total earth care

Vegetation Management Plan

William Charlton Village, Allambie Heights

Total Earth Care Pty Ltd

July 18

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Table of Contents

1 INTRODUCTION

1.1 Background

Total Earth Care (TEC) has been commissioned by Allambie Heights Village Ltd to prepare this Vegetation Management Plan for the rehabilitation of bushland at 181 Allambie Rd, Allambie Heights (William Charlton Village) (Lot 2615 DP 752038). The consent authority reviewing this report is Northern Beaches Council.

This Vegetation Management Plan report will address:

- Review the Statutory Approval framework including relevant environmental planning instruments and Consent Authority requirements;
- Review existing reports, documentation and species records relating to the site;
- Conduct a field survey including targeted Threatened Species, Population and Endangered Ecological Community searches of the subject site and study area;

The conclusions and recommendations within this report will determine the scope of works, techniques, and time frame that are required for the management of the vegetation onsite.

1.2 Subject Site and Study Area

The Subject Site (the Site) comprises the area of land directly affected by the development proposal. The study area comprises the subject site in addition to the surrounding land that may be potentially indirectly affected by the development or affect the development. The locality encompasses a larger area that includes neighbouring properties and includes areas of native biodiversity values nearby.

See Map 1 (p. 5) for the Subject Site and Study Area.

1.3 Relevant Legislation and Planning Instruments

Within the Northern Beaches Council LGA, relevant legislation and policies include:

- 10/50 Vegetation Clearing Code of Practice
- Biodiversity Conservation Act 2016 (NSW)
- Biosecurity Act 2015 (NSW)
- Bushfire Environmental Assessment Code 2006
- Environment Protection and Biodiversity Conservation Act 1999 (Cth)
- Environmental Planning and Assessment Act 1979 (NSW)
- Local Government Act 1993 (NSW)
- National Parks and Wildlife Act 1974 (NSW)
- Planning for Bushfire Protection 2006
- Protection of the Environment Operations Act 1999 (NSW)
- Rural Fires Act 1997 (NSW)
- State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004
- State Environmental Planning Policy (Exempt and Complying Development Codes)
- State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004
- State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017
- State Environmental Planning Policy No 19-Bushland in Urban Areas
- State Environmental Planning Policy No 1-Development Standards
- State Environmental Planning Policy No 33-Hazardous and Offensive Development
- State Environmental Planning Policy No 36-Manufactured Home Estates

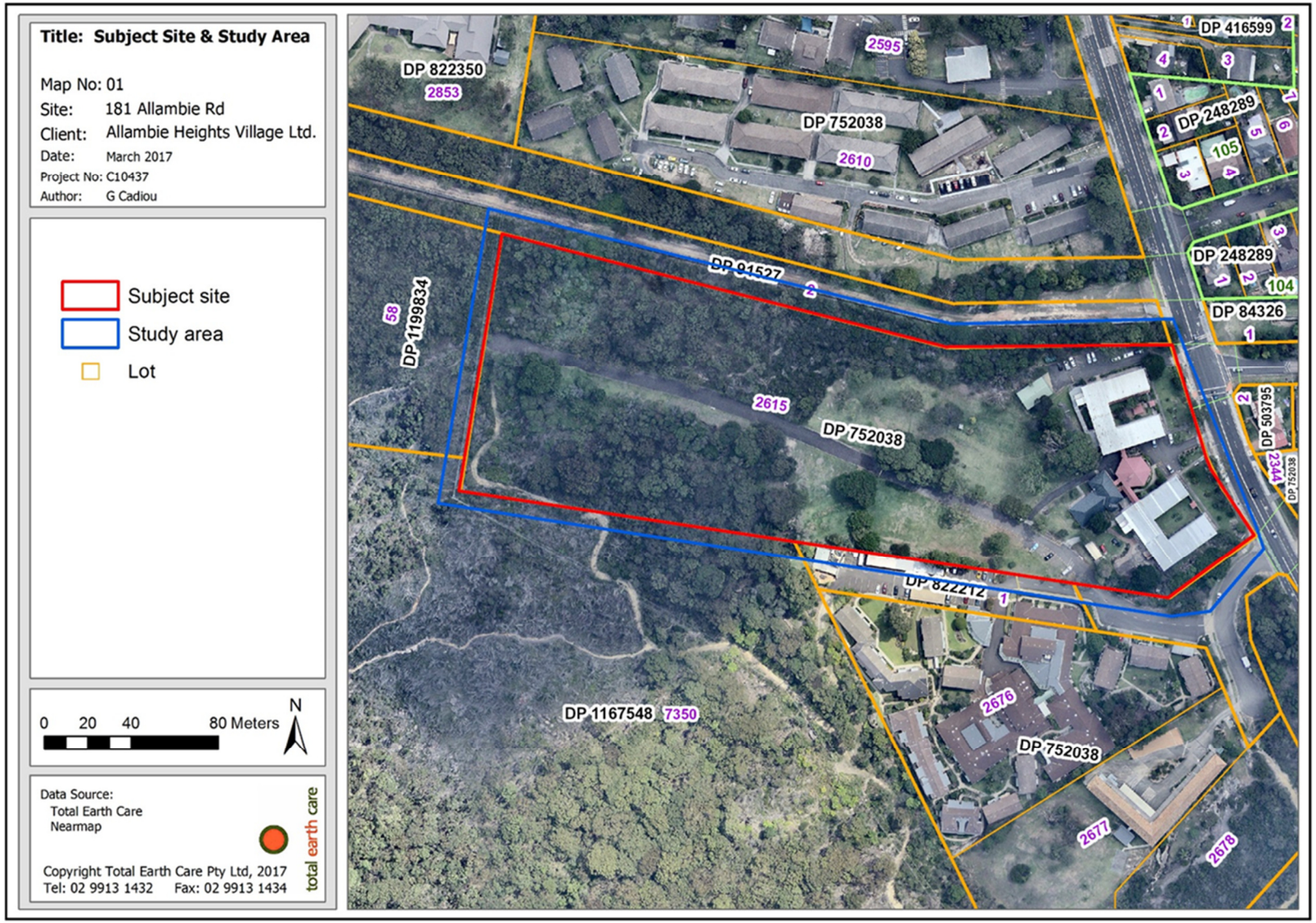
- State Environmental Planning Policy No 44-Koala Habitat Protection
- State Environmental Planning Policy No 55-Remediation of Land
- State Environmental Planning Policy No 65-Design Quality of Residential Apartment Development
- Warringah Development Control Plan 2011
- Warringah Local Environmental Plan 2011
- Water Management Act 2000 (NSW)

2 AIMS and OBJECTIVES

The general aim of this VMP is to provide a working document for the protection, rehabilitation of native vegetation and habitats. More specifically, the objectives of the VMP are to:

- describe the existing flora and fauna within the subject site based on current survey effort, database searches and review of existing reports of the subject site and surveys of the wider study area;
- confirm the presence or likely occurrence of threatened species, populations and ecological communities (or their habitats), as listed under the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) and the Biodiversity Conservation Act 2016 (NSW) (BC Act);
- Address the current status of the vegetation including weed densities, physical disturbance, native plant diversity and resilience;
- Develop an appropriate management regime for the vegetation and habitats of the managed area;
- Determine appropriate vegetation management and impact mitigation measures including bush regeneration, revegetation and sediment control for the managed area, consistent with nature of the retained vegetation; and
- Recommend the appropriate sequence of vegetation management measures and assign responsibilities for work tasks

MAP 1. Subject Site and Proposal



METHODS

2.1 Desktop Research

A preliminary desktop study was conducted to assess the likelihood of the study area to support Threatened Species, Populations or Threatened ecological communities, or their habitats. All records of all threatened species and populations within 5 kilometres of the subject site (10km locality search) were obtained from the Office of Environment & Heritage (OEH) Wildlife Atlas database, and the Federal Environment Department of Environment Protected Matters search tool.

Recent vegetation mapping was used to determine the likelihood of any nearby areas of endangered ecological communities.

- The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area V 3.0 (OEH 2016), and;
- Broad-scale mapping of the Sydney 1:100,000 map sheet by Benson and Howell (1994).
- Tozer (2003)

Where possible, the consent authority and other local experts were consulted, and additional site-specific information was provided.

Site-specific plans and reports relating to the site:

- Warringah Council's Planning instruments
- The Native Vegetation of the Sydney Metropolitan Area, Volume 2 – OEH 2013
- The Sydney Catchment Management Authority, Native Vegetation Maps.
- Planning for Bushfire Protection – NSW RFS 2006
- An AHIM desk top study and an on-site survey was completed

2.2 Site Survey

Two ecologists surveyed the site on the six days between 21st March 2017 and the 12th of October 2017.

The results of this survey are displayed as vegetation communities in Map 3 (p. 11), and the vegetation communities observe described in Appendix 3. The Vegetation Community/zone description are in accordance with those used by the Sydney Catchment Management Authority (SCMA).

2.2.1 Flora

A general botanical survey was conducted across the site over two days in March 2017. The study area was surveyed random meander methods. This involved:

- The identification of native and exotic plant species, according to Field Guide to the Native Plants of Sydney (Robinson 2003) and the Flora of NSW (Harden 1992, 1993, 2000, 2002), with reference to recent taxonomic changes;
- The identification and mapping of plant communities according to the structural definitions of Specht & Specht (1999), Smith and Smith (2008), and the Sydney Metropolitan Catchment Management Authority (SMCMA)
- Targeted searches for plant species of conservation significance according to the “random meander” method (Cropper 1993).
- An assessment of the natural resilience of the vegetation of the site;
- Identification of previous and current factors threatening the ecological function and survival of native vegetation on the site; and

The conservation significance of plant species and plant communities was determined according to:

- TSC Act for significance within NSW; and
- EPBC Act for significance within Australia.

2.2.2 Fauna

The fauna survey was designed based on results from the desktop study, local knowledge of the area, and if possible, advice from the consent authority. All threatened species (and their habitat) known to occur within the locality were targeted during the fauna survey. The survey methods are written in accordance with the *Working Draft Threatened Biodiversity Survey and Assessment Guidelines* (DECC 2004).

The conservation significance of fauna species and populations was determined at a State level according to the TSC Act and at a national level according to the EPBC Act.

Table 1. Fauna Survey Methods

Taxa group	Time of day	Survey Methods	Recommended duration (per strata unit)	Time of year
Avifauna	Diurnal	Area search	<1ha (200m x 500m) 20-minute search is the most common method (Loyn 1986)	All year
Mammals (excluding bats)	Diurnal	Active search	30 minutes active search for tree hollows, nests, scats, tracks and scratches	All year
		Track search	1km of track search with emphasis on where substrate is soft	
Reptiles	Diurnal	Habitat search; logs, rocks, litter & base of trees	30-minute search on two separate days targeting specific habitat (November to March)	November to March

2.3 Limitations

The flora and fauna field surveys were based on the recommendations of *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (DECC, 2004) with particular reference to the size of the subject site and a relatively homogeneous wider urbanised landscape.

Field surveys were conducted over 6 days and 2 nights between the 21st of March and the 12th Of October 2017. If more than 3 months (one season) has lapsed between this assessment and start of works, or it is likely that migratory birds are present, it is recommended that a pre-clearance fauna survey be conducted by a suitably qualified Ecologist.

As stated by the DECC (2004) '*The absence of a species from survey data does not necessarily mean it does not inhabit the survey area. It may simply mean that the species was not detected at that time with the survey method adopted and the prevailing seasonal or climatic conditions.*' Therefore, the relative brevity of the survey and its timing mean that the full spectrum of fauna species and ecological processes likely to occur on the site cannot be fully quantified or described in this report. These limitations have been partly addressed by:

- identifying potential habitats for fauna species; and
- assessing the potential for these species to occur on the site based on
    - previous records,
    - the type and condition of habitats present,
    - the land use throughout the subject site and surrounds, and
    - the landscape context.

3 SITE DESCRIPTION

3.1 General

The subject site is located in the suburb of Allambie Heights in Northern Beaches Council LGA. The site is Zoned as R2 Low Density Residential, with RE1 Public Recreation and SP1 Special Activities: Health Services Facilities characterising the surrounding area. The western and southern boundaries of the site are contiguous with the Manly Warringah War Memorial Park (Manly Dam), a 375ha passive and active recreational bushland park. The northern boundary adjoins a Sydney Water bushland easement for a water reticulation pipe.

The remnant bushland section of the site has been partially developed by the past lessee. A sealed road has been built on cut and filled soil through the centre of the site. Two drains have been excavated into solid rock which have created de-facto creeks. Walking tracks have also been installed and the site has been cleared and burned.

In addition to residential dwellings, the site incorporates open lawns, landscaped gardens with exotic and native horticultural species plantings, and some remnant native vegetation.

3.2 Soils

The Lambert Soil Landscape is mapped by Chapman *et al* (1989) in the study area including the subject site. It derives from Hawkesbury Sandstone which consists of medium to coarse-grained quartz sandstone with minor shale and laminite lenses. Soils are shallow (<50 cm) discontinuous *Earthy Sands (Uc5.11, Uc5.22)* and *Yellow Earths (Gn2.2)* on crests and insides of benches; shallow (<20 cm) *Siliceous Sands/Lithosols (Uc1.2)* on leading edges; shallow to moderately deep (<150 cm) *Leached Sands (Uc2.21), Grey Earths (Gn2.81)* and *Gleyed Podzolic Soils (Dg4.21)* in poorly drained areas; and localised *Yellow Podzolic Soils (Dy4.1, Dy5.2)* where associated with shale lenses.

Much of the soil on the subject site shows some level of disturbance associated with the construction and demolition of the dwellings through excavation and filling, while sealed access ways and formalised drainage have caused some level of soil disturbance outside of excavated areas. Notwithstanding, soils within some of the landscaped areas including lawns and garden beds have retained much of their original structure.

3.3 Topography, Aspect and Hydrology

The site is roughly rectangular in shape with the long axis orientated to the east and west. The western half of the site is substantially bushland while the centre is open parkland and the eastern end contains 2 two-storey residential buildings and a number of smaller service buildings.

The bushland remnant has a south facing aspect and is located on moderately sloping land. The highest point is 134m above sea level (asl) and the lowest point is 117m asl. The median point is 114m asl. It has a 15% grade or 9° slope.

The land is evenly benched along the contour from west to east with the steepest possible grade of 5% grade or 3° slope.

A 20m wide sandstone bench extends beyond and along the southern eastern boundary of the bushland interface. At the downslope edge of this bench is a stepped broken scarp of sandstone bedrock that flattens after approximately 20m. This ground then flattens and meets a vehicle access road. The bench has been excavated at its eastern end to create a narrow drain. This excavation is into solid rock and although it creates steeper ground it, does not support vegetation. This wetter gully is the steepest land adjacent to the site and has a 12% slope or 7°.

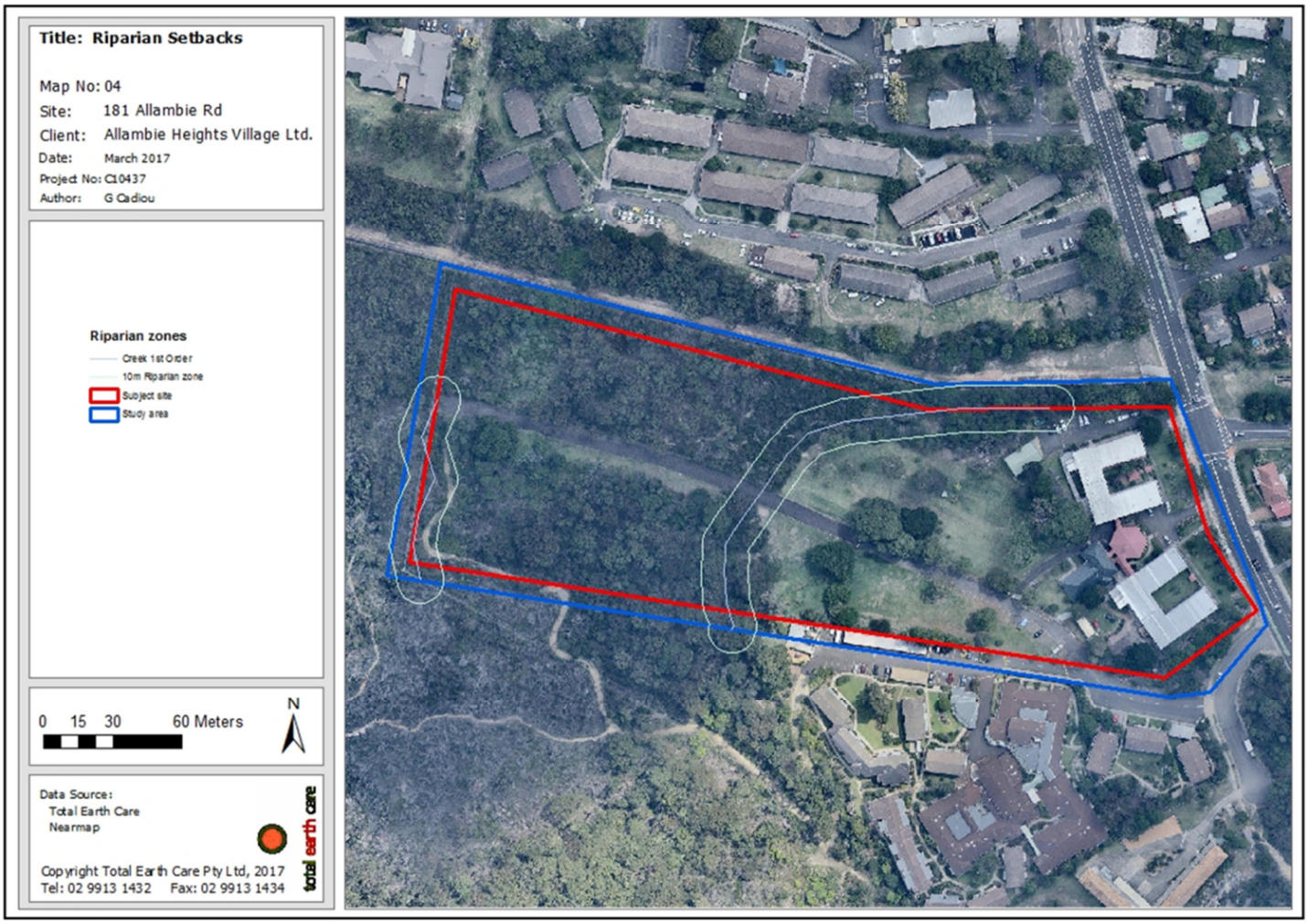
3.4 Riparian Lands and Waterways

Two creeks were found on site both were found to be man-made but neither were mapped by the office of Water as streams recognised by the Strahler System. Even though these have not been mapped they will be treated as riparian Zones however it is understood that being man-made they may be relocated to accommodate future development. First Order streams (Strahler) require the conservation of a 10m corridor beyond the top of the creek banks where those creeks appear on 1:25,000 topographic map as held by the Land Information Centre. Given that one stream is likely to be located within a Fire Inner Protection area the vegetation will be modified to only include ground cover vegetation.

Map 2 (below) shows a map of the drainage lines. A 10m buffer has been included in the map although it is unlikely that such an exclusion zone would be required.

Despite the artificial origin of the ephemeral creeklines, they provide breeding and foraging habitat for fish, amphibians, reptiles and invertebrates. Protection and recovery of riparian vegetation will help to ensure the viability of this unofficial wildlife corridor. It will allow plant and animal species to access areas of suitable habitat and promote genetic diversity via dispersal vectors supported by these corridors. This process encourages diversity and sustainability within ecosystems.

MAP 2. Drainage Lines



3.5 Adjacent Land

The site is situated between a modified urban landscape to the east setting and a bushland setting to the west. The northern boundary adjoins a very narrow bushland easement owned by Sydney Water for a reticulation pipe. Beyond the northern boundary are multiple aged care facilities and the Sunnyfield Cerebral Palsy treatment centre. The Allambie Heights Village has a common boundary on the development site's south eastern boundary. The eastern boundary is Allambie Road.

4 SURVEY EFFORT

The flora and fauna surveys were conducted over 6 days between on the 21st of March and the 12th of October 2017. The flora surveys were conducted according to an informal version of the *Working Draft Threatened Biodiversity Survey and Assessment Guidelines* (DECC 2004). The next stage will require more rigorous survey effort in line with OEH and Council guidelines.

Incidental fauna observations and fauna habitats were recorded as part of the botanical survey effort. These observations were of the presence or absence of:

- direct evidence of animals, scats, pellets, fur, feathers, skin, scratchings and tracks
- notable habitat features including termite mounds, fallen timber and rock outcroppings,

Two night time surveys were also completed with particular focus on amphibian species and microbats. The results of the bat recordings have not been received from a specialist. Avian fauna sightings were noted and call play backs were undertaken for nocturnal owl species.

No threatened species were found during the survey but one call from a frog which might have been *Pseudophryne australis* could not be definitively confirmed.

No trapping has been completed.

The canopy and understorey vegetation provides roosting, nesting, shelter, nectar, blossom and seed for birds and arboreal mammals. Mature trees with the potential to, and containing hollows provide nesting opportunities for birds, bats and mammals. Fallen branches, logs and leaf litter in various states of decay provide foraging and sheltering habitat for ground-dwelling mammals, reptiles, amphibians and invertebrates.

The creek line, riparian vegetation and rocky outcrops provide breeding and foraging habitat for fish, amphibians, reptiles and invertebrates.

Cleared and disturbed habitat on the site favours ecological generalists, capable of utilising a wide range of habitats. The area also provides habitat for disturbance-tolerant species that are ubiquitous in modified urban and rural habitats throughout the region. Generalist native and introduced bird and mammal species are likely to utilise these habitat types.

The subject site is assessed as having moderate to low habitat value for a range of native fauna species. The area has moderate floristic species, and age class diversity, rocky areas and areas of dense ground cover, cleared and disturbed habitat and contains two ephemeral creeklines. This wide range of habitat features provides potential habitat for a broad range of fauna species likely to occur on site.

Protection and recovery of riparian vegetation on the subject site will help to ensure the viability of this wildlife corridor allowing plant and animal species to access areas of suitable habitat, and promote genetic diversity via dispersal vectors supported by these corridors. This process encourages diversity and sustainability within ecosystems.)

A dismembered carcass of a Long-nosed bandicoot (*Perameles nasuta*) was found on site, most probably the result of predation from a Powerful Owl (*Ninox strenua*).

5 RESULTS

5.1 Plant Species

A total of 112 plant species were recorded during the flora survey. The survey identified 102 locally occurring native species and 10 introduced species. The methodology of a random meander within the study site included the subject site and the immediate surrounding contiguous vegetation. All flora species recorded during the current survey are listed in Appendix 2.

See Appendix 5 for noxious weeds recorded on site.

5.1.1 Threatened Plant Species

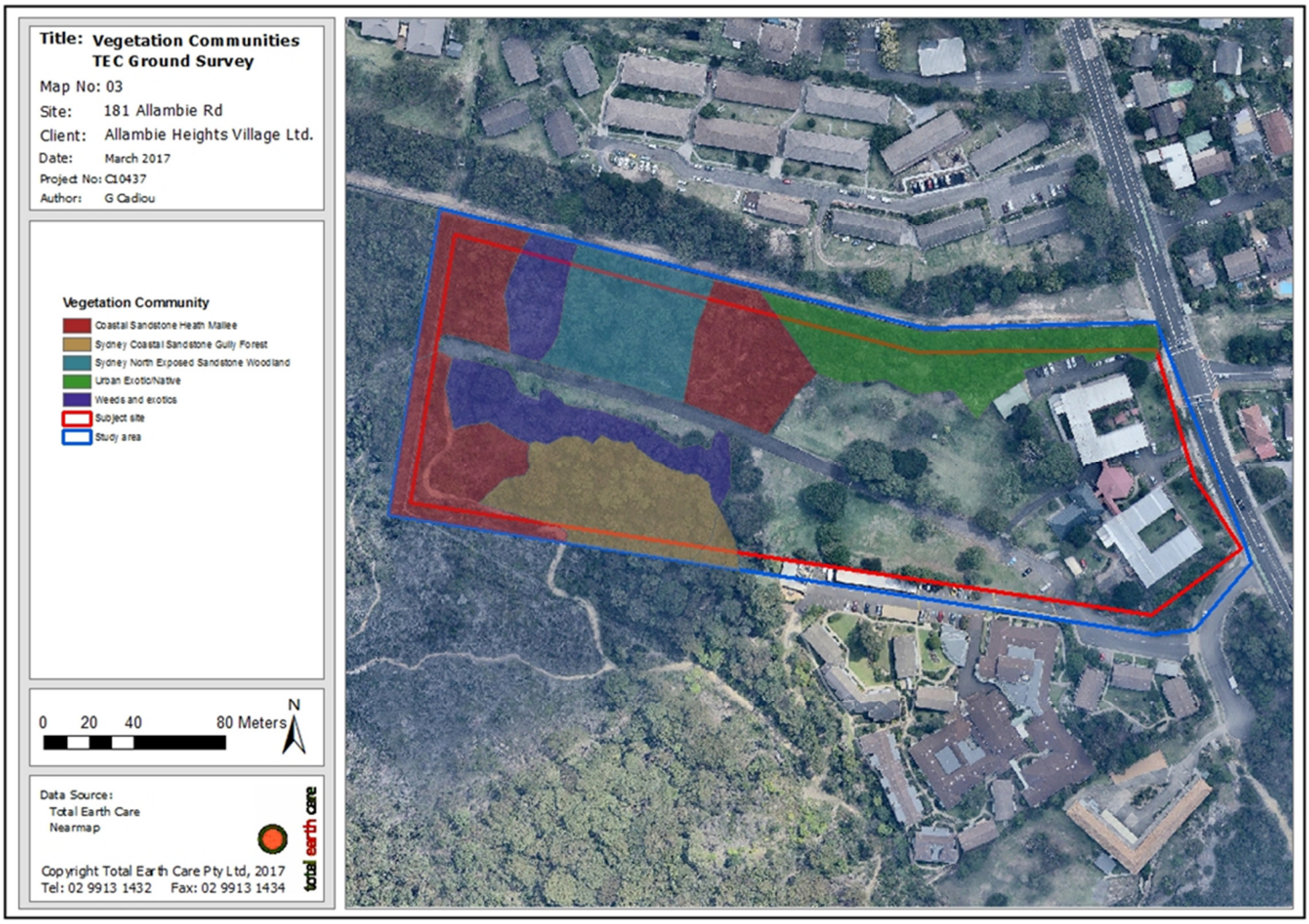
No threatened plant species listed under the Biodiversity Conservation Act and EBPC Act were recorded on the subject site in the current investigation.

A search of the OEH Wildlife Atlas identified 17 threatened plant species previously recorded as occurring within a 5km radius of the site, which are listed below (Appendix 1).

5.2 Native Plant Community Type (PCT)

Survey effort found some variation in the extent of the plant communities identified through desk-top review of the CMA mapping. Appendix 2 show the field survey results of Vegetation Communities found within the proposed development site and contiguous bushland. See Appendix 3 for field survey notes of the structure of observed plant communities.

MAP 3. Native Plant Community Types



5.2.1 Threatened Ecological Communities (TECs)

No TECs were found to be present on site. Consideration was given to the possibility of the presence of Duffys Forest Endangered Ecological Community. This community was not identified on site and the evidence based on plant species found are shown in Appendix 2.

5.3 Fauna Species

See Appendix 4 for field survey results of fauna found within the proposed development site and contiguous bushland. We undertake to do a Flora and Fauna Assessment supplementary to this VMP which further detail fauna results.

6 Resilience Assessment

Resilience refers to the manifested recovery of a plant community, species or ecosystem following disturbance, as well as the potential of the plant community, species or ecosystem to recover after disturbance (DIPNR 2003).

We undertake to do a resilience assessment of the site and monitor the bushland's response to weeding treatment with reference to an assessment method approved by Council. See Table 2 below for example.

Table 2. Native Vegetation Resilience and Condition Classes Key

1	Soil profile intact for regeneration pathways (possible original soil profile and possible soil stored seed, seed rain, or underground plant parts capable of re-shooting)			
	2	Virtually weed free and all vegetation layers present (except if due to natural causes eg. fire, storm)		**Very High**
	2*	Some minor weed growth or layers present		
		3	Minor weed infestations but no layers absent	**High**
		3*	Weed infestations or disturbance leading to a decline of at least one layer	
			4 Loss or strong decline of at least one layer but some active resilience at ground layer	**Medium**
			4* Loss or strong decline of at least two layers with no or little active resilience at ground layer	**Low**
1*	Soil profile NOT intact for regeneration pathways (No possibility of original soil profile nor any possibility for regeneration of soil stored seed, seed rain or underground plant parts capable of reshooting.			**Not Native Vegetation**

7 VEGETATION MANAGEMENT

7.1 Weed Management

Many of the weeds and exotics on site are situated in the proposed clearing area (see Map 4 below) and will be removed entirely. The vast majority of native bushland on site will be retained and managed using effective bush regeneration techniques (see Appendix 6). For the remaining weedy areas, several management strategies are proposed.

To the top left of the study site is an area of weeds and exotics (red) situated between Coastal Sandstone Heath Mallee (orange) and Sydney North Exposed Sandstone Woodland (light green). This area has suffered from altered hydrology due to historical construction, disturbance, and alterations in topography. The effect has been a localised concentration of water and nutrient that favours the growth of exotic weed plumes to the exclusion of most native species. It is impossible to effectively address weed management issues in this area without addressing the underlying hydrological and topographical influences that cause the weed proliferation.

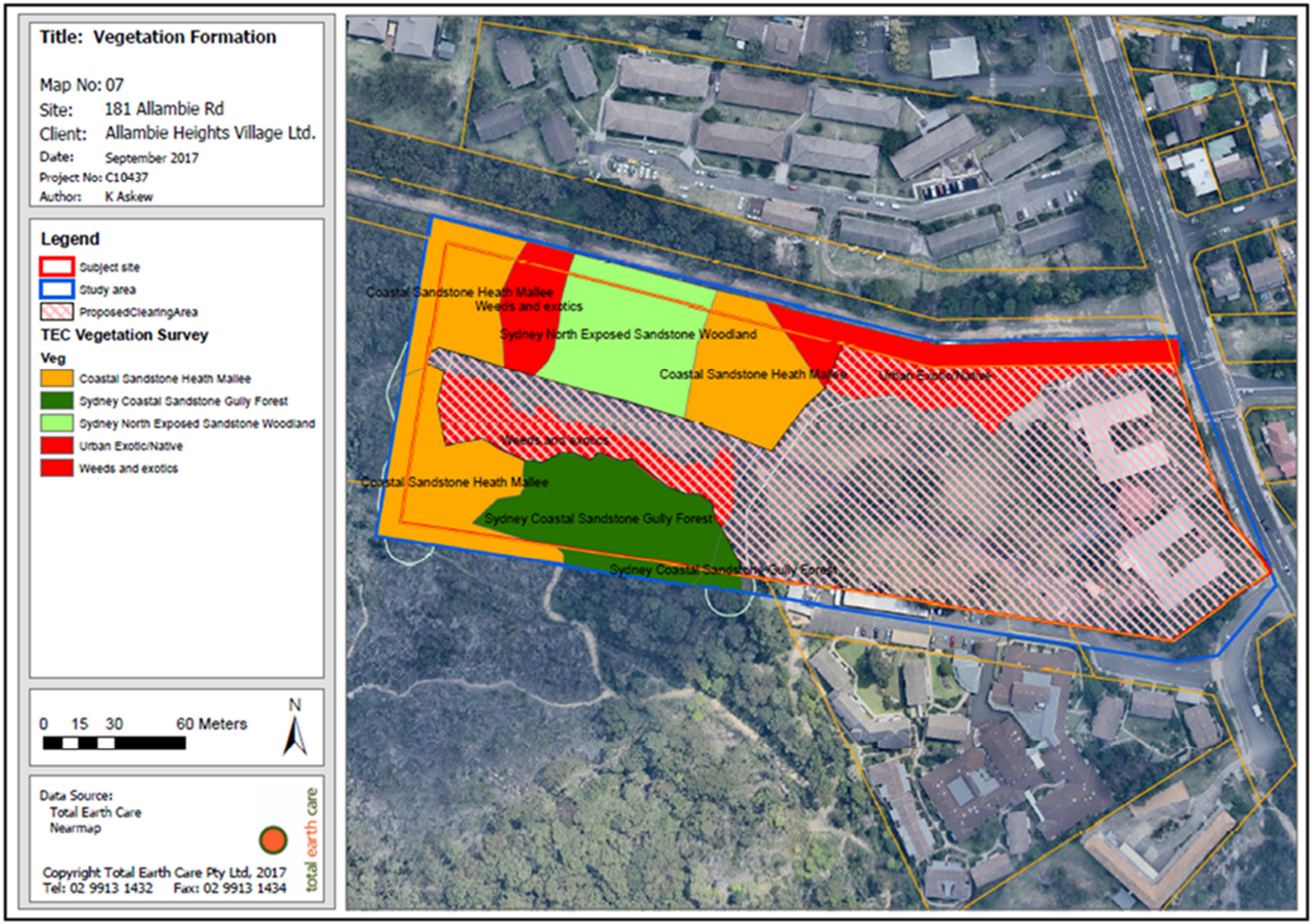
It is proposed that this weed infested area be cleared and managed as an APZ. This will provide ecological benefit by preventing exotic species from further invading the surrounding good condition bush. It will also be a more cost effective solution to perpetual and ineffective bush regeneration works. Non-invasive grass species such as buffalo grass (*Stenotaphrum secundatum*) will be planted and managed by regular mowing and edge spraying.

Sandstone capping, contouring, and the construction of a small retaining wall is proposed for the long weedy embankment situated in the proposed clearing area. The goal is to create a manageable edge where currently there is only a damp, nutrient enriched slope populated with exotic species due to historical landfilling and dumping. The retaining wall will be constructed of sandstone gathered from the construction stage of the development and will be built low enough so as to not impede fauna movement across site.

We also undertake to establish a mulched and revegetated area of low native herbs for a minimum of 5m along the eastern edge of the artificial drainage line. This will further reduce weed encroachment into the good bush.

Additionally, Ecological Monitoring as well as Seed Collection and Revegetation will be conducted on site for the duration of the project.

MAP 4. Weed Distribution



7.2 Key Performance Indicators

This assessment has concluded that the current proposal is unlikely to significantly impact on the native flora and fauna of the study area and wider locality, including threatened species. To minimise or control potential impacts of the current proposal on the native flora and fauna of the subject site and study area, this report recommends the following to guide the proposed development application:

- The current proposal is to be carried out in accordance with all policies, operational procedures and guidelines in place as part of a consent condition or EPI relating to environmental management or impact minimisation for construction projects of the scope for current proposal. This would include but not be limited the Warringah Local Environmental Plan 2011 and the Warringah Development Control Plan 2011;
- Temporary exclusion fencing is to be installed around retained trees as per the arborists report;
- Signage is to be placed on the temporary exclusion fencing that identifies there is to be no entry to the bushland area during construction of the substantial development;
- Measures as recommended in the arborists reports (which will be forthcoming);
- A local wildlife rescue service is to be contacted if native or introduced fauna are injured or disturbed from nesting or sheltering habitat during construction works;
- Landscaping should use a non-invasive grass species such as Buffalo Grass.
- Any revegetation within the bushland regeneration area deemed necessary to supplement areas showing limited resilience for species onsite should be undertaken in the following manner:
    - Seed must be collected from within the local provenance. A Section 91 licence may be required to collect seed, and permission may be required to collect from within Council managed areas;
    - Seed must be collected from as many parent plants as possible to support genetic variability;
    - Seed collection must conform to Florabank Guidelines;
- Outside of areas mapped as bushland, native tree plantings will be of locally indigenous native tree species and located in areas that are not likely to be impacted by future uses of the development. These trees must be of local provenance as outlined above for revegetation protocols;
- Sourcing and ordering of as much local provenance planting stock as possible well in advance of planting works. Tubestock take from 6 – 18 months to produce depending upon time of year and species. Many species have a short and specific time that seed is available to be collected;
- Woody weed removal in the retained area of BGHF is to be carried out by a qualified bush regeneration contractor;
- Tree replacement species and numbers will be in accordance with Northern Beaches Council's guidelines.

ENVIRONMENTAL MANAGEMENT AND RECOMMENDATIONS

Environmental Management Measures to be implemented before Construction:

- Inspection (by a qualified ecologist) of hollow-bearing trees, dense shrub thickets, and derelict built structures for fauna habitation, prior to their felling and removal. Where animals are located, they would be carefully released at the time, or captured for later release. Captured animals would generally be released into the edges of Manly Dam or similar suitable nearby reserves at dusk, and injured fauna would be transferred to the care of WIRES;
- The retention of hollow-bearing trees and all native trees within the Riparian Zone is required. There is to be no net loss of native canopy trees as a result of the development;
- Installation of nest boxes for hollow dependent species such as birds and microbats provide habitat. A Nest Box Plan should be prepared and approved prior to construction. The Nest-Box

Plan should utilise the latest research and set out the numbers of nest boxes required, target species, nest box designs, installation and monitoring requirements;
- Seed collection and establishment of local provenance and collected to ensure genetic integrity (Florabank Guidelines) suitable for use in the revegetation works within the riparian zone and other retained bushland;
- Installation of temporary exclusion fencing along the outer boundaries of buffer zones, including a 10m Buffer Strip and remnant native vegetation areas, prior to construction. The existing vegetation, to be retained, should be protected from root compaction, root, trunk and limb damage, soil contamination and changes in surface level that may affect the health of each specimen. Protection measures are to be installed prior to the commencement of any earthworks. It is suggested that a chain wire fence be erected 1m beyond the dripline of each specimen for the full circumference of all vegetation to be protected;
- Removal of all noxious weeds and conduct primary weeding using bush regeneration techniques of all areas of retained vegetation on the site.

Environmental Management Measures to be implemented during Construction

- Monitoring of retained stands of bushland, the riparian zones and adjacent APZ for the presence of threatened birds species during their breeding season that may nest within this type of habitat.
- A program of weed control and bush regeneration should be implemented for all bushland and riparian zones, in accordance with any approved VMPs. Regular follow-up or secondary weeding within the SSF and Riparian Zones is required as per VMPs;
- Revegetation of the bushland with locally indigenous plant species. Species selection will be based on achieving a target community similar in structure and diversity to the existing PCTs, and canopy cover within the APZ as per the bush fire recommendations.
- Revegetation or landscaping within the Asset Protection Zone must be designed so that the function of the APZ is not compromised by the revegetation or landscaping works. This will require careful selection of species, creation of gaps in the canopy and separation of the ground and canopy fuel layers;
- The location of material stockpiles and vehicle parking areas must be on already cleared and disturbed land, well away from vegetation to be retained on the site and the boundary close to the wetlands;
- Chipping of felled trees and other vegetation (excluding noxious or invasive weeds) from the site for use as mulch in rehabilitation works is recommended;
- Maintenance and installation of appropriate erosion control measures during the construction phase of the development (e.g. silt fences, sediment ponds etc.), to protect terrestrial habitats on-site and wetland habitats downslope of the site. These will conform to Managing Urban Stormwater - Soils and Construction (NSW Department of Housing 1998), and will be maintained throughout the construction period;
- Management of stormwater, wastewater and runoff;
- Management of construction materials, fuels, and wastes should be controlled to minimise the potential for any discharge of chemicals or contaminants (such as concrete or other building materials) impacting upon adjacent areas of native vegetation or waterways.

Environmental Management Measures to be implemented after Construction

- The program of weed control and bush regeneration in all conservation areas retained on-site is to continue in accordance with the approved VMP to enhance the quality of the remaining vegetation. Conduct monitoring in accordance with the approved VMP;
- Implement a fauna monitoring program as set out in a Nest Box Plan;
- Material stockpiles and vehicle parking areas that have been created on site are to be removed and made good upon completion of the construction works;
- Non-permanent erosion control measures (e.g. silt fencing, sediment ponds) implemented during the construction phase of the development are to be carefully removed following completion and stabilisation of the works; and
- Management of stormwater, wastewater and runoff will continue as per the project design.

Hazard Reduction / Ecological Burning

The bushland remnants on site will be burned to reduce the fire risk and also to encourage the germination of fire obligate seeding species.

The shrub, mid-storey and lower limbs of the upper strata will be slashed and cut up in preparation for an ecological burn. It is proposed that the dried fire fuel will be ignited in the Autumn of 2018.

The bushland will be managed post burn in a manner that maintains separation of the canopy trees and fire fuel layers. This area will become an effective Outer Protection Area.

8 Qualifications required to carry out on ground works

Depending on the complexity of the tasks specified under the VMP, a bush regenerator will generally be required to carry out the works. The person(s) implementing the VMP will need to demonstrate the following minimum qualifications and experience:

- a Certificate III in Conservation and Land Management and/or Certificate III in Natural Area Restoration
- a minimum of 500 hours practical bushland regeneration under an experienced supervisor.

Supervisors will need to demonstrate the following minimum qualifications and experience:

- a Certificate IV in Conservation and Land Management and/or Certificate IV in Natural Area Restoration
- a minimum of 700 hours practical bushland regeneration.

A Chemcert AQF III or greater is required for persons undertaking chemical application.

In some cases, the implementation of a VMP may run over several years where the last few years may only require general maintenance and monitoring. The landholder or other persons responsible for maintenance of the site may be suitable to undertake those works themselves. Persons responsible for each action will need to be identified in the plan and should this responsibility change, Council will need to be notified.

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APPENDICIES

- **Appendix 1**

5km Search of NPWS Atlas Database of Threatened Flora and Fauna.

Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1Â°; ^^ rounded to 0.01Â°). Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Public Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Entities in selected area [North: -33.69 West: 151.19 East: 151.29 South: -33.79] recorded since 01 Jan 1980 until 10 Mar 2017 returned a total of 1,442 records of 51 species.
Report generated on 10/03/2017 11:50 AM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records	Info
Animalia	Amphibia	Myobatrachidae	3042	*Heleioporus australiacus*		Giant Burrowing Frog	V,P	V	12	
Animalia	Amphibia	Myobatrachidae	3116	*Pseudophryne australis*		Red-crowned Toadlet	V,P		112	
Animalia	Reptilia	Varanidae	2287	*Varanus rosenbergi*		Rosenberg's Goanna	V,P		87	
Animalia	Aves	Columbidae	0023	*Ptilinopus superbus*		Superb Fruit-Dove	V,P		2	
Animalia	Aves	Ardeidae	0197	*Botaurus poiciloptilus*		Australasian Bittern	E1,P	E	2	
Animalia	Aves	Ardeidae	0196	*Ixobrychus flavicollis*		Black Bittern	V,P		16	
Animalia	Aves	Accipitridae	0226	*Haliaeetus leucogaster*		White-bellied Sea-Eagle	V,P	C	39	
Animalia	Aves	Accipitridae	0225	*Hieraaetus morphnoides*		Little Eagle	V,P		1	
Animalia	Aves	Accipitridae	0230	*^^Lophoictinia isura*		Square-tailed Kite	V,P,3		1	
Animalia	Aves	Accipitridae	8739	*^^Pandion cristatus*		Eastern Osprey	V,P,3		11	
Animalia	Aves	Burhinidae	0174	*Burhinus grallarius*		Bush Stone-curlew	E1,P		5	
Animalia	Aves	Burhinidae	0175	*Esacus magnirostris*		Beach Stone-curlew	E4A,P		1	
Animalia	Aves	Cacatuidae	0268	*^^Callocephalon fimbriatum*		Gang-gang Cockatoo	V,P,3		1	
Animalia	Aves	Cacatuidae	0265	*^Calyptorhynchus lathami*		Glossy Black-Cockatoo	V,P,2		52	
Animalia	Aves	Psittacidae	0260	*Glossopsitta pusilla*		Little Lorikeet	V,P		4	
Animalia	Aves	Psittacidae	0309	*^^Lathamus discolor*		Swift Parrot	E1,P,3	CE	9	
Animalia	Aves	Strigidae	0246	*^^Ninox connivens*		Barking Owl	V,P,3		10	
Animalia	Aves	Strigidae	0248	*^^Ninox strenua*		Powerful Owl	V,P,3		199	
Animalia	Aves	Tytonidae	9924	*^^Tyto tenebricosa*		Sooty Owl	V,P,3		2	
Animalia	Aves	Meliphagidae	0603	*Anthochaera phrygia*		Regent Honeyeater	E4A,P	CE	1	
Animalia	Aves	Neosittidae	0549	*Daphoenositta chrysoptera*		Varied Sittella	V,P		2	

Animalia	Aves	Artamidae	8519	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	V,P		5
Animalia	**Aves**	**Petroicidae**	**0380**	***Petroica boodang***	**Scarlet Robin**	**V,P**		**2**
Animalia	Mammalia	Dasyuridae	1008	*Dasyurus maculatus*	Spotted-tailed Quoll	V,P	E	19
Animalia	**Mammalia**	**Peramelidae**	**1710**	***Isoodon obesulus obesulus***	**Southern Brown Bandicoot (eastern)**	**E1,P**	**E**	**22**
Animalia	Mammalia	Phascolarctidae	1162	*Phascolarctos cinereus*	Koala	V,P	V	2
Animalia	**Mammalia**	**Burramyidae**	**1150**	***Cercartetus nanus***	**Eastern Pygmy-possum**	**V,P**		**98**
Animalia	Mammalia	Pteropodidae	1280	*Pteropus poliocephalus*	Grey-headed Flying-fox	V,P	V	89
Animalia	**Mammalia**	**Molossidae**	**1329**	***Mormopterus norfolkensis***	**Eastern Freetail-bat**	**V,P**		**2**
Animalia	Mammalia	Vespertilionidae	1353	*Chalinolobus dwyeri*	Large-eared Pied Bat	V,P	V	2
Animalia	**Mammalia**	**Vespertilionidae**	**1346**	***Miniopterus australis***	**Little Bentwing-bat**	**V,P**		**17**
Animalia	Mammalia	Vespertilionidae	1834	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V,P		79
Animalia	**Mammalia**	**Vespertilionidae**	**1357**	***Myotis macropus***	**Southern Myotis**	**V,P**		**25**
Animalia	Mammalia	Vespertilionidae	1361	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V,P		2
Plantae	**Flora**	**Dilleniaceae**	**11250**	***Hibbertia superans***		**E1,P**		**1**
Plantae	Flora	Elaeocarpaceae	6205	*Tetratheca glandulosa*		V,P		77
Plantae	**Flora**	**Ericaceae**	**7752**	***Epacris purpurascens var. purpurascens***		**V,P**		**4**
Plantae	Flora	Fabaceae (Mimosoideae)	9672	*Acacia terminalis subsp. terminalis*	Sunshine Wattle	E1,P	E	10
Plantae	**Flora**	**Lamiaceae**	**9884**	***Prostanthera junonis***	**Somersby Mintbush**	**E1,P**	**E**	**2**
Plantae	Flora	Lamiaceae	3418	*^^Prostanthera marifolia*	Seaforth Mintbush	E4A, P,3	CE	103
Plantae	**Flora**	**Myrtaceae**	**4007**	***^^Callistemon linearifolius***	**Netted Bottle Brush**	**V,P,3**		**5**
Plantae	Flora	Myrtaceae	4024	*Darwinia biflora*		V,P	V	1
Plantae	**Flora**	**Myrtaceae**	**4067**	***Eucalyptus camfieldii***	**Camfield's Stringybark**	**V,P**	**V**	**12**
Plantae	Flora	Myrtaceae	4134	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	V,P	V	3
Plantae	**Flora**	**Myrtaceae**	**8314**	***Leptospermum deanei***		**V,P**	**V**	**2**
Plantae	Flora	Myrtaceae	4248	*Melaleuca deanei*	Deane's Paperbark	V,P	V	1
Plantae	**Flora**	**Myrtaceae**	**4293**	***Syzygium paniculatum***	**Magenta Lilly Pilly**	**E1,P**	**V**	**7**
Plantae	Flora	Orchidaceae	9616	*^Microtis angusii*	Angus's Onion Orchid	E1,P, 2	E	1
Plantae	**Flora**	**Proteaceae**	**5365**	***^^Grevillea caleyi***	**Caley's Grevillea**	**E4A, P,3**	**E**	**235**
Plantae	Flora	Proteaceae	5458	*^^Persoonia hirsuta*	Hairy Geebung	E1,P, 3	E	23
Plantae	**Flora**	**Thymelaeaceae**	**6965**	***Pimelea curviflora var. curviflora***		**V,P**	**V**	**22**

- **Appendix 2**

Field survey results of Flora and Found within the proposed development site and contiguous bushland.

Exotic	Scientific Name	Common Name	TSC	Heath	Woodland	Forest	Gully F	Duffy's Diagnostic Value
	Acacia longifolia				x			minus()
	Acacia longifolia			x	x			minus()
	Acacia parramattensis	Parramatta Wattle						
	Acacia suaveolens	Sweet Wattle			x			
	Acacia terminalis subsp. ang				x			
	Actinotus minor	Lesser Flannel Flower		x	x			
*	*Ageratina adenophora*	Crofton Weed						
	Allocasuarina distyla			x	x			
	Angophora costata	Sydney Red Gum						
	Angophora crassifolia				x			minus()
	Angophora hispida	Dwarf Apple		x	x			
	Anisopogon avenaceus	Oat Speargrass			x			
	Aristida vagans	Threeawn Speargrass			x			.48 vs .09
*	*Asparagus aethiopicus*	Asparagus Fern						
	Baeckea diosmifolia	Fringed Baeckea		x				
	Banksia ericifolia	Heath-leaved Banksia		x	x			minus(.3 vs 0.43)
	Banksia oblongifolia	Fern-leaved Banksia		x	x			
	Banksia serrata	Old-man Banksia		x		x		
	Banksia spinulosa	Hairpin Banksia	P	x	x			
	Bauera rubioides	River Rose		x				minus(0.17 vs 0.61)
	Billardiera scandens	Hairy Apple Berry				x		
	Boronia ledifolia	Sydney Boronia	P		x			
	Boronia pinnata		P		x			
	Bossiaea heterophylla	Variable Bossiaea			x			
	Callicoma serratifolia	Black Wattle					x	
	Calochlaena dubia	Rainbow Fern					x	
	Cassytha glabella				x			
	Cassytha pubescens	Downy Dodder-laurel				x		
	Caustis pentandra	Thick Twist Rush	P					
	Centella asiatica	Indian Pennywort					x	
	Ceratopetalum gummiferun	Christmas Bush	P				x	
*	*Chlorophytum comosum*	Spider Plant						
	Corymbia gummifera	Red Bloodwood			x			
	Cyathochaeta diandra				x			
	Dampiera stricta			x	x			
	Dillwynia retorta				x			
	Dodonaea triquetra	Large-leaf Hop-bush			x			
	Elaeocarpus reticulatus	Blueberry Ash					x	
	Eleocharis gracilis			x				
	Entolasia marginata	Bordered Panic				x		
	Entolasia stricta	Wiry Panic			x			
	Epacris longiflora	Fuchsia Heath		x				
	Epacris microphylla	Coral Heath		x				
	Epacris pulchella	Wallum Heath		x	x			
*	*Epidendrum radicans x secu*	Crucifix Orchid						
	Eragrostis brownii	Brown's Lovegrass				x		
	Eucalyptus haemastoma	Broad-leaved Scribbly Gum		x	x			
	Eucalyptus piperita	Sydney Peppermint						
	Eucalyptus piperita	Sydney Peppermint					x	
	Eucalyptus punctata	Grey Gum				x		minus(0.1 vs 0.57)
	Eucalyptus sieberi	Silvertop Ash			x	x		
	Eucalyptus robusta	Swamp Mahogany						
	Eucalyptus saligna	Sydney Blue Gum						
	Gleichenia spp.	Coral fern	#N/A	x			x	
	Glochidion ferdinandi	Cheese Tree					x	
	Gonocarpus teucrioides	Germander Raspwort		x	x			
	Grevillea buxifolia	Grey Spider Flower		x	x			

	Grevillea linearifolia	Linear-leaf Grevillea					x	
	Grevillea speciosa	Red Spider Flower			x			
	Hakea dactyloides	Finger Hakea			x			
	Hakea gibbosa							
	Hakea teretifolia	Needlebush		x				
	Hemigenia purpurea			x	x			
	Hibbertia aspera	Rough Guinea Flower			x			
	Hibbertia linearis				x			
	Homalanthus populifolius						x	
	Hydrocotyle tripartita	Pennywort						
	Hypolepis muelleri	Harsh Ground Fern				x		
	Imperata cylindrica	Blady Grass						
*	*Jacaranda mimosifolia*	Jacaranda						
	Kunzea ambigua	Tick Bush	P	x				
	Kunzea capitata		P	x				
	Lambertia formosa	Mountain Devil			x			
*	*Lantana camara*	Lantana						
	Lasiopetalum ferrugineum					x		
	Lepidosperma latens				x			
	Leptospermum polyanthum			x	x			
	Leptospermum squarrosum			x	x			
	Leptospermum trinervium	Slender Tea-tree						
	Lepyrodia scariosa				x			
	Leucopogon ericoides	Pink Beard-heath			x	x		
*	*Ligustrum sinense*	Small-leaved Privet						
	Lindsaea linearis	Screw Fern			x			
	Lindsaea microphylla	Lacy Wedge Fern				x		
	Lomandra glauca	Pale Mat-rush			x			
	Lomandra longifolia	Spiny-headed Mat-rush					x	
	Lomandra obliqua				x			
	Lomatia silaifolia	Crinkle Bush	P		x			
	Lophostemon confertus	Brush Box						
	Micromyrtus ciliata	Fringed Heath-myrtle		x	x			
	Mirbelia rubiifolia	Heathy Mirbelia		x				
	Nephrolepis cordifolia	Fishbone Fern						
*	*Paspalum quadrifarium*	Tussock Paspalum						
	Persoonia lanceolata	Lance Leaf Geebung	P	x				
	Persoonia levis	Broad-leaved Geebung	P		x			
	Petrophile pulchella	Conesticks	P	x	x			
	Pittosporum undulatum	Sweet Pittosporum					x	
	Platysace linearifolia			x	x			
	Plectranthus parviflorus						x	
*	*Populus nigra*	Lombardy Poplar						
	Pteridium esculentum	Bracken					x	
	Pultenaea rosmarinifolia				x			
	Pultenaea stipularis			x				
	Pultenaea tuberculata				x			
*	*Senna pendula var. glabrata*							
	Smilax glyciphylla	Sweet Sarsparilla					x	
	Thysanotus tuberosus	Common Fringe-lily			x			
	Viminaria juncea	Native Broom		x				
	Woollsia pungens							
	Xanthorrhoea media		P		?			minus()
	Xanthosia tridentata	Rock Xanthosia			x			minus()
	Crowea saligna		P		x			minus()

- **Appendix 3**

Field survey notes of the structure of observed plant communities.

The zones use are those identified in vegetation survey shown on **Map 3**.

Zone 1: Parkland and Gardens around the buildings at the corner of Martin Luther Place and Allambie Rd.

Vegetation Community: Weeds and Exotics:

Tree layer. Moderate dense tree canopy consisting of *Pinus* sp, *Lophostemon confertus Populus nigra* and *Erythrina crista-galli*. The ground and shrub layer is dense containing mostly non-indigenous– *Nephrolepsis cordifolia*, *Paspalum quadrifarium*, *Ligustrum sinense*, *Asparagus aethiopicus*, *Ageratina adenophora*, *Senna pedula*. Ground layer is mostly a mown exotic lawn of mixed turf species.

Zone 2: Lawn area to the west of the existing Aged Care facility.

Vegetation Community: Weeds and Exotics:

Mown exotic lawn/ road area contains mostly non-locally indigenous trees – *Pinus sp*, *Erythrina sykesii* with a row of mature planted *Eucaluptus robusta* and *E. botryoides.*

Zone 3: Between the lawn area and the water pipe easement to the north.

Vegetation Community*:* Urban exotic Native

This is a largely disturbed areas of native/weed vegetation. . Some small native trees persist including *Acacia parramatensis* and *Glochidion ferdinandi*. The zone is dominated by a tall shrub layer of *Kunzea ambigua* and weed species – Crucifix orchid, *Paspalum quadrifarium*, *Lantana camara*. Native species include a fern layer of *Gleichenia sp*, *Imperata cylindrical* and *Entolasia marginata*. The shrub layer becomes more dense northward from the boundary.

This remnant is approximately 10 metres wide by 150 metres long ie 0.15 HA including Sydney Water land. Approximately 300m2 of WCV land will be cleared of the eastern end for Bush fire protection purposes under the 10:50 regulations reducing the area to 0.12 HA. It has also been proposed that a circular driveway be installed for the proposed development this will require the clearing of all this bushland within the property. Once all proposed clearing works have been completed the bushland will be reduced to a 150 metre long x 4 metre wide strip, ie 0.06 HA

Zone 4: Bushland to the west of the lawn/parkland above the access road.

Vegetation Community: Coastal Sandstone Heath Mallee

A small man made drainage line creates a boundary to the west of the lawn area. It is comprised of a heath mallee growing shallow sandy soils. Plants are typical of this community - *Angophora hispida, Bankisa ericifolia, Allocasuarina distyla* and a variety of sedges. The native species diversity and resilience is high and there is very few exotic species despite records of heavy disturbance.

Zone 5:Bushland above the access roadway (west of zone 4.)

Vegetation Community: Sydney North Exposed Sandstone Woodland

Beyond the heath the soils become deeper and there is evidence of some lateritic inclusion. Trees height increases with soil depth. Tree species are dominated by *Corymbia gummifera, E. seberi, E. haemastoma, E. capitellata, Angophora crassifolia*, ground layer is a diverse mix of sedges, grasses, and small shrubs. Diversity is high and there is very little non-indigenous species.

Zone 6: Wet/drainage line above the access roadway (West of Zone 5).

Vegetation Community:Weeds and Exotics.

A strip of weedy growth extends from the pipe easement at the north, down to the sealed access road. It is likely to correspond to an area of disturbance and nutrient rich stormwater draining from the adjacent northern property. Weed density in this zone is very high- close to 100% exotic consisting *of Paspalum quadrifarium, Senna pendula* and

Ageratina adenophora. Some hardy wet loving natives persist including *Gahnia sp, Callistemon linearis, and Gleichenia* sp.

Zone 7: Sandstone Heath Mallee above the access roadway

Vegetation Community: Coastal Sandstone Heath Mallee

A narrow strip between the Western boundary and Zone 6.The bushland changes to moist Sandstone heath mallee (SSHM) which is dominated by a dense shrub layer of *Kunzea ambigua and Allocasuarina distyla.*

West of the boundary. (Offsite) contiguous with Zone 7.

Vegetation Community: Coastal Sandstone Heath Mallee

The walking track to the West roughly follows the contour and can be used to distinguish the vegetation types. The SSHM continues west north of the walking track. South of the Walking track, west of the boundary recently burned low woodland

Zone 8: Adjacent to and south of the access road.

Weeds and Exotics:

The road construction disturbance (Cut and fill of excavated soil) has created opportunities for weeds to invade. Weeds are at their highest density below the road way along the rd embankment, between the western boundary and the parkland.

Weed species present include -*Erythrina sykesii, Lantana camara, Solanum mauritanum, Cestrum parqui, Ipomoea indica, Ageratiina adenophora, Paspalum quadrifarium, Senna pendula*.

South of Boundary (Offsite) contiguous with Zone 7 and 8.

Vegetation Community: Coastal Sandstone Heath Mallee

The zone down slope of the boundary south to the power lines. Many plants have died for unknown reason/s. The remaining bushland is sedge dominant heath, the shrub layer is dominated by *Leptospermum polygalifoium*, the vegetation community transitions to woodland/gully forest east of the major bend in the walking track.

Zone 9: Sydney Sandstone Gully forest

Vegetation Community: Sydney Coastal Sandstone Gully Forest

Weed density reduces from high to low as you travel from west to east. Native plants include *Hypolepsis mullerii* and maiden hair in the moister areas. In the forest trees species include *Corymbia gummifera, Eucalyptus seiberi, E, punctata Angophora costata,* and *Banksia serrata*. Closer to the creek line at the western side of this zone, gully species are clearly present, including *Callicoma serratifolia and Ceratopetalum gummifera*.

- **Appendix 4**

Field Survey results of Fauna found within the proposed development site and contiguous bushland

Common Name	Species
Swamp Wallaby	*Wallabia bicolor*
Ring-tailed Possum	*Pseudocheirus peregrinus*
Striped Marsh Frog	*Limnodynastes peronei*
Common Eastern Toadlet	*Crinia signifera*
Rabbit	*Oryctolagus cuniculus*
Kookaburra	*Dacelo novaeguineae*
Red-Bellied Black Snake	*Pseudechis porphyriacus*
Brushtail Possum	*Trichosurus vulpecula*
Red-Wattle Bird	*Anthochaera carunculata*

- **Appendix 5**

Weeds declared in the Local Control Authority of the Northern Beaches Council

Four noxious weed species listed under the *Biosecurity Act 2015* within The Northern Beaches Council have been recorded on the subject site and are listed below in Table 1. All noxious weed species present on the site must be either controlled or removed (and disposed of appropriately) according to the requirements of the Act.

Common Name	Scientific Name	Control Class
Green cestrum	*Cestrum parqui*	3
Corky Passionfruit	*Passiflora suberosa*	4
Lantana	*Lantana camara*	4
Tussock Paspalum	*Paspalum quadrifarium*	4

- **Appendix 6**

BUSHLAND REGENERATION TECHNIQUES

This section outlines the main philosophies behind the two key techniques of bushland regeneration. This section also outlines a conceptual prioritisation approach to the management of bushland based on the resilience assessment.

THE BRADLEY METHOD: COMPREHENSIVE WEEDING

The Bradley method of bush regeneration advocates the removal of weeds from bushland that has adequate natural resilience and that work should only proceed at that pace which the bushland regenerates. It also assumes that weeding will continue without disruption until all weeds are eradicated and the bushland is very stable.

This method of regeneration has many positive aspects to it, however it does not pay regard to the scale of the problem that is encountered in many of Sydney's bushland areas, nor does it account for the vagaries of contract management or contract funding. For example, the costly control, not eradication, of *Ehrharta erecta* in large infestations demonstrates that good intentions of comprehensive weeding cannot keep pace with the reality of the resources required to manage urban bushland.

THE TARGET WEEDING METHOD.

The target weeding method of bushland regeneration concentrates on the eradication of the most destructive weed species. A target group of weeds are treated intensively so that the health of the remnant plant community is maintained and the chance of re-invasion by the targeted species is minimal. The combinations of target weed type i.e. vine or woody will dictate the treatment method and duration.

Noxious weeds are treated in this manner.

In contrast to *Ehrharta erecta*, *Ipomoea indica* is a rampant vine that can swamp and kill an entire plant community. The time it takes to eradicate Ipomoea is a fraction of the time it takes to "contain" Ehrharta.

This pre-emptive method can undoubtedly save more floral components of bushland than comprehensive weeding can for less cost. It does not however ensure the survival of all remnant native species threatened by non-target weeds species.

FINDING THE MIDDLE GROUND

The forest community is more important than the individual species or vegetation strata that comprise it. The survival of the plant community depends upon two key factors. The first is the presence of native plant propagules. Native propagules can survive in two ways; as healthy plants or as dormant propagules. The second is the specific growing conditions that these plants need to grow. If the growing conditions change dramatically then living plants and propagules might not adapt and could die. If either of these factors are absent then the plant community as a whole is threatened.

Target weeding mitigates the plant growth factors that targeted weed species alter such as high humidity in the soil and at the base of trees, or excessive shading of the ground. By conserving living plants as well as maintaining the viability of the native seed bank, a comparatively larger area may be regenerated than can be achieved by comprehensive weeding. Large areas may have threatening species eradicated while maintaining pristine high resilience areas. This method saves more bushland with the same budget from target weeds than can be regenerated by comprehensive weeding.

Target weeding is proposed here as a first step in a comprehensive weeding strategy that may span twenty years depending on the funding. Both approaches should move from high resilient bushland to low resilient bushland. Comprehensive weeding should only begin in highly resilient areas when the target weeding is substantially completed.

BUSHLAND PRIORITISATION ZONES

Priority 1 Zones: High resilience areas

Target species should be removed as soon as practicable from those places where they threaten highly resilient bushland. Secondary and maintenance weeding of the target weeds will be required in successive seasons. Comprehensive weeding should then be undertaken to maintain the health of all the plant species in the good bush areas.

Priority 2 Zones: Moderate resilience areas

Target weeding should be completed as soon as practicable in places where bushland has moderate resilience and target species have already caused plant and seed death. Maintenance of these target species should continue until they are completely eradicated.

Comprehensive weeding should only begin in Priority 2 zones when the priority one areas are comprehensively weeded or when there is adequate funding.

Priority 3 zones: Low resilience areas

Target weeding should only be completed in order to contain the infestation and reduce the production and dispersion of propagules. Patches of target weed can also be treated to assist the health of larger native trees or remnant natives. Patches may also be created in dense weed so that native canopy plantings can be established before implementing a full-blown target-weeding program.

BUSHLAND MANAGEMENT RECOMMENDATIONS

SETTING PRIORITIES

A precautionary approach to bushland management would hold that mitigating the threatening process, by target weeding, should occur before remedial work can begin. However the protection of endangered species, the conservation of soil stored native seed, maintaining past works, finance and encouraging community involvement are all competing management considerations. An integrated plan of management must successfully balance these competing needs without compromising the primary aim of conserving biodiversity.

The recommendations provided below aim to conserve as much bushland as possible by focusing resources on the key threatening processes. The resource allocations recommended have also been made because they are seen to be sustainable. If funding were to cease or be delayed the site will lie dormant or only revert slowly; i.e. the work that has already been completed would not be wasted.

The recommendations have also been made to encourage and solicit support from the community at large.

GENERIC RECOMMENDATIONS FOR BUSHLAND MANAGEMENT

The financial resources available may be very restricted and will require careful allocation if the best possible use of these resources to be achieved. The following broad recommendations should be consulted as a guide to the more specific recommendations made later in this plan of management.

Ongoing Flora Survey

All flora surveys require updating as the floral communities are dynamic in their nature; ephemeral species germinate, diagnostic features grow, new species are recruited and as other species die out. Some species stored in the soil as seed may not germinate until after fire or after being exposed to light. Subsequently we recommend that the species list be updated seasonally.

The updated list should be included in the largest database available, at present this would be the NSW NPWS NVCPS 1999. Councils flora survey consultant should be used to assess the reserves plant communities using the same criteria set in the NVCPS 1999. After this initial assessment the additional unrecorded species can be included by any experienced professional horticulturist / bush regenerator.

Comprehensive Fauna Survey

Knowledge regarding the type and abundance of animal species is fundamental to its management. A comprehensive fauna survey is crucial to the production of a plan of management that has integrity. A comprehensive fauna survey would also provide a very good guide to the health of a bushland ecosystem.

Subsequently it is recommended that a comprehensive fauna survey should be undertaken. This survey should span at least five 5 years and then be reviewed at five year intervals. It is suggested that the initial survey establish some base line data that can be used for comparative analysis to establish the success or otherwise of the implemented of this Plan of Management.

This survey should address all of the animal classes discussed above and should be undertaken seasonally to account for migratory species. The results of this survey should also be included in the

most appropriate regional fauna database. At this time it is suggested that this be the UBBS NPWS 1997.

Protection of rare and endangered plants and animals

All Species that have been listed on the Threatened Species Conservation Act should be protected in accordance with the Act. Until a complete native fauna list has been compiled a specific protection program cannot be designed for the Huns Creek Reserve, however threatening processes must be addressed before further loss of bushland occurs.

A twenty-meter weed free zone should be established around all individual *Epacris purpurescens* var*. purpurescens.* All other species that are deemed to be locally significant species under the ROTAP system should also be maintained in a weed free state.

Any fauna species that are found should be managed in accordance with the relevant NPWS species recovery plan.

Protection of all native fauna, flora and other habitat components

Holistic care of bushland ecosystems requires an integrated approach to its management. A single focus on weed removal would compromise the habitat needs of fauna, however focusing only on fauna habitat could allow weed infestations to kill a healthy plant community. Another example is allowing a creek bank to erode to save a plants that should be removed to stop the erosion. Leaving that plant might come at the cost of other plants and animals that would be covered by the silt deposition downstream. It is necessary to balance the broader environmental benefits with the immediate environmental costs.

The other important parameter that requires consideration is the budgetary constraints that ultimately dictate what can be achieved. Given the uncertain funding sources, the untimely allocation of these funds and unpredictable seasons, bushland management targets are very rarely achieved and are constantly reviewed to fit the changing financial and physical climate. Vast sums of money and many years of hard work can be wasted as a consequence of these limitations.

This bushland plan of management has been proposed strives to dampen the effect of these inconsistencies.

Remove Noxious Weeds

The removal of noxious weeds is in effect a recognition that these weeds constitute a key threatening process in their own right while contributing further to other weeds being considered in the same light. The specific treatment of noxious weeds is outlined in the Noxious Weeds Legislation.

Cost Effective Bushland Management

Type 1: Highly resilient bushland

High resilience, species rich bushland, which is free of weed costs very little to manage. These areas also have the greatest biodiversity. Subsequently its care is paramount and should not be over looked. Implementing an appropriate fire regime is very important in maintaining species diversity. All weeds that are found in this type of bushland should be eradicated.

Type 2: Highly resilient bushland

Bushland that has minor infestations of weeds, that can establish themselves in clean healthy bushland, is also very inexpensive to maintain. Bushland that has sporadic weeds of this nature should be weeded so that full-blown infestations do not develop. All weeds species encountered in this type of bushland should be eradicated.

Type 3: Moderately resilient bushland

E.g. .Over-mature unburnt forests

Over mature forests can develop high humidity levels, especially on south facing slopes or in steep gullies. These wetter forest conditions are conducive to weed growth and are also colonised by mesophyllic native plants that colonise dry areas and extend the margins of rainforest communities.

Burning this Type of forest is the most cost effective and ecologically sound primary weeding technique available to the bushland manager.

Generating sufficient fire fuel to burn these areas often requires that weed and mesophyllic native woody plants be felled and left to dry on the ground. Cutting and drying these plants also has the secondary effects of; letting light reach the ground, reducing humidity, drying the soil and encouraging the germination and growth of dormant weed seedlings such as Privet. All weed seedlings that grow in response to this light change will be killed during the ecological burn.

Hereby instead of thoroughly hand weeding these areas twice, at great expense, a quick sweep of woody weeds and the burn preparation are all that is required to significantly reduce the store of weed seeds and seedlings while simultaneously encouraging native plant regeneration.

Without burning areas like this it is very likely that much of the native seed stored in the ground would rot and species may be lost. Once burnt these forest communities can however require years of subsequent maintenance weeding.

Type 4: Low resilient bushland

E.g. Forest that has canopy intact and physically altered soil

Many dense weed infestations occur in areas where the soil has been physically altered. The soil profiles may be filled over, inverted or truncated or the soil may be imported or mixed with contaminants such as building materials. Road edges that have had road building material pushed into them around remnant trees are a common example.

These areas generally have poor natural resilience and have high infestations of weed species and subsequently need at least 5 years of intensive management and the regular visits indefinitely to maintain their stability.

The care and enrichment planting of the native canopy species is very important to the short term and long term stability of these areas.

Felling and burning of fire fuel in these areas is very efficient way to clear the slopes of weeds, improve access for further work, and also gauge the resilience of the soil.

Often these areas required either reshaping, fill removal and capping with clean crushed sandstone or heavy mulching. Additional works might also include a staggered planting program. Refer to planting programs below.

Type 5: Low resilient bushland

E.g. Forest that has chemically altered soil with sick or dead native canopy species and full weed canopy

This bushland Type is usually found below stormwater of sewerage outlets, the chemical alterations are explained in section 5.3 Pollutants. These constantly wet soil conditions rot dry forest plant seeds in the ground so resilience is very low.

These areas are very difficult to regenerate due to their highly altered state and require the source of the problem to be addressed or a substitute plant community to be established. This new plant community needs to be comprised of high nutrient and wet loving plant species. These areas frequently have dense weed groundcover of species such as *Tradescantia fluminesis.*

Ideally these areas should have their native canopy established first to maintain the shade over the groundcover and shrub weeds. Planting wet soil tolerant tree species, in between the weed tree species, allows the weeds to continue shading the ground while new native plants grow to ultimately replace them.

In preparation for this planting small patches in the canopy weed need to be created by removal of all large woody weeds and vines. *Tradescantia fluminesis*, or similar dense groundcover weed should be left on the ground to act as a living mulch.

These plots should be left fallow for two months and new woody weed seedlings eradicated by spraying.

Once the bulk of the woody weed seed has been encouraged to germinate and harvested in this manner then the native trees should be planted. These trees require maintenance until they are well above the threat of groundcover weeds. Once a native canopy has been established then they should be treated as in Type 4 bushland.

Type 6: Bushland without resilience

E.g. Bushland that has both chemically and physically altered soil

These areas are generally depauperate of native plants and are likely to require revegetation and or fabrication.

Alternatively areas such as this might be left as parkland or used for an alternate use such as car park or playground.

If these areas are to be revegetated then soil testing and soil amelioration would be required. Sandstone capping or deep mulching would then be needed to smother weed species and only the hardiest tree species should be used in the initial years of the revegetation until a full canopy is created.

Once canopy is present then the shrub and ground cover species can be introduced.

Planting

In order to program plantings properly at least a year's seed collection time will be required and another 6 months will be needed to grow the tubestock and cellstock. All plant propagules should be collected within the province and ideally from within the immediate catchment.

Planting preparation should include preparatory eradication of all woody and vine weeds. The site should be left fallow until all propagules of tree and vine weeds, especially target species, have germinated and have been harvested. This may take several years.

Once the key intractable and destructive weeds have been controlled then the site should be hand weeded around regenerating native plants, spot sprayed and then mulched very heavily. The site should be left fallow for one month to allow the mulch to settle and Nitrogen draw to occur.

Planting programs should be timed to ensure that plantings happen during the mild and wetter Autumn months, not during spring and summer when the maintenance weeding and watering costs would be greatest.

The planting holes should be twice as wide and twice as deep as the pot size. The soil should loose and friable. Trees should then be planted in tree guards, to allow for easy maintenance spraying.

Plantings should concentrate firstly on establishing canopy. No grass or shrub species should be planted within the first three years of any revegetation program and should only be planted once the canopy is well established. The maintenance costs can be significantly reduced if only straight stemmed trees require maintenance for they can be easily weeded or sprayed between.

Once the canopy is well established then a thorough weeding of the planting area can be completed and then groundcover species alone can be planted once these are well established then shrub species and vines can be introduced.

The most costly aspect of bush regeneration is the maintenance weeding of ground that has both natives and annual / groundcover weeds growing adjacent to each other. The reason that this type of weeding is most expensive is because of the repetitive and slow fine hand weeding required.

The ultimate controls of weeds in this regenerating environment is via strong native plant competition, a lack of weed seed source, and most importantly a good native canopy. The most cost effectively control of most exotic annuals and perennial grass weeds in forest or woodland regeneration sites is achieved by shading the ground. Creating shade is also a sustainable method of concurrently regenerating bushland while eradicating weeds.

Some groundcover weeds will grow in dense shade as thick monocultures, however these monocultures can be very cost effective to treat when groundcover and shrub planting is required. The management of nuisance weeds, such as a *Ehrharta erecta*, must be considered within the bigger picture. If time, money and the political will exists to remove all weed species in the future well and good, but in the mean time the most important management objective must be the conservation of the entire bushland community especially if the community is endangered.

PUBLIC AWARENESS AND VOLUNTEER REGENERATION PROGRAM

A copy of the Plan of management should be sent to all of the government bodies and public utilities that hold a stake in the management of the reserve. These stakeholders should forward correspondence

to council regarding the future use of easements and council should be included in their planning at the earliest possible stages. Utilities should be asked to agree to this as a matter of policy.

A series of interpretation signs should be erected along the bush tracks and a volunteer bush regeneration open day should be held bi-annually in the reserve. The first of these open days should be held at Northam drive in support of the existing volunteer group.

The immediate neighbours should be informed that the Plan of Management is on display at council's chambers. This should be achieved by posting a newsletter along with their rates notices.

An information day should be held at council's chambers and a bushwalk through the reserve should be arranged once the plan has been fully adopted.

The public awareness campaign should also include a target weeding program that encourages bushland neighbours to remove target weed species within their own yards and in the bushland adjacent to their yards. In response to those people who do remove these weeds, contract regenerators should assist in the primary clearing and maintenance of these weeds within the reserve. The neighbours who participate in the program should be included in a file so that they receive the promised support.

In conjunction with this target weeding program, a noxious weed removal program should be initiated, with noxious weed notices sent to bushland neighbours 6 months after the program begins.

Extracts from the Companion Animal Act should also be sent to all households that inform them that periodic trapping of cats and dogs will be undertaken.

As a final measure bushland neighbours should be informed of the reserve boundaries and the fines for dumping rubbish *including green waste* into the reserve.