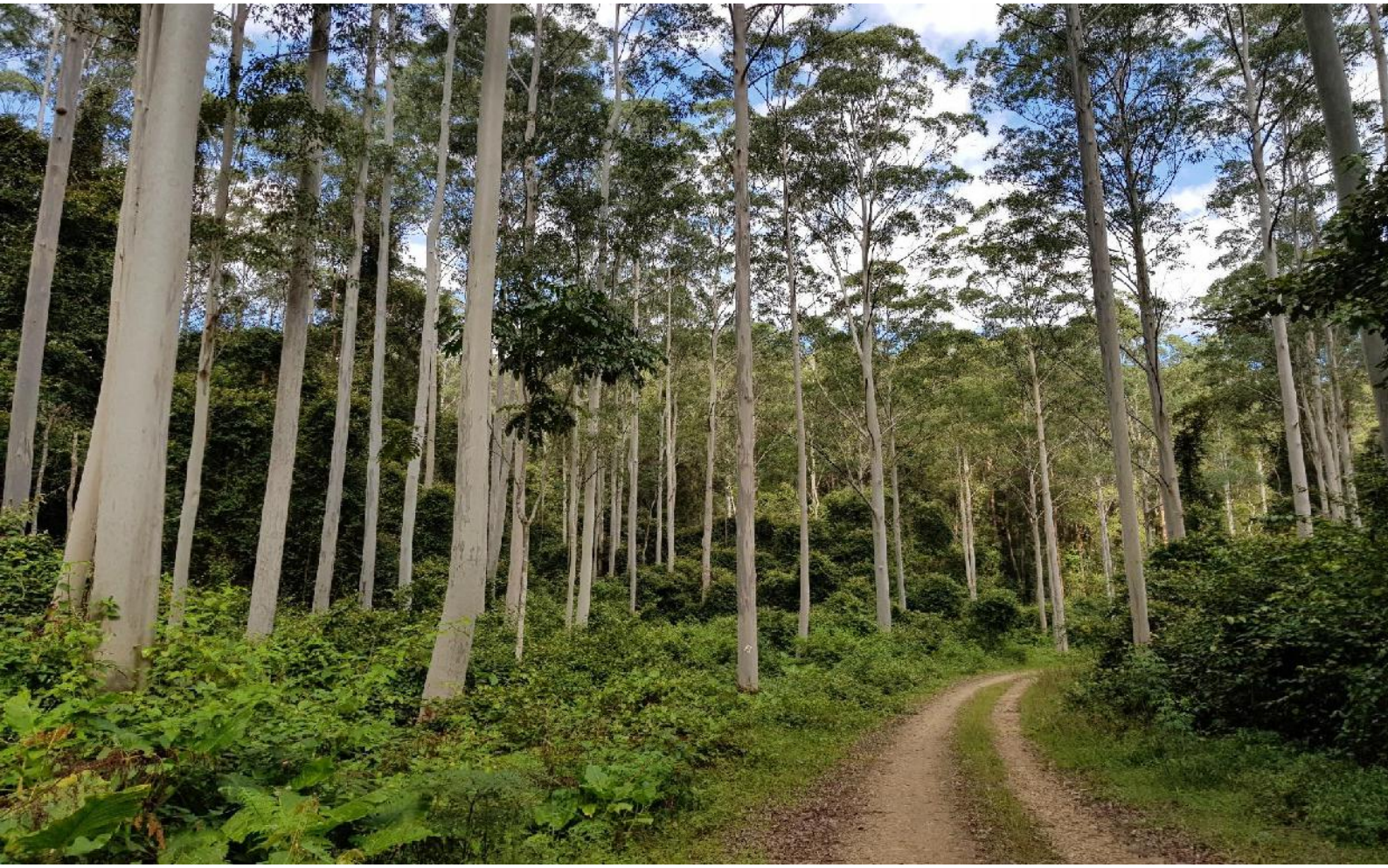
HABITAT
ENVIRONMENTAL SERVICES

Vegetation Management Plan

51, 134, & 146 Station Lane, Lochinvar, NSW

HBT0021_VMP_V1.0

28/04/2022



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Document No: HBT0021_VMP_V1.0

28/04/2022

Prepared for

McCloy Project Management Pty Ltd

Prepared by

Habitat Environmental Services Pty Ltd

Document Control

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Contents

Definitions

Bush regeneration - Defined by the Australian Association of Bush Regenerators (AABR) as the practice of restoring bushland by focusing on reinstating and reinforcing the systems' ongoing natural regeneration processes. It may also involve assisting the recovery of ecosystems' that have been degraded, damaged, or destroyed. Regeneration can be divided into the following categories:

- Natural regeneration
- Assisted regeneration
- Reconstruction and fabrication

Ecological restoration - Aims to restore pre-existing indigenous ecosystems and ecological processes, maintaining and developing the capacity of a natural system to self-perpetuate. (Perkins, 1999, NSW Department of Infrastructure, Planning and Natural Resources 2003.

Resilience - Refers to the ability of an ecosystem to regenerate naturally and to withstand, or recover from, disturbances such as weed invasion, clearing, or fire.

Natural ecosystems - Communities of biotic and abiotic components in oceans, rivers and on land in which the components interact to form complex food webs, nutrient cycles and energy flows. The term 'ecosystem' describes an ecological community of any size or scale.

Management Zone – Management zones are areas that require different levels of management intervention or different restoration actions at different times. These actions can include maintenance and repair, measures to minimize impacts to flora and fauna during restoration works.

Stream Order – The watercourse order as classified under the Strahler System using Hydrospatial data.

Vegetated riparian zone (VRZ) – The required width of the VRZ measured from the top of the high bank on each side of a watercourse

1 Introduction

1.1 Project background

Habitat Environmental Services Pty. Ltd. (Habitat) was engaged by McCloy Project Management Pty Ltd to prepare a Vegetation Management Plan (VMP) for the project site located at 51, 134, & 146 Station Lane, Lochinvar, NSW (**Figure 1**). The VMP has been prepared for the site in anticipation of consent from Maitland City Council (Council) for the approval of a residential development project (**Figure 2**).

The VMP was prepared following a site inspection undertaken by Ecologist Dr. Gilbert Whyte on 16/02/2022. Information presented in a Biodiversity Development Assessment Report (BDAR), prepared for the development by Anderson Environment and Planning (AEP May 2020), was also reviewed.

The VMP aims to provide suitable management actions and strategies to restore native vegetation and biodiversity values within areas of the Subject Site, hereafter referred to as the VMP Area, as shown in **Figure 3** (further described in **Section 3**).

1.2 Objectives

The VMP is a practical document specifically aimed at improving the integrity of existing areas of native vegetation within the VMP Area. The VMP also aims to re-establish native vegetation in cleared areas and improve habitat values for biodiversity.

The VMP has been prepared in accordance with the requirements provided by Maitland City Council. Given that mapped waterways occur within the VMP, consideration was also given to the *Guidelines for Vegetation Management Plans on Waterfront Land* (NRAR 2012).

The overarching objective of the VMP is to guide the establishment of a weed-free self-maintaining ecosystem in the VMP Area. Specific objectives include the following:

- Provide management strategies for the control of weeds.
- Provide management strategies for the retention, protection and rehabilitation of existing native vegetation communities to a desirable state.
- Promote the rehabilitation of key plant species to enhance habitat values.
- Provide management strategies to reduce potential impacts of the surrounding land use on biodiversity and ensure that the construction phase of the project has minimal impact on biodiversity.
- Designate performance criteria.
- Define a maintenance and monitoring program for ongoing management.

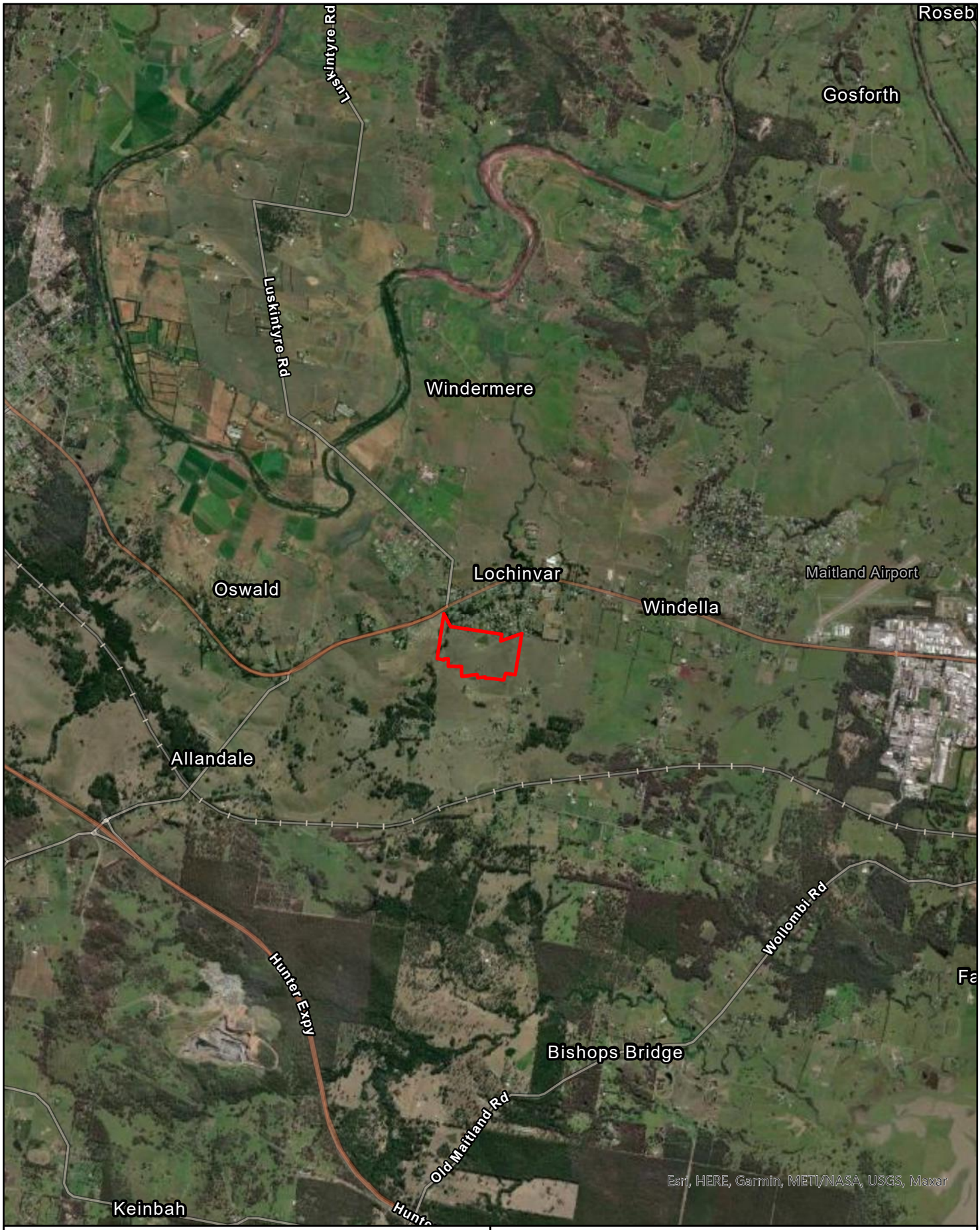
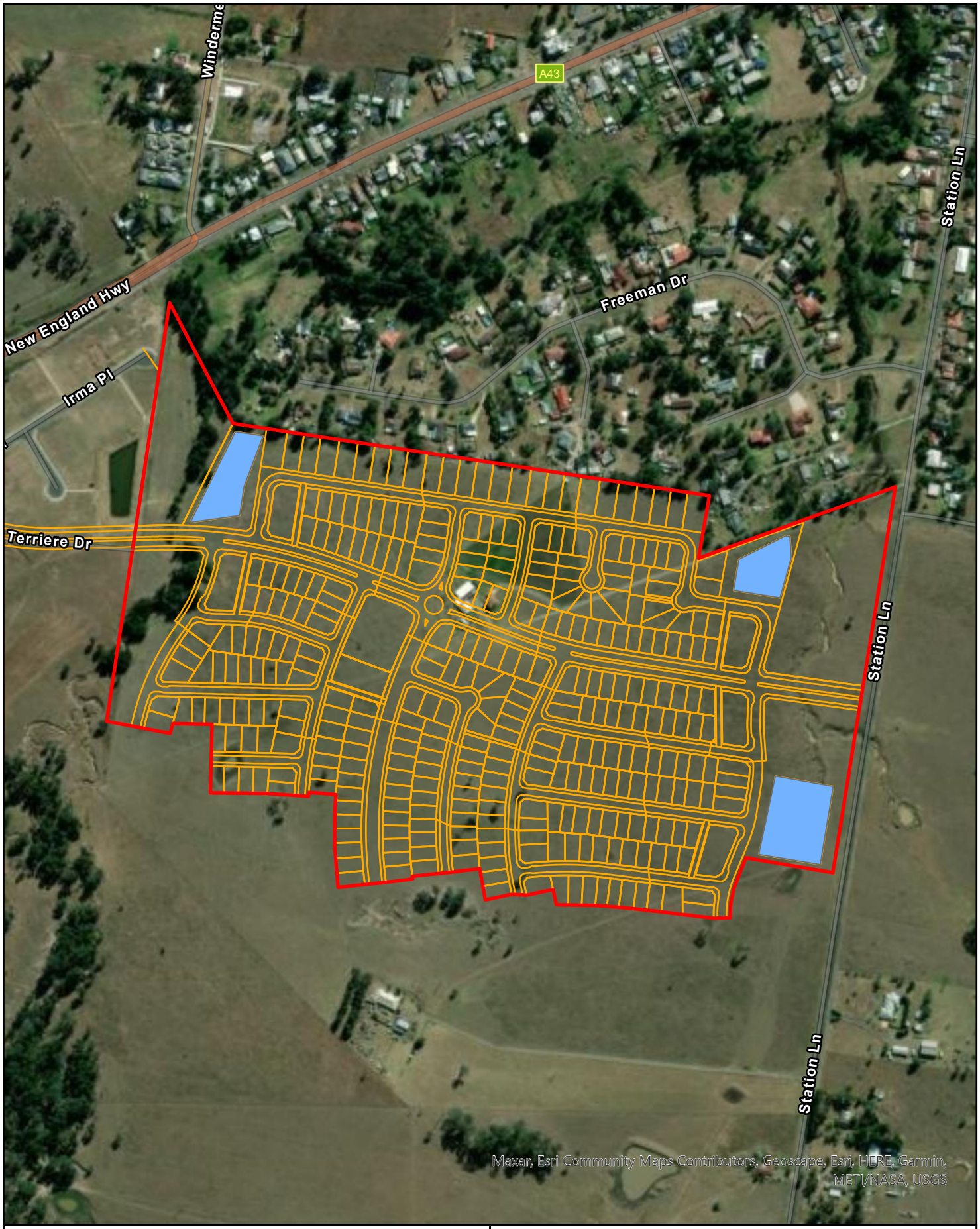


Figure 1: Locality Map



0 0.05 0.1 0.2 0.3 0.4 0.5 Kilometers

Legend

- Subject Site Boundary
- Development Design
- Detention Basins

Figure 2: Proposed Development

2 Legislation

The following Commonwealth and State Government legislation and policies were considered in the preparation of this VMP:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Environment Planning and Assessment Act 1979* (EP&A Act)
- NSW *Biodiversity Conservation Act 2016* (BC Act)
- NSW *Biodiversity Conservation Regulation* 2017
- State *Environmental Planning Policy Koala Habitat Protection 2021* (Koala SEPP)
- *Water Management Act 2000* (WM Act)
- *Biosecurity Act 2015* (Biosecurity Act)

2.1 Biosecurity Act 2015

Under the Biosecurity Act, all plants in NSW are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. There are four weed categories that are recognised, although all weed species are regulated with a general biosecurity duty:

- Weeds of National Significance (WONS): These weeds have national importance due to their potential for spread and due to their socioeconomic and environmental impact.
- National Environmental Alert List weeds: Alert Weeds are non-native plant species that are in the early stages of establishment and have the potential to become a significant threat to biodiversity if they are not managed.
- Water weeds.
- Native plants considered weeds.

2.2 Water Management Act 2000

Controlled activities carried out in, on or under waterfront land are regulated by the Water Management Act 2000 (WM Act). 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.

On 1 July 2012 new rules commenced regarding controlled activities within riparian corridors. The new rules amend the riparian corridor widths that apply to watercourses, providing more flexibility in how riparian corridors can be used and making it easier for applicants to determine the Office of Water controlled activity approval requirements. Key aspects of the changes include:

- Provision of greater flexibility in the allowable uses and works permitted within riparian corridors.
- The core riparian zone and vegetated buffer have been combined into a single Vegetated Riparian Zone (VRZ).
- The width of the VRZ within the riparian corridor has been pre-determined and standardised for first, second, third and fourth order and greater watercourses.
- Where suitable, applicants may undertake non-riparian corridor works or development within the outer 50 per cent of a VRZ, as long as they offset this activity by connecting an equivalent area to the RC within the development site.
- A new 'riparian corridors matrix' enables applicants to determine what activities can be considered in riparian corridors

The rehabilitation works to be undertaken within the riparian corridor of the VMP area an allowable activity.

3 Site Description

3.1 Landscape Context

Subject Site

The Subject Site is approximately 44.64 hectares (ha) and is located directly south of the township of Lochinvar within the Maitland Local Government Area (LGA). The site occurs within a rural landscape and has long history of agricultural development. The majority of the site has been cleared, and native vegetation is largely limited to the occurrence of isolated trees and small patches of native vegetation (further discussed in **Section 3.3**).

The Subject Site has a relatively flat topography with an elevation that ranges from 52 meters above sea level (MSL) in the central portion of the site to 35m (MSL) in the eastern and western portions.

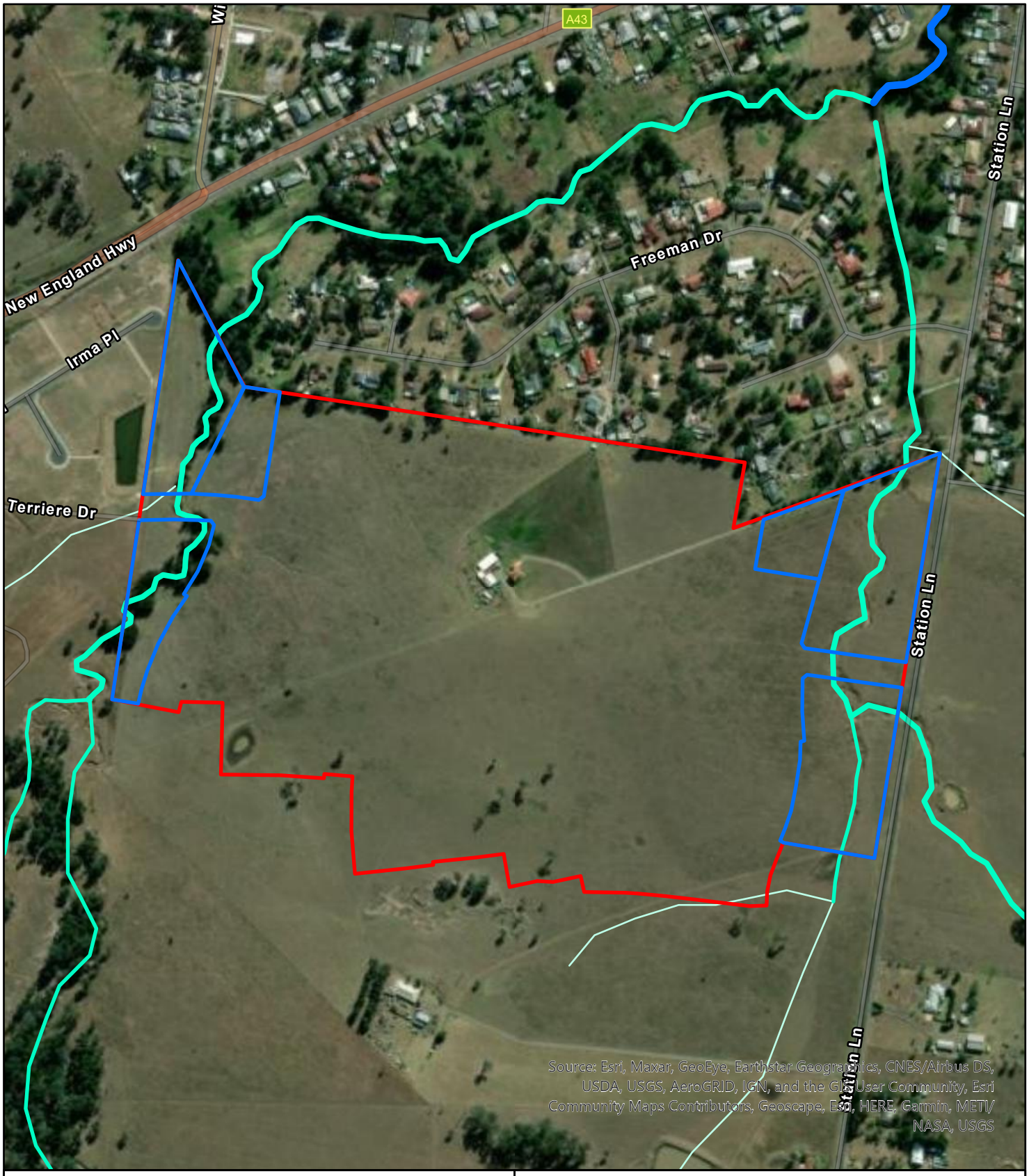
VMP Areas

The VMP Area is made up of four separate land parcels that were selected to ensure that the riparian zones of the mapped waterways within the Subject Site are protected and restored. Drainage channels and associated mapped waterways are shown previously in **Figure 3**.

For the purposes of discussing the implementation of various management strategies, the VMP Area was delineated into two separate areas:

- **VMP Area (East)** – This area is comprised of two separate land parcels that occur in the eastern portion of the Subject Site. The area is predominantly cleared of native vegetation and is approximately 4.94 ha. A central watercourse flows through both land parcels in a northern direction. The central watercourse is a second order stream in the southern portion and forms a third order stream in the northern portion. A review of hydrospatial data shows that first, second and third order streams flow into the central watercourse from the east and from the south (Strahler 1952) (see **Figure 3**).
- **VMP Area (West)** – This area is comprised of two separate land parcels that occur in the western portion of the Subject Site. The total area of the two land parcels is approximately 3.54 ha. The area is predominantly cleared of native vegetation, although narrow strips of riparian vegetation occur within and directly adjacent to a central watercourse, which flows in a northern direction. A review of hydrospatial data indicates that the central watercourse is a third order stream, which is fed from west and from the south by first and second order streams (Strahler 1952).

Site photographs taken on 16/02/22 showing general features of each land parcel are presented in **Plate 1** and **Plate 2**. Additional site photographs of key habitat features are presented in **Appendix A**.



0 0.05 0.1 0.2 0.3 0.4 0.5 Kilometers

Figure 3: VMP Area

Legend

- VMP Area
- Subject Site Boundary

Stream_Order

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream

Plate 1 **Grassland areas within the northern land parcel of the eastern VMP Area**

Plate 2 **Riparian vegetation within the northern land parcel of the western VMP Area**

3.2 Geology and Soils

The *Soil Landscapes of the Singleton 1:250,000 Sheet* (Kovac and Lawrie 1991) indicates that the entirety of the Subject Site lies within the Lochinvar Soil Landscape. This soil landscape covers undulating rises around the village of Lochinvar. The main soils are comprised of the following:

- Non-calcic Brown Soils (Db1.12) occur on the gentle slopes.
- Brown Podzolic Soils (Db2.11, Db1.41) occur on steeper areas.
- Yellow Solodic Soils (Dy2.12) occur on the mid to lower slopes of the steeper hills and in some drainage lines.

3.3 Vegetation

Regional Vegetation Mapping Projects

The most relevant regional vegetation mapping project that pertains to the locality of the Subject Site is the *Lower Hunter and Central Coast Regional Environment Management Strategy* (LHCCREMS 2003, VIS ID 2227). This mapping is broadscale and indicates that the Subject Site lies within an area mapped as *Lower Hunter Spotted Gum Ironbark Forest,* which is listed as an Endangered Ecological Community (EEC) under the BC Act. The Lower Hunter Spotted Gum Forest EEC mapping undertaken by Bell (2010), also shows remnants of the community in areas surrounding the Subject Site.

Areas to the south of the Subject Site are mapped as *Hunter Lowland Redgum Forest,* which is also listed as an EEC.

The site inspection revealed that the majority of the VMP Area is cleared of native vegetation, although relict floristic elements of *Lower Hunter Spotted Gum Ironbark Forest* and *Hunter Lowland Redgum Forest* exist in the form of isolated trees and small patches of forest remain in some areas.

Plant Diversity

The site inspection determined that the VMP Area contains a relatively low diversity of native plant species. This was expected given that the extent of vegetation clearing that has occurred and the sites long-term history of agricultural development.

A total of 38 natives and 33 exotic plant species were detected. The majority of these species were comprised of common grasses and herbs that are typically associated with agricultural landscapes.

A complete list of plant species is presented in **Appendix A**.

Weeds

As stated previously, a total of 33 exotic plant species were detected throughout the VMP Area. Of these species, seven are listed as Priority Weeds for the Hunter Region (DPI 2022) and five are Weeds of National Significance (WONS) (**Table 1**). The severity of weed infestation was relatively low for all species except for Fireweed (*Senecio madagascariensis*), which occurred sparsely but consistently throughout the Subject Site. Due to the sparsity of infestations, no weed mapping was undertaken.

Table 1 Priority Weeds and WONS detected within the VMP Area

Family	Scientific Name	Common Name	Status
Asteraceae	*Senecio madagascariensis*	Fireweed	Priority Weed and WONS
Oleaceae	*Olea europaea subsp. cuspidata*	African Olive	Priority Weed
Rosaceae	*Rubus anglocandicans*	Blackberry	Priority Weed and WONS
Solanaceae	*Cestrum parqui*	Green Cestrum	Priority Weed
Cactaceae	*Opuntia stricta*	Prickly Pear	Priority Weed and WONS
Cactaceae	*Opuntia aurantiaca*	Tiger Pear	Priority Weed and WONS
Solanaceae	*Lycium ferocissimum*	African Boxthorn	Priority Weed and WONS

Vegetation Communities

Grasslands

The majority of the Subject Site and VMP Area is vegetated with grassland vegetation containing a high coverage of exotic perennial grass species and low diversity of native species. A summary of the floristic characteristics of the grasslands are below:

- The dominant exotic grass species included: *Paspalum dilatatum* (Paspalum), *Setaria parviflora* (Pigeon Grass), *Sporobolus africanus* (Parramatta Grass) *Axonopus fissifolius* (Narrow-leaved Carpet Grass) and *Chloris gayana* (Rhodes Grass).
- The dominant exotic herbs included: *Verbena bonariensis* (Purple Top), *Hypochaeris radicata* (Cat's Ear), *Conyza bonariensis* (Flax-leaf Fleabane), *Aster subulatus* (Wild Aster), *Sida rhombifolia* (Paddy's Lucerne), *Facelis retusa* (Annual Trampweed) and *Linum trigynum* (French Flax).
- Native grasses occurred in sparse occurrences and included the following species: Bothriochloa macra (Red-leg Grass), *Capillipedium spicigerum* (Scented-top Grass), *Cynodon dactylon* (Couch), *Panicum effusum* (Hairy Panic), *Dicanthium sericeum* (Blue Grass), *Cymbopogon refractus* (Barbed-wire Grass), *Themeda australis* (Kangaroo Grass), *Bothriochloa decipiens* (Pitted Bluegrass), *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Sporobolus creber* (Slender Rat's Tail Grass), *Aristida ramosa* (Purple Wiregrass), *Digitaria parviflora* (Small-flowered Finger-grass) and *Eragrostis brownii* (Brown's Lovegrass).
- Occasional native herbs were observed, including: *Tricoryne simplex* (Autumn Lily), *Centella asiatica* (Indian Pennywort), *Dichondra repens* (Kidney Weed), *Chrysocephalum apiculatum* (Yellow Buttons), *Dianella revoluta var. revoluta* (Blue-flax Lily), *Wahlenbergia communis* (Australian Bluebell), *Pimelea glauca* (Smooth Rice-flower) and *Asperula conferta* (Common Woodruff).

- Isolated trees and shrubs occur within the grassland. The main shrub species include *Acacia salicina* (Sally Wattle) and *Hakea sericea* (Needlebush). Tree species include *Eucalyptus crebra* (Narrow-leaved Ironbark), Eucalyptus moluccana (Grey Box) and to a lesser extent *Eucalyptus tereticornis* (Forest Redgum).
- The dominant Priority Weed within the grasslands was *Senecio madagascariensis* (Fireweed). Occasional occurrences of *Opuntia stricta* (Prickly Pear) also occurred.

Constructed Dam

A constructed dam occurs to the south of the Eastern VMP Area. This dam does not contain native emergent vegetation, although small patches of *Ludwigia peploides* (Water Primrose) and regenerating *Eleocharis sphacelata* was observed.

Swamp Oak Floodplain Forest (Riparian Vegetation)

The riparian zone of the drainage channel that runs in a northly direction through the western VMP Area is vegetated with a narrow strip of woody vegetation. A summary of the floristic characteristics of this vegetation is below:

- The canopy is dominated almost exclusively with regenerating *Casuarina glauca* (Swamp Oak). Occasional other canopy species occur such as *Eucalyptus tereticornis* (Forest Redgum), *Angophora floribunda* (Rough-barked Apple) and *Acacia salicina* (Sally Wattle).
- The shrub layer is sparse with occasional shrubs such as *Acacia elongata* (Swamp Wattle), *Melaleuca armillaris* (Bracelet Honey-myrtle) and *Hakea sericea* (Needlebush).
- The groundcover is predominantly exotic and dominated by introduced grasses such as *Erharta erecta* (Panic Veldt Grass), *Paspalum dilatatum* (Paspalum), *Setaria parviflora* (Pigeon Grass), *Sporobolus africanus* (Parramatta Grass) *Axonopus fissifolius* (Narrow-leaved Carpet Grass) and *Chloris gayana* (Rhodes Grass).
- Several priority weeds occur, although levels of infestation were relatively low for all species, including *Olea europaea* subsp. *cuspidata* (African Olive), *Rubus anglocandicans* (Blackberry), *Cestrum parqui* (Green Cestrum), *Opuntia stricta* (Prickly Pear), *Opuntia aurantiaca* (Tiger Pear) and *Lycium ferocissimum* (African Boxthorn).

Vegetation Mapping

The extent of each vegetation community within the eastern and western VMP Areas was delineated during the site inspection and is illustrated respectively on **Figure 4** and **Figure 5**.

0 0.020.04 0.08 0.12 0.16 0.2

Kilometers

Legend

VMP Area

Subject Site Boundary

Vegetation

Grassland (Native/ Exotic)

Stream_Order

1st Order Stream

2nd Order Stream

3rd Order Stream

Figure 4: Vegetation Mapping - Eastern VMP Area

0 0.020.04 0.08 0.12 0.16 0.2

Kilometers

Legend

VMP Area

Subject Site Boundary

Vegetation

Grassland (Native/ Exotic)

Swamp oak Floodplain Forest

Stream_Order

1st Order Stream

2nd Order Stream

3rd Order Stream

Figure 5: Vegetation Mapping - Western VMP Area

4 Management Zones

For the purposes of implementing appropriate management strategies, two management zones were created within the VMP Area:

- **Management Zone A (Woodland)** – This management zone is defined as the riparian zone of the central watercourses that flow through the Western VMP Area and the central portion of the Eastern VMP Area**.** As discussed previously, the watercourses contain first, second and third order steams, although the majority of the length of the central channels in both the Eastern and Western VMP are comprised of second and third order streams (see **Section 3.1**). In accordance with the *Guidelines for Vegetation Management Plans on Waterfront Land* (NRAR 2012), the riparian zone was defined as approximately 30m either side of the central channel.
- **Management Zone B (Managed Grassland)** – This management zone is defined as the remaining areas of the VMP Area that cannot be revegetated with woodland due to the location of detention basins or due to the potential for increased bushfire risk. These areas have a predominantly relatively flat topography and are suitable for establishment of grassland vegetation.

The extent of each management zone within the VMP Area is illustrated on **Figure 6**.

0 0.05 0.1 0.2 0.3 0.4 0.5
Kilometers

Legend

Detention Basins

Management_Zones

Management Zone A (Woodland)

Management Zone B (Managed Grassland)

Figure 6: Management Zones

5 Management Strategies

5.1 Vegetation Protection

Fencing

The perimeter of the VMP Area should be fenced with bollard and cable, or similar, fencing. These works should be conducted prior to the construction phase of the project. Inspection and maintenance of the fencing is be conducted as required.

Signage

Appropriate "No Go" signage and high visibility tape is to be installed along the fence lines of the VMP Area during the construction phase. All construction personnel are to be informed prior to site entry that the VMP Area is a No Go Zone, and that no vehicles or machinery is permitted entry. Additionally, no construction materials or stockpiles are to be stored within the VMP Area.

Following completion of the construction period, signage is to be replaced with appropriate signage that indicates to the public that the area is a "Conservation Area".

5.2 Topsoil Management

Topsoil Translocation

The VMP Area generally contains a good coverage of groundcover throughout. This groundcover contains key native plant species that should be protected to allow for natural regeneration of native vegetation communities. The VMP Area also contains natural drainage channels, the health of which can influence downstream aquatic habitat to the north.

Based on the above, no topsoil translocation is to occur within the VMP Area.

5.3 Erosion Control

The following recommendations are to be implemented during the construction and operational phases of the project to reduce erosion potential within the Subject Site:

- Sediment fences should be installed along the boundaries of the VMP Area to prevent the spread of sediment and other materials. This is particularly important to protect the health of watercourses within these areas.
- Sediment fences are also be installed around all construction areas where exposed soil or stockpiles occur.
- Soil stockpiles to be maintained long-term, should be covered or seeded with a temporary cover crop to further reduce the potential for sediment transfer or the establishment of

weeds. It is important that cover crops are confirmed to be of a sterile variety prior to seeding to ensure that unwanted non-native species do not establish within the Subject Site.

- Any rills or areas of the site showing signs of erosion should be rehabilitated within two weeks to prevent sediment transfer. Sediment fences should also be erected in these areas.

5.4 Weed Control

All weed control works are to be undertaken by a suitably qualified bush regenerator that has experience controlling weeds in sensitive environments such as riparian vegetation. All works must be supervised by someone who holds at a minimum, a Certificate III in Bushland Regeneration/ Conservation and Land Management and at least 500 hours of practical bushland regeneration. Those working under the supervisor must have at least 100 hours experience in bush regeneration and should be at a minimum enrolled in a Certificate II in Bushland Regeneration/ Conservation and Land Management.

Several species of priority weeds were detected within the VMP Area (see **Table 1** in **Section 3.3**). Given that the severity of infestation was relatively low for all species throughout the VMP Area, annual weed control is recommended, with follow-up works within approximately 2 weeks of initial works.

Weed control should be undertaken in accordance with best practise methodologies in accordance with methods described in Ensbey (2007). A Weed Control Protocol is presented in **Appendix C**.

The frequency of rehabilitation maintenance is directly dependent on monitoring assessments. The feedback from monitoring will indicate the location, timing, species and preferred methods for weed management, and whether any follow-up works are required for the revegetation areas.

Following initial weed control within the Subject Site, follow-up weed control should be conducted every 3 months for the first 12 months after planting. This will ensure that weed infestations do not become re-established. Weeds are to be continually suppressed and maintained at achieved target levels (100% removal for noxious weeds and 90% removal for other weeds) for a minimum two-year period following the initially 12-month management phase. Where targets have not been met the maintenance phase will need to be extended.

5.5 Revegetation

As stated previously, the VMP Area occurs within an agricultural landscape where historical land management practises have reduced the extent and integrity of native vegetation. Revegetation is required to restore native vegetation communities and improve habitat values for native biodiversity.

Prior to agricultural development, the Subject Site and surrounding areas were likely to have been vegetated with open forest and woodland vegetation. Revegetation within each management zone should aim to restore as target vegetation community as discussed in the following subsections.

Management Zone A (Woodland)

Areas within Management Zone A are suitable for the re-establishment of *Hunter Lowland Redgum Forest*. This community occurs on gentle slopes of depressions and drainage flats on the Hunter Valley floor.

Hunter Lowland Redgum Forest has an open forest to woodland structure where the most common canopy tree species are *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus punctata* (Grey Gum). Other frequently occurring canopy species are *Angophora floribunda* (Rough-barked Apple). The shrub layer is generally sparse and common shrub species include *Breynia oblongifolia* (Coffee Bush), *Leucopogon juniperinus* (Prickly Beard-heath), *Daviesia ulicifolia* (Gorse Bitter Pea) and *Jacksonia scoparia* (Dogwood). The ground cover typically comprises grasses and herbs with common species being *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Pratia purpurascens* (Whiteroot), *Lomandra multiflora* (Many-flowered Mat-rush), *Cymbopogon refractus* (Barbed Wire Grass), *Cheilanthes sieberi* (Poison Rock Fern) and *Dichondra repens* (Kidney Weed).

The revegetation effort should focus on the establishment of key species that will from a complex vegetation strata. This will create habitat suitable for the natural establishment of other native plant species and provide foraging habitat and refugia for native fauna.

A list of species recommended for revegetation of Management Zone A is presented in **Table 2**.

Table 2 Management Zone A – Recommended Plant Species (Revegetation)

Scientific Name	Common Name	Recommended Density
Canopy Stratum		
Angophora floribunda	Rough-barked Apple	1 tree/ 20m²
Eucalyptus tereticornis	Forest Red Gum	1 tree/ 20m²
Eucalyptus moluccana	Grey Box	1 tree/ 20m²
Shrub Stratum		
Breynia oblongifolia	Coffee Bush	1 shrub/ 5m²
Leucopogon juniperinus	Prickly Beard-heath	1 shrub/ 5m²
Jacksonia scoparia	Dogwood	1 shrub/ 5m²
Ground Stratum		
Themeda australis	Kangaroo Grass	4 plants/ 1m²
Cymbopogon refractus	Barbed-wire Grass	4 plants/ 1m²
Lomandra longifolia	Spiney-headed Matt-rush	4 plants/ 1m²

Management Zone B (Managed Grassland)

Areas within Management Zone B are suitable for the re-establishment of managed grassland. Non-invasive native groundcover species are appropriate. Tussock grass species and sedges may be planted around the edges of detention basins. Low-lying groundcover species are appropriate in areas that will be managed.

A list of recommended species is presented in **Table 3**.

Table 3 Management Zone B – Recommended Plant Species (Revegetation)

Scientific Name	Common Name	Recommended Density
Tussock Species		
Cymbopogon refractus	Barbed-wire Grass	4 plants/ 1m²
Carex appressa	Tall Sedge	1 plant/ 1m²
Imperata cylindrica	Blady Grass	4 plants/ 1m²
Themeda australis	Kangaroo Grass	4 plants/ 1m²
Lomandra longifolia	Spiney-headed Matt-rush	1 plant/ 1m²
Low-lying Species (Manageable)		
Bothriochloa macra	Red-leg Grass	4 plants/ 1m²
Cynodon dactylon	Australian Couch	4 plants/ 1m²
Dichanthium sericeum	Silky Blue Grass	4 plants/ 1m²
Microlaena stipoides var. stipoides	Weeping Grass	4 plants/ 1m²

Maintenance

- Watering of all seedlings should be conducted immediately after planting to ensure they have a greater chance of establishing.
- Regular watering of plants during the establishment phase will reduce costs associated with replacement planting as mortality of seedlings would be much higher if adequate water is not provided. Native plants sourced from local provenance should be used where possible during supplemented planting.
- The tree and shrub plantings should be planted during cooler months (Spring or early Autumn) of the year when adequate rains are forecasted.
- In dry conditions plantings should be monitored and watered if required.
- All trees should have individual tree guards staked around them to protect them from herbivory and other environmental factors.

6 Monitoring and Reporting

6.1 Timing

Baseline monitoring is to be conducted before the management strategies detailed in **Section 5** are implemented. Monitoring is then to occur every six (6) months for a minimum period of five (5) years.

6.2 Monitoring Methods

A minimum of four monitoring locations are to be established in each management zone during baseline monitoring. The following methodology is to be implemented at each monitoring location.

100 m Transects

- A 100m transect or meander is to be conducted at each monitoring location. Using a line of best-fit, the transect is to be positioned to capture representative floristic data within the management zone. Care should be taken to avoid ecotones.

- Each end of the transect should be marked with a GPS so that the transect can be consistently located each year.
- Place a 1 x 1m quadrat every 10 meters (starting at the 0 point) on alternating sides along the transect. The percentage cover of all species should be recorded

20mx20m Floristic Plots

- Plots should be established during baseline surveys in areas of each management zone where the highest density of weeds occur.

- Use stakes and/or flagging tape to mark out plot corners
- Orient plots north south
- Survey using meander method recording all weed species within the quadrat
- Record location of quadrats using GPS
- Record densities of all plant species (including weeds) in each distinct layer present within the plot. Treat each vegetation layer (if present) as follows:
    - Canopy layer > 5m
    - Tall shrub layer 2 -5m
    - Small shrub layer 0.5m – 2m
    - Ground cover layer < 0.5 m

Photo Monitoring

A photograph from each corner of the plot facing toward the centre should be taken during each monitoring event. All efforts should be made to ensure excessive sunlight does not affect the image quality and that image framing for subsequent photos matches the baseline image. The following methods are also to be followed to ensure consistency between monitoring events:

- Star picket/wooden stakes to be installed to mark the corners of the plot.
- Photos to be taken setback at a minimum or 2m from the stake.
- Yellow safety caps to be placed on star pickets.
- Photos should include a photo point number
- Photos taken at a consistent height using the established reference point.

6.3 Reporting

A monitoring report should be prepared and provided to Council following each monitoring event. Key objectives of the report include the following:

- Present the findings of the monitoring event using relevant maps, figures and tables.
- Provide a summary of the effectiveness of the implementation of each of the management strategies presented in **Section 5,** in consideration of the performance criteria detailed in **Section 7.**
- Provide adaptive management recommendations to ensure that ensure that performance criteria are achieved.

7 Targets and Performance Criteria

Targets and performance criteria for the management and rehabilitation of vegetation within the VMP Area are as follows:

- Rehabilitated areas are to have a species composition that represents the following target vegetation community types:
- Management Zone A (Woodland) should aim to represent a woodland form of *Hunter Lowland Redgum Forest*
- Management Zone A (Woodland) should have a canopy projective foliage coverage (PCF) of 20-30% and a sparse open shrub layer.
- Management Zone B (Managed Grassland) should be managed. Disturbed areas should be revegetated with native groundcover species.
- The VMP Areas should be free of both Priority weeds and Weeds of National Significance (WONS).
- The VMP Areas will be free of environmental weeds to an extent that the establishment of native plantings is not adversely affected.
- VMP Areas should be vegetated with no less than 80% native species.

8 Risks and Contingency Measures

The VMP Area occurs within an agricultural landscape where various risks exist, which may affect the success of implementation of each of the management strategies. Risks include the following:

- Bushfire could adversely affect the site by reducing flora diversity in the VMP Area and destroy tube-stock plantings.
- Adverse weather could prevent establishment of tube-stock.
- Native or feral herbivores such as kangaroos and rabbits could damage tube-stock plantings and prevent successful establishment.
- Flooding could wash away stockpiles of soil or mulch and inadvertently reduce the survival rate of tube-stock plantings.

In the event that any of the above events occur, any damaged tube-stock is to be replaced within six months.

9 Project Schedule

A summary of timing and responsibility for each management strategy is presented in **Table 4.**

Table 4 Management Strategy Summary

Item	Strategy	Timing	Responsibility	Approx. Costs
Baseline Monitoring	Baseline Monitoring prior to implementation of the VMP	Prior to implementation of the VMP	Project Ecologist	$6,000.00
Fencing	The perimeter of the VMP Area should be fenced with bollard and cable, or similar, fencing	Prior to commencing construction	Land Management Contractor	3742m fencing @ $15/m: $56,130.00
Signage	Appropriate “No Go” signage and high visibility tape is to be installed along the fence lines of the VMP Area during the construction phase	Prior to commencing construction	Land Management Contractor	$2000.00
Erosion Control	Sediment fences should be installed along the boundaries of the VMP Area to prevent the spread of sediment and other materials.	Prior to commencing construction	Land Management Contractor	$10,000.00
Weed Control	Control of target weed infestations	Ongoing	Qualified Bush Regenerator	$5,000.00 (per event)
Revegetation	Install tube-stock in the VMP Areas to achieve target species composition and densities	Following weed control – preferably in Spring	Qualified Bush Regenerator	TBC (Bush Regenerator)
Monitoring	Inspection to assess weed regrowth and outbreaks, areas of active or potential erosion and establishment of native revegetation areas.	Monitoring is then to occur every six (6) months for a minimum period of five (5) years	Project Ecologist	$4,000.00
Reporting	Preparation of annual reports (Annual reports be submitted to Council	Following each monitoring event.	Project Ecologist	$2,000.00
Maintenance	Control of weed regrowth, watering, replacing failed plantings within management zones	Once every three months for first year	Qualified Bush Regenerator	TBC (Bush Regenerator)

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Appendix A – Site Photographs

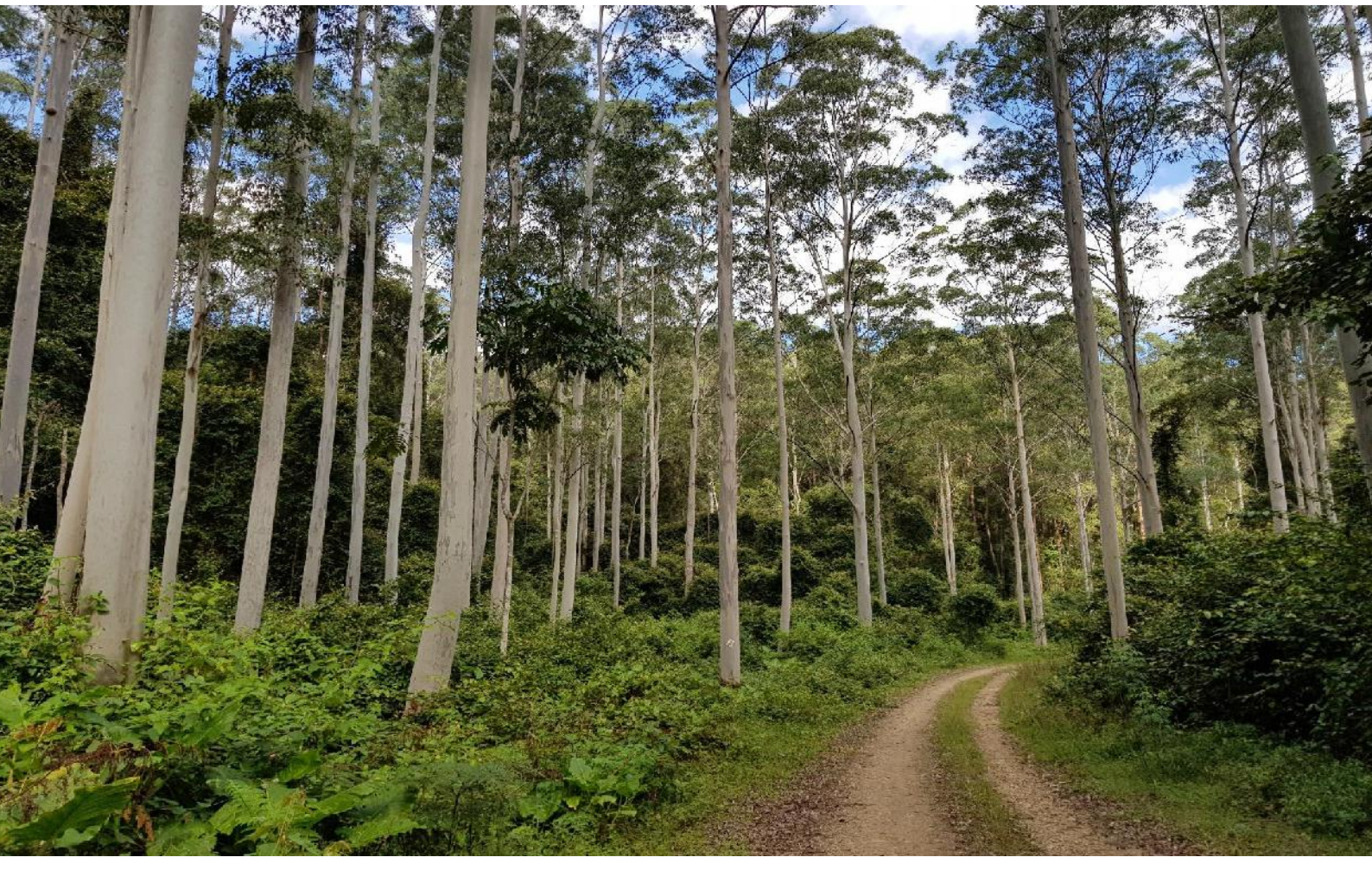


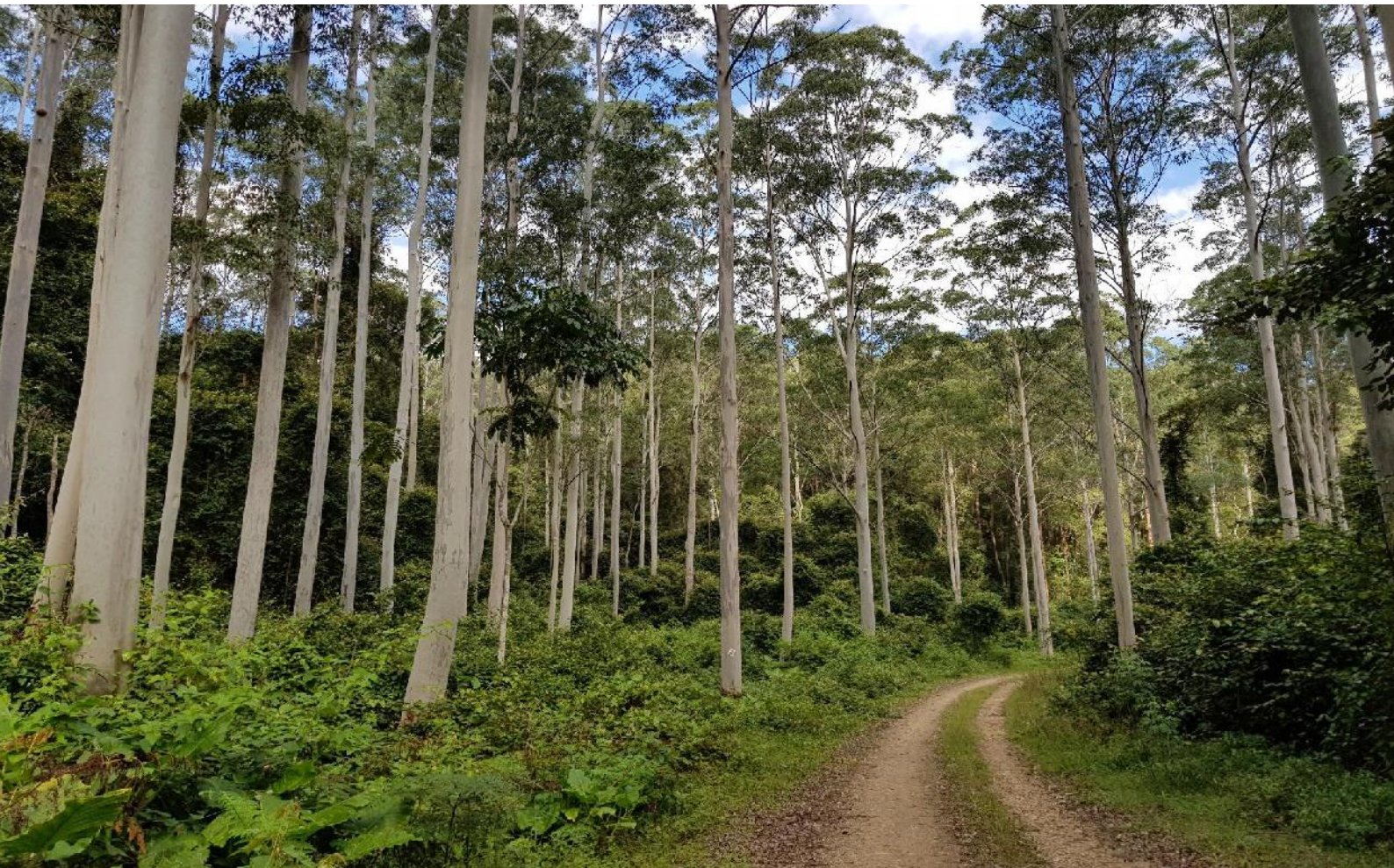
Plate 1 **VMP Area (East) – Grassland areas within the southern land parcel**

Plate 2 **VMP Area (East) – Constructed dam in the southern land parcel**

Plate 3 VMP Area (West) – Riparian vegetation within the southern land parcel

Plate 4 VMP Area (West) – Aquatic habitat within the southern land parcel

Appendix B – Flora Species List



Growth Form	Scientific Name	Common Name
Priority Weeds (Hunter Region)		
Herb	*Senecio madagascariensis*	Fireweed
Shrub	*Olea europaea subsp. cuspidata*	African Olive
Shrub	*Rubus anglocandicans*	Blackberry
Shrub	*Cestrum parqui*	Green Cestrum
Shrub	*Opuntia stricta*	Prickly Pear
Shrub	*Lycium ferocissimum*	African Boxthorn
Environmental Weeds		
Grass	*Echinochloa colona*	Awnless Barnyard Grass
Grass	*Paspalum dilatatum*	Paspalum
Grass	*Setaria parviflora*	Pigeon Grass
Grass	*Sporobolus africanus*	Parramatta Grass
Grass	*Axonopus fissifolius*	Narrow-leaved Carpet Grass
Herb	*Verbena bonariensis*	Purple top
Herb	*Hypochaeris radicata*	Cat's Ear
Herb	*Conyza bonariensis*	Flax-leaf Fleabane
Herb	*Aster subulatus*	Wild Aster
Herb	*Sida rhombifolia*	Paddy's Lucerne
Herb	*Facelis retusa*	Annual Trampweed
Herb	*Linum trigynum*	French Flax
Herb	*Solanum pseudocapsicum*	Jerusalem Cherry
Herb	*Malva parviflora*	Small-flowered Mallow
Herb	*Plantago lanceolata*	Lamb's Tongues
Herb	*Carthamus lanatus*	Saffron Thistle
Rush	*Juncus effusus*	-
Rush	*Juncus acutus*	Sharp Rush
Rush	*Juncus cognatus*	-
Sedge	*Cyperus eragrostis*	Umbrella Sedge
Shrub	*Solanum nigrum*	Blackberry Nightshade
Shrub	*Acacia saligna*	Golden Wreath Wattle
Shrub	*Ligustrum sinense*	Small-leaved Privet
Shrub	*Solanum mauritianum*	Wild Tobacco
Shrub	*Gomphocarpus fruticosis*	Balloon Bush
Shrub	*Opuntia aurantiaca*	Tiger Pear
Vine	*Arajua sericifera*	Moth Vine
Native Species		
Grass	*Bothriochloa macra*	Red-leg Grass
Grass	*Capillipedium spicigerum*	Scented-top Grass
Grass	*Cynodon dactylon*	Couch
Grass	*Panicum effusum*	Hairy Panic
Grass	*Dicanthium sericeum*	Blue Grass
Grass	*Cymbopogon refractus*	Barbed-wire Grass
Grass	*Themeda australis*	Kangaroo Grass

Growth Form	Scientific Name	Common Name
Grass	*Bothriochloa decipiens*	Pitted Bluegrass
Grass	*Paspalum distichum*	Water Couch
Grass	*Microlaena stipoides var. stipoides*	Weeping Grass
Grass	*Sporobolus creber*	Slender Rat's Tail Grass
Grass	*Aristida ramosa*	Purple Wiregrass
Grass	*Digitaria parviflora*	Small-flowered Finger-grass
Grass	*Eragrostis brownii*	Brown's Lovegrass
Herb	*Tricoryne simplex*	Autumn Lily
Herb	*Centella asiatica*	Indian Pennywort
Herb	*Ludwigia peploides*	Water Primrose
Herb	*Dichondra repens*	Kidney Weed
Herb	*Chrysocephalum apiculatum*	Yellow Buttons
Herb	*Dianella revoluta var. revoluta*	Blue-flax Lily
Herb	*Wahlenbergia communis*	Australian Bluebell
Herb	*Pimelea glauca*	Smooth Rice-flower
Herb	*Asperula conferta*	Common Woodruff
Herb	*Einadia nutans*	Climbing Saltbush
Herb	*Einadia hastata*	Berry Saltbush
Rush	*Eleocharis sphacelata*	-
Shrub	*Acacia salicina*	Sally Wattle
Shrub	*Hakea sericea*	Needlebush
Shrub	*Solanum prinophyllum*	Forest Nightshade
Shrub	*Melaleuca armillaris*	Bracelet Honey-myrtle
Shrub	*Acacia elongata*	Swamp Wattle
Tree	*Casuarina glauca*	Swamp oak
Tree	*Corymbia maculata*	Spotted Gum
Tree	*Angophora floribunda*	Rough-barked Apple
Tree	*Eucalyptus crebra*	Narrow-leaved Ironbark
Tree	*Eucalyptus moluccana*	Grey Box
Tree	*Eucalyptus tereticornis*	Forest Redgum
Vine	*Parsonsia straminea*	Common Silkpod

Appendix C – Weed Control Protocols

The Bradly Method

The Bradley method described by Buchanan (1999) is recommended for weed control within remnant forest areas. This method aims to remove weeds with minimal disturbance and allow native species to re-establish naturally from the existing seed bank and rootstock.

The following steps are to be followed when controlling weeds on the site:

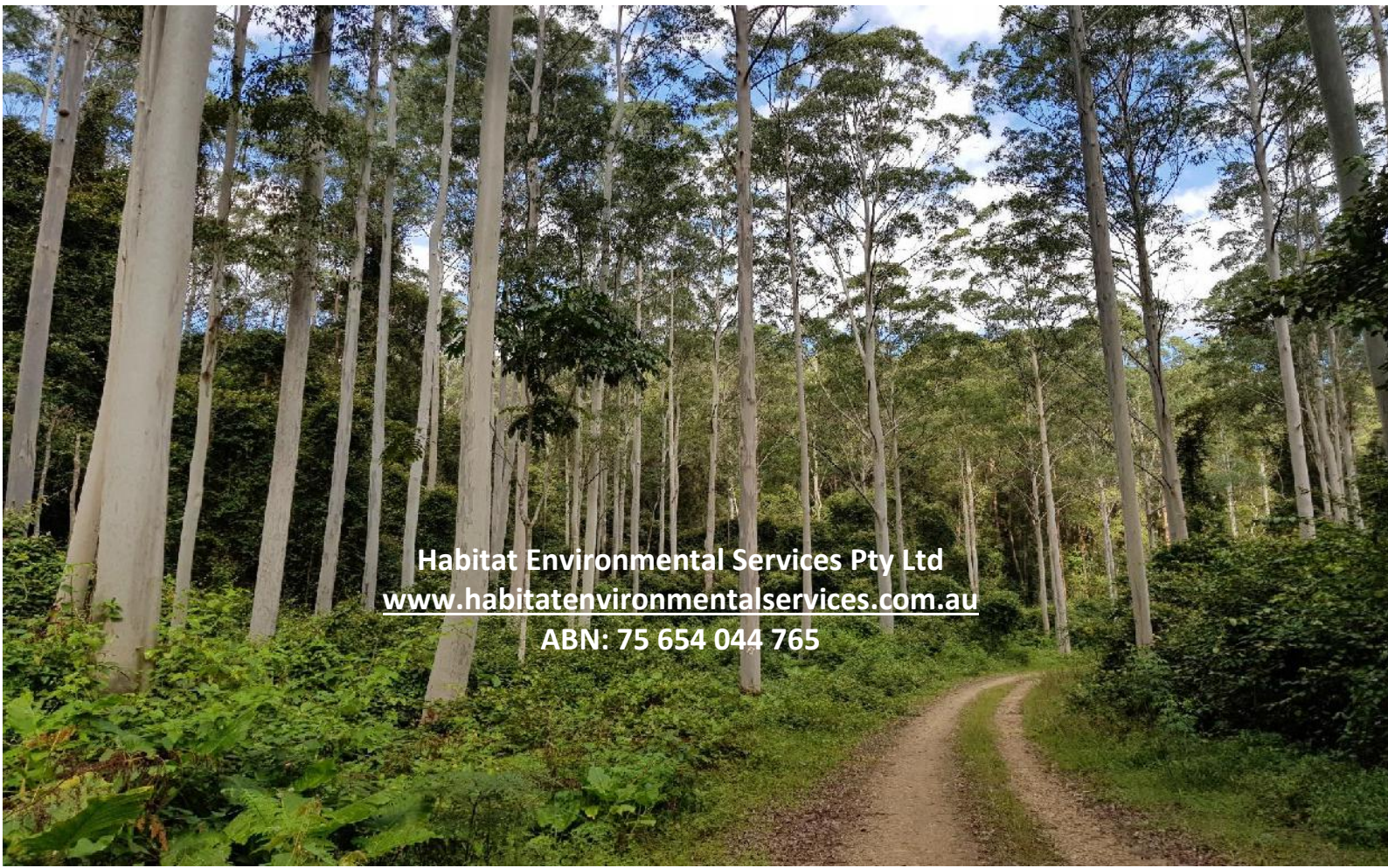
- The weed removal team will require a site-specific induction, to understand what weeds are to be removed, the process of removal, identification of the native species, and the procedures to be followed.
- Manual weed removal. Where there is native understorey present, dominant weeds will need to be manually treated within the existing forest area where possible.
- Weed vegetative material collected during weed control activities is to be taken offsite. This will stop weed material smothering native plants and prevent re-establishment. This material is to be taken to an appropriate waste disposal centre to prevent further weed spread in the region.
- Chemical weed control. Chemical should be applied only where application to larger weeds can be isolated. No broad application is to be conducted.
- Concentrations and dosage rates on targeted chemical control, should be determined in accordance with the *Noxious and Environmental Weed Control Handbook* (Ensbey and Johnson 2007).
- Any weed spraying should be conducted by an authorised person, having a Chemical Application Certificate or similar qualification. This would ensure that best practice is adhered to in consideration of the sensitive nature of the surrounding ecosystems.

Specific methods for the control of weed species recorded within the VMP Area are presented below.

Family	Species Name	Common Name	Control Methods
Asteraceae	*Senecio madagascariensis*	Fireweed	**Mechanical control**: Chip out, bag and burn any isolated plants or dispose of them at council-approved landfill tips. You should not burn any toxic plants in household wood-burning stoves or heaters. Remove chipped-out plants from paddocks because they may still set seed and poison stock. Slashing is usually ineffective as it may lead to increased stock poisoning. Slashing tends to give a good visual effect because it removes the flowers, but at best it delays flowering and seeding and at worst damages the pasture, making conditions more favourable for fireweed **Chemical control**: Herbicides are most effective if sprayed before plants reach maturity. However, application during flowering will be effective if higher recommended rates of herbicide are applied
Oleaceae	*Olea europaea subsp. cuspidata*	African Olive	**Mechanical control:** Cut down is ineffective as plants will sprout new shoots. **Chemical control**: Herbicides can be used on their own or in combination will mechanical removal. Triclopyr + picloram can be applied to foliage, stem or cut stump. Glyphosate and picloram can be injected in tree stems or applied to cut stumps. For further information on herbicide use such as dosage rate, refer to page 37 of the Noxious and Environmental Weed Control Handbook: A Guide to Weed Control in Non-Crop, Aquatic and Bushland Situations (Ensbey and Johnson, 2007)
Rosaceae	*Rubus anglocandicans*	Blackberry	**Mechanical control**: Physical control alone is rarely successful because it's hard to remove all the roots. Cultivation often spreads blackberry further. Slashing can help make access through infestations but promotes regrowth. After slashing, use a follow-up control. **Chemical control**: Herbicides are the most reliable blackberry control method. Use herbicides in combination with other control methods. There are many herbicides registered for use on blackberry. A mixture of triclopyr + picloram used with or without aminopyralid gives the best long-term control. Spray healthy, actively growing plants with new leaves on the cane tips. Apply to both the outer and inner leaves. First year plants are easier to kill with herbicide. Well-established thickets may need more treatments. After slashing or burning, wait until plants have up to 1 m of regrowth before applying herbicide. Some blackberry species are more resistant to certain herbicides than others. Identify the species before choosing a herbicide.
Solanaceae	*Cestrum parqui*	Green Cestrum	**Mechanical control**: Successful weed control relies on follow up after the initial efforts. This means looking for and killing regrowth or new seedlings. Using a combination of control methods is usually more successful. All parts of this green cestrum are poisonous. Wear gloves and other protective clothing when handling the plant. **Chemical control**: Spray with a herbicide such as glyphosate. Alternatively, the cut stump method may be used on plants by cutting the stem at the base of the plant and applying a suitable herbicide to the cut stem within 15 seconds. Treat mature plants in early spring, before they flower. Control

Family	Species Name	Common Name	Control Methods
			regrowth from treated plants. Look for and kill new seedlings in autumn. Be aware that control attempts can encourage seed germination. Keep checking for new seedlings for many years because seeds can lie dormant.
Cactaceae	*Opuntia stricta* *Opuntia aurantiaca*	Prickly Pear Tiger Pear	**Mechanical control**: Small seedlings can be pulled out by hand (wearing gloves). Slashing is not recommended because new plants can germinate from propagules (pads). **Chemical control:** Spray with a herbicide such as glyphosate. Alternatively, the cut stump method may be used on plants by cutting the stem at the base of the plant and applying a suitable herbicide to the cut stem within 15 seconds.
Solanaceae	*Lycium ferocissimum*	African Boxthorn	**Mechanical control:** Small juvenile plants can be pulled out by hand. Larger infestations may be slashed preferably before seed set and follow up with herbicide application. **Chemical control:** Spray with a herbicide such as glyphosate. Alternatively, the cut stump method may be used on plants by cutting the stem at the base of the plant and applying a suitable herbicide to the cut stem within 15 seconds.

HABITAT
ENVIRONMENTAL SERVICES



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www.habitatenvironmentalservices.com.au
ABN: 75 654 044 765