were identified within the Subject Site. These provided suitable habitat for threatened hollow-roosting microchiropteran bats including:

- *Mormopterus norfolkensis* (Eastern Freetail-bat);
- *Saccolaimus flaviventris* (Yellow-bellied Sheathtail-bat);
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle);
- *Miniopterus australis* (Little Bentwing-bat);
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat)
- *Myotis macropus* (Southern Myotis); and
- *Scoteanax rueppellii* (Greater Broad-nosed Bat).

Coarse woody debris, large logs and leaf-litter, that may provide foraging habitat for invertebrates, small reptiles and frogs, however it is not expected that any threatened species would utilise such habitat on the Subject Site.

A suite of foraging habitat, including fruit and flower-bearing trees provide foraging habitat for local and nomadic fauna, including:

- *Pteropus poliocephalus* (Grey-headed Flying Fox) (vulnerable BC Act and EPBC Act)
- *Anthochaera phrygia* (Regent Honeyeater) (critically endangered BC Act and EPBC Act)
- *Lathamus discolor* (Swift Parrot) (endangered BC Act and critically endangered EPBC Act)
- *Glossopsitta pusilla* (Little Lorikeet) (vulnerable BC Act).

Rough-barked woodland trees and dense woodland shrubs provided potential foraging and nesting for the following vulnerable, insectivorous bird species:

- *Daphoensitta chrysoptera* (Varied Sittella) (confirmed present by Lesryk 2020)
- *Artamus cyanopterus* (Dusky Woodswallow)

A scattering of *Casurina glauca* (Swamp Oak) provide potential, intermittent foraging habitat for *Calyptorhynchus lathami* (Glossy Black Cockatoo) across the subject site.

Small-medium sized mammals and birds within the site are likely to attract vulnerable large predatory birds including:

- *Ninox connivens* (Barking Owl) (confirmed present by Lesryk 2020)
- *Tyto novaehollandiae* (Masked Owl);
- *Ninox strenua* (Powerful Owl);
- *Haliaeetus leucogaster* (White-bellied Sea Eagle);
- *Lophoictinia isura* (Square-tailed Kite); and
- *Hieraaetus morphnoides* (Little Eagle).

Management of the vegetation under this BMP will contribute to improvements on the existing fauna habitat values of the site.

Plate 1. Large hollow in a mature *Eucalyptus robusta*

2.4 Riparian Habitat

The extent of the riparian habitat is situated along the western boundary of the Subject Site and is considered to represent low quality vegetation. This riparian corridor follows the Narrabeen Creek watercourse which flows in an eastern direction ton Warriewood Wetlands and Narrabeen Lagoon. The vegetation community associated with this riparian buffer has been identified as Swamp Sclerophyll Forest EEC.

Weeds species formed a majority of the vegetation biomass along the riparian corridor. There were few native trees, shrubs and groundcovers scattered amongst the dense weed infestations of this corridor.

Intensive, ongoing management of both environmental and priority weed species within this corridor is to form a key recommendation and action of this BMP and will contribute to the biodiversity gains expected across the subject site.

3. Biodiversity Management

Some of the management issues discussed in this report are already in action within the Subject Site; and others have the potential to occur as a result of the proposed works.

This section of the report details management issues and actions to mitigate on-going impacts from these management issues.

3.1 Vegetation Management Zones

Management of the Biodiversity within the Subject Site has been divided into the following Management Zones which were created based on proposed vegetation community or habitat type (**Figure 3**).

- Management Zone 1: Revegetation Area
- Management Zone 2: Regeneration Area

3.2 Vegetation Clearing for Adjoining Development

The proposed development will require clearing of a small area of native vegetation comprised of PCT 1795 from the subject property. This has been assessed in the BDAR (Lesryk 2020). In total 0.88ha of vegetation be impacted comprised of:

- 0.68 ha of PCT1795 Exotic/Weed Dominant
- 0.20 ha of PCT1795 Canopy Remnant (weed-infested)

All native vegetation required to be removed as a result of the proposed development is representative of low-quality, weed infested PCT1795. This will all be offset through the NSW Biodiversity Offset Scheme.

To further compensate for this vegetation removal:

- at least 0.03 ha of native vegetation will be revegetated from an exotic-dominated wasteland to floristically diverse Swamp Sclerophyll Forest EEC,

- at least 0.62 ha of native vegetation will be managed of weeds to improve biodiversity and function of the Swamp Sclerophyll Forest EEC.

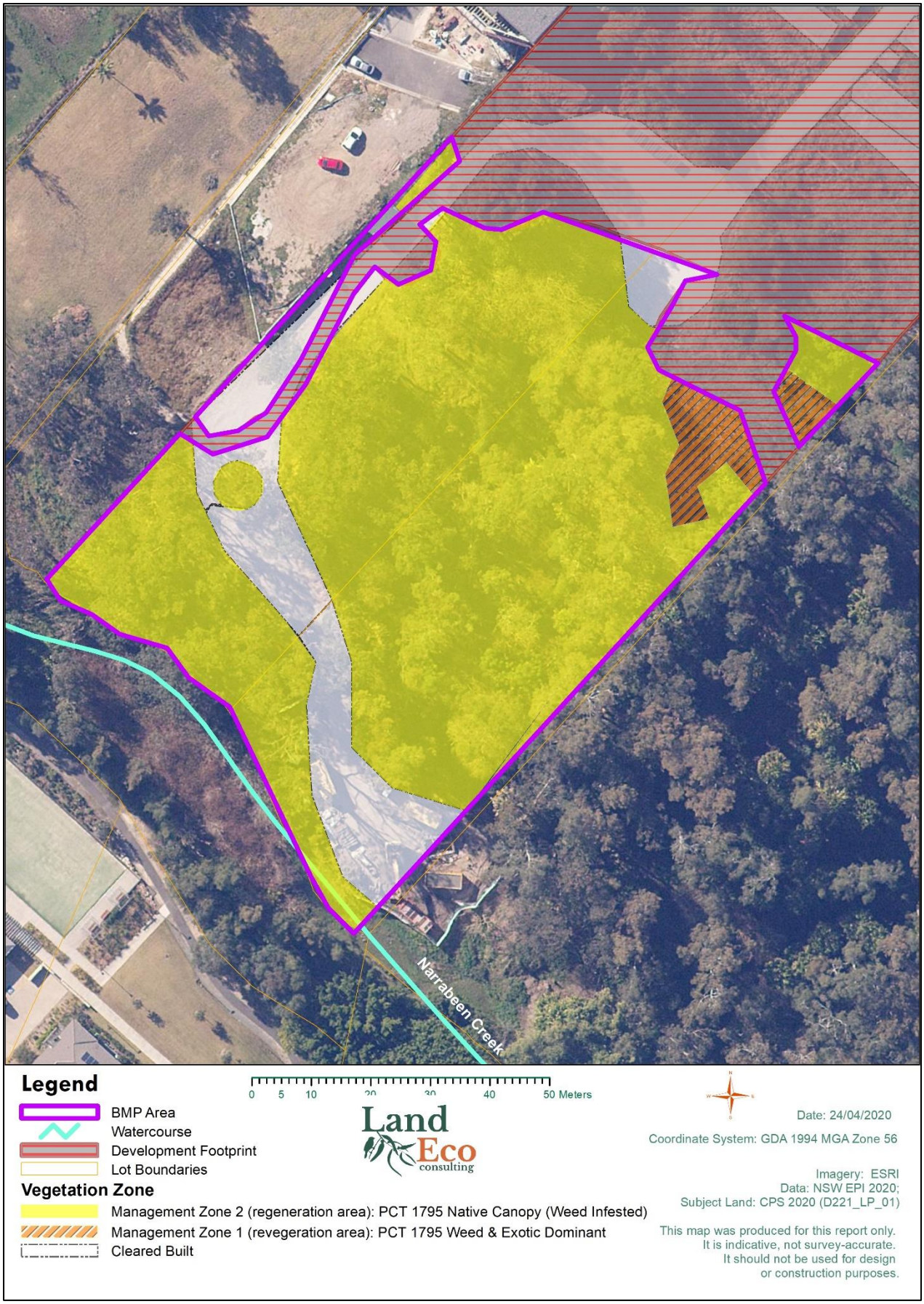

Figure 3. Management Zones in the BMP Area

3.3 Weeds

Weed infestations are concentrated throughout the subject property.

The most severe woody weed infestations occur in the north-eastern corner of the BMP Area on the border with the development site. All of the remnant vegetation in the BMP area is severely infested with woody weeds and vines in the understorey. The most significant weed species (in order of infestation severity are) listed in **Table 1**.

Management of these weeds under this BMP will contribute to improved habitat and vegetation floristic quality, for a long-term gain in biodiversity values for the region.

Table 1. Weeds Encountered in the BMP Area and their On-site Severity Rating

Weed Type	Species and Severity Rating (1 is most severe)
Woody	1. *Erythrina x sykesii* 2. *Erythrina crista-galli* 3. *Arundo donax* 4. *Acer negundo* 5. *Ligustrum lucidum* 6. *Cinnamomum camphora* 7. *Ligustrum sinense* 8. *Acacia saligna* 9. *Solanum mauritianum* 10. *Morus albens* 11. *Toxicodendron succedaneum*
Shrubs	1. *Lantana camara* 2. *Senna pendula var. glabrata* 3. *Rubus fruticosus sp. agg.* 4. *Cestrum parqui* 5. *Cyperus papyrus* 6. *Ricinus communis* 7. *Ageratina adenophora* 8. *Colocasia esculenta* 9. *Ochna serrulata* 10. *Phytolacca octandra*
Herbaceous	1. *Ludwigia peruviana* 2. *Hydrocotyle bonariensis* 3. *Conyza spp.* 4. *Cirsium vulgare* 5. *Hypochaeris spp.* 6. *Plantago lanceolatus* 7. *Cyperus brevifolius* 8. *Anagallis arvensis*
Grasses	1. *Stenotaphrum secundatum* 2. *Cenchrus clandestinus* 3. *Megathyrus maxima* 4. *Paspalum dilatatatum* 5. *Paspalum urvillei*
Vines	1. *Ipomoea indica* 2. *Cardiospermum grandiflorum* 3. *Anredera cordifolia* 4. *Lonicera japonica* 5. *Araujia sericifera* 6. *Acetosa saggittata* 7. *Asparagus aethiopicus* 8. *Asparagus asparagoides*

3.3.1 Priority Weeds

At the time of the survey, the primary management issue was the presence of weeds throughout the vegetated areas of the Subject Site. The riparian corridor of Narrabeen Creek was identified as a particular point of concentration for weed infestation within the Subject Site.

Seven Priority Weed species were identified within the Subject Site (**Table 2**) as listed within the Northern Beaches LGA (DPI 2020). All noxious weed infestations were largely concentrated within the margins of the property as well as the riparian corridor in the western extent of the Subject Site.

All of the identified Priority Weed species besides *Cestrum parqui* are also listed as Weeds of National Significance (WoNS) and as such, are to be controlled where possible.

Table 2. Summary of priority weeds recorded within the Subject Site.

Species	Priority Weed Duty	Management Requirement
Arundo donax	Regional Recommended Measure	Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.
***Rubus fruticosus* species aggregate (Blackberry)**	Prohibition on dealings	Must not be imported into the State or sold
***Cestrum parqui* (Green Cestrum)**	Regional Recommended Measure	Land managers should mitigate the risk of new weeds being introduced to land used for grazing livestock. Land managers should mitigate spread from their land. Plant should not be bought, sold, grown, carried or released into the environment
***Asparagus aethiopicus* (Ground Asparagus)**	Prohibition on dealings	Must not be imported into the State or sold
***Senecio madagascariensis* (Fireweed)**	Prohibition on dealings	Must not be imported into the State or sold
***Lantana camara* (Lantana)**	Prohibition on dealings	Must not be imported into the State or sold
Ludwigia peruviana	Regional Recommended Measure	Land managers mitigate the risk of the plant being introduced to their land. Land managers prevent spread from their land where feasible. Land managers reduce the impact on priority assets. The plant should not be bought, sold, grown, carried or released into the environment. Local Control Authority is notified if the plant is found on the land.

3.4 Management Recommendations

3.4.1 Assigning a Project Ecologist

Prior to commencement of any vegetation clearing, weed removal or construction works on the Subject Site, a Project Ecologist must be assigned to oversee relevant works and ensure the proponent is adhering to the recommendations of this BMP and the corresponding BDAR (Lesryk 2020). The Project Ecologist must as a minimum hold:

- a relevant tertiary degree in Science, Biology, Ecology, Environmental Science, Environmental Management or Natural Resource Management,
- licensed under the *Biodiversity Conservation Act 2016* (or equivalent) and,
- licensed with a NSW Animal Research Authority (or equivalent) permitting the handling, relocation and humane euthanasia of all terrestrial fauna

3.4.2 Vegetation Protections

Native vegetation including trees, shrubs or groundcovers must not be cleared from within the BMP area under any circumstance.

A qualified Ecologist must attend the Subject Site in the presence of a surveyor, qualified Consulting Arboriculturalist and the construction contractor to mark-out the boundaries of the proposed construction works (i.e. with flagging tape) in order to delineate where to erect temporary fencing or flag-rope / safety bunting which is required to prevent inadvertent clearing or other harm to all native trees and vegetation located outside of the construction zone.

The site is to be fenced to prevent civil construction machinery from entering the site unless under supervision from a suitably qualified ecologist or bush regenerator. This will be undertaken on active development interfaces.

This is separate to Tree Protection Fencing (TPZ) which will be addressed independently by a Consulting Arboriculturalist.

Informational signage must be installed around the site as needed to convey the works that are being undertaken and the final strategy for the site. The exact information and location of these signs will be determined during implementation works. At a minimum this signage should identify, at all access points to the site, that the riparian area is being managed for conservation purposes. Further signage may include permanent signs describing the natural values of the site and surrounding area.

3.4.3 Assigning a Bushland Restoration Contractor / Bush Regenerator

All works associated with native vegetation and or flora providing habitat, including weed management are to be implemented by a fully qualified and experienced Bush Regeneration Contractor.

The Bushland Restoration Practitioner selected to complete the project works must:

- Provide a statutory declaration stating their compliance with provisions of the national Gardening & Landscape Services Award 2010;
- Provide completed and signed Subcontractor Statement regarding payment of worker's compensation, payroll tax and remuneration;
- Provide established Workplace Health & Safety and Environmental Management Systems. Preferably the company has third-party accredited systems in place;
- Demonstrate implementation of safe workplace and appropriate environmental management practices and procedures (e.g. appropriate transport and management of herbicides);
- Provide Public Liability (min. $10M) and Workers Compensation Insurance;
- Have previous experience undertaking bushland restoration works within the local area, particularly within Swamp Sclerophyll Forest EEC. Contractor references are to be contacted;
- Provide supervisor with minimum qualifications and experience including Certificate III Conservation & Land Management and two years full-time equivalent experience as a trained bush regenerator;
- Provide a minimum of two trained bush regenerator per team (minimum qualifications and experience including Certificate III Conservation & Land Management and one year full-time equivalent experience as a bush regenerator);
- Provide a minimum of one trained bush regenerators per team of four (minimum qualifications and experience including Certificate III Conservation & Land Management and one year full-time equivalent experience as a trained bush regenerator);
- Schedule appropriately resourced regular site visits for the duration of contract period;
- All herbicide usage, including storage and transport, to be in accordance with WorkCover NSW (2006) and all relevant legislation.

3.4.4 Weed Management

All weed removal, bushland restoration, and landscape planting works carried out within the Subject Site must be undertaken by qualified Bushland Restoration Professionals with the required qualifications, as discussed in **section 3.4.3.** All site supervisors should have the ability to identify any additional threatened flora which may emerge during the weed management works.

All weeds, including woody weeds in the understorey will require treatment. At the discretion of the bush regeneration contractor, initial / primary weed control works, may be undertaken using forestry mulcher. If a forestry mulcher is used, a team leader or project ecologist will be o nsite to direct the operator to avoid damaging native flora.

Secondary weed control will include vine control, specifically the control of *Ipomoea indica* and *Andereda cordifolia*. Successful control of *A. cordifolia* required that all tubers and bulbils are to be removed or killed. Chemical and mechanical control techniques will be required in follow up treatments. Follow up treatments of woody weeds including *Arundo donax, Ligustrum spp.* seedlings and *Cestrum parqui* re-growth will be required.

Table 3. Weed Control Methods

Weed type	Management
Annual grasses	Annual grasses, should be hand removed or spot sprayed where isolated or in low concentrations. Larger patches of annual grasses may be slashed/brush cut in late spring to early summer, after flowering, but prior to seed set. For most species, slashing/brush cutting prior to late spring through to early summer will promote vigorous growth and should not occur. However, some annual grasses can grow and produce seed at any time of the year dependent on climatic conditions such as high rainfall and warm temperatures. Monitoring of annual species should be undertaken and if new growth occurs, the same treatment will be applied to the new growth to prevent seed production. Individual plants should be hand removed, bagged and disposed of appropriately offsite.
Perennial grasses	Perennial grasses, such as Paspalum dilatatum (Paspalum), Pennisetum clandestinum (Kikuyu Grass) and Axonopus fissifolius (Carpet Grass) will be hand removed where isolated or in low concentrations. Larger patches may be slashed prior to seed production in spring or summer (depending on the growth cycle of the species) and the regrowth spot-sprayed 2-3 weeks later when it is actively growing and approximately 10 cm in length. Monitoring of these species will occur and if new seed production occurs, the same treatment will be applied again as required. However, slashing will not reduce the presence of exotic grasses on its own and must always be combined with targeted removal to reduce densities and allow for native regeneration. Individual plants should be hand removed, bagged and disposed of appropriately offsite.
Woody weeds	Follow up treatment of woody weeds, including *Erythrina crista-galli. Erythrina x sykesii, Cestrum parqui (Green Cestrum), Lantana camara, Ligustrum sp. and Camphor laurel* will be controlled by the cut and paint or drill and fill method using a non-selective herbicide. The most appropriate method to be used depends on the size of the individual to be removed and will be determined by the bush regeneration contractor. Primary weed control should use techniques that will not encourage flushes of secondary weed growth. All seedlings of woody weeds will be hand pulled or spot-sprayed with a non-selective herbicide.
Creepers and climbers	The control of creepers, including Ipomoea indica (Morning Glory), *Anredera cordifolia* (Madeira Vine), *Asparagus aethiopicus* (Ground Asparagus) and *Lonicera japonica* (Japanese Honeysuckle) varies depending on the species. For the most part, seedlings will be hand pulled, while mature plants can be controlled by the stem-scrape method or spot spraying using a non-selective herbicide. The precise method to be used will be determined by the bush regeneration contractor depending on the species, size and reproductive status of the individual. All vegetative material removed should be bagged, removed from site and disposed of appropriately.
Herbaceous weeds	Where individual plants of herbaceous weeds, including *Parietaria judaica (Asthma weed), Solanum mauritianum and Ageratina adenophora* (Crofton weed), are found, they will be hand pulled prior to flowering. Where large swaths of these species occur they will be sprayed using a non-selective herbicide. If high densities of mature stands occur, weeds may be slashed first using a brush cutter and any subsequent regrowth sprayed. Regular monitoring of these species will be required to prevent seed production. *Cirsium vulgare* (Spear Thistle) and young *Rubus fruticosus* will not be hand-pulled due to thorns and instead will be spot sprayed using a non-selective herbicide. All vegetative material that is pulld out and has the potential to regrow if deposited on ground will be bagged and removed from site.

3.4.5 Greenwaste Disposal

All weed and vegetation waste created on site through the required vegetation clearing and weed management is to be removed and taken to an appropriate waste management facility approved by Northern Beached Council to allow for the correct disposal of the green waste.

None of the felled weed trees should be retained on site. Because *Erythrina spp.* can re-sprout from logs and stumps, all vegetative and woody material produced from controlling coral trees must be removed from the site, even if mulched.

At no time should mulch generated through weed control be left on the subject property.

3.4.6 Vegetation Clearing

Care must be taken to avoid accidental clearing or disturbance to any vegetation located outside the 'maximum limit of disturbance' of the development adjacent to the BMP area. This limit is to be delineated to all site contractors by installing temporary fencing or 'flag-rope' / 'safety bunting', erecting signs indicating 'Vegetation Protection Area' as well as permanent post and rail fencing (**Section 3.4.2**).

Native vegetation/tree removal/clearing is not permitted in the BMP area. Weed tree removal can be undertaken in Management Zone 1 or Management Zone 2 and delivered by a qualified Landscape , Earthmoving or Arborist Contractor under the supervision of a Bush Regenerator. Clearing of weed trees in the BMP area may take place using a tritter, backhoe, or excavator (on rubber trucks only). In sensitive areas where there is risk of harming native trees or vegetation the contractor must only use chainsaw-rope-pulley procedures. Tree protection measures should be implemented and adhered to during all construction and development works.

Vegetation removal in Management Zone 2 will be restricted to removal of exotic trees/shrubs/groundcovers and only delivered by Qualified Bush Regeneration Contractors using hand methods (not machinery).

After tree clearing for the development, contractors should stockpile native logs or hollow limbs for use as habitat in Management Zone 1 and 2.

3.4.7 Retaining Native Habitat Logs

Felled *Casuarina glauca* and *Eucalyptus spp.* can be mulched and spread in Management Zone 1, or alternatively the logs can be placed in the BMP area to continue providing habitat. Weed species logs, branches and other vegetative material especially *Erythrina spp.* (Coral Trees) must be removed from site.

3.4.8 Pathogen Controls

Phytophthora and Myrtle Rust are pathogens which can be spread through infected soil, with potentially large detrimental impact. The risk to biodiversity related to each pathogen has resulted in them being listed as Key Threatening Process (KTP) under the BC Act. Although these pathogens were not observed within the Subject Site, as a precautionary measure, hygiene procedures are essential.

Such hygiene protocols have the additional benefit of limiting the potential to facilitate the introduction or spread of weed propagules to the Subject Site, which can be costly to manage later.

Basic principles include avoiding transport of sediment onto and off site by cleaning all work clothing, gloves, tools and machinery. In some cases, a solution of 70% ethanol or methylated spirits in 30% water may be sufficient to disinfect equipment prior to use.

The report, 'Arrive Clean, Leave Clean' (Commonwealth of Australia 2015) provides further information and best practice methods to reduce spread of these pathogens between work Subject Sites.

3.4.9 Stormwater

The proposed development is likely to modify the current stormwater flow from within the Subject Site into the adjoining Narrabeen Creek, west of the proposed development. The introduction of increased hard surface development and landscaping within the Subject Site is expected to increase the volume of stormwater discharge entering the waterway.

In order to protect the adjoining waterway from the potential impacts of increased stormwater discharge, the proposed onsite stormwater detention system (OSD) stormwater capture system will store and treat stormwater runoff prior to releasing any overflow into Narrabeen Creek in order to maintain and/or improve the nature of runoff discharging from the site via the creek (C & M Consulting Engineers 2020).

The OSD will be vegetated with locally indigenous wetland plants and managed of vegetative growth and weeds to insure the continued effective operation of the OSD. Only plant species listed in **Appendix A** are to be planted in and around the OSD.

The proposed stormwater outlets will be designed and installed in accordance with the appropriate *Guidelines for Outlet Structures on Waterfront Land* (DPI 2012) in order to reduce the potential impact of the increased stormwater accumulation and runoff. Riparian revegetation efforts undertaken will ensure stability and prevent bank erosion/ scour/ failure (C & M Consulting Engineers 2020). No barriers between existing waterways and floodplains are proposed and as such, there will be no modification to the existing flood regime of Narrabeen Creek (C & M Consulting Engineers 2020).

All proposed construction and site works are to be done so with the appropriate sediment and erosion mitigation measures in place as per the relevant guidelines of *Managing Urban Stormwater: Soils and construction* (Landcom 2004).

Ensuring adherence to the recommendations outlined within the corresponding Engineering Plans (C & M Consulting Engineers 2020) and BDAR (Lesryk 2020), the proposed development and associated vegetation restoration as per this BMP are expected to have a positive impact on the waterway environment of Narrabeen Creek (C & M Consulting Engineers 2020).

3.4.10 Sewage

Sewage generated on the subject property will be piped offsite to the nearest sewage treatment plant. The pipes will be constructed to industry standard, underground and will not impact upon biodiversity values of the site.

3.4.11 Water Contaminants

The proposed development does not represent an ongoing contamination risk. Use of chemicals (fertilisers, insecticides etc), where required, will be carefully managed to prevent leaching into groundwater and waterways. Examples of methods may be the use of cutting and painting larger weeds as an alternative to spraying.

All chemicals used on site should be stored appropriately, according to their relevant Material Safety Data Sheet (MSDS), away from the riparian corridor at all times and adequate spill kits should be made available.

3.4.12 Pests

Rabbits were observed in the development area during the site inspection. It is recommended that construction fencing and sediment fencing be installed in such a way that can also exclude rabbits.

The rabbit control program for the site should be implemented based on identification and fumigation of rabbit warrens, particularly once the exclusion fencing has been installed. Other techniques may be used, such as release of biological control or Pindone. This is to only to be undertaken in consultation with Local Land Services. The site is to be constantly monitored for evidence of rabbit activity. Any damage by rabbits, primarily due to grazing young plants, will require rectification.

Evidence of fox was recorded on the subject site. Trapping should be undertaken alternatively other methods for fox control should be discussed with Local Land Services.

3.4.13 Revegetation

Revegetation is only proposed for Management Zone 1. Prior to revegetation the entirety of Management Zone 1 should be cleared of weeds, the area sprayed with herbicide (i.e. Roundup Biactive) 6 weeks in advance to kill recolonising weeds. Revegetation is to be undertaken by suitably qualified, experienced Bush Regeneration Contractors with a history of work within Swamp Sclerophyll Forest EEC.

All revegetation efforts should be representative of the naturally occurring Swamp Sclerophyll Forest EEC. All plants installed are to be sourced from locally indigenous stock of known provenance that are representative of the Swamp Sclerophyll Forest EEC revegetation list (**Appendix B**). No non-indigenous 'native', cultivars or exotic plant species are to be planted in this zone at any time.

Revegetation of Swamp Sclerophyll Forest EEC is to adhere to the proposed planting densities (**Table 4**) adapted from revegetation of similar communities in the Sydney Water *Storm Water Connections to Natural Waterways Guidelines* (Sydney Water 2014). Plantings within this zone are to be comprised primarily of canopy, midstorey shrubs/trees and groundcover strata.

Plantings must only be undertaken in autumn, winter or early spring after adequate rainfall. Plantings should never be undertaken in summer. Tubestock or hiko cells are adequate for planting in this zone. Planting of advanced stock is not necessary. Planting should be undertaken following a low impact method such as hand digging or hand auger.

The holes dug for each plant should be at least one and a half times the width and double the depth of the rootball. Fertiliser should be added to each hole dug as per the label specifications. Water crystals or wetting agents should be added to each plant hole. This will increase the water holding capacity of the soil and reduce watering schedules. Initial irrigation of the plantings is essential to ensure that the soil forms around the rootball and no air pockets are left. This will be required unless sufficient rainfall (approx 10mm) occurs on the day of planting. A tree guard must be applied to each plant in order to prevent predation by fauna.

Mulch should be used where identified. The use of mulch is important because it provides organic matter to the top soil, improves soil structure and aeration, water infiltration, nutrient availability, and is also useful in the suppression of weed growth. Mulch should be sourced from within the local area. Mulch must be free of weed propagules and invasive woody species such as Coral Tree (Erythrina x sykesii). Mulching should not be undertaken within areas of high potential erosion. It is recommended jute matting is used in these areas prior to revegetation. If deemed necessary to aid in weed control, crushed sandstone (certified clean) may be imported and spread over the soil surface.

Following the revegetation works, irrigation needs to be undertaken for at least 8 weeks following planting to ensure the establishment of the plants. The level of irrigation will be determined by rainfall and temperature experienced at the planting site. A temporary irrigation system may be installed to assist in the establishment of vegetation. Timing of the planting of these areas will need to take into consideration surrounding civil works and erosion/sediment control requirements, these areas will not be planted until earthworks have been completed.

Methods proposed in this BMP may be altered by a qualified Bush Regenerator however, plant species selections cannot be changed without the approval of an Ecologist.

A maximum rate of attrition of 10% is to be tolerated (i.e. 90% survival), with any plant loss above this rate to be replaced at the Bush Regeneration contractor's expense.

Table 4: Proposed Swamp Sclerophyll Forest EEC revegetation planting densities within Management Zone 1

Growth Strata	Estimated Height at Maturity	Planting Density	Number of Plants (tubestock/hiko)
Canopy trees	>6m	One plant per 20m^2	30
Mid-storey trees and shrubs	>1.5m and <6m	One plant per 20m^2	60
Low / groundcover shrubs, sedges, herbs, scramblers, vines and grasses	<1.5m	Two plants per 1m^2	300

3.4.14 Fauna Protections

During the clearing or thinning of any vegetation, including weeds, it is important that landowners are aware of potential for indirect harm to native animals and loss of their natural habitat (regardless of whether vegetation is native or exotic). Landowners who clear trees and vegetation are not exempt from prosecution under the BC Act, *National Parks and Wildlife Act 1974* for harm to protected fauna, or for cruelty to animals under the *Prevention of Cruelty to Animals Act 1979*.

A qualified Ecologist with experience in handling wildlife should be present on the Subject Site to conduct a pre-clearing survey prior to the removal of any shrubs and/or trees to check for the presence of fauna that may be utilising vegetation as habitat.

An Ecologist pre-clearing assessment should occur no more than 1-2 weeks prior to the commencement of clearing works, and at least 12 hours prior to commencement of clearing works.

As a priority the Ecologist should inspect the site for roosting or nesting *Ninox connivens* (Barking Owl), *Ninox strenua* (Powerful Owl), *Daphoensitta chrysoptera* (Varied Sittella) or *Ixobrychus flavicollis* (Black Bittern) as all of these species have potential to roost or breed in the BMP area. If any of these species are detected, works should be put on hold until such time nesting is complete, or the birds have left the area.

The Project Ecologist will identify and delineate which of the trees (including dead trees) scheduled for removal from the proposed development area contain fauna habitat. This will take place during a pre-clearing survey of the Subject Site prior to any tree removal works taking place.

An Ecologist should be present during felling of any dense shrubbery, or hollow-bearing trees in order to capture and relocate and displaced fauna. In the event any fauna is displaced during vegetation clearing, the Ecologist will advise the best course of action. This may involve transportation of injured wildlife to a carer for care and rehabilitation.

In the event any fauna is displaced during weed removal clearing or general site works, the Project Ecologist should be notified immediately to provide expert advice on the best course of action. This may involve an Ecologist attending site to capture and relocate any displaced, healthy animals, or transport any injured wildlife to a carer for care and rehabilitation.

3.4.15 Erosion Control

There is limited potential for erosion to occur across the riparian corridor as there is sufficient ground cover vegetation. No ground disturbance is expected to be undertaken within the mapped riparian corridor and as such, it is unlikely that riparian areas around Narrabeen Creek or the creek bank will become unstable as a result of the construction works as they are a significant distance apart.

Within the wider Subject Site, erosion risk will be moderate to high due to historic clearing and the earthworks proposed. In pre-emptive action, adequate erosion and sediment measures will be in place at all times during construction activities (C & M Consulting Engineers 2020) in case of minor sediment run off and/or disruption to soil profiles. Sediment transport can result in imbalances in nutrient levels across the site and provide a source of contamination and siltation in down slope waterways.

Preceding construction works, the 'Blue Book' (Landcom 2004) should be consulted to ensure any additional necessary erosion controls are adequately installed. This may also involve mitigation measures to control any changes to stormwater flow over the construction site.

3.4.16 Rubbish Removal

Dumped rubbish occurs throughout the BMP area (**Plate 2**). All anthropogenic rubbish must be removed from the BMP as a priority and disposed of in a licensed waste disposal facility. The proponent may be required to remove woody weeds to safely access this rubbish.

Plate 2. Dumped rubbish occurs throughout the BMP Area and must be removed as a priority

4. Work Schedule

Land Eco propose the following schedule to manage the preparation of the Subject Site for construction, the implementation of construction, the remediation of the site (e.g. exposed soils) and the on-going management of weeds across the Subject Site.

Table 5. Work Schedule over the five-year period of this BMP

Action	Work Zone Affected	Phase	Estimated Time Frame	Responsible Party	Requirements	Scheduling of Works (Year)				
						1	2	3	4	5
Implement Hygiene Protocols	Zone 1 and Zone 2	Preceding Construction Phase	Entire length of proposed development and life of this BMP	All involved parties	Implementation of Hygiene Protocols as per the 'Arrive Clean, Leave Clean' guidelines (Commonwealth of Australia 2015)					
Engage Project Ecologist	Zone 1 and Zone 2	Preceding Construction Phase	No later than one month prior to construction commencement.	-Project Coordinator -Project Ecologist	Provide written evidence that a Qualified Ecologist has been engaged in the position of 'Project Ecologist' to implement this BMP.					
Establishment of construction fencing around trees/ native vegetation located outside of clearing/construction footprint. *(*not including TPZ which will be addressed separately by an Arboriculturist)*	Zone 1 and Zone 2	Preceding Construction Phase	As advised by contractor	-Project Coordinator -Qualified Arboriculturist -Project Ecologist	Effectively ensure protection of any native vegetation at risk of adverse impact from construction by marking-out 'maximum limit of disturbance' required for the construction activities with flag-rope/safety bunting or temporary fencing. Prevent accidental impact to native bushland and adjoining riparian corridor by containing construction work in designated areas.					
Establishment of erosion and stormwater controls	Zone 1 and Zone 2	Preceding Construction Phase	As advised by contractor	-Project Coordinator -Construction Contractor -Project Ecologist	Implement all necessary erosion and sediment controls prior to any vegetation clearing, excavation or construction as guided by 'The Blue Book' (Landcom 2004) and Martens (2018). Mitigate indirect impacts by controlling sedimentation transport or changes to stormwater flow during construction					
Engage Qualified Bush Regeneration Contractor	Zone 1 and Zone 2	Preceding Construction Phase	No later than one month prior to completion of construction.	Project Coordinator Project Ecologist	Provide written evidence that a Qualified Bush Regeneration Contractor has been engaged to the satisfaction of this BMP and the Project Ecologist.					
Removal of Vegetation from within proposed Construction Area	Zone 1	During Construction Phase	As advised by contractor	-Project Coordinator -Construction Contractor -Contract Arborist -Project Ecologist	Removal of small trees and shrubs using chainsaw rope and pulley or heavy machinery under the presence of an Ecologist present during tree removals to capture, treat/relocate any displaced fauna. Ensure no damage to surrounding trees/vegetation located outside of the 'maximum limit of disturbance'. Stockpile logs or hollow limbs for use as habitat during revegetation efforts.					

Action	Work Zone Affected	Phase	Estimated Time Frame	Responsible Party	Requirements	Scheduling of Works (Year)				
						1	2	3	4	5
Construction of proposed development	Proposed Development Footprint	During Construction Phase	According to work scheduling	-Project Coordinator -Construction Team	Contain work within designated zones. Prevent any direct impact on surrounding native vegetation and riparian corridor as well as mitigate indirect impacts such as erosion and changed stormwater flow.					
Management of weeds from within all Management Zones in BMP Area	Zone1 and Zone 2	Post construction Phase - Ongoing	As advised by Bush Regenerator	Bush Regenerator	See section 5.3					
Revegetation of Swamp Sclerophyll Forest EEC	Zone1	Post Construction Phase	As advised by Bush Regenerator	Bush Regenerator	See section 5.3					
On-going Management of Plantings	Zone 1 and Zone 2	Post Construction Phase	As advised by Bush Regenerator	Bush Regenerator	See section 5.3					
Bush Regenerator Progress Reports	Zone 1 and Zone 2	Post construction-Ongoing	Once annually for five years. Submit each report by end of financial year.	Bush Regenerator	See section 5.2					
Ecologist Monitoring of native vegetation condition within the Subject Site (including both retained and newly planted vegetation)	Zone1 and Zone 2	Post construction-Ongoing	Once annually for five years. Submit each report by end of financial year.	Project Ecologist	See section 5.1					

5. Monitoring and Reporting

5.1 Annual Monitoring

Annual monitoring is required to assess the effectiveness of the management actions and their progression toward to performance criteria. Monitoring will be undertaken through vegetation surveys and photo monitoring.

Monitoring is to be undertaken by a qualified Ecologist with experience in restoration ecology. The first monitoring event will need to be undertaken prior to works being commenced to establish a benchmark for performance, and to occur on an annual basis until the completion of the project. Monitoring results will be included in the 'Annual BMP Monitoring Report'. Monitoring must take place for five years from the date of adoption of this BMP.

The property owner must commission an Ecologist to establish a minimum of four monitoring plots (20m x 20m in dimension). Within each plot, the Ecologist must identify all plant species and provide an abundance and percentage cover for each species.

Photo monitoring points should be set-up using a permanent reference point to provide a visual reference of changes in the vegetation as follows:

- set up a minimum of four photo monitoring plots within the BMP area (at minimum you will need one plot in each monitoring site)
- place two six-foot star pickets 10 m apart (check dial before you dig and/or services locator prior to disturbing the soil surface)
- record the location (eastings and northings) of the first star picket with a GPS
- take a digital photo from the first star picket looking towards the second star picket

Monitoring must be supported by an 'Annual Biodiversity Monitoring Report' and records kept by the client to ensure site management efforts are contributing to the overall aim of mitigating any biodiversity impacts associated with the proposed development and achieving a long-term net gain in biodiversity for the Subject Site and surrounding locality.

5.2 Annual Bush Regenerators Report

The bush regeneration contractor will produce an annual report by the end of each financial year. The report will detail:

- A GIS map of all of the works methods undertaken
- what environmental threats have been reduced?
- what environmental improvements have been achieved?
- what tasks have been successful?
- what has not been successful?
- what measures, if any, have been taken to rectify problems?
- what issues need to be addressed?
- what are the outcomes of the management activities?
- what species fauna were seen during the year?
- what threatened species (if any) were seen during the year?
- recommendations for revising the task program, if necessary.

5.3 Performance Criteria

Performance criteria to be assessed during site assessments required to complete the monitoring reports should focus on the primary target factors given in **Table 6**.

In the event the survival rate of native plantings falls below the prescribed target of 90%, replacement plantings are to be installed by Qualified Bush Regenerators in order to ensure this minimum survival rate target is achieved. Replacement plantings installed are to be representative of those plants lost (Swamp Sclerophyll Forest EEC species only).

Copies of the routing monitoring reports are to be provided to the Natural Environment Unit of Northern Beaches Council.

Table 6. Performance evaluation targets to be assessed during annual monitoring of the Subject Site for five years from BMP adoption.

Performance Evaluation Targets				
Management Zone	**Performance Criterion**	**Year 1 (12 months after construction certification)**	**Year 2 (24 months after construction certification)**	**Years 3-5**
Management Zone 1	Reduction in Weed Cover	<2% weed cover across zone	<2% weed cover across zone	<2% weed cover across zone
	Woody Weed Control Undertaken	0% woody weed cover	0% woody weed cover	0% woody weed cover
	Complete Revegetation (planting)	Commence revegetation (see Table 4)	Complete revegetation (see Table 4)	Maintain plants at 90% survival
Management Zone 2	Reduction in Overall Weed Cover	<20% weed cover across zone	<10% weed cover across zone	<5% weed cover across zone
	Woody Weed Control Undertaken	<20% woody weed cover	<10% woody weed cover	<2% woody weed cover
Both Zones	Engage Project Ecologist	Formally engage Project Ecologist	Continue engagement of Project Ecologist	Continue engagement of Project Ecologist
	Engage Bush Regeneration Contractor	Formally engage Bush Regenerator	Continue engagement of Bush Regenerator	Continue engagement of Bush Regenerator
	Pest Control Undertaken	Liaise with LLS commence first round of pest control	Continue pest control	Continue pest control
	Vegetation Protections Installed	Install vegetation and tree protections, fencing and signage as per this BMP prior to any earthworks constructions		
	Removal of Dumped Rubbisg	Commence removal of dumped rubbish from BMP area	All dumped rubbish removed from BMP area	No dumped rubbish remaining in BMP area.

5.4 Review of this BMP

This BMP document is to be reviewed by a qualified Restoration Ecologist every five (5) years from the date of its adoption (i.e. the date of Construction Certification).

During the review period, the Ecologist may make changes to planting efforts, weed control measures and other management actions where relevant, under the provision that they can provide adequate evidence to support the reasons for this change.

Changes to management recommendations must only be undertaken once it has been proven that the specific management action has been adequately managed to the extent that it no longer applies or requires less attention than previous.

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Appendices

Appendix A: Revegetation List

Appendix B: Potential Sediment Control

Appendix A: Revegetation Lists

Swamp Mahogany Forest Revegetation List

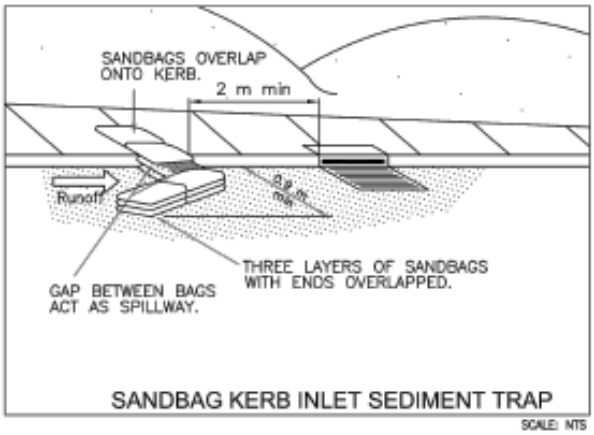
Scientific Name	Canopy (>6m tall)	Midstory (1.5m to 6m tall)	Groundcover (<1.5n tall)	Climbers
Eucalyptus robusta	x			
Banksia integrifolia	x			
Glochidion ferdinandi	x			
Casuarina glauca	x			
Livistona australis	x			
Allocasuarina torulosa	x			
Melaleuca linariifolia		x		
Melaleuca ericifolia		x		
Elaeocarpus reticulatus		x		
Notelaea longifolia		x		
Pittosporum undulatum		x		
Polyscias sambucifolia		x		
Homalanthus populifolius		x		
Acacia parramattensis		x		
Acacia longifolia subsp. longifolia		x		
Dodonaea triquetra		x		
Hibiscus diversifolius		x		
Phragmites australis			x	
Typha orientalis			x	
Gahnia clarkei,			x	
Gahnia sieberiana				
Gonocarpus micranthus			x	
Goodenia paniculata			x	
Goodenia ovata			x	
Viola hederacea			x	
Viola banksii			x	
Hydrocotyle sibthorpioides			x	
Alternanthera denticulata			x	
Calochlaena dubia			x	
Histiopteris incisa			x	
Oplismenus aemulus			x	
Oplismenus imbecillis			x	
Imperata cylindrica			x	
Blechnum camfieldii			x	
Blechnum indicum			x	
Dianella caerulea			x	
Carex appressa			x	
Centella asiatica			x	
Commelina cynaea			x	

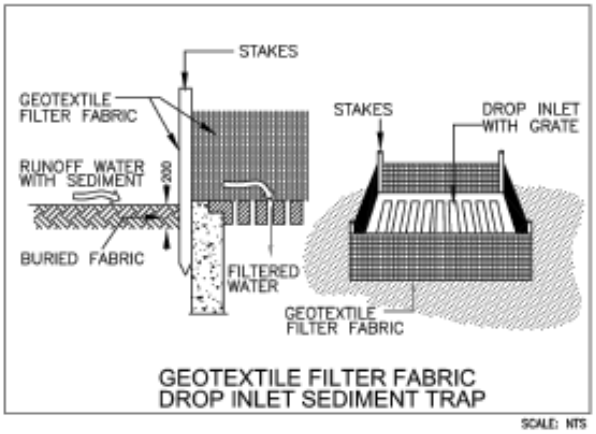
Scientific Name	Canopy (>6m tall)	Midstory (1.5m to 6m tall)	Groundcover (<1.5n tall)	Climbers
Pratia purpurascens			x	
Stephania japonica var. discolor				x
Pandorea pandorana				x
Parsonsia straminea				x
Kennedia rubicunda				x
Cayratia clematidea				x
Cissus hypoglauca				x
Eustrephus latifolius				x
Geitonoplesium cymosum				x
Glycine clandestina				x
Hibbertia dentata				x
Hibbertia scandens				x
Morinda jasminoides				x
Smilax australis				x
Smilax glyciphylla				x
Geranium homeanum			x	
Geranium solanderi			x	
Dianella caerulea			x	
Entolasia stricta			x	
Entolasia marginata				
Lomandra longifolia			x	
Pteridium esculentum			x	

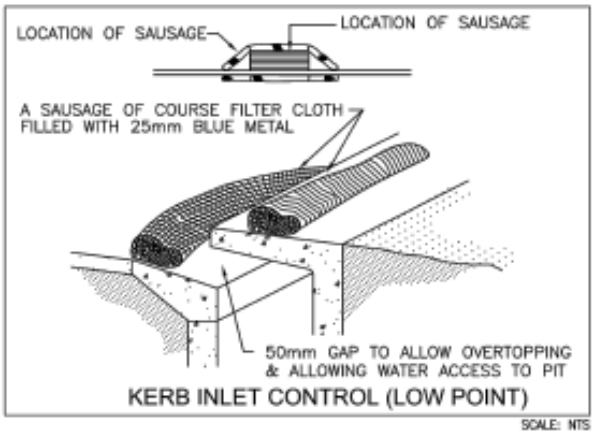
Wetland/Stormwater Ponds Revegetation List

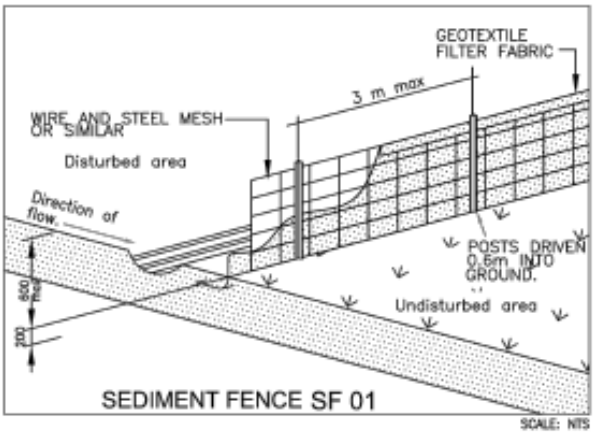
Scientific Name	Native Wetland Plant
Baumea articulata	x
Baumea juncea	x
Baumea rubiginosa	x
Bolboschoenus fluviatilis	x
Carex appressa	x
Cyperus exaltatus	x
Cyperus polystachyos	x
Isolepis nodosa	x
Juncus kraussii	x
Juncus polyanthemus	x
Juncus usitatus	x
Leptocarpus tenax	x
Lobelia alata	x
Phragmites australis	x
Typha orientalis	x
Gahnia clarkei,	x
Myriophyllum trachycarpum	x
Hydrocotyle sibthorpioides	x
Alternanthera denticulata	x
Calochlaena dubia	x
Persicaria decipiens	x
Persicaria strigosa	x
Philydrum languinosum	x
Centella asiatica	x
Ranunculus inundatus	x
Schoenoplectus validus	x
Triglochin procera	x
Villarsia exaltata	x

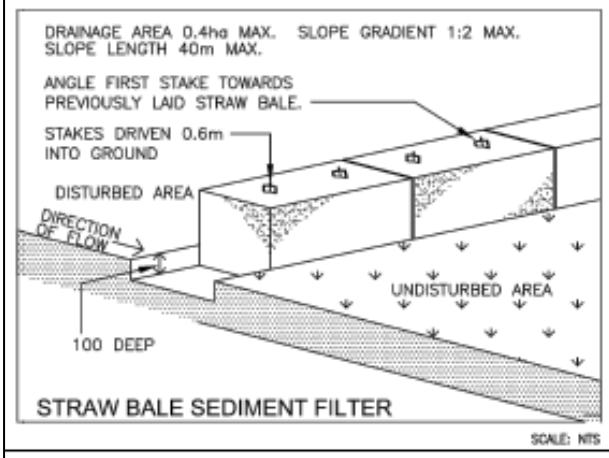
Appendix B: Potential Sediment Control Measures

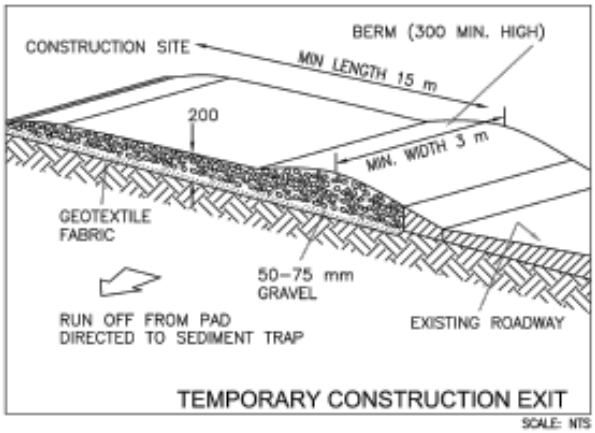












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