Cleveland Rd Nth and Sth Overarching VMP

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Contents

List of Figures

List of Tables

Abbreviations

Abbreviation	Description
APZ	Asset Protection Zone
BC Act	NSW Biodiversity and Conservation Act 2016
EEC	Endangered Ecological Community
ELA	Eco Logical Australia
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FM Act	NSW Fisheries Management Act 1991
ILGW	Illawarra Lowlands Grassy Woodland
LLS	Local Land Services
NRAR	Natural Resources Access Regulator
PCT	Plant Community Type
ToB	Top of Bank
VMP	Vegetation Management Plan
VRZ	Vegetated Riparian Zone

1. Introduction

1.1 Background

This Overarching Vegetation Management Plan (VMP) has been prepared by Eco Logical Australia Pty Ltd (ELA) on behalf of Newquest Property Pty Ltd (the proponent) for the proposed rezoning at Cleveland Road, West Dapto (the study area) (herein referred to as 'Cleveland Road'). The planning proposal aims to rezone this land to allow for a residential subdivision, with riparian and vegetated areas, small business areas, recreation areas and roads. The proposal also incorporates bushfire Asset Protection Zones (APZs). The area proposed to be rezoned covers approximately 366 ha.

This VMP aims to guide the future restoration of native vegetation along riparian zones within the study area. This VMP has been prepared to address the requirements of the NSW *Water Management Act 2000* and the associated *Guidelines for riparian corridors on waterfront land* (NSW Office of Water 2012). Any restoration works conducted in areas of *Illawarra and south coast lowland grassy woodland ecological community* must be carried out in accordance with the *Draft listing advice and conservation advice for the Illawarra and south coast lowland grassy woodland ecological community* (Department of the Environment and Energy, 2016).

1.2 Key terms

For this VMP, the following terminology has been adopted:

Study area: The extent of the lots listed in Table 1.

Table 1: Properties included in the study area

Lot	DP
1	532391
1	156208
59	1125379
1 and 2	730326
200 and 201	803810
401 and 402	1254873
310, 312 and 313	1188000
1	1126171
100	1086479
1	999485
A	156446
1	194419
1	741423

VMP area: The proportion of the site to be conserved and managed under future VMPs.

2. Site description

The study area is approximately 19 kilometres south west of Wollongong. The study area is around 366 ha in size and is dominated by exotic vegetation. Agricultural land is present to the south of the study area and low-density residential development is located to the north and east. The foothills of the Illawarra Escarpment are located to the west of the study area. The Illawarra Escarpment forms a large, continuous vegetated corridor running in a northerly direction connecting Dharawal National Park and the Upper Nepean State Conservation Area.

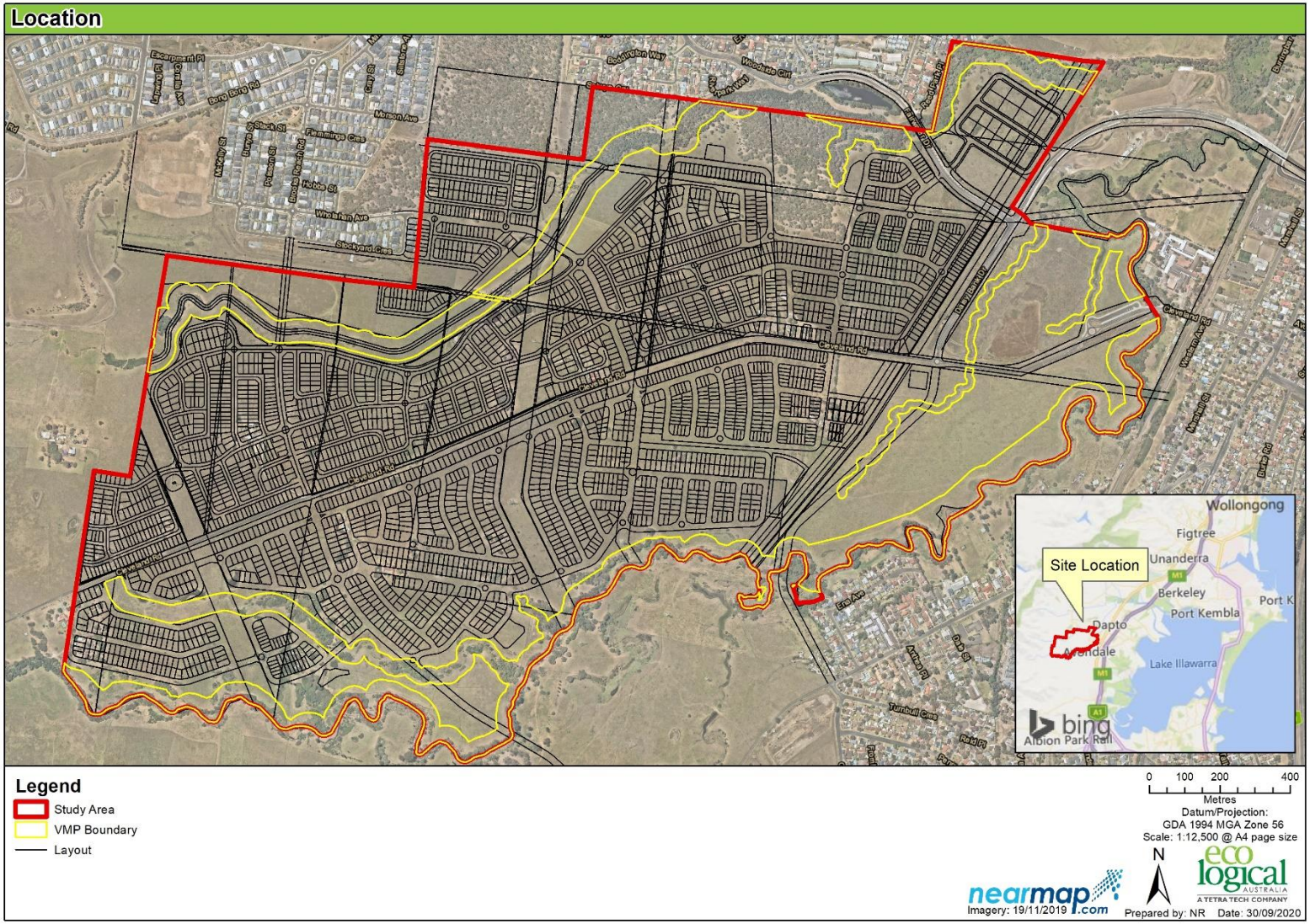

Figure 1: Site location

2.1.1 Waterways and riparian corridors

The study area contains Mullet Creek (a 4th order stream), one 3rd order stream, five 2nd order streams and 16 1st order streams as mapped by the Strahler stream order classification system. Mullet Creek is mapped as Key Fish Habitat under the NSW *Fisheries Management Act* 1991 (FM Act). The Natural Resources Access Regulator (NRAR) requires vegetated riparian zones to be preserved or instated along streams (Table 2). Wollongong City Council also has recommended riparian corridor widths based on a different category system (Table 2). Some Wollongong City Council buffer requirements are larger than those proposed by NRAR. Strahler riparian corridor requirements have been mapped according to the field validated top of bank mapping (Figure 5).

Table 2: Required riparian corridor widths (NRAR 2018)

Strahler stream order classification	Wollongong city council stream order classification	VRZ width (from top of bank) (NRAR 2018)	Total riparian corridor width (NRAR 2018	Wollongong City Council recommended riparian corridor (either side from top of bank)
1st order	Category 3	10 m	20 m + channel width	10 m
2nd order	Category 3	20 m	40 m + channel width	10 m
3rd order	Category 2	30 m	60 m + channel width	30 m
4th order	Category 1	40 m	80 m +channel width	50 m

2.1.2 Averaging rule

The Guidelines for Riparian Corridors on Waterfront Land (Office of Water, 2003) provide an Averaging Rule, which allows non-riparian works / activities to be carried out within the outer riparian corridor provided that the average width of the riparian zone can be achieved over the length of the watercourse within the development site. Under this rule, the outer 50% of the riparian corridor may be used for development lots, infrastructure, etc, provided that an equivalent area connected to the riparian corridor is offset on the site. The inner 50% must be protected and fully revegetated.

The future VMP areas indicated in Figure 1 are based on the locations of existing and proposed riparian corridors but may vary be varied in the future subject to detailed designs. Infrastructure, development lots, recreational areas, etc, may encroach the outer 50% of riparian corridors, in which case an equivalent area would be provided along the same riparian corridor. As such, the VMP areas indicated in Figure 1 are subject to change following detailed design.

2.2 Topography and Geology

The topography of the site ranges from gently undulating rises in the south-west to very flat areas around the rivers and streams (Figure 2). Elevation varies from 2 - 30 metres AHD with low-lying wetlands along the eastern areas of the creeks. The landscape is a mostly cleared rural environment.

The geology of the site consists of Berry Siltstone and an undifferentiated geology (Figure 3). Low lying sections of the West Dapto area (in the vicinity of creeks and drainage lines) are dominated by Quaternary aged alluvium, gravel, beach and dune sand (MG Planning, 2007). Mid grey to dark grey siltstone to fine sandstone are also recorded in the Yallah region to the north of Marshall Mount Creek. At higher elevations, early late Permian red-brown and grey volcanic sandstones of the Shoalhaven

Group (Budgong Sandstone) dominate the study area. Small areas of volcanic melanocratic and coarse grained to porphyritic latite (south of West Dapto Road) and aphanitic to porphoritic latite (on elevated areas to the north of Mount Marshall Creek) also occur within the study area. The geology of the area is considered to be stable.

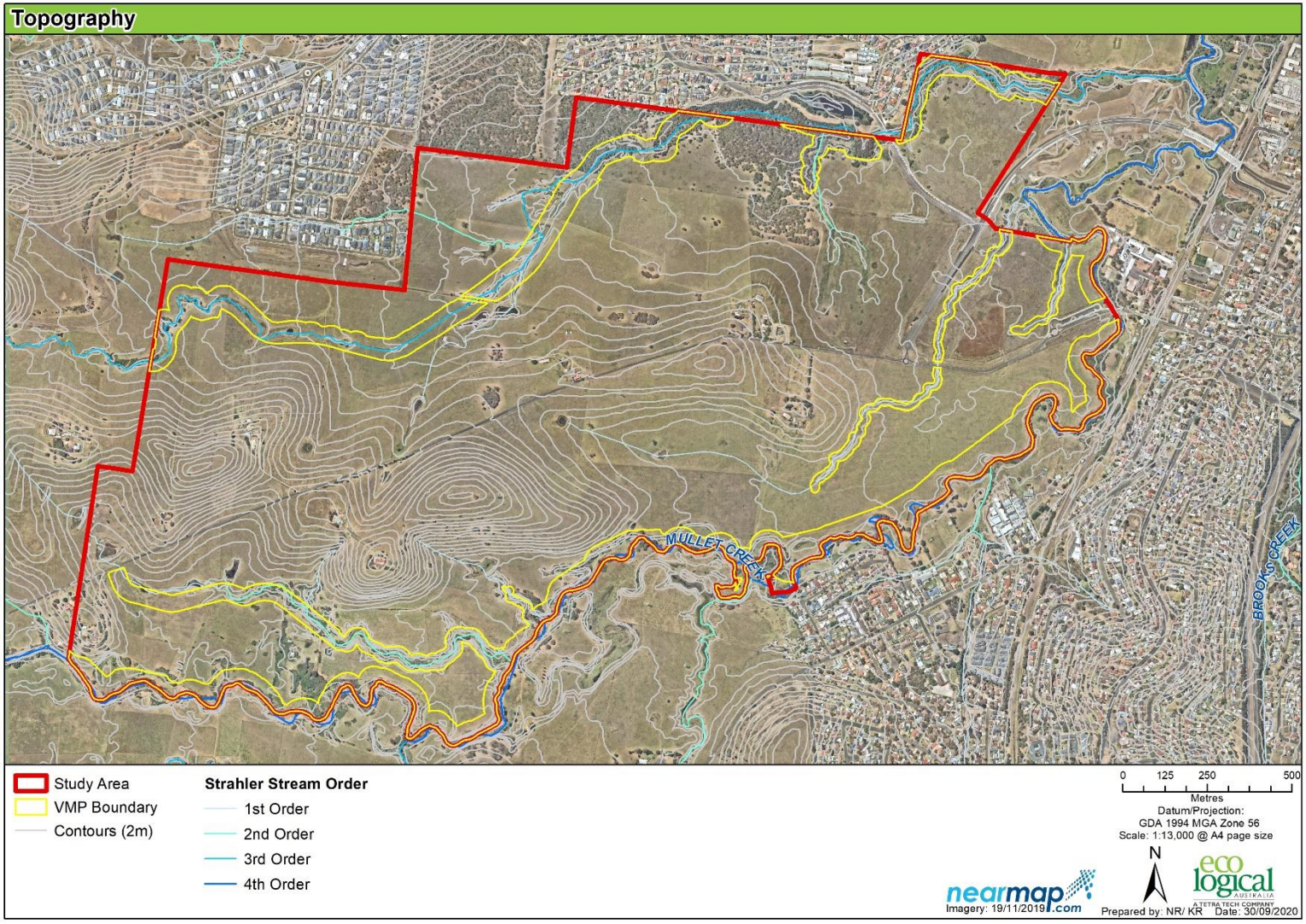

Figure 2: Topography of Cleveland area

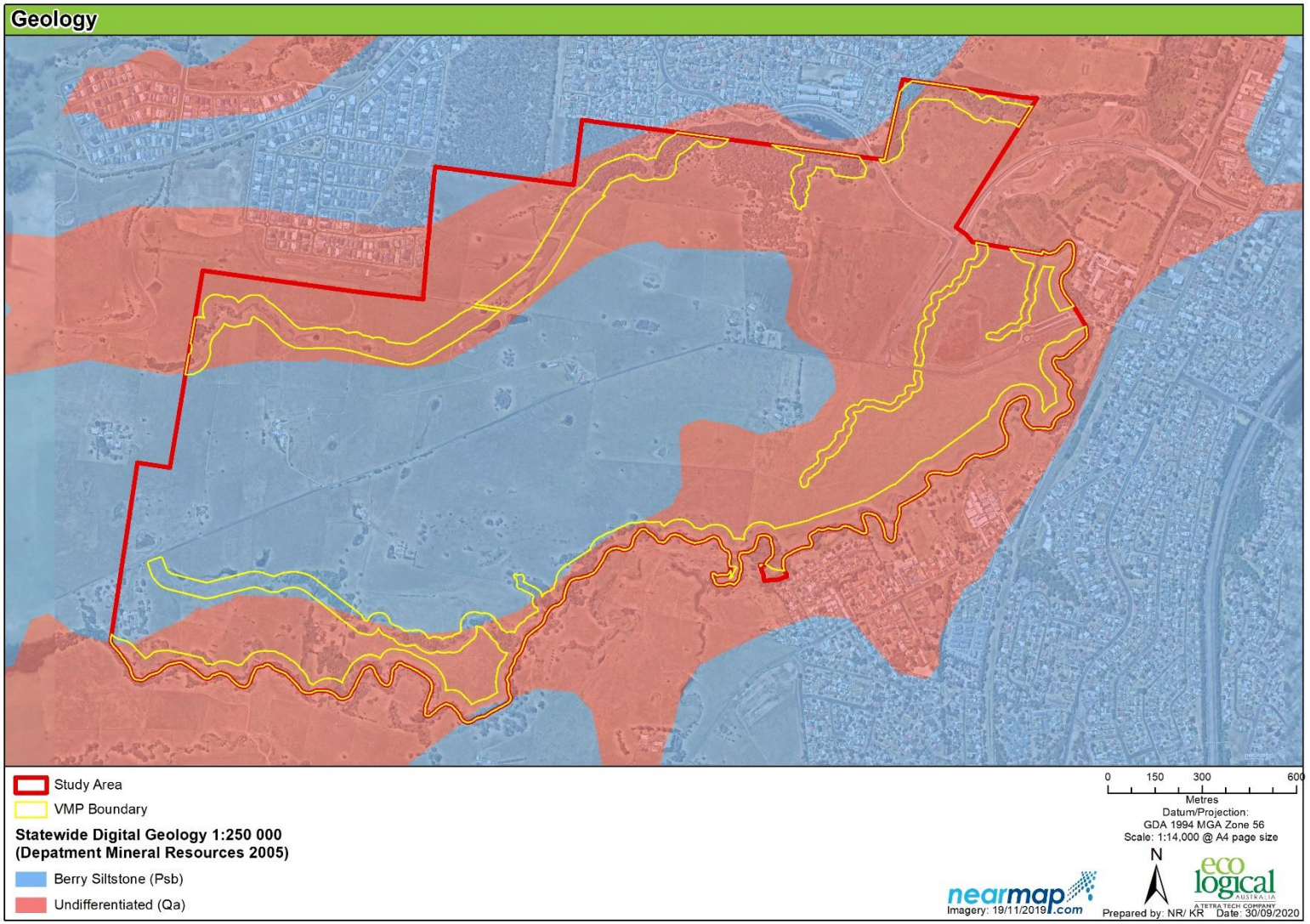

Figure 3: Geology of Cleveland area

2.3 Vegetation communities

Validation surveys to identify type, condition and extent of the vegetation communities present across the study area were conducted by ELA ecologists Alex Gorey, Rachel Brown and Karen Spicer on 11 and 16 May 2018, on 22 January 2020, and 21 and 26 May 2020 respectively (Figure 4). The surveys concluded that the study area contains four vegetation communities:

- Plant Community Type (PCT) 838 – Forest Red Gum – Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion
- PCT 1326 - Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1232 – Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1071 – *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion

PCT 838 and 1326 both correspond to:

- Illawarra and south coast lowland forest and woodland ecological community. Listed as critically endangered under the under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999*; and
- Illawarra Lowlands Grassy Woodland (ILGW) in the Sydney Basin Bioregion. Listed as an Endangered Ecological Community (EEC) under the *NSW Biodiversity Conservation* (BC) *Act 2016.*

ILGW was present in five conditions within the study area; good, moderate, poor, derived native shrubland and scattered paddock trees.

PCT 1232 corresponds to:

- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. Listed as endangered under the EPBC Act and BC Act.

Swamp Oak Floodplain Forest was present in three conditions within the study area; good, moderate and poor.

The study area is predominantly covered by exotic pasture and exotic trees, shrubs and other ground cover species.

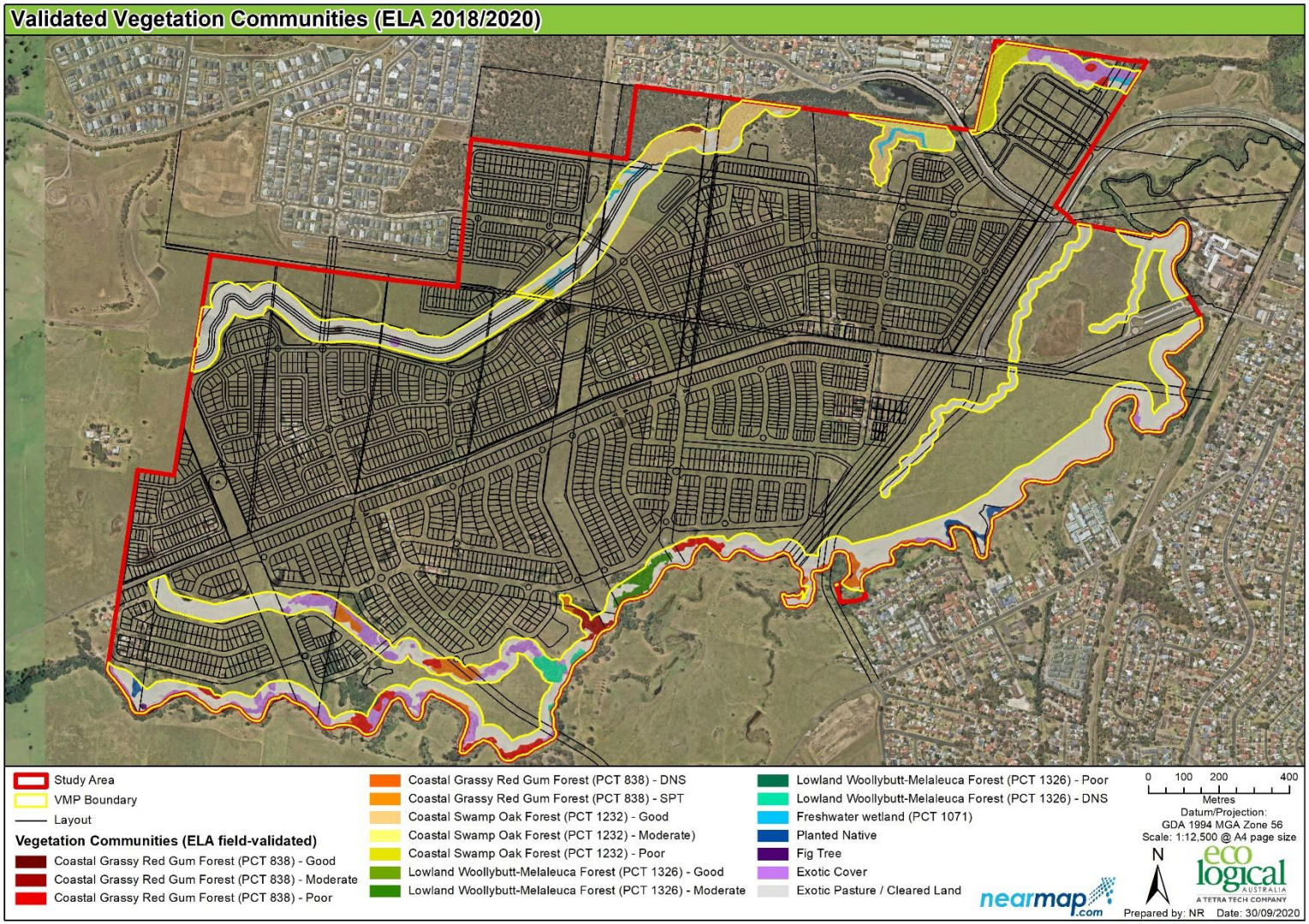

Figure 4: Validated vegetation communities (ELA 2018 & 2020)

2.4 Flora and fauna

Across all surveys conducted, 175 flora species were identified in the study area, 68 of which were exotic and 107 were native. A total of 14 fauna species listed as threatened under the BC Act and/or EPBC Act have been identified as having potential to utilise the study area for either foraging or habitat.

The full results of flora and fauna studies, including detailed species lists, are provided in the *Cleveland Road, West Dapto Planning Proposal Flora and Fauna Assessment (ELA 2020).*

2.5 Asset protection zones (APZ)

Asset Protection Zones (APZ) are areas located between bushfire hazards and development to provide a defendable space in which to undertake emergency operations and to provide a buffer from direct flame contact, and the impacts of radiant heat, smoke and embers. In some circumstances APZs may consist of managed areas outside an allotment e.g. managed open space, managed service easements and roads.

APZs are typically refined during subdivision stages, with the Structure Plan at re-zoning stage ensuring the APZ dimensions required at subdivision stage can be achieved. The final APZ requirements will be dependent on the eventual location of the development footprint and building envelopes.

The APZs for the development are provided in accordance with *Planning for Bushfire Protection 2019* and contained within the Bushfire Opportunities and Constraints Analysis Report (ELA, 2020). The planned location of APZs reflects the indicative VMP areas. The implementation of APZs are permissible within the outer 50% of the riparian corridor provided any clearing within the riparian corridor is offset within an adjoining area.

2.6 Resilience potential

The resilience of a site refers to the degree, manner and pace of recovery of species after disturbance or stress, or the potential for such recovery. Resilience is impacted by factors such as vegetation composition, structure and function as well as the amount of biodiversity and presence/absence of key threats (e.g. weeds or pest fauna species).

The VMP area has moderate-poor resilience. Areas of retained ILGW are in moderate to poor condition, some structural layers are absent from the study area (canopy and groundcovers). There is a high number of weeds at all structural layers (canopy, midstorey and groundcovers). A diverse range of abiotic features such as litter and dead wood are absent across the site, providing very little habitat for a range of fauna species. Remnant vegetation in the study area is isolated to small patches surrounded by exotic pasture. There is limited opportunity for plant seed or animal dispersal across the study area.

2.7 Management issues

2.7.1 Loss of native vegetation

The extent of native vegetation loss in the study area due to the proposed future construction of residential lots and associated infrastructure is currently unknown. Detailed mapping of native vegetation loss will be provided in individual VMPs. Rectification actions including restoration of lost vegetation will also be specified in individual VMPs in the study area.

2.7.2 Priority weeds

Of the 68 exotic flora species identified (Appendix A), 25 are listed as high threat weeds (Table 3). Most of these weeds were detected within the Riparian corridor of the study area. The risk of priority weed encroachment into Retained ILGW and the riparian corridor is high.

Table 3: High threat weeds identified in the study area

Scientific Name	Common Name
Ageratina adenophora	Crofton Weed
Anredera cordifolia	Madeira Vine
Arundo donax	Giant Reed
Asparagus aethiopicus	Asparagus Fern
Axonopus fissifolius	Narrow-leafed Carpet Grass
Chloris gayana	Rhodes Grass
Cinnamomum camphora	Camphor Laurel
Cyperus eragrostis	Umbrella Sedge
Delairea odorata	Cape Ivy
Ehrharta erecta	Panic Veldtgrass
Eragrostis curvula	African Lovegrass
Juncus acutus	Sharp Rush
Lantana camara	Lantana
Ligustrum sinense	Small-leaved Privet
Lonicera japonica	Japanese Honeysuckle
Olea europaea	Common Olive
Paspalum dilatatum	Paspalum
Plantago lanceolata	Plantain
Ricinus communis	Castor Oil Plant
Rubus fruitcosis spp. aggregate	Blackberry
Senecio madagascariensis	Fireweed
Senna pendula	Easter Cassia
Solanum seaforthianum	Climbing Nightshade
Stenotaphrum secundatum	Buffalo Grass
Tradescantia fluminensis	Wandering Jew

2.7.3 Pest animals

Pest animals are listed as a Key Threatening Process and are identified as being potentially threatening to the survival or evolutionary development of species, populations and ecological communities (OEH 2020). A 10 x 10 km radius search for records of pest species within the study area identified records of 31 pest species as occurring (Bionet 2020). Key threatening processes relevant to the study area and records of pest species within a 10 km radius of the study site include:

- Competition and grazing by the feral European rabbit
- Competition and habitat degradation by Feral Goats, *Capra hircus* Linnaeus 1758
- Herbivory and environmental degradation caused by feral deer
- Predation by feral cats
- Predation by the European red Fox
- Predation by the Plague Minnow (*Gambusia holbrooki*)

2.7.4 Climate change

Human-caused climate change is listed as a key threatening process specifically in relation to habitat loss/change (OEH 2017). The existing and anticipated effects of climate change including temperature and rainfall are likely to have an effect on species distribution and genotypes. Climate change resilience must be a key consideration with respect to the likely future viability of any plantings within the more detailed VMPs which will follow approval for this project.

3. VMP aims and objectives

3.1 Aims

The aims of this overarching VMP are to:

- Provide indicative VMP areas for VMPs that will accompany future DAs.
- Provide general management principles that will apply to future VMPs to improve the composition, structure and function of native riparian vegetation.
- Provide consistency with best practice guidelines including the Society for Ecological Restoration Australasia *National Standards for Ecological Restoration, 2016*.
- Be consistent with relevant environmental legislation and policies including NRAR and the EPBC Act 1999 - Approved conservation advice for the Illawarra and south coast lowland forest and woodland ecological community.

3.1.1 Objectives

Broad objectives of future VMPs are to:

- By the end of Year 5, reduce exotic species cover to <5% within each VMP area.
- No new exotic species established in each VMP area in Years 1-5.
- Characteristic diversity of indigenous plant species from each stratum established.

Individual VMPs will be developed to accompany future DAs. These will outline specific aims, objectives and indicators and will cover a five-year period, prior to hand over to Wollongong City Council or other land owner.

4. Action plan

4.1 Management zones

VMP management zones will be prescribed upon receipt of detailed designs during the Development Application stage for the study area. The proposed VMP area is indicated in Figure 5. Future management zones would be based on the natural resilience of each area. Resilience categories have been predicted for the future VMP areas (Figure 6).

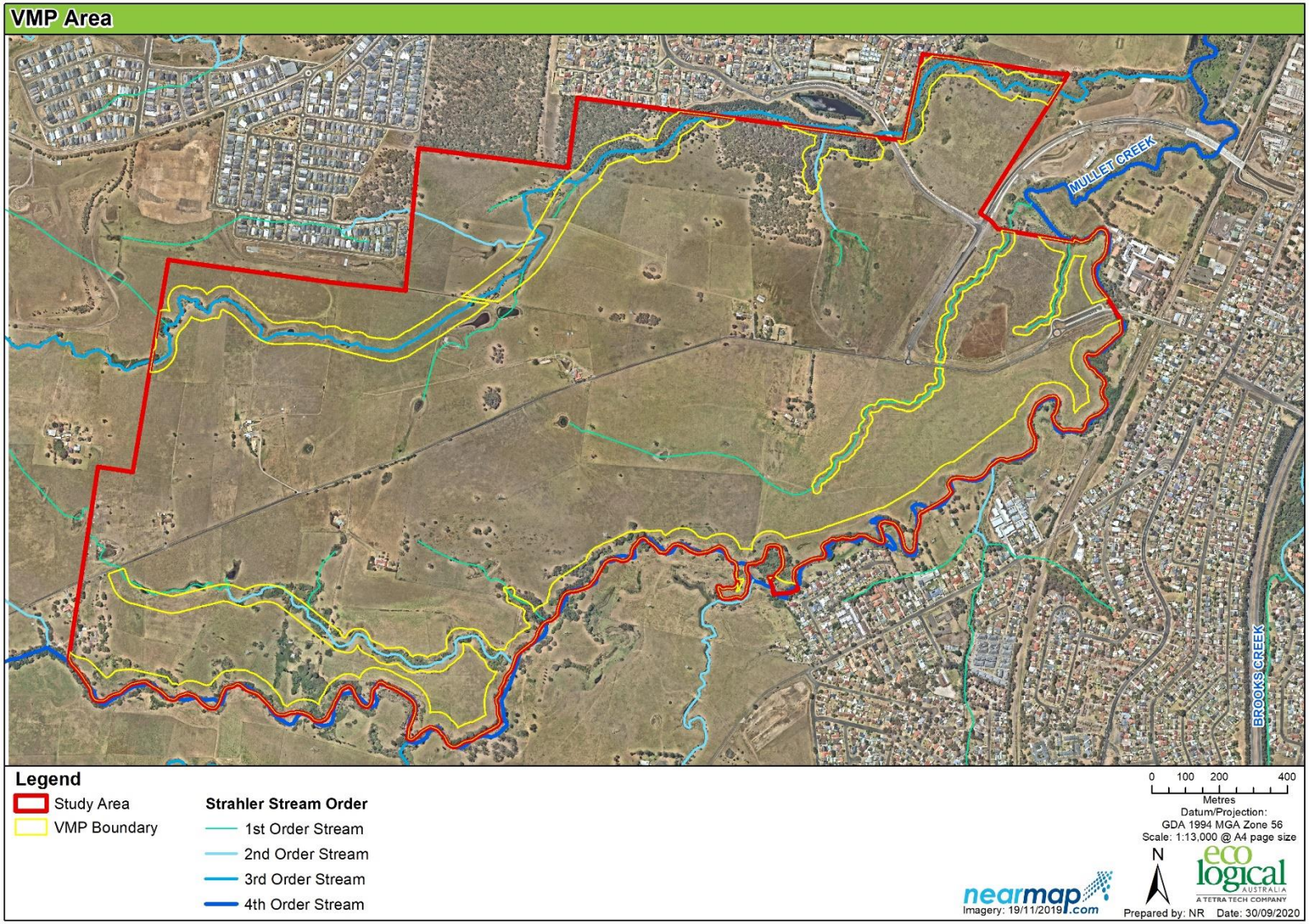

Figure 5: VMP area for the entire study site

4.2 Site management principles for future VMPs

4.2.1 Temporary construction fencing

The edge of the VMP area where it borders the development footprint is to be fenced with temporary construction fencing to prevent civil construction machinery from entering the VMP area unless under supervision from a suitably qualified ecologist or bush regenerator.

Informational signage must be installed on the construction fencing that identifies that there is to be no entry into the VMP area without an ecologist or bush regenerator present.

4.2.2 Preclearance and earthworks supervision

During construction activities, when clearing areas of existing vegetation in the riparian corridor, earthworks and tree removal should be undertaken with the fauna ecologist or wildlife carer to supervise works. All timber should be retained onsite and cut into logs to be utilised as habitat for native fauna.

4.2.3 Soil preparation

During all earthworks in the VMP area, i.e. for stormwater connections, the natural soil is to be retained and returned to the area following works. Top soil will need to be a loose, friable soil free of weed propagules suitable for planting. Top soil is to be kept free of weed propagules whilst retained on site.

4.2.4 Pest control

Pest control is the responsibility of the land holders, which is to be undertaken by relevant contractors in consultation with Local Land Services (LLS).

The site is to be monitored for evidence of pest species (e.g. rabbits, foxes), which will be included in annual monitoring reports. The results of this monitoring will be used to inform whether pest control actions are required to protect native vegetation and fauna in the VMP area.

4.2.5 Erosion and sediment control

Erosion and sediment control will follow the Soil and Water Management Plan prepared as part of the construction certificate. General consideration for erosion and sediment control include:

- Minimising the area of disturbance at any one time.
- Rapid covering and restoration of disturbed areas.
- Installation of temporary sediment controls (e.g. sediment fencing, coir logs, jute matting).
- Careful placement of stockpiles of soil and other materials away from drainage lines and protected by erosion controls.
- Restricting vehicle access to designated areas.
- Maintenance of all controls until earthworks are complete and the site is rehabilitated.

4.2.6 Revegetation

Complete revegetation is required where there are areas of low natural resilience (Figure 6). These areas occur where the vegetation is predominantly exotic cover. Some revegetation is also likely to be required in areas of moderate resilience, together with assisted regeneration. Revegetation usually

involves two rounds of weed removal followed by replanting of native groundcovers, shrubs and trees either by direct seeding or planting of tubestock once adequate weed control has been achieved. Replanting is typically required at the densities indicated in Table 4: Indicative revegetation densities for each resilience category. Species for revegetation will be based on characteristic species of the PCT native to that location. If species are unavailable, others may be substituted but they must be typical species of that PCT and be a 'like-for-like' substitution, i.e. a tree can only be substituted for a tree. All plantings are to be sourced from local provenance stock, as per WCC guidelines and Florabank guidelines (Mortlock, 2000).

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

4.2.7 Assisted regeneration

Assisted natural regeneration is based on the ecological principles of community succession and is most practical if there are patches of natural vegetation within the cleared area. It involves the natural regrowth of vegetation using the existing seed bank in the soil. It guarantees that vegetation will be a representation of what was previously growing at the site. Due to the varying condition of native vegetation and largely poor resilience across most of the VMP area, it is anticipated that assisted regeneration will be used only in areas of moderate - high resilience (Figure 6) as a complementary method for maintaining the health and integrity of vegetation communities. Supplementary planting over a 5 year timeframe will be the primary method of site management and outlined in future more detailed VMPs.

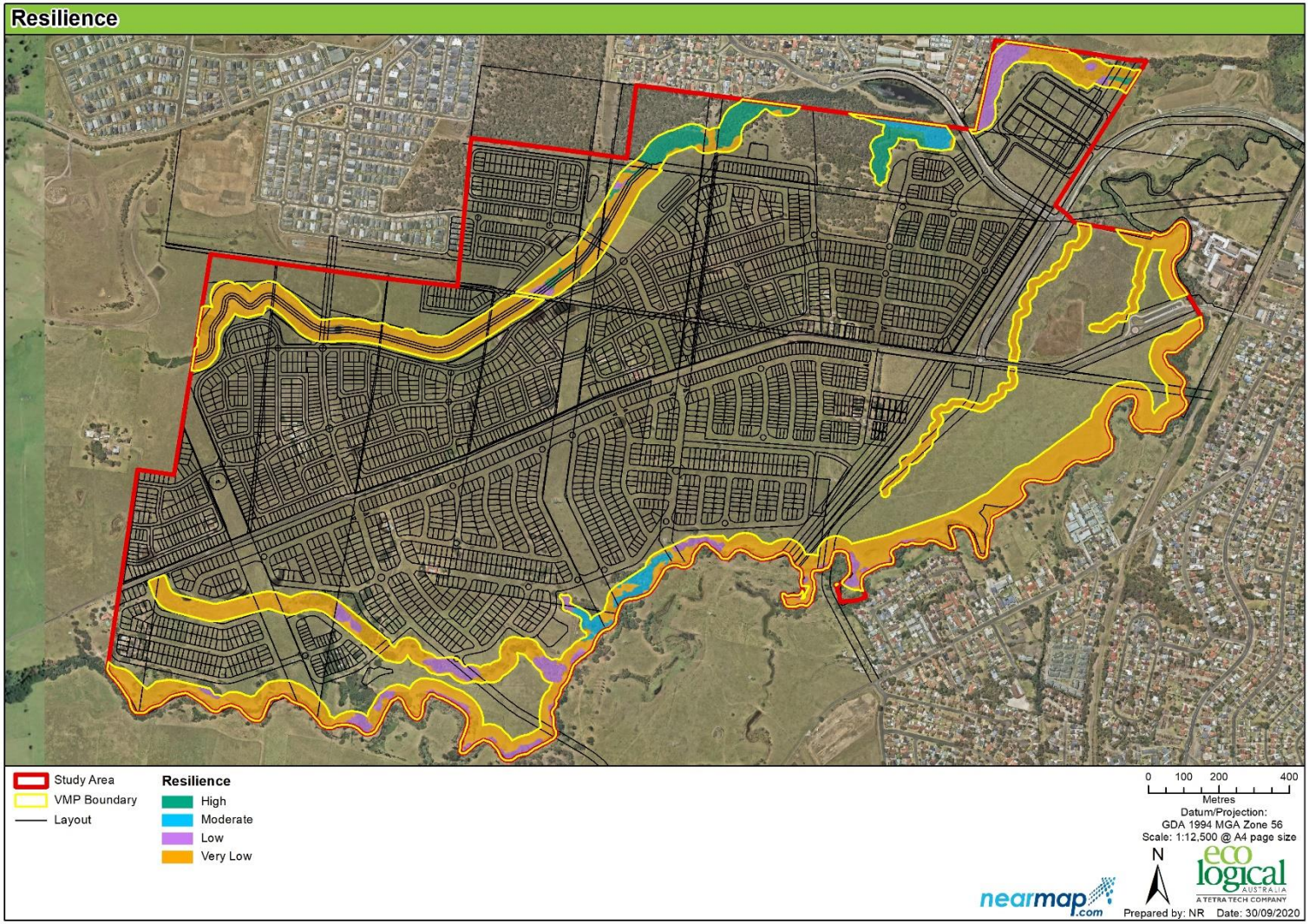

Figure 6: Resilience categories for future VMP areas

Table 4: Indicative revegetation densities for each resilience category

Description	Revegetation Area (m^2)	Revegetation densities (m^2)				Total
		Tree	Shrub	Herbs / scramblers	Sedge	
Very high resilience	0	1/50m^2	1/25m^2	1/m^2	3/m^2	0
High resilience	3,852	1/50m^2	1/25m^2	1/m^2	3/m^2	15,638
Moderate resilience	5,826	1/50m^2	1/25m^2	1/m^2	3/m^2	23,653
Low resilience	35,801	1/50m^2	1/25m^2	1/m^2	3/m^2	145,353
Very low resilience	426,862	1/50m^2	1/25m^2	1/m^2	3/m^2	1,733,060
Totals	472,341	9,447	18,894	472,341	1,417,023	1,917,704

4.3 Weed treatment

Weed control will be undertaken across all VMP areas. A selection of the best suited weed control method within the study area depends on several factors including:

- The species or combination of weeds being targeted.
- The density of the weeds.
- Resources available (time, labour, equipment and finances).
- Weather conditions of the day.

Due to the high density and abundance of weed species in the VMP area, primary weed control is required. Following primary weed control, maintenance weed control will occur for a period of five years to ensure exotic species do not encroach into the VMP area.

4.3.1 Weed control techniques

Details of specific weed control techniques to be used such as cut and paint, scrape and paint, herbicide spraying, and hand weeding are given in Brodie (1999). The principles of bush regeneration and techniques to trigger natural regeneration are to be in accordance with the Bradley Method and other techniques described in Buchanan (2000). Management techniques for different types of weeds, are provided in (Appendix B).

4.3.2 Management of weed waste

All exotic vegetation material should be removed from site and composted at a registered green waste disposal facility. Fruiting parts and tubers should be bagged before being removed from site.

4.3.3 Herbicide use

The use of herbicide to control weeds should be carefully considered. Herbicide use should assess potential long-term impacts of the technique including whether the proposed works address the source of the weed infestation. However, herbicide application forms an important and useful component of

an integrated weed management approach and can be the most appropriate method to control some weed species.

Herbicide use should occur during the active growing season for plants to encourage the chemical uptake into the plant. The selection of herbicides should also consider the type of weed and the location. Where non-selective herbicides are required for use, glyphosate is the most suitable. If herbicides are required to be used near waterways, a glyphosate-based herbicide formulated for use near waterways will be used (e.g. RoundUp© Biactive™).

Broad-leaf selective herbicide may be used as per the *Noxious and environmental weed control handbook* (DPI 2010). However, this type of herbicide is extremely toxic to aquatic life and must not be used in, or adjacent to, waterways. Registration and records must be kept in accordance with the NSW *Pesticide Regulation 2009*. Herbicide use for different types of weeds, is provided in (Appendix B)

4.4 Site maintenance

Maintenance weed control will be completed for a minimum five-year period, to control emergent and encroaching weeds. Maintenance work is to be undertaken by a qualified bush regeneration contractor(s) as per specifications provided in (Appendix B).

Maintenance will be undertaken on a regular basis in the peak growing seasons (spring and summer), with less frequent visits in cooler periods (autumn and winter). Maintenance programs will also comment on other site issues such as pest animal activity and condition of sediment control structures. Maintenance work will include actions to encourage native regeneration where it is not occurring naturally.

4.5 Performance criteria

The progress and compliance with the VMP will be monitored and reviewed annually. This process will involve the bush regeneration contractor, Newquest Property or their appointed representative and a staff member from Wollongong City Council. A report will be prepared commenting on each performance criteria. If required, reporting will be followed by a site visit.

The performance criteria which will be applied to management zone are described in Table 5.

4.6 Bush regeneration contractors

All vegetation management works in establishment and 5-year maintenance period is to be undertaken by suitably qualified and experienced bush regeneration contractors or individuals. In addition to this, team leaders should have, as a minimum, a Certificate III in Conservation & Land Management or equivalent. The contractor will need to carry out best practice bush regeneration techniques as described by Buchanan (2009). A flexible approach to this site is recommended since techniques may need to be changed or modified to suit site conditions. This approach is consistent with adaptive management and allows the contractor to develop and build on site knowledge whilst implementing this VMP. Monitoring will assist in the development of the VMP actions in subsequent years.

Works in the maintenance period will be the responsibility of the land owner in accordance with this VMP.

Table 5: VMP Action plan and performance criteria

Objective	Actions	Management Zone	Timing	Responsibility	Performance criteria
By the end of Year 5, reduce exotic species cover to <5% in the VMP area.	Hand weeding, spot spray weed control, mapping new infestations	All	Monthly inspections	Bush regeneration contractor	Exotic species cover <5% by the end of Year 5
No new exotic species established in the VMP area Years 1-5.	Hand weeding, spot spray weed control, mapping new infestations.	All	Monthly inspections	Bush regeneration contractor	
Create a 59 ha riparian zone	Sediment erosion control structures installed, 'no go' zones for machinery established.		Weekly inspections during construction of sediment basin	Newquest Property/Bush regeneration contractor	No damage to vegetation in riparian zone, no sediment discharge into stream during construction works.

5. Monitoring, evaluation and reporting

The bush regeneration contractor and the land manager will monitor the vegetation for changes over time. VMPs adopt the principle of observing, recording and monitoring treatments and responses to interventions in order to inform changes and different approaches for future work. Regular assessment and analysis of progress is required to adapt treatments (adaptive management) as required.

5.1 Monitoring

Monitoring will be targeted to specific targets and measurable objectives identified at the start of the VMP period and include:

- Collection of data prior to works commencing and at annual intervals to identify whether objectives, goals and targets are being attained; and
- Collecting data on specific treatments and approximate costs.

A minimum standard of monitoring is the use of photo points (Section 5.1.1), along with species lists and condition descriptions. VMPs also monitor the recovery performance using pre-identified indicators consistent with the objectives. These are used to track progress towards full recovery (see Appendix C). Formal quantitative sampling methods (e.g. vegetation plots) supported by a condition assessment are preferred mechanism to demonstrate achievement of objectives.

Adequate records of VMP interventions and all monitoring are maintained to enable evaluation. Secure records of the provenance of re-introduced plants should include location, description of site, reference to collection protocols and date of acquisition.

5.1.1 Photo monitoring

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

- set up a minimum of five photo monitoring points within the VMP area
- place two six-foot star pickets 10 m apart
- record the location (eastings and northings) of the first star picket with a GPS
- as well as the bearing to the second star picket
- take a digital photo from the first star picket looking towards the second star picket, the entire length of the gap
- label each digital image with a unique reference number that indicates where the photo was taken (i.e. the photo monitoring point) and the date it was taken (e.g. 01_190405 for a photo taken at the first photo monitoring point on the 5th April 2019.

5.1.2 Evaluation and reporting

Evaluation of the outcomes of VMP interventions is carried out, with progress against objectives of the project. Evaluation includes asking key questions to adequately assess the results from monitoring. Evaluation results are used to inform ongoing management.

Progress reports are to be provided on an annual basis until the completion of the project. This reporting includes the implementation of the monitoring actions specified in Section 4 and a description of the works that have been undertaken. These reports will be submitted to Council and NRAR. Reports will include at a minimum:

- The time period the report relates to.
- Qualifications and experience of contractors.
- A summary of works carried out within the period including.
    - Date and time of site visits.
    - Works completed on the site at each visit.
    - A table detailing total man hours for each task carried out on site.
    - Methods of weeding undertaken and details of herbicide use.
    - Methods implemented for Assisted Natural Regeneration.
    - Photo and quadrat monitoring results to date.
    - A description of any problems encountered in implementing the works recommended in the VMP and how they were overcome.
    - Any observations made, including new plant species recorded (native and weed species), comments on rates of regeneration and any problems which impact on the implementation of the VMP.
- If applicable, the results of the implementation works in relation to the relevant performance criteria.

6. References

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Appendix A – List of weeds recorded in the study area

Table 6: List of weeds recorded in the study area, ELA 2018 & 2020.

Scientific Name	Common Name	High Threat Weed
Abutilon grandifolium		
Agapanthus spp.		
Ageratina adenophora	Crofton Weed	
Anagalis arvensis	Chickweed	
Anredera cordifolia	Madeira Vine	Yes
Araucaria heterophylla	Norfolk Island Pine	
Araujia sericifera	Moth Vine	
Arundo donax	Bamboo	
Asparagus aethiopicus	Asparagus Fern	Yes
Axonopus fissifolius	Narrow-leafed Carpet Grass	Yes
Azolla pinnata	Mosquitofern	
Bidens pilosa	Cobblers Pegs	
Celtis sinensis	Japanese Hackberry	
Cenchrus clandestinus	Kikuyu Grass	
Chloris gayana	Rhodes Grass	Yes
Cinnamomum camphora	Camphorlaurel	Yes
Cirsium vulgare	Spear Thistle	
Citrus x *limon*	Lemon Tree	
Conyza bonariensis	Flax-leaf Fleabane	
Corymbia citriodora	Lemon-scented Gum	
Cotoneaster coriaceus	Milk Flower Cotoneaster	
Cotula sp.		
Cuppressus sp.	Cypress	
Cynodon dactylon	Couch	
Cyperus eragrostis	Umbrella Sedge	Yes
Delairea odorata	Cape ivy	Yes
Eragrostis curvula	African lovegrass	Yes
Ehrharta erecta	Panic-veldt Grass	Yes
Einadia hastata	Berry Saltbush	
Erythrina x *Skyesii*	Coral Tree	
Gomphocarpus fruitcosis	Narrow-leaved Cotton Bush	

Scientific Name	Common Name	High Threat Weed
Hypochaeris radicata	Catsear	
Jacaranda mimosifolia	Jacaranda	
Juncus acutus	Sharp Rush	Yes
Lagerstroemia indica		
Lantana camara	Lantana	Yes
Ligustrum lucidum	Large-leaved Privet	
Ligustrum sinense	Small-leaved Privet	Yes
Lonicera japonica	Japanese Honeysuckle	Yes
Modiola caroliniana	Red-flowered Mallow	
Morus sp.	Mulberry	
Murraya paniculata		
Olea europaea	Common Olive	Yes
Paspalum dilatatum	Paspalum	Yes
Passiflora sp.	Passionfruit	
Pennisetum clandestinum	Kikuyu	
Plantago lanceolata	Plantain	Yes
Ricinus communis	Castor Oil Plant	Yes
Rubus fruitcosis spp. aggregate	Blackberry	Yes
Rumex obtusifolia	Broadleaf Dock	
Salix babylonica	Weeping Willow	
Senecio madagascariensis	Fireweed	Yes
Senna pendula		Yes
Setaria gracilis	Pigeon Grass	
Setaria parviflora		
Sida rhombifolia	Paddy's Lucerne	
Solanum mauritanium	Tobacco Bush	
Solanum pseudocapsicum	Madeira Winter	
Solanum seaforthianum	Climbing Nightshade	Yes
Sonchus oleraceus	Common Sowthistle	
Spathiphyllum wallisii	Peace Lily	
Sporobolus africanus	Parramatta Grass	
Stenotaphrum secundatum	Buffalo Grass	Yes
Tagetes minuta	Stinking Roger	
Taraxacum officinale	Dandelion	
Tecoma capensis	Cape Honeysuckle	
Thunbergia elata	Black-eyed Susan	

Scientific Name	Common Name	High Threat Weed
Tradiscantia fluminensis	Trad	Yes
Trifolium sp.		
Trifolium repens	White Clover	
Ulmus parvifolia	Chinese Elm	
Urtica dioica	Stinging Nettle	
Verbena bonariensis	Purpletop	
Verbena rigida	Veined Verbena	

Appendix B

Weed control techniques are summarised below. These techniques are guidelines only. An adaptive weed management program should include a combination of different weed control techniques and involves consideration of monitoring and reporting outcomes and potential changes to the weed management program based on those result.

To effectively manage the issue of weed invasion an understanding of the types of vectors responsible is important. The movement of wind and water is often considered the greatest mode of weed dispersal into new habitats. Water is commonly responsible for the transport of weed propagules along the riparian corridors and contributes to weeds establishing downstream watercourses. However, there are many options for weed dispersal by vectors other than wind or water. A list of some of the potential weed vectors and examples of weeds species is shown the table below.

Vector	Weed Examples	Description	Ecological Implications
Watercourse	Trad	Fleshy stems can be transported along watercourse	Widely dispersed into native and disturbed environments
Drain	Moth Vine	Light feathery capsules float on water	Widely distributed along creek lines and into downstream habitats
Wind	Pampas Grass	Very light seeds are windborne over long distances	Readily invades disturbed open habitats, particularly along road verges
Track	Cobblers Pegs	Burrs stick to animals and humans	Invades disturbed bushland along tracks and is carried into adjacent habitats
Birds	Blackberry, Lantana	Edible fruits are dispersed over large areas	Birds increase weed dispersal into new habitats
Mammals	Blackberry,	Eat fruit or transport burrs on fur	Mammals spread seeds or burrs into new habitats
Humans	African Lovegrass	Transport propagules on clothes and shoes	Humans spread seeds or burrs into new habitats

B1 Hygiene protocols

A strict hygiene protocol must be implemented to control the spread of weed propagules between habitats and the accidental introduction of invasive species into sensitive areas. Best management practices recommend work from should target areas of high native resilience to areas then move towards high weed infestation. Weed propagules may be spread on the clothes or boots of humans or in the soil on vehicles. It is important that all vehicles, especially earth movement, are thoroughly washed down before moving to a new site. This also applies to humans. Clothes must be free of weed propagules before entering a new site.

B2 Principles of weed control within natural areas

Weed control programmes within natural areas follow the principles of bush regeneration including the Bradley Method and other techniques to promote natural regeneration as described in Buchanan (2000). These are summarised below:

- Where available, refer to best practice guidelines for individual weed species which may need to be adapted to a natural setting and ecological outcome
- Ensure correct plant identification – many weed species are difficult to identify because they resemble native species or typically occur in a vegetative (i.e. non-flowering) form.
- Limit the creation of bare patches of soil and soil disturbance in general, since this will encourage weeds to establish and grow – do not create unnecessary tracks with vehicles or other machinery;
- As a first option for weed control, consider methods that do not use herbicide (e.g. hand pulling and crowning) and which create very little soil disturbance;
- When using herbicides, use the least toxic chemical whenever possible and always follow the instructions;
- When working on or near drainage lines, use an approved herbicide for this environment;
- Refer to Australian Pesticides and Veterinary Medicines Authority (APVMA) website (www.apvma.gov.au) for information on off-label permits;
- Apply herbicides when the plants are actively growing and prior to seed set to achieve the best results;
- Regularly monitor for new infestations; and
- Where woody weeds are providing habitat for native birds and animals, use the drill and fill technique to enable the same structure to remain in situ while the tree or shrub dies – this will enable the plant to provide shelter for a period of time, while giving the birds and animals a chance to move on of their own accord. Where this is not practical considering the size of an infestation consider a mosaic approach to control.

B3 Integrated Weed Management

Integrated weed management may use a combination of any of the following techniques; mechanical, chemical, manual handling and biological methods. According to the Department of Primary Industries‟ (DPI) *Noxious and environmental weed control handbook* the best management practices considers a long-term perspective and does not rely solely on herbicide application (DPI 2010).

Weed control can be broken down into three main categories:

Primary Treatment: the first weeding of the site.

Secondary Treatment: the second weeding of the site which may be very intensive as all regrowing/germinating weeds should be removed before they seed and out-compete native plants.

Maintenance/Follow-up Treatment: every re-weeding of the site after the secondary phase.

The first time an area is weeded (primary treatment) can be labour intensive and time consuming and depending on the target species and site conditions. It may take over several months to complete for one species (Buchanan 2009). In areas of high weed infestation and with no native resilience and/or native plants present, primary weeding may be accelerated as preparatory works for revegetation. However, in areas where native plants may occur, primary weeding should be undertaken at a pace that assists with the natural regeneration of the site.

Secondary treatment of an areas can take longer than primary treatment as new species can be present that more difficult to treat than the original weed (Buchanan 2009). Secondary treatment needs to be carefully timed to:

- Prevent weeds from setting seed;
- Suppress vegetative regrowth while plants are still small; and
- Allow native plants to recruit without being smothered or out-competed by weeds.

However, secondary treatment should allow enough time for the soil profile to recover following primary treatment and the establishment of weed growth from the soil seed bank.

Maintenance treatment refers to weed control that is carried out after the secondary treatment (Buchanan 2009). The goal of follow-up treatments is to remove weedy recruits so that native species can re-colonise the area; frequent visits are likely to be needed at first, although the amount of time and resources used should gradually decrease through time.

B4 Chemical Weed Control – Herbicide Application

Herbicide Selection

Any herbicide used in weed management activities must be registered for use in the appropriate situation for the species being treated. It is the responsibility of the weed control operator to check that the herbicide intended for use is registered at the time of control. Where herbicide application is used, many hardy species may require re-treatment between six and twelve months after the initial treatment to ensure mortality of individual plants.

Spot Spray Application

Hand operated spray gun connected to a knap-sack or vehicle (e.g. truck, ATV, etc.) mounted herbicide storage tank is used to direct diluted herbicide spray to defined areas. When applied under correct conditions, individual plants or parts of plants may be treated using this method with minimal risk of overspray and non-target damage. Spot spraying is an effective and targeted way of treating weeds on a landscape level, though non-target damage is possible on an individual plant level. This can be mitigated in some situations through the use of selective herbicides.

This method is most suitable for low growing or juvenile grasses, herbs, and woody weeds that have copious, but compact, foliage. In most cases, spot spraying should be undertaken after new growth is produced but before flowering. Because the plant is left *in situ* after spraying, there is potential of seed to mature on the plant if spraying is left to late. In some cases the target plant may also take weeks or months to die off.

Splatter Gun Application

Individually operated splatter or gas guns are connected to a 5L backpack which may be equipped with a canister of LPG. The hand gun applicator is charged with a dose of herbicide and a splatter of low volume-high concentration herbicide solution is applied. The LPG forces the herbicide out of the pack up to several meters distance; however, instead of a fine spray mist, as in the case of spot spray application, the herbicide is applied in a large droplet form leaving a line of herbicide on the plant.

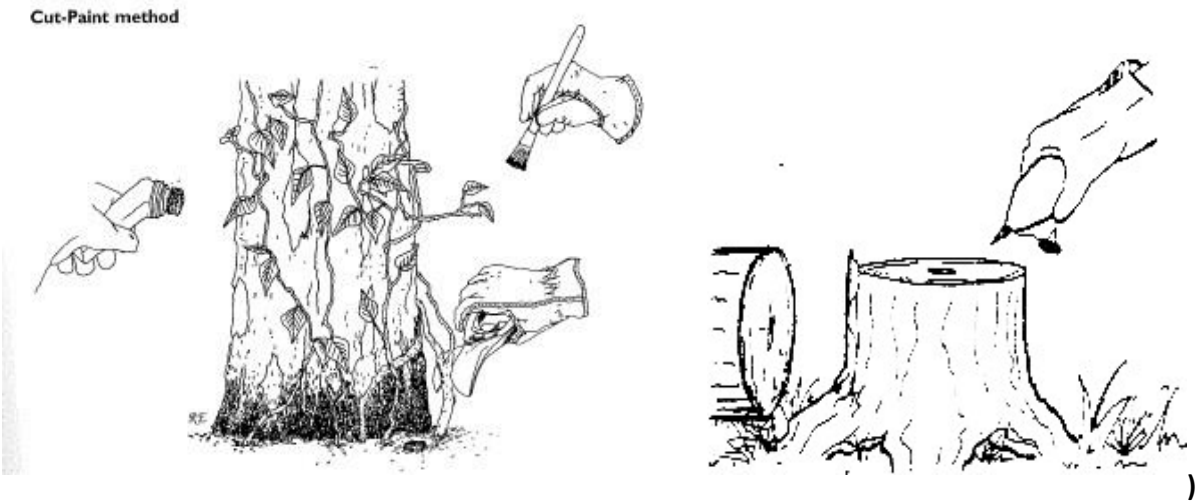
"Stripes" of herbicide are applied across large plants instead of coating all parts of the plant in a fine mist.

Splatter guns are very effective as the application of the herbicide is more directed and produces limited off target damage. This treatment provides a good alternative to spot-spraying where access is difficult or materials have to be carried in, as they use much less water. Splatter guns can also provide an alternative to mechanical removal or herbicide treatments requiring access to the stem of the plant (e.g. cut and paint, drill and frill, etc.) amongst dense, low growing woody weeds such as Bitou and Lantana. This treatment is not effective on vegetation with sparse foliage cover.

Cut and Paint

In the cut and paint treatment, the stem of the plant is cut all the way through and herbicide applied to the stump. The plant should be cut as close to the base as possible, below any branches and the cut should be horizontal. The remaining stump should not exceed 10mm in height. The tools required to make the cut may be a handsaw, secateurs or chainsaw. Any dirt on the stump needs to be removed and the herbicide needs to be directly applied within 30seconds to the stump using a dabber bottle. Some plant species re-sprout after this treatment and follow up work may be required to kill the plant effectively. A non-specific herbicide should be used for the cut and paint method.

The cut and paint method is suitable for the control of woody weeds, large herbaceous weeds and vines/climbers. When done with vines/climbers it is referred to as „skirting". This treatment is commonly used when the biomass is to be removed from the site following the primary weed control. It is most suitable for plants with a small diameter at the base and a single stem or trunk. Given that to be effective the herbicide has to be applied as soon as possible after cutting, this method is not effective where extensive cutting is required.



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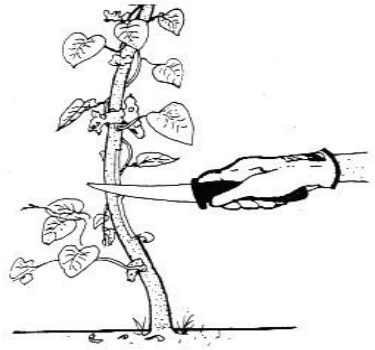
Stem Scrape

The stem scrape method involves using a sharp knife to scrape back the top layer of bark from the vine 20-30cm long. An appropriately mixed herbicide needs to be applied immediately (within 30 seconds) using a dabber bottle. The root system of the plant should not be disturbed until the plant has died as this may reduce the effectiveness of the herbicide. Skirting method may be used in conjunction with stem scrape. This method is especially important to remove large infestations of vines within the canopy layer. Skirting involves cutting the vines within the canopy at chest height. This will allow an increase in the amount of light and resources to the canopy trees through the reduction of vine biomass



The stem scrape method is most useful when used to treat species that need greater herbicide coverage than can be provided by the cut and pain method (e.g. Green Cestrum, Ochna), or a species that has reproductive material (e.g. tubers) that must be poisoned as well (e.g. Madeira Vine). For the latter, this is especially important if it is not possible to collect the reproductive material. However, for most woody weeds and vines, this method is not necessary.

B5 Manual and Mechanical Weed Control

This technique physically removes plants from the soil and depending on the weed species may require special conditions for disposal (e.g. some noxious weeds must not be transported off-site and must be disposed of by deep burial). Manual treatment effectively removes the entire plant using hand tools such as shovels or the use of heavy machinery. This technique is most productive when treating small area infestations and successfully removes the entire plant effectively preventing future seed set.

Certain parts of plants may also be targeted for removal to prevent flowering or seed set (i.e. post flowering but prior to mature seed being released from the fruit or seed head). Re-treatment may be required if mature plants have previously released viable seed into the soil which may germinate post soil disturbance.

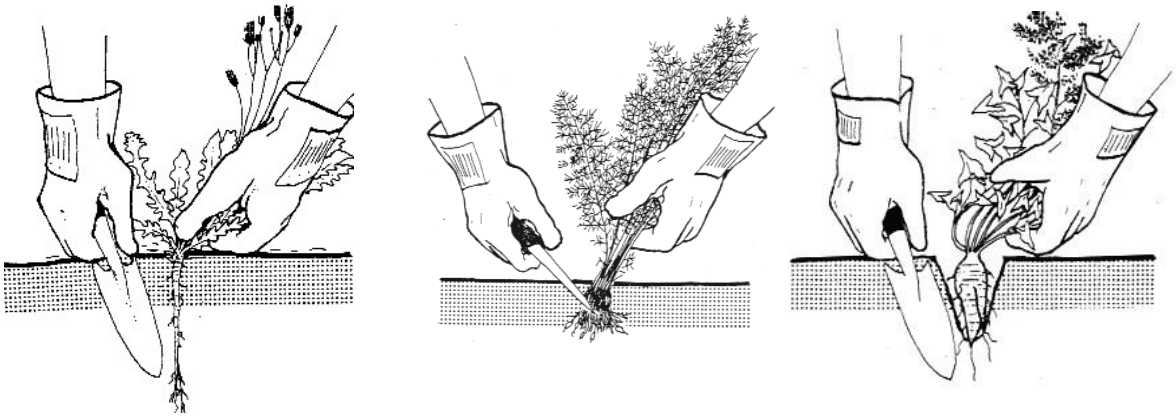
To reduce the risk of localised increased fuel load no debris should stockpiled on site.

Hand Removal / manual methods

Hand removal of weeds involves pulling the plant as close to the base as possible and ensuring the entire tap root is pulled out of the soil. This usually results in soil disturbance and the soil should be replaced and compressed to prevent further weed invasion.

The successful hand removal of some other weeds may require the removal of the plant's roots, bulbs or tubers. This method includes digging and crowning with the use of a hand mattock, knife or trowel. Crowning involves using a knife to cut the roots around the crown of the plant.

The hand removal or pulling of weeds is suitable for many species of weeds as long as they have a shallow root system. This includes woody weeds, grasses and herbaceous species. It is useful for follow up work on woody weeds to control seedlings



Herbicides

Herbicide application often forms an important component of an integrated weed management approach and can be the most appropriate method to control some weed species. Many herbicides are harmful not only to plants, but also fauna, particularly fish and amphibians.

Any herbicide used in weed management activities must be registered for use in the appropriate situation for the species being treated. These registration requirements are provided on the product label or an „Off-label Permit". Some species which are known to be difficult to control may be treated

using combinations of herbicides registered for use in „Off-label Permits" which are issued by the Australian Pesticides and Veterinary Medicines Authority (APVMA). It is the responsibility of the weed control operator to check that the herbicide intended for use is registered at the time of control.

The situation of control should be carefully considered to ensure correct herbicide usage. In all cases the application technique must be aligned to the registration requirements of the individual herbicides selected for the weed control program. Where a sensitive environment coincides with weed infestation only herbicides suitable for use in sensitive areas (as dictated by the product registration) should be used. For example, to target a weed infestation in close proximity to water courses such as a creek line, a product such as Roundup® Biactive® could be used as it is registered for use in this type of situation.

Residual herbicides can be present in the soil profile for several months post application to reduce the incidence of regrowth of the target weed species. A residual selective herbicide would not, however, be appropriate if plans for the area involved revegetation, particularly with species intolerant to the herbicide. This would pose a serious threat to rehabilitation maintenance works where the area was to be revegetated with species which are susceptible to herbicide impact. Application of a residual herbicide may reduce recruitment of these species, further compounding the maintenance issues. In this situation a non-residual herbicide would be recommended to reduce the impact on establishing vegetation.

Herbicides fall into two main categories with regard to their impact on particular plants

- Non-selective herbicides which will, at appropriate rates, kill all plants. Glyphosate is a non-selective herbicide.
- Selective herbicides which will target either grass (monocot) species or broad-leaf (dicot) species.

Herbicide use should occur during the active growing season for plants to encourage the chemical uptake into the plant. Where herbicide application is used, many hardy species may require retreatment between six and twelve months after the initial treatment to ensure mortality of individual plants. Off target damage is common with herbicide use and consideration should be given to the following factors to avoid this damage.

- Correct identification of target species
- Spray drift in high winds
- Environmental conditions at time of application

A number of selective herbicides have been approved for grasses and for broad-leaf species in the NSW Department of Primary Industries (DPI) *Noxious and environmental weed control handbook.*

These selective herbicides represent a range of environmental toxicities and the Material Safety Data Sheets (MSDS) should be referred to in each instance. For instance, Metsulfuron-methyl poses a low risk to the environment, while Triclopyr is considered to be relatively toxic and has the potential to pose a moderate risk to the environment. Dimethylamine salt is in the same category as triclopyr, but is moderated by mixing it with metsulfuron-methyl.

Registration and records of any herbicide use must be kept in accordance with the NSW *Pesticide Regulation 2009*.

The correct training and appropriate application of herbicides must be followed at all times. There is a high risk of ecological impacts associated with use of herbicides. These risks include accidental death of plants due to spray-drift or due to incorrect handling technique or sensitive plants. There is also evidence that there are indirect impacts on microbats due to herbicide poisoning and reduced numbers of prey items for microbat species. Where possible consider alternative methods to herbicide use.

All weed control operators must be properly trained and hold required certification e.g. ChemCERT® and comply with requirements of the Pesticides Regulation 2009 (NSW) and Pesticides Act 1999 (NSW).

Appendix C - Society for Ecological Restoration Evaluation Recovery proforma

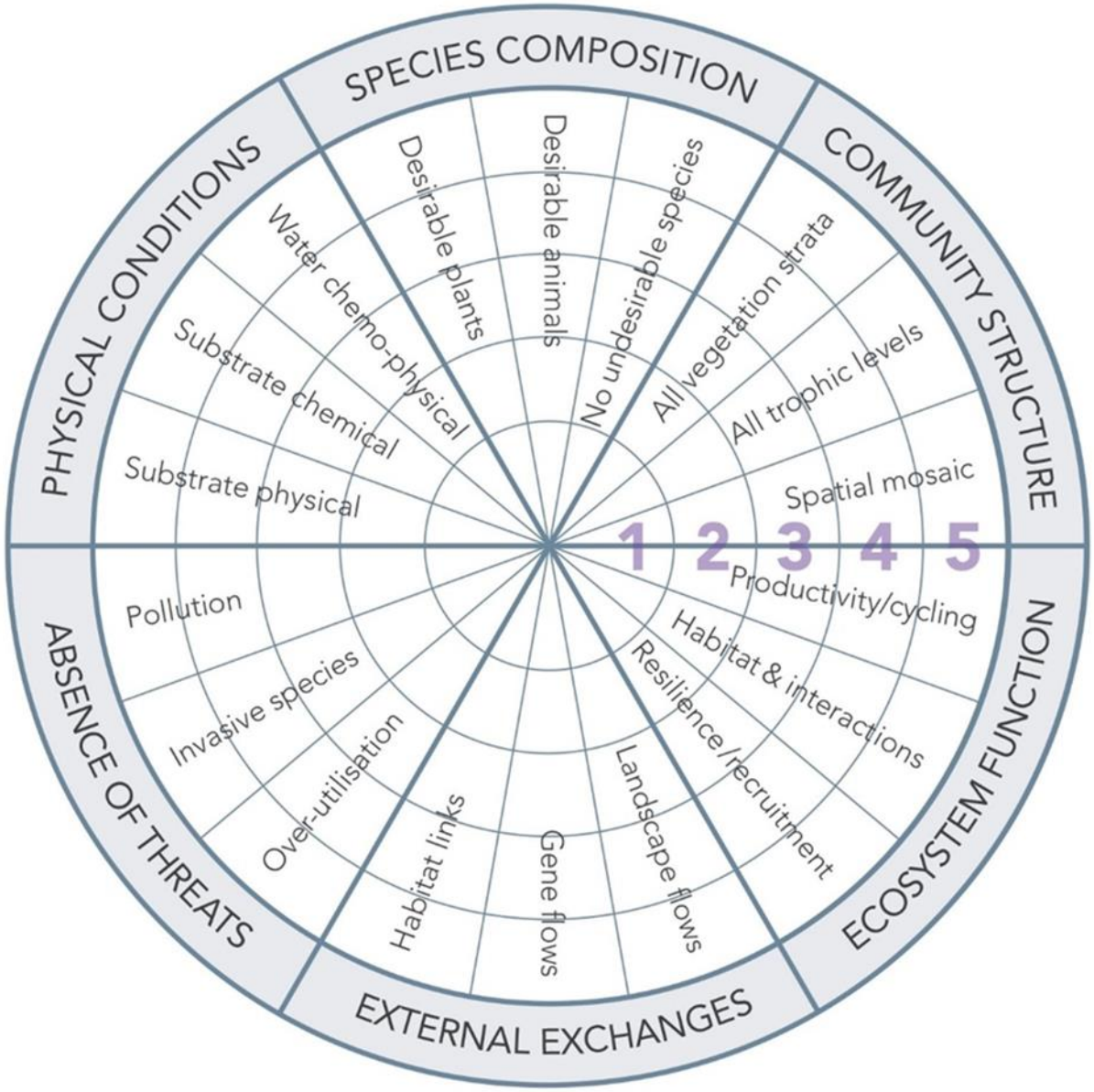


Figure 7: Society for Ecological Restoration ecosystem evaluation tool

Figure 4 allows a manager to illustrate the degree to which the VMP is achieving its goals over time. A practitioner with a high level of familiarity with the goals and achievements of the project can shade the segments for each sub-attribute after formal or informal evaluation. Sub-attribute labels (e.g. productivity/cycling) can be adjusted or more added to better represent a particular ecosystem. The scores must be based on informal or formal monitoring indicators for the project and reflect the rigour and reliability of that monitoring. These should be identified at the outset of the VMP to provide ecologically meaningful information about the sub-attributes and attributes being finally evaluated.

Evaluation of Ecosystem Recovery proforma

Site: .....

Assessor: ..... Date: .....

ATTRIBUTE CATEGORY	RECOVERY LEVEL (1-5)	EVIDENCE FOR RECOVERY LEVEL
ATTRIBUTE 1. Absence of threats		
Over-utilization		
Invasive species		
Pollution		
ATTRIBUTE 2. Physical conditions		
Substrate physical		
Substrate chemical		
Water chemo-physical		
ATTRIBUTE 3. Species composition		
Desirable plants		
Desirable animals		
No undesirable species		
ATTRIBUTE 4. Community structure		
All vegetation strata		
All trophic levels		
Spatial mosaic		
ATTRIBUTE 5. Ecosystem function		
Productivity, cycling, etc.		
Habitat and plant-animal interactions		
Resilience, recruitment, etc.		
ATTRIBUTE 6. External exchanges		
Landscape flows		
Gene flow		
Habitat links		

Figure 8: Society for Ecological Restoration Evaluation of Ecosystem Recovery Proforma

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