



Badgerys Creek Riparian Corridor | SUEZ SAWT Facility at Elizabeth Drive Landfill

VEGETATION MANAGEMENT PLAN

Prepared for SUEZ | 15 April 2021





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PR153

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DOCUMENT CONTROL

Revision	Date	Description	Prepared by	Reviewed by
0	24 March 2021	For SUEZ review	Element Environment	SUEZ
1	15 April 2021	Final	Element Environment	SUEZ

Contents

1	INTRODUCTION	3
1.1	Site Description	4
1.1.1	SUEZ Elizabeth Drive Landfill Site	4
1.1.2	Badgerys Creek Riparian Corridor	4
1.2	VMP Aims and Objectives	4
1.3	VMP Preparation Methodology	5
1.4	Existing Vegetation Description	5
1.5	Management Zones	6
1.6	Threatened Species	8
1.6.1	Flora Species	8
1.6.2	Fauna	8
1.7	Pests	8
1.8	Weeds	9
1.9	Hydrology, Soils and Erodibility	9
1.10	Heritage Considerations	9
1.11	Health and Safety	10
1.12	Bush Fire Hazard Management	10
1.13	Engaging a Qualified Bush Regeneration Contractor	10
2	VEGETATION MANAGEMENT GUIDELINES	3
2.1	Soil Stabilisation and Mulching	3
2.2	Primary Weed Treatment	3
2.3	Secondary Weed Treatment	3
2.4	Litter Removal	4
2.5	Heritage Finds	4
2.6	Bushfire Management	4
3	VEGETATION MANAGEMENT ACTIONS	7
3.1	Zone 1 - Riparian Corridor	7
3.1.1	Current Condition	7
3.1.2	Regeneration Approach	8
3.2	Zone 2 - Biodiversity Offset Area	9
3.2.1	Current Condition	10
3.2.2	Regeneration Approach	10
3.3	Environmental Monitoring Infrastructure	13
3.4	Restoration Monitoring, Reporting and Review Process	13
3.4.1	Bush Regenerators Monitoring	13
3.4.2	Annual Monitoring	13
3.5	Review of this VMP	14
4	PERFORMANCE CRITERIA	17
5	REFERENCES	21

Tables

Table 1 Summary of Management Actions and Performance Criteria..... 17

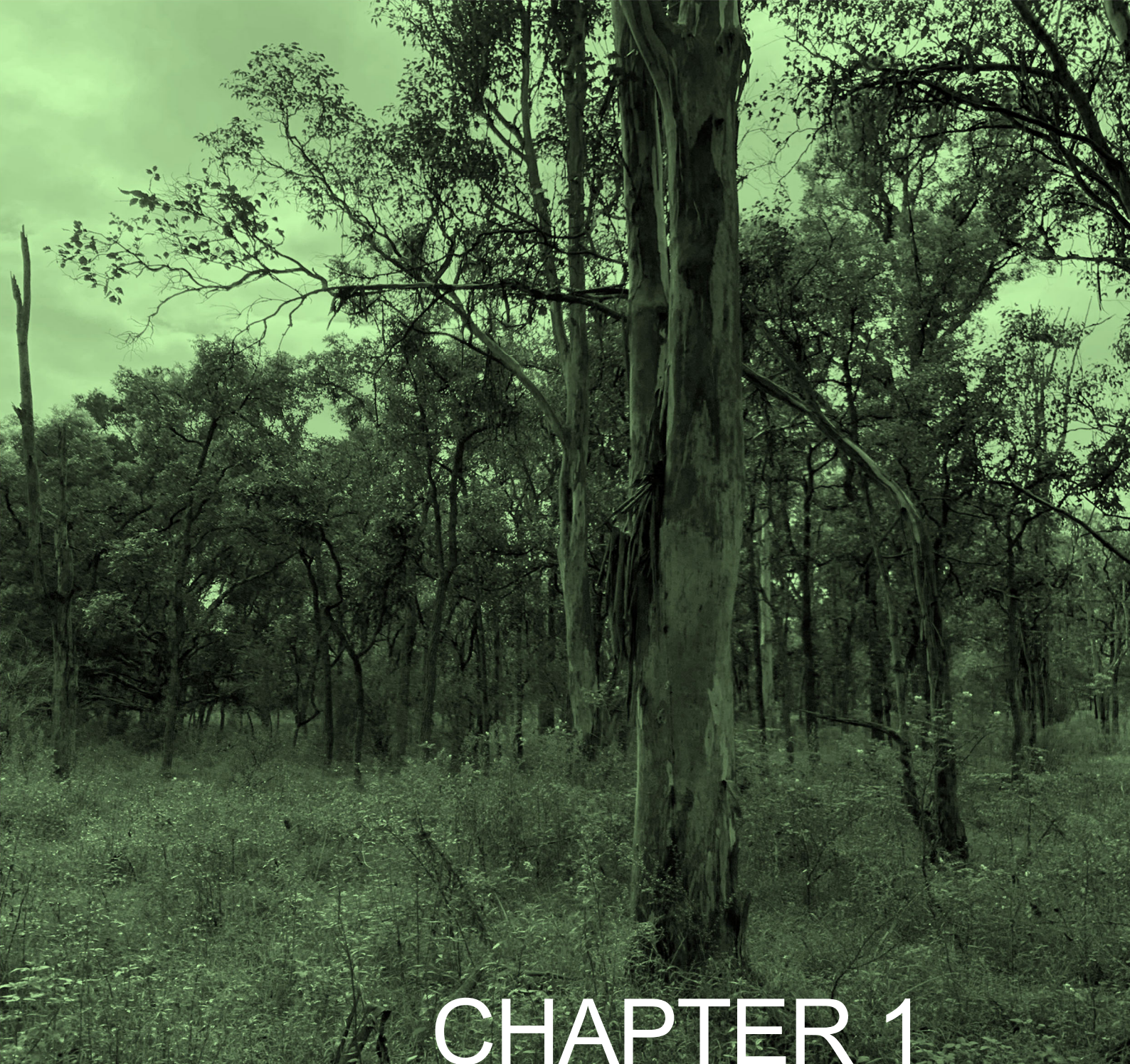
Figures

Figure 1 Location of Management Zones in Vegetation Management Plan Area 7

Plates

Plate 1 Zone 1 regeneration only area. Typical vegetation supports structurally complete native canopy shrub layer with dense weed Infestation in the understorey and ground layer 7

Plate 2 Zone 2 regeneration area. Showing slashed understorey and minimum structural complexity..... 10



CHAPTER 1

INTRODUCTION

1 INTRODUCTION

This Vegetation Management Plan (VMP) was prepared by Element Environment Pty Ltd (Element) on behalf of SUEZ Recycling & Recovery Pty Ltd (SUEZ).

This VMP is a contemporary revision of the original VMP which was produced by Maunsell AECOM (2008) for the former owner of this facility, SITA Environmental Solutions. The VMP is a requirement of Schedule 3, Condition 27 of the Project Approval of Development Application 06-0185 for the SUEZ Advanced Waste Treatment Facility ('SAWT') at Elizabeth Drive Landfill site, Kemps Creek, NSW. Condition 27 is reproduced below:

27. The Proponent shall prepare a Vegetation Management Plan for the site, in consultation with NOW. This Plan shall be submitted and approved by the Director-General, prior to the commencement of construction. The Vegetation Management Plan shall:

- (a) be prepared in accordance to NOW's How to Prepare a Vegetation Management Plan Guideline;
- (b) include a detailed plan to protect and rehabilitate the Badgerys Creek riparian corridor onsite;
- (c) provide details of the on-site revegetation program to offset clearing of 0.81 hectares of Cumberland Plain Woodland; and
- (e) outline the weed management program to be implemented on-site.

The purpose of this revised VMP is to guide the rehabilitation activities within the adjacent section of the Badgerys Creek riparian corridor within the Elizabeth Drive Landfill site and revegetation within the proposed biodiversity offset area, these areas are collectively referred to as the 'VMP area' (Figure 1).

SUEZ has been undertaking weed control activities in order to address legislative requirements relating to noxious weeds and maintains areas rehabilitated under a funding agreement with the former Hawkesbury Nepean Catchment Management Authority (CMA) (now 'Greater Sydney Local Land Services') and the former NSW Natural Heritage Trust. Under this agreement, SUEZ agreed to maintain the vegetation of the riparian corridor for a period of 10 years from the 8th of September 2006 to 8th of September 2016.

The original VMP (Maunsell AECOM 2008) is 13 years old and in need of a thorough review for currency. This VMP is the outcome of this review.

This revised VMP provides:

1. a review of the vegetation management actions that have been undertaken up until the end of the 2016 management period,
2. contemporaneous recommendations for on-going management of the VMP area.

This VMP has been refined to ensure aims, objectives and management actions remain relevant to the current on-going operations of the facility.

This document applies to on-going management, maintenance and monitoring of the VMP area for a period of five years from the date this VMP is formally adopted. At the end of this five year 'maintenance and monitoring' period, this VMP should be reviewed by a qualified ecologist and management zones and management actions redefined as necessary.

1.1 Site Description

1.1.1 SUEZ Elizabeth Drive Landfill Site

The SAWT facility is in the northwest corner of SUEZ's existing 84 ha landfill site, located on Elizabeth Drive, Badgerys Creek, approximately 5 km west of Kemps Creek and approximately 41 km west of Sydney CBD.

The SAWT facility is approved to treat up to 134,400 tonnes per annum (tpa) of waste, comprising up to 120,000 tpa of mixed waste and garden waste and up to 14,400 tpa of biosolids from sewage treatment plants. The landfill is approved to receive up to 950,000 tpa of non-putrescible solid wastes. The SAWT facility and the landfill are separately licensed by NSW Department of Planning Industry and Environment (DPIE) under the Protection of the Environment Operations Act 1997 (POEO Act).

1.1.2 Badgerys Creek Riparian Corridor

The SAWT facility is situated adjacent to the Badgerys Creek riparian corridor (hereafter referred to as the riparian corridor) (Figure 1). Badgerys Creek, which forms part of the Hawkesbury-Lower Nepean River System, borders the Elizabeth Drive site to the west and north.

Schedule 3, Condition 26 and 27 of the Project Approval identifies the 'riparian corridor' as the area illustrated in the figure in Appendix 2 of the Project Approval. The Project Approval requires that the section of Badgerys Creek riparian corridor adjacent to the SAWT facility site is preserved and rehabilitated in accordance with an approved VMP, to reduce possible impacts of the built environment and operations on the quality of the riparian vegetation.

This riparian corridor is the focus of this VMP and is referred to as the 'VMP area'.

The majority of the vegetation of the VMP area has been mapped as River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (River-Flat Eucalypt Forest) which is an endangered ecological community (EEC) listed under the BC Act and a critically endangered ecological community (CEEC) listed under the EPBC Act. This community was found to vary from highly degraded to relatively intact condition. The edges of this VMP area contain transitional vegetation displaying elements of Cumberland Plain Woodland in the Sydney Basin Bioregion (Cumberland Plain Woodland) which is a CEEC under both the BC Act and EPBC Act.

Badgerys Creek has been identified as a flora and fauna corridor in the Penrith City Council Draft LEP 2010 (Flora and Fauna Conservation).

In addition to this, the DPIE required that an offset plan be implemented involving revegetation using indigenous vegetation to compensate for the clearing of 0.81 hectares of Cumberland Plain Woodland.

SUEZ has been implementing a vegetation management program within the entire section of the riparian corridor on SUEZ property in accordance with the existing VMP. This program involves weed management and revegetation activities additional to the legislative requirements related to noxious weeds and landfill operations.

1.2 VMP Aims and Objectives

The aims of this plan are to:

- provide a description of the existing vegetation composition and condition within the VMP area;

- delineate zones in which vegetation clearing, revegetation, weed removal, habitat augmentation are undertaken;
- describe the staging and timing of rehabilitation and regeneration works;
- guide the selection and procurement of locally indigenous native plants species for revegetation;
- guide the protection and enhancement of biodiversity and habitat values of the VMP area;
- provide guidelines for the treatment of noxious and environmental weeds, revegetation and habitat enhancement;
- recommend a program of ongoing vegetation management and maintenance;
- describe the monitoring required to ensure the successful implementation of the VMP; and
- provide adaptive management principles.

The planned outcomes of the VMP are:

- Ensure conditions 26 and 27 of Project 06_0185 Approval continue to be met
- a reference document for the detailed design of revegetation and weeding activities;
- enhanced condition of native vegetation within Badgerys Creek riparian corridor;
- protection of biodiversity and habitat values of the site through best-practice regeneration methods which are relevant to the condition and constraints of the site; and
- maintenance of the existing on-site revegetation and regeneration program to offset the approved, historical clearing of 0.81 hectares of Cumberland Plain Woodland.

1.3 VMP Preparation Methodology

This VMP has been informed by:

- Literature review of relevant technical information including the previous site assessment by Environmental Appraisal and Planning (2004); and
- Site assessment and survey by two ecologists using random meander vegetation survey techniques in February 2021.

The publication Recovering bushland on the Cumberland Plain: best practice guidelines for the management and restoration of bushland (DEC 2005) was an important source of information and guidance in the preparation of this VMP.

1.4 Existing Vegetation Description

All of the vegetation in the VMP area consists predominantly of River-Flat Eucalypt Forest with some Cumberland Plain Woodland on the edge of the VMP area. In this vegetation remnant, Maunsell (2007) identified 97 species of flora, of which 35 (36%) were exotic.

During the February 2021 survey, Land Eco Consulting identified that the entirety of the VMP area was dominated by *Eucalyptus amplifolia* (Cabbage Gum), *Eucalyptus tereticornis* (Forest Red Gum), *Angophora subvelutina* (Broad-leaved Apple), *Angophora floribunda* (Rough-barked Apple), *Eucalyptus moluccana* (Grey Box) over a sub-canopy of *Casuarina glauca* (Swamp Oak), *Melaleuca decora* (Snow in Summer) and *Melaleuca styphelioides* (Prickly-leaved Tea Tree).

Scattered low shrubs included *Acacia parramattensis* (Parramatta Wattle) and *Bursaria spinosa* (Blackthorn).

The ground layer is dominated by *Microlaena stipoides* (Weeping Rice Grass) with scattered low shrubs and herbs including *Plectranthus parviflorus*, *Clematis glycinoides*, *Rubus parvifolius*, *Geranium solander* and *Desmodium varians*.

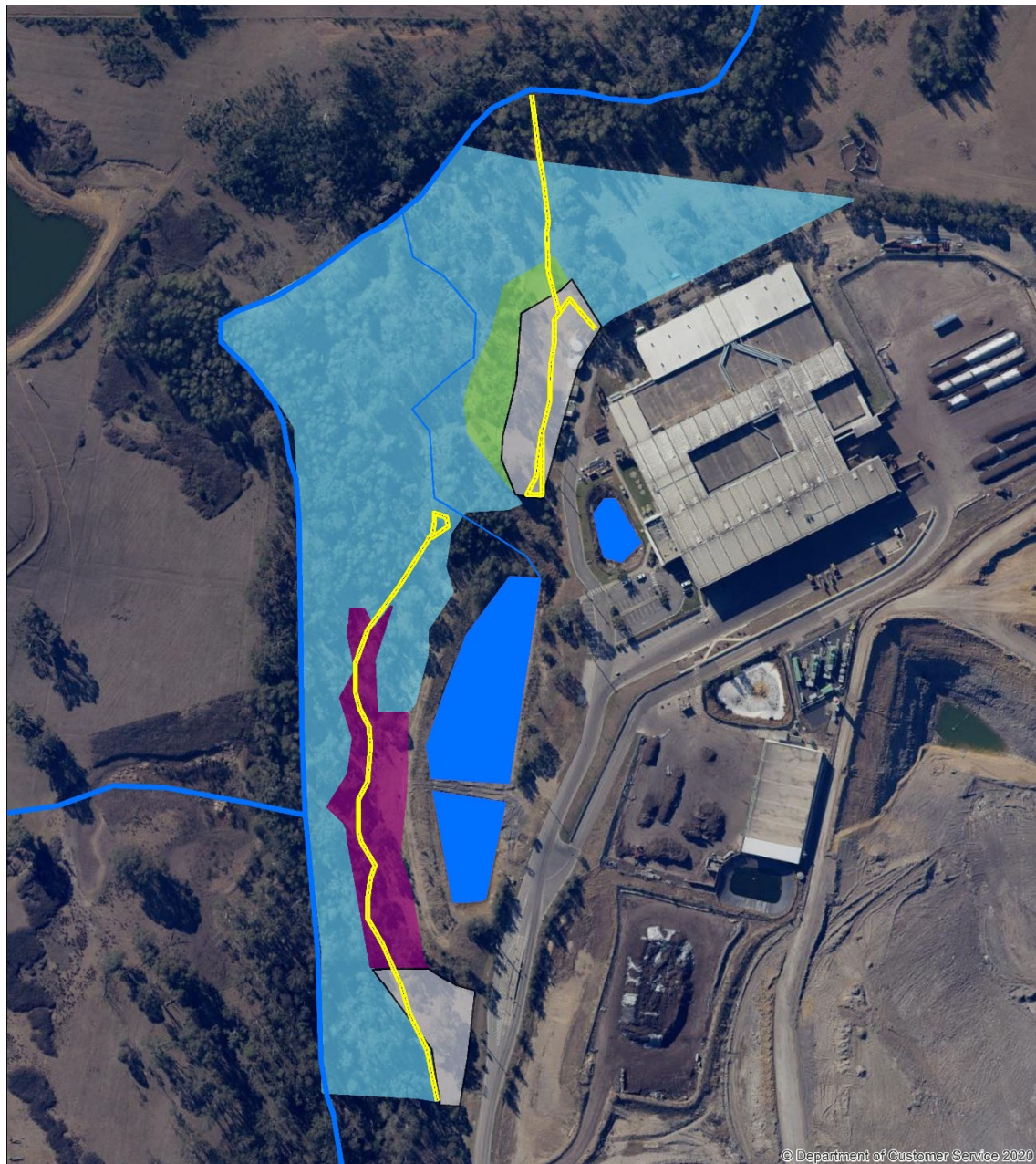
1.5 Management Zones

The riparian corridor has been sectioned into Management Zones.

Zone 1 is located within the western section of the VMP area where Badgerys Creek defines the western boundary of this zone. This zone contains the higher density vegetation within the riparian corridor.

Zone 2 is split into Zone 2a (northern section) and Zone 2b (southern section) and contains relatively sparse tree and understorey vegetation cover.

Since the previous VMP (Maunsell AECOM 2008) there has been sufficient regeneration of the native vegetation in parts of Zone 2b to warrant inclusion of these areas in Zone 1. The revised map presented in this VMP should be referred to for all future management actions undertaken in the VMP area (Figure 1).



Legend

- | | |
|-------------------------|-----------------------------|
| Watercourse | Zone2a - Biodiversity |
| Ephemeral Drainage Line | Offset (Planting and Regen) |
| Waterbody | Zone2b - Biodiversity |
| Existing Vehicle Track | Offset (Planting and Regen) |
| Management Zones | Monitoring Area (Keep |
| Zone1 - Regen Only | Slashed to Allow Access) |

0 15 30 60 90 120 150 Metres



This map was produced for this report only.
It is indicative, not survey-accurate
and should not be used for design or
construction purposes.

Date: 9/04/2021

Coordinate System: GDA2020 MGA Zone 56

Imagery: © NSW EPI

Figure 1 Location of Management Zones in Vegetation Management Plan Area

1.6 Threatened Species

1.6.1 Flora Species

At the time of preparing this VMP, no threatened flora species had been identified within the VMP area, however a suite of threatened flora have the potential to occur within the VMP area. The threatened species most likely to occur are:

- *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas (BC Act: Endangered).
- *Acacia pubescens* (BC Act: Vulnerable; EPBC Act: Vulnerable).
- *Pimelea spicata* (BC Act: Endangered; EPBC Act: Endangered).

Descriptions of these plant species should be held by contractors working on the site to enable accurate identification of these species such that they can be specially protected from accidental impacts associated with management activities. Vegetation management staff working in the VMP area must be inducted on the identifying features of these species in order to aid in the recognition of these species during works.

Should any of these species be encountered, their location should be marked with flagging tape and should subsequently be recorded using a GPS device. The location of the plants should then be reported to the DPIE.

1.6.2 Fauna

The BC Act listed Vulnerable *Meridolum corneovirens* (Cumberland Land Snail) was previously recorded within the VMP area, however, no individuals were recorded by ecologists preparing this revised VMP in February 2021. People working in the VEMP area must be careful where they walk to avoid accidentally stepping on a snail.

Several other threatened fauna species are considered likely to occur within the VMP area, however, it is not expected that any of these species will be impacted by vegetation management activities.

1.7 Pests

The only pest fauna observed in the VMP area during the February 2021 ecologist site assessment were:

- *Vulpes vulpes* (European Red Fox) (a carnivorous mammal).
- *Acridotheres tristis* (Common Myna) (a bird).
- *Spilopelia chinensis* (Spotted Dove) (a bird).
- *Helix aspersa* (Common Garden Snail) (a snail).

Of these pest fauna species, only the European Red Fox was found to be causing damage to the ecological values of the VMP area.

A targeted pest control regime should be implemented across the facility by a bush regenerator, with advice sought from Local Land Services to determine the best course of action for this species.

1.8 Weeds

Given the disturbance and weed invasion adjacent and upstream of the VMP area, the creek-line within the VMP area is susceptible to future weed invasion. To ensure a thorough approach to weed control, this VMP should be co-ordinated with other weed control activities in the local area. Weed control activities should be conducted concurrently to avoid reinfestation from adjacent areas.

The following weeds recorded in the VMP area are listed 'Priority Weeds' under the NSW Biosecurity Act 2015:

- *Alternanthera philoxeroides* (Alligator Weed).
- *Conyza* spp. (Fleabane).
- *Cestrum parqui* (Green Cestrum).
- *Aruajia sericifera* (Moth Vine).
- *Ligustrum lucidum* (Broad-leaved Privet).
- *Solanum sisymbriifolium* (Sticky Nightshade).
- *Solanum mauritianum* (Tree Tobacco).
- *Tradescantia fluminensis* (Trad).

These species must be prevented from spreading and the number and distribution reduced. An appropriately qualified person must undertake removal of these weeds.

The most significant weed in the VMP area is Sticky Nightshade, followed by Alligator Weed, (which is also a Weed of National Significance), Green Cestrum, Moth Vine, Tree Tobacco, Broad-leaved Privet and Trad.

1.9 Hydrology, Soils and Erodibility

Badgerys Creek flows along the western boundary of the VMP area.

A vegetated corridor is maintained along the Badgerys Creek waterway. The corridor provides habitat, water flow features and stream shading. The 1 in 100-year flood level also coincides with the western boundary of the SAWT facility site.

The erosive potential of the soil of the site limits the use of mechanical weed control techniques that would expose large areas of soil surface, especially in creek bank areas that are difficult to stabilise.

1.10 Heritage Considerations

The riparian areas within the local region tend to contain the highest density of Aboriginal sites.

Archaeological studies within the Penrith Local Government Area have revealed that Aboriginal sites cluster towards seasonal streams or gully rises (Rhoads and Dunnett 1985). Kohen (1991) noted that Badgerys Creek is likely to contain Aboriginal sites along its series of meanders.

One archaeological site was identified near the VMP area (Kohen 1991). This site type is an open campsite consisting of a surface scatter of stone artefacts located near the north-western corner of the SAWT site, adjacent to Badgerys Creek. Kohen (op cit) coded the Aboriginal site as Site KC/I (Kemps Creek 1).

During heritage assessment conducted in May 2004 for the SAWT site, attempts to relocate KC/I by a specialist consultant (Environmental Appraisal and Planning 2004) were not successful. Due to the passage of time, the Aboriginal site is now well covered with a dense layer of riparian vegetation and weeds and the KC/I site is no longer visible or exposed to the surface.

Searches of the Federal Register of the National Estate, State Heritage Register, State Heritage Inventory and Aboriginal Heritage Information Management System (AHIMS) revealed no sites of European heritage, historic or archaeological significance within a 1.5 km radius of the site. Several were found within a 5 km radius but these are too distant to be relevant to the VMP.

1.11 Health and Safety

The health and safety of personnel involved in vegetation management activities should be considered in conjunction with issues such as cost-effectiveness and potential adverse environmental impacts when choosing appropriate management techniques. Some weed management techniques involve greater risks to personnel due to the use of chemicals, repetitive strain on joints or the potential for disease or infection. Examples of higher risk activities include working near deep water, wading in potentially polluted water, the use of herbicides other than Glyphosate and repetitive use of manual techniques such as sawing and weed pulling without sufficient variation in tasks. Other risks associated with the site include interactions with site plant and machinery, bites and stings from snakes, spiders and venomous insects.

It is important that staff are adequately trained and equipped with protective equipment, and that a variety of manual and chemical weed control techniques are employed in order to minimise the risks to health and safety. All personnel working in the VMP area will be required to undergo SUEZ general and site inductions and work under Safe Work Method Statements (SWMS) that are reviewed and approved by SUEZ.

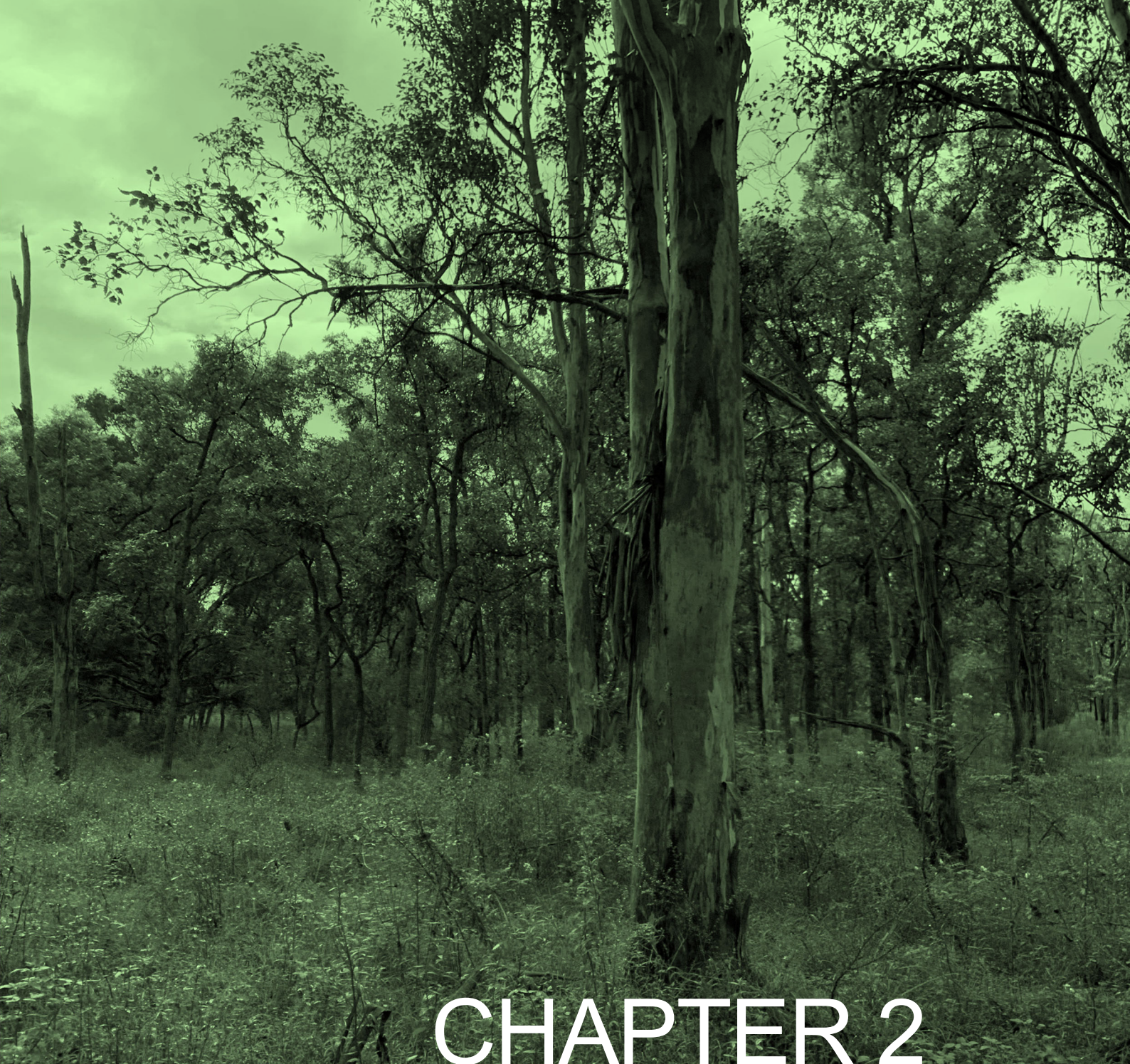
1.12 Bush Fire Hazard Management

Revegetation has the potential to decrease the distance between tree canopies and increase connectivity between vegetation strata which would increase the ability of bush fire to spread.

1.13 Engaging a Qualified Bush Regeneration Contractor

All vegetation restoration works proposed in this VMP are to be implemented by a qualified bush regeneration contractor. The contractor should, as a minimum:

- Hold a current 'Bush Regeneration License' pursuant to the NSW BC Act 2016.
- Provide a site supervisor who is:
 - experienced in bush regeneration in Western Sydney, and
 - holds certificate IV in Conservation Land Management.
- Have enough qualified personnel to provide a team of at least four persons on site at any one time.
- Hold a current, relevant chemical certification.
- Provide at least one person who holds a current, Senior First Aid certification.



CHAPTER 2

VEGETATION MANAGEMENT GUIDELINES

2 VEGETATION MANAGEMENT GUIDELINES

2.1 Soil Stabilisation and Mulching

The potential for flooding of revegetation areas and the resulting damage to plants and loss of mulch should be considered in the timing of planting. Mulching should be conducted in relatively dry conditions to allow mulch to settle prior to any significant rain events. Planting is best conducted during dry weather but within a few days after rainfall when soil is moist but not water-logged. Planting should not be conducted if heavy rain is predicted to occur in the weeks following planting.

The tendency for surface flow on the site has implications for mulching activities as this flow could carry away mulch during rain events leaving the soil surface exposed to erosion. A coarse mulch is thus recommended which is less easily displaced by surface flows.

Physical soil stabilisers should be applied in areas where there is an erosion risk. The choice of method would depend on the appearance of stabiliser, the effect on soil aeration, water penetration and soil temperature and its weed suppressing and native plant germination properties (Buchanan, 1989).

Weed suppression materials may include.

- Mulched, weed-free tree lopping's;
- Brush matting;
- Eucalyptus mulch;
- Commercially available weed suppressant matting; and
- Hay or straw.

Erosion control could include chicken wire pegged on to steeper bank sections. Small to large logs and rocks from the site can be pegged or wedged into place to prevent erosion (Buchanan 1989).

2.2 Primary Weed Treatment

The term primary weed treatment describes the initial removal of weeds in a specific location. This usually involves treating all the reproductively mature specimens of a weed species (or group of species). Primary weed treatment has already been undertaken in the VMP area and is not required again.

2.3 Secondary Weed Treatment

Secondary weed removal is usually required to remove weed seedlings and regrowth such that the gains made through primary weed treatment are not lost due the rapid regrowth and colonisation of disturbed ground. Care must be taken to ensure that any regeneration of native plant species is identified and protected, both from weed regrowth and from accidental damage during secondary weed treatment.

Glyphosate application through spot spray and cut and paint are the preferred weed control methods. Alternatively, other herbicides may be used to control these species as guided by a qualified Bush Regenerator, however, surfactants and herbicides other than Glyphosate should be used sparingly and with caution, especially around watercourses as these chemicals are likely to have a greater impact on aquatic life and terrestrial fauna than Glyphosate. Mechanical removal of these species also has potential drawbacks due to the soil disturbance and potential for erosion created.

2.4 Litter Removal

Litter should be removed by hand opportunistically when bush regeneration contractors are working in the VMP area. All litter collected should be removed from the VMP area and disposed of appropriately.

Natural debris such as brush, logs and rocks should be left in-situ or set aside and reused for wildlife habitat within the VMP area.

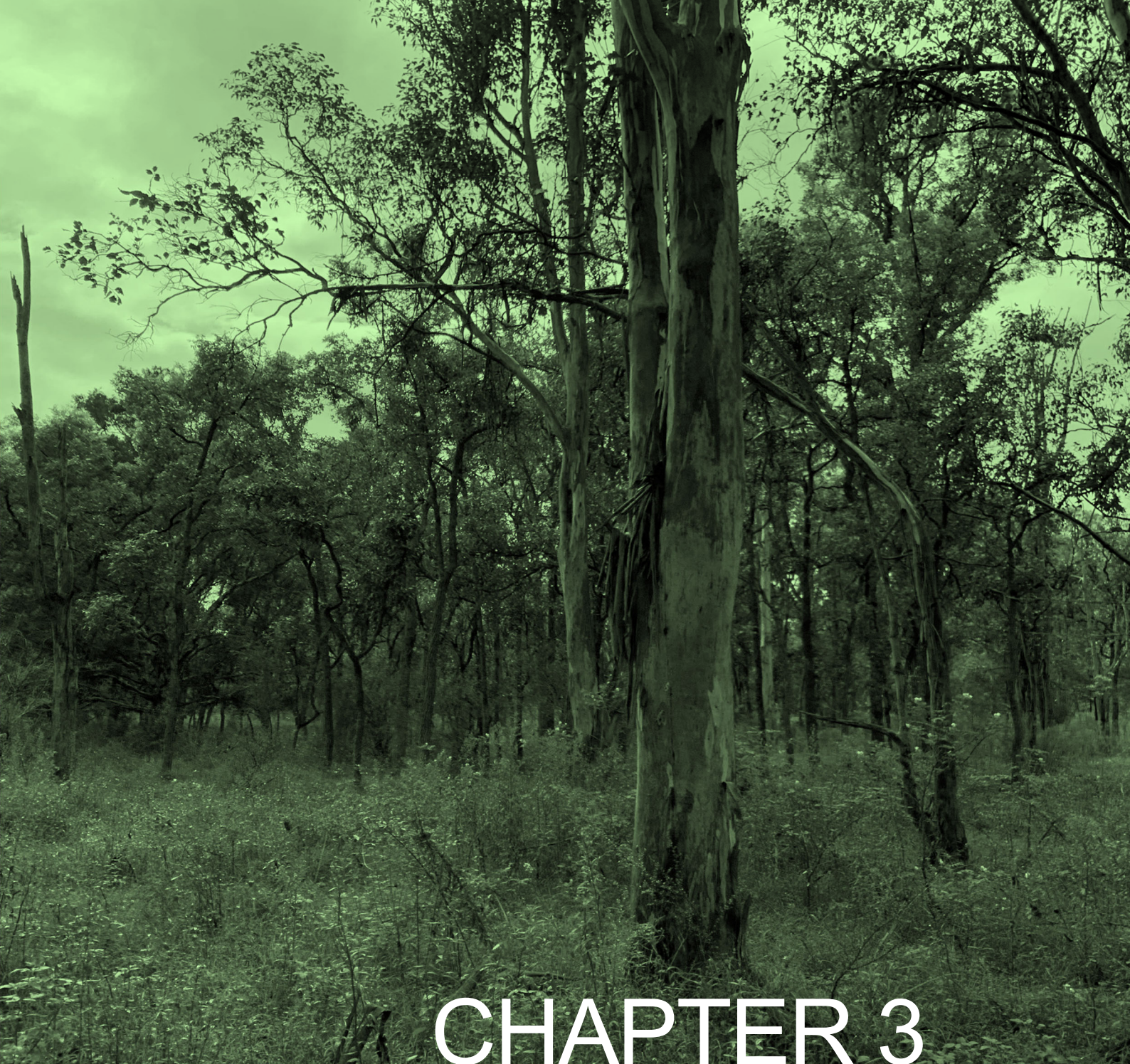
Any non-biodegradable materials used in the regeneration process such as virocells, pots and tree guards should be removed as soon as they are no longer required.

2.5 Heritage Finds

Stone artefacts may be located during weed control works in the riparian corridor. Should artefacts be uncovered, works should be restricted to those that will have minimal impacts on the soil containing the artefacts. Careful hand-weeding involving the use of small hand tools should be used in preference to the use of larger tools such as mini-mattocks which are more likely to damage artefacts. If artefacts are found in areas for which revegetation is proposed, methods such as direct seeding should be used in preference to methods that require substantial digging.

2.6 Bushfire Management

It is recommended that no trees or shrubs are planted within eight metres of the fence line that runs along the eastern boundary of the VMP area. This will allow defendable space along the fence line in the event of a bush fire.



CHAPTER 3

VEGETATION MANAGEMENT
ACTIONS

3 VEGETATION MANAGEMENT ACTIONS

3.1 Zone 1 - Riparian Corridor

Zone 1 is characterised by a structurally complete, species rich woodland / forest assemblage. Through its involvement in the River Restoration Program with the former Hawkesbury Nepean CMA, (now known as Greater Sydney Local Land Services) as well as works undertaken in line with the previous VMP (AECOM 2008), SUEZ has conducted extensive primary, secondary and maintenance weeding of priority weeds across this zone.

Owing to extensive regeneration within the VMP area, Zone 1 has expanded in area from the last VMP as parts of Zone 2b have regenerated to a condition indistinguishable from Zone 1 (Figure 1).

The information and recommendations below are designed to guide this ongoing maintenance to ensure it is effective in achieving the desired vegetation management outcomes.



Plate 1 Zone 1 regeneration only area. Typical vegetation supports structurally complete native canopy shrub layer with dense weed Infestation in the understorey and ground layer

3.1.1 Current Condition

The bulk of the relatively intact vegetation within the VMP area is in Zone 1. The canopy stratum in this management zone is of moderate to high density but shows signs of previous partial clearing in the form of groves of eucalypt regrowth and the lower than natural abundance of large old trees. The canopy species include *Eucalyptus. teriticornis*, *E. amplifolia*, *E. eugenioides*, *E. creba*, *Angophora subvelutina*, *A florbunda* and *Casuarina glauca*. The sub-canopy stratum is patchy and sparse and consists of *Melaleuca decora* and *M. styphelioides*.

The tall shrub stratum consists primarily of occasional patches of *Bursaria spinosa*, *Acacia parramattensis*, with localised patches of the woody weeds, Broad Leaved Privet and Tree Tobacco.

The understorey is also patchy and is dominated by *Bursaria spinosa* with occasional occurrences of other native shrubs *Dodonaea viscosa subsp. Cuneata* and *Phyllanthus gunnii*.

Weeds including dense regrowth patches of the priority weeds, Green Cestrum and Sticky Nightshade, along with *Verbena bonariensis*, *Sida rhombifolia*, *Coynza spp.* and *Solanum pseudocapsicum* form the majority of the biomass in the shrub layer.

Sticky Nightshade and Green Cestrum are the most abundant and dense priority weeds in this management zone and require the most effort to manage and eradicate.

The groundcover stratum is comprised of native and exotic grasses and forbs. The native grass *Microlaena stipoides* is the dominant groundcover species through much of this management zone but is replaced in places by exotic grasses such as *Paspalum dilatatum*, *Pennistenum clandestinus*, *Chloris gayana* and *Setaria pumila* with dense patches of Trad.

A variety of native forbs are also found in the groundcover stratum throughout this management zone, most common are *Plectranthus parviflorus*, *Dichondra repens*, and *Geranium solanderi*. Several species of vine occur in this management zone and can be found creeping through the groundcover and climbing through the shrub layers of the vegetation. Native vines include *Clematis aristata*, *Desmodium varians*, *Glycine microphylla*, *Convolvulus erubescens* and *Parsonsia straminea*. Moth Vine is the most abundant vine weed and requires a targeted approach to management.

The western barrier of this management zone is the bank of Badgerys Creek and hence the aquatic vegetation of the riverbed is not included in this zone. A number of native and exotic submerged, floating and emergent plants occur within the creek with some of these species extending for a short distance up the creek banks. Alligator Weed occurs both within the waterway and on the bank.

3.1.2 Regeneration Approach

This management zone contains most of the infestations of noxious weeds and highly invasive environmental weeds. Of particular concern is the presence of Alligator Weed. Control of this species is difficult due to its relatively high tolerance to Glyphosate, its presence in sensitive aquatic habitats and its ability to regrow and spread vegetatively from swollen underground stems or broken floating stems. Attempts at control of this weed independently within the Elizabeth Drive Landfill site are unlikely to be successful due to the ability of the species to rapidly re-colonise the area from the opposite creek bank and from broken sections of stem carried from further upstream. Given the difficulty in controlling this species and the associated environmental risks, it is recommended that the presence of the infestation on the site is reported to Greater Sydney Local Land Services and that SUEZ continues to work with the Local Land Services and adjacent land managers to ensure a combined approach to the control of this species in the area.

Green Cestrum is best controlled by cutting and injecting the root ball of the plant with neat Glyphosate. Repeat treatment may be required.

Tree Tobacco and Broad-leaf Privet should be controlled through the hand removal of seedlings, application of neat Glyphosate to the cut stumps of medium-sized specimens and the drilling/chiselling and injection of Glyphosate into the base of large specimens. These techniques are also applicable to the other exotic trees and shrubs found on the site.

Wandering Jew is capable of forming dense mats of growth that exclude native groundcover species and prevent the germination of the seeds of indigenous plants including trees and shrubs.

This species is the dominant groundcover species in some areas of this management zone while in other areas it occurs at lower density in a mixture with other weeds and indigenous plant species. Priority should be given to treating Wandering Jew in areas of lower density to allow patches of indigenous species to increase in density and expand in area. A combination of hand-weeding and spot spraying of regrowth is recommended for these species. Hand-weeding should involve the digging up and disposal off site of rhizomes and the removal of smothering growth from trees. Spot-spraying with an appropriate herbicide should only be used where rhizomes are inaccessible due to their depth or proximity to tree roots or other obstructions.

Moth Vine grows over and smothers shrubs and small trees. It is a fast-growing species that spreads via wind-dispersed seeds. Control of Moth Vine should take the form of hand-pulling and scrape-and paint methods. Hand-pulling can be successful if soils are soft enough to allow the removal of the stem and the tap root. In hard soils the stem will snap near ground level allowing the plant to re-shoot. In these conditions, scraping of the stem and the application of neat Glyphosate is more effective.

All target weed species should be controlled to prevent these species from becoming more abundant and spreading to nearby areas. Eradication of some target weed species that currently occur in low density such as Tree Tobacco, Green Cestrum, and Broad-leaf Privet is achievable within the proposed maintenance period though re-infestation from nearby areas is likely to require ongoing management.

The maintenance program should also aim to gradually reduce the current extent of species such as Wandering Jew and Moth Vine. Eradication or large-scale removal of these species is not considered feasible at present due to the extent of infestations, the ability of these species to regrow from small fragments and/or recolonise from surrounding areas, and environmental constraints such as fauna habitat and erosion potential. The rate at which natural regeneration is expected to occur in the VMP area is also a constraint to the feasibility of extensive removal of exotic groundcover species.

Planting within this management zone is not necessary because natural regeneration is occurring throughout.

3.2 Zone 2 - Biodiversity Offset Area

The regeneration works in Zone 2 are designed to offset the clearing of 0.81 ha of Cumberland Plain Woodland within the SAWT facility site through a combination of weed control, revegetation and habitat augmentation.

Current vegetation management approach in this zone consists of the control of noxious weeds and mowing of grassed areas to minimise bushfire hazard.

Considering the level of weed infestation and low density of natives in some areas of this management zone, additional planting will be necessary, especially in areas of extensive weed removal.



Plate 2 Zone 2 regeneration area. Showing slashed understorey and minimum structural complexity.

3.2.1 Current Condition

The woodland vegetation of this management zone has been partially cleared. Trees are widely spaced and little remains of the mid-storey and understorey vegetation strata. The ground layer is dominated by grasses and forbs and exists as a mosaic of patches dominated by indigenous plants in some areas and weeds in others.

In many areas indigenous and exotic species are approximately equal in abundance. The exotic grasses *Paspalum dilatatum*, *Pennisetum clandestinum* and *Chloris gayana* dominate the ground layer throughout this management zone. Native groundcovers are present but not common. The same weeds as those occurring in Zone 1, including exotic vines, shrubs and ground covers, are present in lower abundance in Zone 2.

3.2.2 Regeneration Approach

The aim of this management zone is the re-creation of the naturally occurring vegetation structure and composition by connecting and expanding existing patches in which indigenous groundcover species are dominant.

Given its location on the edge of the riparian zone, adjacent to the remnant shales of the Cumberland Plain, the original vegetation of this management zone is likely to have been intermediate in structure and composition between River-Flat Eucalypt Forest and Cumberland Plain Woodland. Thus, a combination of species consistent with each of these vegetation communities may be used in revegetation. The species used for a particular location should be dependent on the distance from the creek and the elevation from the creek bank. Species confined to the Cumberland Plain Woodland vegetation community should be used in better-

drained, more elevated locations (e.g. Zone 2a and 2b), whilst riparian species such as *Melaleuca spp.* should be used in lower lying areas closer to the creek and prone to waterlogging.

Planting

Revegetation within this management zone should chiefly consist of tree and shrub planting as the canopy and understorey strata here is sparse.

Planting densities proposed for the VMP area are be guided by best practice rehabilitation guidelines produced for a similar riparian landscape in north-western Sydney (Sydney Water 2014). At minimum, a density of one tree and one shrub should be planted per 10 m² of land in Zone 2. This equates to the following:

Zone 2a (total area = 4430 m²)

- 443 trees
- 443 shrubs

Zone 2b (total area = 6510 m²)

- 651 trees
- 651 shrubs

Wherever possible, shrubs should also be planted beneath existing mature tree canopies to increase habitat complexity.

Mowing should cease in areas prepared for revegetation.

Only species native to the area, appropriate to the landscape and compatible with the surrounding vegetation community should be utilised. Denser plantings are considered necessary where the weed density is thickest and/or native vegetation is absent.

Plant stock should be sourced from an approved local supplier. Species selected to be planted should consist of those currently present on the site and/or those likely to have naturally occurred there before disturbance. This can be determined by referral to the native species listed in this VMP or the NSW scientific committee determinations for the endangered communities (2010; 2011).

Quantities should allow for 5% contingency to cover plant failures or damage during the establishment period.

Plants to be supplied should be vigorous and free from pests and disease. Plants should be stored in trays of like species and labelled for ease of identification.

Soil Amelioration

Soil should be prepared to allow for plant root penetration. Spacing will depend on the form of the species and the vegetation structure to be re-created. Planting should be in groups or clustered whenever possible.

Apply a soil conditioner (e.g. Terraform) to each pit dug before planting.

Mulches or coconut/jute matting should be applied around plants to control water loss, soil temperature fluctuation and weed invasion.

Weed Management Before Planting

Weeds should be manually removed to a minimum distance of one metre surrounding each proposed planting location. Weed control should be carried out around planted areas for at least four years post planting. An area of between one and two metres diameter around each plant should be maintained weed free (Buchanan, 1989).

Replacement Plantings

A dense vegetation cover should be maintained. For areas where vegetation has failed, been damaged or is suffering from pests and/or disease, replanting should occur twice a year in spring and late summer/early autumn when temperatures are milder, and the risk of frost is reduced.

Plants lost or damaged should be replaced. Plants should be replaced at the size originally specified and in accordance with all planting methods as previously described.

Fertilizers

Plant containers (hiko/virocells and tubes) are generally pre-fertilised at the nursery. The use of additional fertiliser is unnecessary.

Pest Herbivore Management

Rabbits, native animals and wind may pose a threat to newly planted seedlings. If necessary, each tree and shrub could be protected by a clear plastic sleeve and stakes or entire areas fenced off. The use of tree guards and fencing should initially be at the discretion of the bushland regeneration contractor/supervisor and the requirement for any changes should be determined during monitoring.

Watering Plants

The aim is to establish vegetation that can tolerate the local conditions. Watering frequency will depend on the species, weather conditions, soil type and plant size. If the soil is dry at the time of planting each plant should be given 10 to 20 litres with follow-up maintenance watering. Plants should be watered well at least two (2) to three (3) times a year whether by natural heavy rain or by artificial means. This would encourage development of deep root systems and a self-sufficient plant. By comparison, frequent light watering encourages development of a shallow root system and plants that are likely to die in subsequent dry periods, (Buchanan, 1989).

To avoid mortality, plants should be delivered and planted on the same day. In the event that plants cannot be planted on the day of delivery, they should be planted as soon as possible but be kept moist at all times.

Prior to planting, a temporary irrigation system such as a water tanker should be available, so plants can be watered immediately after planting. Watering should take place within two hours of planting or less in dry conditions.

Watering of seedlings should be continued as required until all plants are established. Weather and site conditions should determine the frequency of watering for plants over the maintenance period to ensure they do not perish. Moisture levels and plant health should be monitored fortnightly during drier periods.

Any Penrith City Council water use restrictions should be adhered to. Watering should be undertaken early morning or late afternoon to avoid the hottest part of the day and unnecessary water loss.

General Weed Management

The focus of weed management in this zone should be the preparation of areas for revegetation. Revegetation using indigenous species should be used to connect and expand existing patches in which indigenous groundcover species are dominant. A weeding approach involving a combination of hand-weeding and herbicide spraying is thus considered appropriate. Where spraying is employed, it should be followed by mowing or slashing to create a mulch layer to prevent erosion, suppress weed growth and retain soil moisture. Where soil is laid bare due to hand-weeding, mulching may be required. Weeding should also be conducted within patches of

better condition to maintain the dominance of indigenous species. Seedlings of the target weed species identified in Zone 1 should also be removed where they are encountered in Zone 2.

Habitat Augmentation

Habitat for terrestrial fauna within Zone 2 is limited due to the current lack of structural complexity in the form of woody debris, low vegetation and leaf litter. Revegetation works should result in an increase in the complexity of the vegetation, especially the targeted planting of shrubs beneath the canopy of mature trees.

3.3 Environmental Monitoring Infrastructure

Access must be maintained to the environmental monitoring bores and meters located within Zone 2a and Zone 2b. Access will be maintained by slashing the area around each monitoring instrument to a distance of three metres. These areas are illustrated in Figure 1.

3.4 Restoration Monitoring, Reporting and Review Process

Monitoring of the implementation of vegetation management measures is necessary in order to determine which measures are successful in achieving desired outcomes. This information can be used to modify practices in order to maximise the success of future management works. This may require this VMP to be amended.

3.4.1 Bush Regenerators Monitoring

Informal monitoring should be conducted by the bush regeneration contractor during management tasks. Brief monthly reports should be provided to SUEZ by the bush regeneration contractor such that management activities are documented. These monthly reports should be summarised in an annual report produced by an independent ecologist at the end of each calendar year.

3.4.2 Annual Monitoring

An annual monitoring survey should be conducted by an independent ecological consultant or suitably qualified bushland regenerator. This survey should involve a qualitative assessment of the condition of the vegetation and a quantitative assessment of plant species composition and abundance along a pre-designated transect within Zone 1 and Zone 2.

By the end of each calendar year a suitably qualified ecologist is to undertake annual monitoring of bush regeneration works against this VMP. The ecologist is to:

- Visit and photograph six permanent photographic monitoring points. Each photographic monitoring point is to be marked with a labelled star picket; and
- Sample two random monitoring plots 20 m x 20 m in each zone. The ecologist must identify all flora species within each plot and estimate projected foliage cover of each species across the 20 m x 20 m area.

Permanent photographic points could be established and used to provide a visual record of vegetation growth and structural diversity over time.

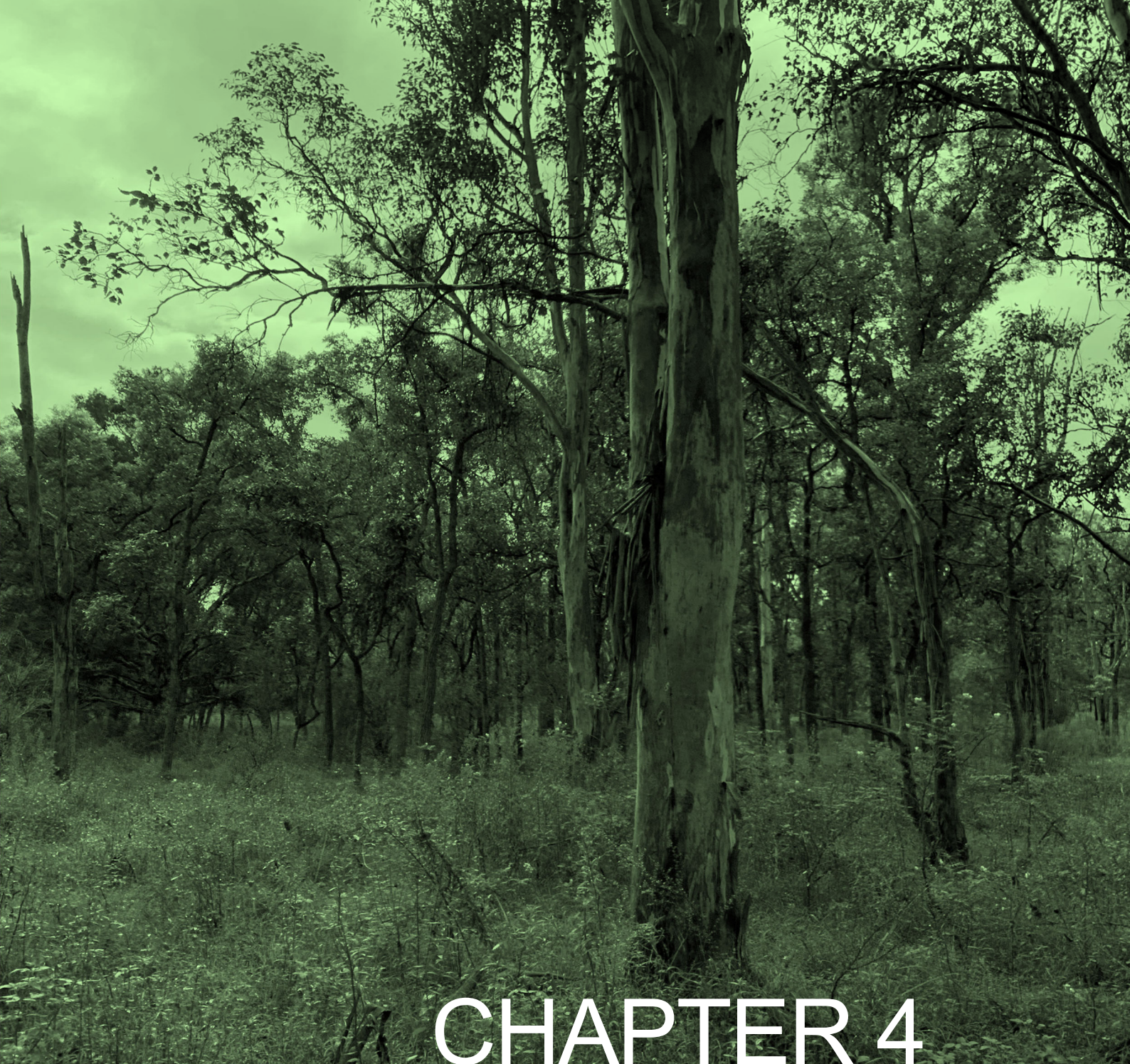
The location of the monitoring points and plots will be determined by the independent ecologist.

A brief report on vegetation condition should be produced following each annual monitoring survey, building on the results of the previous survey to show the trends in vegetation condition

over time. The results of these annual monitoring reports should be considered to identify any changes to practices that may improve management outcomes.

3.5 Review of this VMP

This VMP should be reviewed by a qualified ecologist prior to the end of the fifth calendar year after this VMP is adopted.



CHAPTER 4

PERFORMANCE CRITERIA

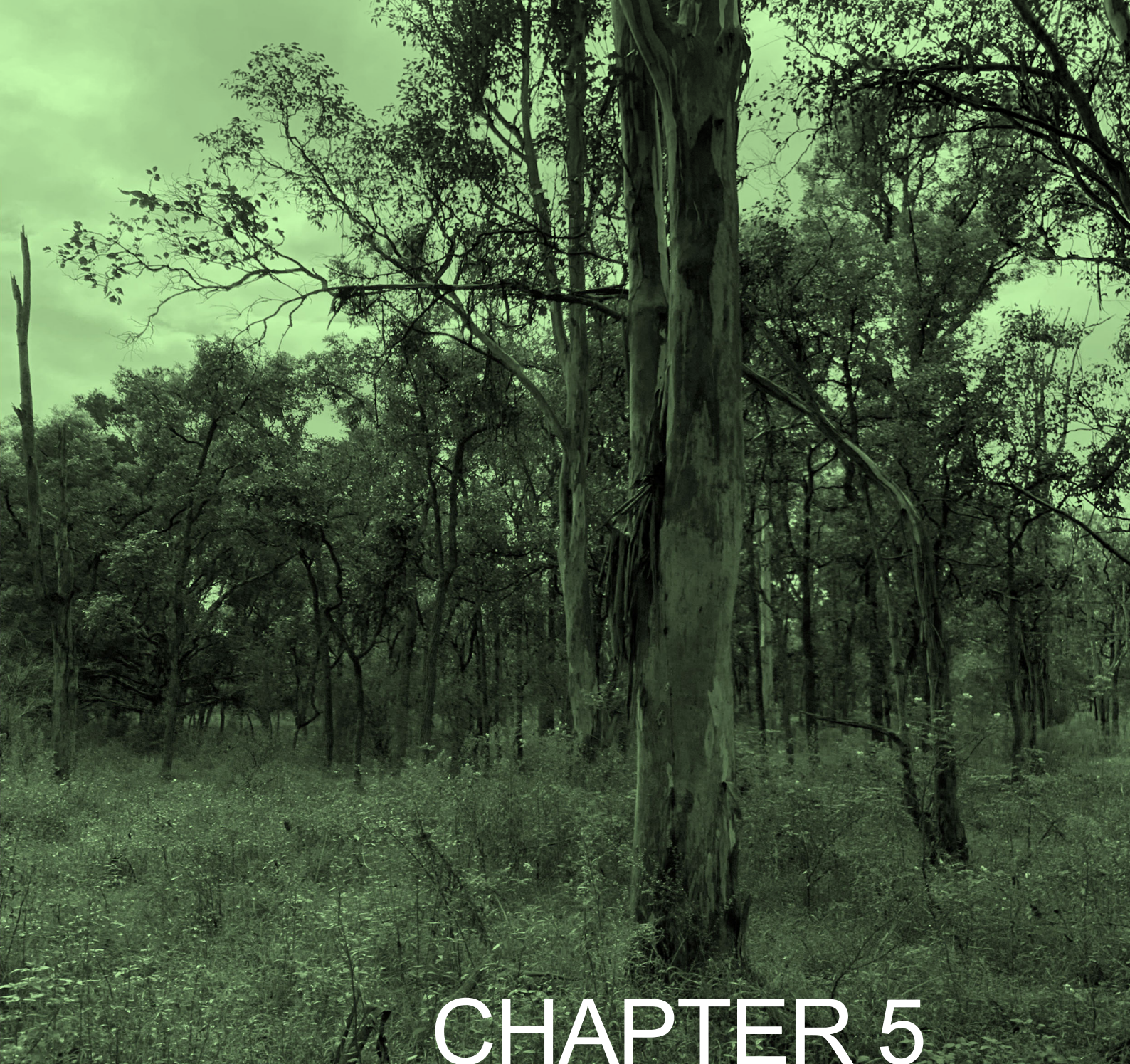
4 PERFORMANCE CRITERIA

Revegetation and rehabilitation efforts should be evaluated against the criteria identified in **Table 1**.

Table 1 Summary of Management Actions and Performance Criteria

Action	Zone	Key Performance Criteria	Milestone Met
Bush Regeneration Contractor Engaged	All zones	Engage one or more bush regeneration contractors to undertake the management actions in this VMP.	By the end of the first year after adoption of this VMP.
Revegetation			
Source plants	2	Source all 1,094 trees and 1,094 shrubs for planting.	By the end of fifth year after adoption of this VMP.
Prepare planting areas	2	Areas proposed for planting free of weeds and soil moist.	By the end of fifth year after adoption of this VMP.
Plant all stock	2	100 trees and 150 shrubs planted.	By the end of fifth year after adoption of this VMP.
Install tree guards	2	Install tree guards around all planted trees and shrubs.	By the end of the year all plantings are undertaken.
Watering	2	All plants watered 10 times. Twice in the first week of planting (unless raining) and eight times thereafter as guided by the bush regenerator to maximise plant survival.	By the end of the year all plantings are undertaken.
Weed Management			
Green Cestrum	All zones	Green Cestrum projected foliage cover reduced to less than 1% of each zone.	By the end of fifth year after adoption of this VMP.
Sticky Nightshade	All zones	Sticky Nightshade projected foliage cover reduced to less than 2% of each zone.	By the end of fifth year after adoption of this VMP.
Tree Tobacco and Privet	All zones	Tree Tobacco and Privet eradicated from each zone.	By the end of fifth year after adoption of this VMP.
Moth Vine	All zones	Moth Vine projected foliage cover reduced to less than 1% of each zone.	By the end of fifth year after adoption of this VMP.
Trad	All zones	Trad/Wandering Jew projected foliage cover reduced to less than 2% of each zone.	By the end of fifth year after adoption of this VMP.
All other weeds	All zones	Projected foliage cover of all other weed species to cover no more than 5% of each zone.	By the end of fifth year after adoption of this VMP.
Pest Control			
Fox Control	All zones	Implement fox control in each zone at least once each year for five years.	By the end of each year after adoption of the VMP until the end of the fifth calendar year.
Monitoring			

Action	Zone	Key Performance Criteria	Milestone Met
Bush Regeneration Reports		Bush regenerator to provide a letter report including a scale map of works undertaken during the visit along with three representative photographs (before and after).	By the end of each visit by bush regeneration team.
Annual Monitoring Report		Independent consultant to undertake annual monitoring of bush regeneration works against this VMP. Visit photograph monitoring points and two random monitoring plots 20 m x 20 m in each zone. Identify all flora species and estimate projected foliage cover of each across the 20 m x 20 m area.	By the end of each calendar year after adoption of this VMP.



CHAPTER 5

REFERENCES

5 REFERENCES

- Bradley, J (1997) Bringing back the Bush: the Bradley Method of Bush Regeneration. Landsdowne Publishing. Sydney.
- Briggs, J.D and Leigh, J.H (1995) Rare or threatened Australian Plants, CSIRO. Canberra.
- Buchanan, R. (1989) Bush Regeneration, Recovering Australian Landscapes. Macarthur Press Pty. Limited. Australia.
- NSW Department of Environment and Climate Change (DECC) (2005) Recovering bushland on the Cumberland Plain: best practice guidelines for the management and restoration of bushland. Department of Environment and Climate Change 59—61 Goulburn Street, Sydney.
- NSW Scientific Committee (2010) Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing
- NSW Scientific Committee (2011) River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - Determination to make a minor amendment to Part 3 of Schedule 1 of the Threatened Species Conservation Act
- NSW Department of Primary Industries (DPI) (2021) NSW Weedwise
<https://weeds.dpi.nsw.gov.au/>
- NSW Government Department of Environment of Water and Energy (DWE) (2007) How to Prepare a Vegetation Management Plan Guideline (DRAFT Version 7: March 2007).
- Environmental Appraisal and Planning (2004). Flora, Fauna & Ecological Assessment for the proposed Advanced Waste Treatment Facility, Elizabeth Drive, Kemps Creek.
- Holling, C.S. (1973) Resilience and stability of ecological systems. Annual Review of Ecological Systematics 4: 1-23. Cited in R.J. Hobbs and C.d. Yates (eds) (1999) Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration. Surrey Beatty & Sons. Chipping Norton.
- Kohen J. (1991) Working Paper Number 2 An Archaeological Survey at Lot 2 Elizabeth Drive Badgerys Creek. Macquarie University
- Maunsell (2007) for SUEZ Advanced Waste Treatment Facility - Elizabeth Drive Environmental Assessment.
- Maunsell (2008) for SITA Environmental Solutions. Vegetation Management Plan Badgerys Creek riparian corridor adjacent to SAWT Facility site at Elizabeth Drive Landfill SITA Environmental Solutions 06 March 2008
- McDonald T. (1999) Chapter 16 - Strategies for the ecological restoration of woodland plant communities: harnessing natural resilience. In R.J. Hobbs and C.J. Yates (eds) (1999) Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management And Restoration. Surrey Beatty & Sons. Chipping Norton.
- Mortlock, W. (1998) Florabank Guideline 5: Seed Collection from Woody Plants for Local Revegetation. Florabank. Canberra. (<http://www.florabank.org.au/>)
- NPWS (2002) Native Vegetation of the Cumberland Plain. NSW National Parks and Wildlife Service, October 2002.
- Penrith City Council (2010) Penrith Local Environmental Plan2010. (Flora and Fauna Conservation)
- Sydney Water (2014) Stormwater connections to natural waterways Rouse Hill Development Area. 31 July 2014



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