# Vegetation Management Plan for Oakville Park, Oakville

**18 December 2007**

Prepared for

**Hawkesbury City Council**

Prepared by

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# CERTIFICATION

I, Judith Rawling Managing Director of Urban Bushland Management Consultants Pty Ltd hereby state that the **Vegetation Management Plan for Oakville Park** has been prepared in accordance with the NSW Department of Natural Resources[1] *Urban Bushland Management Guidelines*, and their publication entitled '*How to Prepare a Vegetation Management Plan'*.

Judith Rawling
17 December 2007

[1] Formerly, Department of Infrastructure, Planning and Natural Resources ('DIPNR') and now part of Department of Environment & Climate Change ('DECC').

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# 1 INTRODUCTION

## 1.1 BACKGROUND INFORMATION

Urban Bushland Management Consultants Pty Ltd ('**UBMC'**) has been retained by Hawkesbury City Council (**hereafter** '**Council**') to prepare a Vegetation Management Plan for Oakville Park in the suburb of Oakville, which is located in the Hawkesbury Local Government Area.

Oakville Park (Reserve #203) is reserved as Crown Land under the care and control of Council. It comprises a central sportsground or oval, with an area of fringing bushland. Oakville Park is a well used local community facility and adjoins several other recreational facilities - the Oakville Scout Hall and the Vines Pony Club.

Under the *Local Government Act 1993 ('**LG Act'**),* community land in the care and control of Council is required to be categorised according to the land use, attributes or specific characteristics of the land. Lands are evaluated on the basis of their conservation value in terms of natural or cultural environmental heritage to the local, regional or National context, and Council is required to prepare a plan of management to manage the lands appropriately.

Oakville Park is <u>not</u> community land but Crown Land, but using the criteria listed in the *LG Act*, for management purposes it has been categorised as '**Natural Area (Bushland)'** and as a **Sportsground**. Under *Hawkesbury Local Environmental Plan 1989* (as *Amended 2005*), Oakville Park has been zoned as Open Space (Existing Recreation).

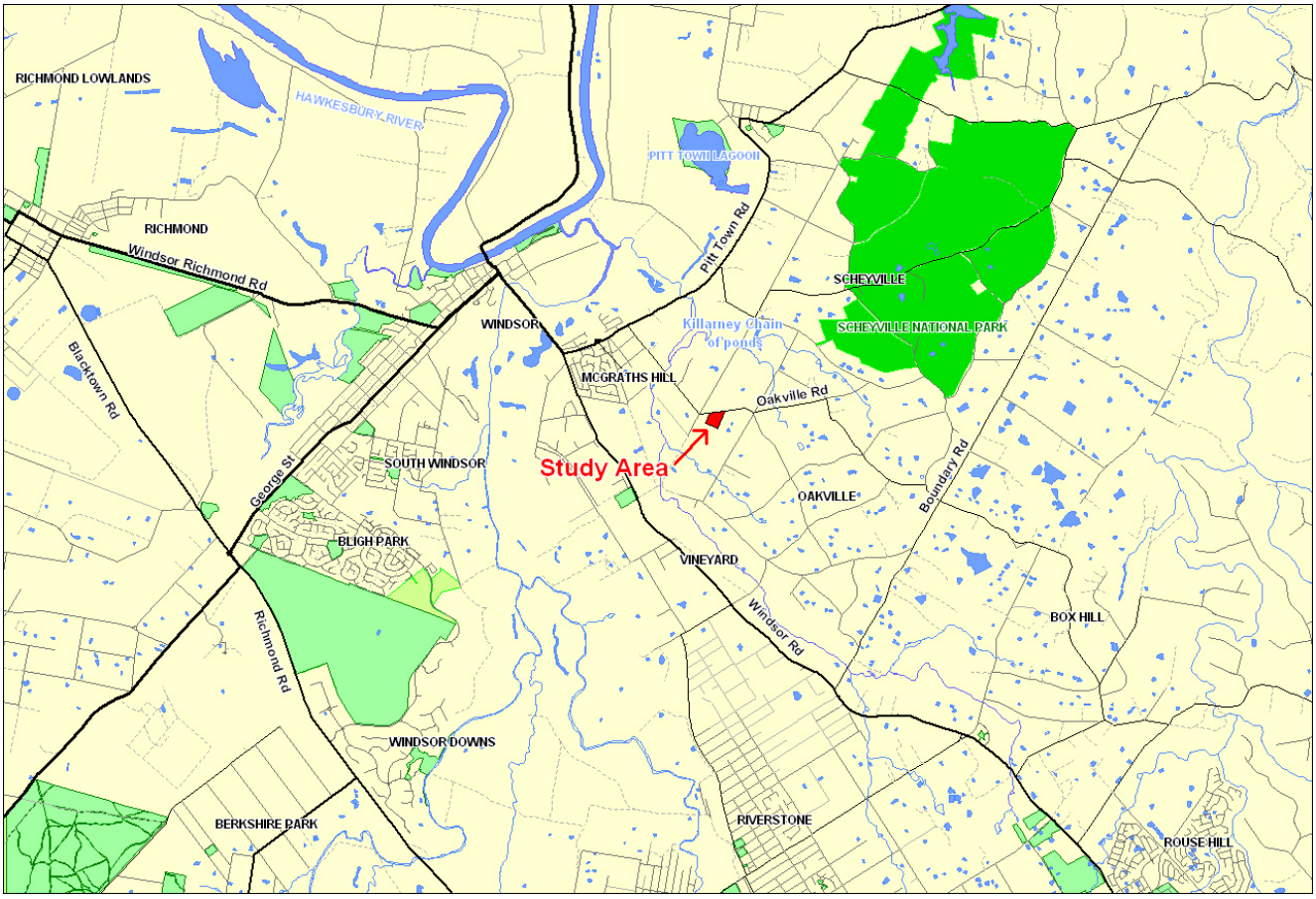
The native vegetation (**hereafter** '**bushland**') around the oval at Oakville Park has been identified as **Shale Gravel Transition Forest** – an ecological community of State conservation significance (NPWS[2] 2002). Therefore Council has requested that a Management Plan be developed which specifically addresses the management of the bushland component of the Park.

This draft Vegetation Management Plan (**hereafter 'the 'VMP'**) establishes the framework for the rehabilitation and future management of the native bushland surrounding the oval, and in order to provide compatibility with other such Plans prepared for Council, the VMP for Oakville Park has been prepared in accordance in the general requirements of the *LG Act*.

The regional positioning of Oakville Park (**hereafter 'the subject land'**) is shown in Figure 1.1.

[2] Now part of the NSW Department of Conservatoin & Climate Chance ('**DECC**').

**Figure 1.1: Regional Positioning of Subject Land**




## 1.2 SITE IDENTIFICATION & LAND SCHEDULE

| Name | Address | Lot Number / DP | Co-ordinates (Size/ha) |
|---|---|---|---|
| Reserve #203 | 14 Oakville Road, Oakville | Lot 7006<br>DP 10727993 | 56 301100 / 62 77330<br>(4.047 ha) |

## 1.3 AREA TO WHICH THE VMP APPLIES

This VMP applies only to those areas of native bushland occurring immediately around the Sportsground (oval). The bushland is located on the outside of the fenced central oval, with a mown grass track maintained between the bushland and the oval itself (see Figure 2.1). The external Park boundaries are similarly fenced.

This VMP does not address the care and management of the Sportsground or its facilities, or the maintenance of the Park's public amenities. Nor does it apply to the car parking area (except where edge treatments impact on the adjacent bushland). It is understood that these items within Oakville Park are managed according to a different plan of management, as prepared by Council for its designated Parks and Sportsgrounds.

Recommendations relating to Park access, fencing, pathways and tracks have been made only in relation to the management of the bushland.

## 1.4 PLAN AIMS & OBJECTIVES

A Vegetation Management Plan for a bushland reserve is an important document as it serves to clarify the goals and objectives of the restoration and management programs, and clearly sets out the proposed actions and their general sequence. Other tasks not necessarily related to bushland restoration should also be included in the Plan. For example, infrastructure works, track construction, fencing, signage, soil erosion and remedial drainage works form an integral part of any such plan (DIPNR 2003).

The essential role of a Plan of Management is to identify appropriate goals and objectives, to determine best-practice management strategies, and to provide guidelines for on-going assessment and review. The Plan will also serve as a vehicle for agreement between all stakeholders.

The aims and objectives of the VMP for native bushland at Oakville Park have been developed to ensure the on-going development of open space strategies and administrative policies within Council to effectively protect, rehabilitate (or restore) and conserve the natural areas included within this Plan.

Within the context of the continued provision of Council services to the community regarding these lands, this VMP identifies all significant natural bushland areas, assesses their conservation values in accordance with the current State and Federal environmental legislation, and establishes the means of managing the environmental values of the land.

**Note**: This VMP does NOT constitute a detailed 'Works Plan' for undertaking of on-ground work – although general recommendations for bushland rehabilitation and restoration have been made. Such Works Plans (or Action Plans) are usually prepared by the professional bush regeneration contractors employed to undertake the bushland restoration program.

Works Plans will determine the extent and sequence of on-grounds works, and provide a timetable and an indicative costing. These Work Plans will need to be updated as the restoration program progresses. Works plans should always be set within the context and framework of the adopted Plan of Management for the subject land.

## 1.5 SCOPE OF WORK

The VMP for bushland at Oakville Park has been prepared in accordance with the requirements of the (former) NSW Department of Natural Resources, as set out in their publication *How to Prepare a Vegetation Management Plan* (*Version 4*)

The scope of works required for preparing a VMP for an area of native vegetation (bushland) is set out as follows.

- Undertake a comprehensive review of information and other baseline data relating to the geophysical and biological resources and values of the subject land.
- Identify and map extant ecological communities, plant associations and location of threatened species occurring within the subject land.
- Review local planning, State and Federal government policies and legislative requirements and explain their relevance to the subject land, with the landowner's role and responsibilities clearly defined.
- Clearly define goals, objectives and strategies for the purposes of nature conservation, passive recreation, education, landscape enhancement and other values (as appropriate).
- Develop bushland restoration and rehabilitation strategies, including the identification of remedial measures for existing impacts and strategies to ameliorate potential future threats.

- Consider infrastructure requirements, including signage, pathways, seating, lighting and other public amenities (if appropriate).

……and where appropriate,

- Consider stakeholder participation – including a review of existing roles/contribution, recommendations for role enhancement, educational opportunities etc.

This VMP has been prepared to cover the next five (5) year period; commencing from the date of its adoption by Council.

Under Section 42 of the *LG Act*, a Plan of Management for community land may remain in force unless the plan is revoked by Council, or the land is reclassified as 'operational land', or if the land is not owned by Council the land ceases to be controlled by Council. This VMP, although not specifically prepared to the requirements of the *LG Act*, should similarly remain in place until such time as it is revoked by Council.

However as this VMP deals specifically with the restoration and management of native bushland – which is a dynamic process - after five (5) years the VMP should be reviewed, the progress of works assessed using the Performance Indicators identified, and relevant management strategies and actions amended as required.

# 2 STATUTORY & PLANNING CONTEXT

## 2.1 LAND TENURE & ZONING

The subject land – Oakville Park (Reserve #203) – is Crown Land under the care and control of Council. Under *Hawkesbury Local Environment Plan 1989* (as Amended August 2005), the Reserve is zoned as Open Space (Existing Recreation).

## 2.2 LAND CATEGORY

Reserve #203 Oakville Park is categorised as a Natural Area using criteria listed under Section 36(4) of the *LG Act*. Under Section 36(5), that part of the Park categorised as a Natural Area is further categorised as 'Bushland and the playing fields (oval) are categorised as 'Sportsground'

## 2.3 LOCAL GOVERNMENT ACT S36 CORE OBJECTIVES FOR NATURAL AREAS (BUSHLAND)

The bushland surrounding the Sportsground at Oakville Park has been categorized as Natural Area (Bushland). The *LG Act* provides a definition and lists a series of core objectives for the category of Bushland. These are set out in Table 2.1, below.

**Table 2.1: Guidelines for Categorisation of Community Lands**

| Category | Description | Core Objectives |
|---|---|---|
| **Bushland** | Under Section 36(5) of the Act, the term bushland is assigned to land that contains primary native vegetation, and vegetation that is:<br>(a) The natural vegetation or a reminder of the natural vegetation of the land, or<br>(b) Although not the natural vegetation of the land, is still representative of the structure or floristics, or structure and floristics, of the natural vegetation in the locality.<br>Such land includes:<br>- bushland that is mostly undisturbed with a good mix of tree ages, and natural regeneration, where the understorey is comprised of native grasses and herbs or native shrubs, and which contains a range of habitats for native fauna (such as logs, shrubs, tree hollow and leaf litter), or<br>- moderately disturbed bushland with some regeneration of trees and shrubs, where there may be a regrowth area with trees of even age, where native shrubs and grasses are present in the understorey even though there may be some weed invasion, or<br>- highly disturbed bushland where the native understorey has been removed, where there may be significant weed invasion and where dead and dying trees are present, where there is no natural regeneration of trees or shrubs, but where the land is still capable of being rehabilitated. | ▪ To ensure the ongoing ecological viability of the land by protecting the ecological biodiversity and habitat values of the land, the flora and fauna (including invertebrates, fungi and micro-organisms) of the land and other ecological values of the land, and<br>▪ To protect the aesthetic, heritage, recreational, educational, and scientific values of the land, and<br>▪ To promote the management of the land in a manner that protects and enhances the values and quality of the land and facilitates public enjoyment of the land, and to implement measures directed to minimising or mitigating any disturbance caused by human intrusion and<br>▪ To restore degraded bushland, and<br>▪ To protect existing land forms such as natural drainage lines, watercourses and foreshores, and<br>▪ To retain bushland in parcels of a size and configuration that will enable the existing plant and animal communities to survive in the long term, and<br>▪ To protect bushland as a natural stabiliser of the soil surface. |

## 2.4 COUNCIL MANAGEMENT OBJECTIVES FOR OAKVILLE PARK

The protection of remnant bushland within the City of Hawkesbury is a high priority of Council. The ecological values of bushland on public land are considered of significance to the community, and any development of recreation of community facilities on such sites can only occur where it can be demonstrated that the site's ecological values are not threatened.

This VMP establishes a framework for the management of native bushland in Oakville Park, which are generally in accordance with those objectives identified for Community Land which similarly retain areas of native vegetation.

***Vision Statement*** **– the native bushland at Oakville Park will be conserved as a valuable remnant of a State-listed significant ecological community - Shale-Gravel Transition Forest - and will be managed jointly by Council and the community for its natural conservation values. Oakville Park will also continue to be available to the local community for passive recreational usage, and in those areas designated as a Sportsground, for active recreation.**

In order to achieve this Vision, a series of management objectives are proposed. These incorporate the core objectives for Bushland set out in the *LG Act* (see Table 2.1), and include a number of supplementary objectives for the management of the Oakville Park Bushland.

These supplementary objectives are set out as follows:

- To develop proactive land management policies for the remnant Shale-Gravel Transition Forest ecological community within the subject land;
- To establish practical and cost effect management strategies to assist in the conservation, regeneration and/or restoration of remnant native bushland within the subject land;
- To manage the bushland regeneration process to ensure the retention of suitable habitat for those threatened and/or significant flora and fauna present in the subject land;
- To provide a means of managing the Park's bushland areas in order to retain the natural values inherent in the flora, fauna and landscape elements, and their relationship to the local community;
- To provide a means for the monitoring the environmental management of the Park's bushland areas;
- To protect adjoining residents from potential hazards arising from the retention of bushland on residential boundaries, including bushfire;
- To provide for community access and usage, including establishing areas for passive recreation and environmental education; and
- To provide a timetable of works and to establish a Protocol for the review for the VMP within five (5) years of its formal adoption by Council.


**Fig 2.1**
**Condition of Bushland Map**

**URBAN BUSHLAND**
**MANAGEMENT CONSULTANTS PTY LTD**

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## 2.5 LEGAL AND PLANNING FRAMEWORK

A number of local planning policies, as well as State and Commonwealth Acts and Policies apply to the management of remnant native vegetation (bushland) within Hawkesbury LGA. The most relevant of these are listed in Table 2.2, below.

**Table 2.2: Summary of Policies, Planning & Legislative Requirements**

| Government Level | Relevant Policy /Legislation | Relevance to Subject land |
|---|---|---|
| **Local** | *Hawkesbury Local Environment Plan 1989, Amended August 2006* | Under the LEP, Reserve #203 is zoned as Open Space (Existing Recreation). |
| **State** | *Local Government Act 1993, incorporating Community Lands Amendment Act 1998* | Section 36 of the Act requires all local councils to prepare draft plans of management for community land under its care, control and management, but as Crown Land Council is not legally obliged to prepare such a Plan for Oakville Park.<br>Nevertheless, Council has commissioned a VMP for the Park, focused on the management of the remnant native bushland. |
| | *Threatened Species Conservation Act 1995* | One (1) endangered ecological community occurs on site – Shale-Gravel Transition Forest (see Appendix 1).<br>The threatened shrub *Acacia pubescens* has been recorded in the Park, also *Dillwynia tenuifolia* and *Pultenaea parviflora* (see Table 5.1).<br>No threatened fauna species are known to occur in the subject land. |
| | *Noxious Weeds Act 1993* | Four (4) noxious weed species were recorded for the subject land (see Appendix 5).<br>As the landowner, Council has a legal responsibility to control and prevent weed spread to adjoining land. |
| | *Rural Fires Act 1997 / Amendment Act 2002* | Council's Bushfire Risk Management Plan defines the Bushland within the subject land and surrounding area as vegetation classification 1 with a high bushfire risk (HSC).<br>Overall, the fire risk in this bushland is classed as 'low' on a local scale, but fire within the Reserves would potentially impact on reserve infrastructure (signage, fencing) and on private property adjoining. |
| | *State Environmental Planning Policy No 19 – Bushland in Urban Areas* | The aims, objectives and requirements of SEPP-19 apply only to land zoned as community land (formerly Open Space). Therefore land in Reserve #203 (as Crown Land) does <u>not</u> fall under the protection of SEPP-19. Nevertheless, this VMP has been prepared in the spirit of the Policy.<br><u>*Note*</u> that Clause 9 of the Policy requires development on adjoining land to be cognisant of the aims of SEPP-19. This is relevant to any development or redevelopment on adjoining land (residential or commercial). Council should therefore take this into consideration when considering any development on lands adjoining Oakville Park. |
| **Federal** | *Environment Protection and Biodiversity Conservation Act 1999* | The threatened shrubs – *Dillwynia tenuifolia, Acacia pubescens* and *Pultenaea parviflora* are recorded for the subject land.<br>No threatened fauna species or ecological communities listed under this Act are known to occur within or utilise the resources of the subject land. |

# 3 SITE DESCRIPTION

## 3.1 LEGAL DESCRIPTION

Table 3.1 summarises the legal description of the subject land – Oakville Park (Reserve #203)

**Table 3.1: Summary of Legal Description**

| | |
|---|---|
| **Title Information** | Reserve # 203 Oakville Park |
| **Ownership** | Crown Land under the care and control of Hawkesbury City Council |
| **Location** | 14 Oakville Road, Oakville.<br>Located on the southern side of Oakville Road close to the intersection of Old Stock route Road. An unnamed tributary of McKenzies Creek is located a short distance to the west of the Park.<br>Entry points are located at the car park on the north-eastern corner of the Park, while access is also available from the car park next to the Scout Hall (north-west). |
| **Total Area** | Reserve # 203 - 4.1096 hectares |
| **Zoning (LEP 1989, Amendment 2006)** | Reserve #203 – Open Space (Existing Recreation) |
| **Classification (LGA)** | Reserve #203 -Crown Land |
| **Categorisation (LGA)** | Reserve #203 Natural Area (Bushland) and Sportsground |
| **Land Use and Public Purpose** | Sportsground and Native Bushland (active and passive recreation) |

## 3.2 LOCATION & SETTING

The suburb of Oakville is located about 4.5 km from Pitt Town, on the Cumberland Plain west of Sydney City. Oakville Park is located on the southern side of Oakville Road close to its intersection with Old Stock route Road. The subject property **('Oakville Park')** is surrounded by generally rural residential properties, although some older farming land still persists in the district.

Oakville Park is bounded by Oakville Road to the north, the Vines Pony Club to the south-west, the Oakville Scout Hall to the west, undeveloped land to the south, and a high voltage transmission line and service corridor to the east.

The Park itself covers an area of 4.11 hectares, which includes both the fringing native bushland and open space which is currently used for recreation (the oval).

## 3.3 CULTURAL & HISTORIC DESCRIPTION

### 3.3.1 Pre European Heritage

The Daraug (also known as the Darug) and Darkinung tribes of Aborigines were the original inhabitants of the Cumberland Plain west of Sydney, extending from the mouth of the Hawkesbury River, westward to Mt Victoria, east to Sydney and south to Camden and Liverpool. The River known as Derrubbin (or Venrubben) was critical to the indigenous tribes as a source of food and as a transport route, as were large local watercourses such as South Creek (Nicholls 2004).

It is not known if there are any Aboriginal relicts remaining in the Oakville Park area or immediate environs, but the likelihood of these having survived more than a century of agriculture is unlikely.

Further, there are no large watercourses in the vicinity and no sandstone outcrops where engravings would have been made by the original inhabitants.

### 3.3.2 European Heritage

As part of the Pitt Town Common, the Oakville District was set aside for public grazing by Governor King in 1804. Settlement began in the late 19th Century, when John Clark took up land next to Oak Hollow – so named because of the many She-oaks (*Casuarina* sp) that lined the local watercourses. A school was established in 1900, and a small rural community was established.

From that time, it seems that local livelihoods in the Oakville area were made from poultry farming and citrus orcharding. Other farming pursuits, including dairying, pig framing and (since the 1930s) mushroom growing were based at Oakville, with some of these activities surviving to current times (Nichols 2004). In the last several decades, horse grazing and hobby farming have been popular local land uses.

Local historical sources indicate that Oakville Park (or Reserve) was an early establishment, with photographs showing cricket and other sporting pursuits underway in the local park – presumably our subject land (see Plates).

## 3.4 PHYSICAL DESCRIPTION

The physical characteristics of the subject land, Oakville Park and the immediate locality have been summarised in Table 3.2, below.

**Table 3.2: Physical Features of the Subject land & Environs**

| FEATURE | DESCRIPTION |
|---|---|
| **Co-ordinates** | Reserve # 203 – 33.62314N , 150.8545E |
| **Topography** | Locality - gently undulating rises on the **Wianamatta Group Shales**. Crests and ridges are broad and rounded with convex upper slopes and concave lower slopes. Outcrops of shale are not usual, and may occur where soil removal has occurred. (Bannerman & Hazelton 1990).<br>Subject land (Reserve #203) – comprises gently sloping land, towards the eastern boundary from 20 to 30 metres above sea level. |
| **Geology** | Formed on the Wianamatta Group Shales and the Ashfield Shale sub-group.<br>**Ashfield Shale** consisting of laminate and dark grey siltstone, with Bringelly Shale consisting of shale with occasional calcareous claystone, laminate and infrequently, coal, as well as fine to medium grained lithic sandstone. |
| **Soil Landscape Unit** | The subject land is mapped as the **Blacktown Soil Landscape Unit** (a residual landscape).<br>Blacktown soils are shallow to moderately deep (<100cm), and hard setting with mottled texture contrast soils. The soils are saline and consequently dispersive once the vegetation cover is removed.<br>Limitations of this soil type include moderately reactive highly plastic subsoil, low soil fertility and poor soil drainage. (Bannerman & Hazelton 1990). |
| **Local Hydrology** | The subject land is part of the greater Hawkesbury-Nepean Catchment with drainage to the Killarney Chain of Ponds and the McKenzies Creek sub-catchment.<br>No permanent drainage lines are present, although some ephemeral swales occur, generally running off the oval to the east. |
| **Climatic Details** | The mean daily maximum temperature is 23.7°C, with highest temperatures recorded in December, January and February. The mean daily minimum temperature is 10.9°C, with lowest temperatures recorded in June, July and August.<br>Mean annual rainfall is 810.3 mm; with January, February and March recording the highest mean levels (Bureau of Meteorology 2005, Richmond RAAF #067033). |

## 3.5 BIOLOGICAL DESCRIPTION

The biological description of the subject land is discussed in detail in Section 5 of the VMP.

**Table 3.3: Biological Characteristics**

| Item | Descriptive | Status |
|---|---|---|
| **Native Plant Community** | Shale-Gravel Transition Forest | Endangered ecological community – listed under the Schedules of the NSW *TSC Act* |
| **Threatened Species** | *Acacia pubescens* | Listed as threatened under the Schedules of the NSW *TSC Act* & Federal *EPBC Act* |
| | *Dillwynia tenuifolia* | Listed as threatened under the Schedules of the NSW *TSC Act* & Federal *EPBC Act* |
| | *Pultenaea parviflora* | Listed as threatened under the Schedules of the NSW *TSC Act* & Federal *EPBC Act* |
| **Regionally Significant Species** | 9 flora species are listed as inadequately conserved (see Table 5.1) | Inadequately represented in conservation reserves in Western Sydney (NPWS 1997) |
| **Noxious Weeds in Hawkesbury River Local Control Area** | Four (4) species present: one (1) woody weed and three (3) herbaceous species (see Section 5.1.3) | *Noxious Weeds Act 1993*, Amendment 2005 |

## 3.6 MANAGEMENT CONTEXT

### 3.6.1 Services & Management History

Reserves services and infrastructure are detailed in Table 3.4, while the maintenance regime for the Park (as made available by Council) has been summarised below.

**Table 3.4: Summary of Services and Management History**

| | |
|---|---|
| **Access** | Main access is from Oakville Road via a gravelled car park on the north-eastern side of the Park. Secondary (overflow) car park located at the Oakville Scouts Hall on the north-western side of the Sportsground.<br>Circular mown grass track located between bushland and perimeter fence around oval.<br>Numerous tracks and clearings have been created into and through the bushland, which as a result is highly fragmented. There are no gates or bollards. |
| **Services & Infrastructure (Assets)** | Assets include a Sportsground with goal posts, fencing and four (4) flood light pylons as well as lighting in the buildings.<br>A toilet block, changing sheds and canteen are situated adjacent to the oval between the oval fence and the gravel car park. Two (2) demountables used for storage of maintenance equipment are also in this area<br>The oval and other facilities are maintained by Council, and the grass mown in a three (3)-m strip around the oval. The bushland is located outside this mown strip and is not maintained.<br>The gravel car park of approximately 0.14 ha in size is situated at the north-eastern corner between Oakville Road and the oval.<br>There are two (2), three (3)-metre wide dirt tracks running through the bushland that have been used to gain access for trail bikes, dumping and other inappropriate activities.<br>One track makes a circuit from the demountables into the bushland and out to the gravel car park (see Figure 2.1). The other track extends off this loop track and goes deeper into the bushland. Both tracks have open public access, with no means of restricting unauthorised vehicles.<br>No signage prohibits vehicular access, and there is no interpretive or directional signage installed in the Park.<br>The fencing on the southern Park boundary is in is in disrepair, and there is no fencing on the western and northern boundaries. The bushland extends into the adjacent Scout Hall property to the south-west, and the subject land abuts Oakville Road to the north.<br>The fencing on the eastern boundary is ~one (1) metre high and is constructed of chicken wire and metal posts. |
| **Lighting & Solar Access** | Installed floodlight lighting around the Sportsground. Lighting is also available in the picnic shelter, toilet block and changing sheds.<br>The floodlighting of the oval during evening recreational use impacts on the bushland, penetrating approximately 15 metres from the edge of the oval. The floodlighting is generally used three (3) times a week until around 8pm. |
| **Current Grounds Maintenance** | Council is responsible for managing the Sportsground, car park and other public areas, and for maintaining Park infrastructure. Slashing is carried out monthly in the summer growing season: less frequently in winter.<br>Although Council is also responsible for maintaining the bushland around the Sportsground, there would appear to be no active management program in place. |

### 3.6.2 Establishment of Management Zones

For the purposes of this VMP, the subject land (Oakville Park Bushland) has been dividend into a number of separate Management Units or Zones, grouped according to physical attributes such as location within the subject land, degree of weed infestation and/or damage to the native vegetation, and the management strategies proposed to achieve the Zone's categorised land use (i.e. Bushland or Sportsground).

In order to provide consistency, Management Zones have been matched to the Weed Polygons illustrated in Figure 5.4 (Condition of Bushland Map), and to the presence of threatened species.

Accordingly, four (4) Management Zones have been determined as follows (see Figure 3.2).

- Zone 1 – Weed Infested Bushland with *Acacia pubescens* (north-eastern corner)
- Zone 2 – Weedy Perimeters around Oval;
- Zone 3 - Core Bushland with Threatened Species; and
- Zone 4 – Car Park, Edges and Access Tracks

**Note:** the weed polygons recorded for each of Management Zone 1 to 3 are set out in Table 5.2. There were no weed polygons prepared for Zone 4 as this area comprises a car parking area, with tracks.


**Figure 3.2**
**Management Zones**

**URBAN BUSHLAND**
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# 4 PLAN PREPARATION - METHODOLOGY

## 4.1 LITERATURE REVIEW

During the preparation of this VMP, relevant Council files were accessed, previous studies and investigations for general locality, and local history sources were consulted. As the Plan is intended to serve as a 'stand alone' document, data and other background information has been sourced from these documents, and where appropriate incorporated into the VMP. All such information has been appropriately referenced.

The main documents referenced were:

- Western Sydney: Urban Bushland Biodiversity Survey (NSW NPWS 1997).
- Native Vegetation of the Cumberland Plain (NSW NPWS 2002); and]
- EcoLogical (Australia) Pty Ltd - Vegetation Mapping for Hawkesbury Local Government Area (draft 2005).

In addition, the *Environment Protection and Biodiversity Conservation Act* (***'EPBC Act'***) Online Database (Department of the Environment and Heritage 2007; search area five (5) km radius around the subject land) and the NPWS Atlas of New South Wales Wildlife Database (Department of Environment and Conservation 2006; search area 10 km x 10 km centred on the subject land) were accessed to identify previous recordings of flora and fauna species of conservation significance within the Region.

## 4.2 FIELD INVESTIGATIONS

Field investigations were undertaken to identify the extant vegetation community and to prepare a list of native and introduced flora and fauna occurring within the Park bushland. Habitat assessment was undertaken and the results documented; and the presence of any vegetated linkages and connectivity to other bushland areas were noted.

Management issues and all major impacts to the bushland were identified; while a range of remedial actions and management strategies were considered. Methods used to undertake the flora and fauna surveys and to carry out the condition of bushland (weed) mapping are described below.

## 4.3 FLORA FIELD SURVEY

Karen Visman (B. Env.Sc [Hons]) and Cally Howe (B. Env.Sc [Hons]) conducted a botanical survey of the subject land on 28 May 2007. The survey identified and mapped the native vegetation community extant on the subject land and prepared a list of native and introduced flora species present. Approximately 4 hours was spent surveying the subject land.

The study area was surveyed using the random meander method described by Cropper (1993). The use of this method ensures that all vegetation communities are thoroughly investigated. This method is considered the most effective for detecting plant species of conservation significance, and involves walking randomly throughout the study area and recording every plant species observed.

Vegetation community classifications were consistent with NPWS (2002). Vegetation community boundaries were drawn on an aerial photograph. Where boundaries were indistinct on the aerial photograph, a GPS unit (Thales MobileMapper) was utilised to log the boundary location.

A targeted search was carried out for plant species of conservation significance previously recorded in the vicinity of the subject land based on information sourced from:

- *EPBC Act* Online Database (Department of the Environment and Heritage 2006; search area: 5 kilometre radius centred on study area) and the
- NPWS Atlas of New South Wales Wildlife Database (Department of Environment and Conservation 2006; search area: 10 x 10 kilometre centred on study area)

The significant species recorded on site were Downy Wattle (*Acacia pubescens*), *Pultenaea parviflora* and *Dillwynia tenuifolia*.

The location and distribution of threatened flora species found (see Figure 5.2) were mapped with the MobileMapper. Points were recorded for clumps of individuals that were restricted to an area of approximately 10 square metres. Polygons were recorded if the species occupied an area greater than 15 square metres. A stem count or estimate was undertaken for the species at each point and polygon.

The survey for threatened species was not undertaken during the peak flowering season of any of the species listed (which generally occurs generally from August to November for all three (3) species), which can make identification difficult. Furthermore, *Dillwynia tenuifolia*, in particular, has a fairly sparse habit, and when it is not in flower can easily be overlooked. Also, due to the dense cover of *Melaleuca nodosa* (which is similar in appearance to *Dillwynia tenuifolia*) present through much of the site, individuals of the threatened plant were possibly obscured from sight. Consequently it is expected that the stem count provided in this VMP is an underestimation of the true population sizes.

The methods used to map the extent and distribution of weed and introduced plants in the bushland have been described in Section 4.5, below.

## 4.4 FAUNA FIELD SURVEY

Field survey was undertaken by Toby Eastoe (BNatRes GradCertEnvMan]) on 16 May 2007. Weather conditions during the survey were sunny, with little to no breeze and moderate to cool temperatures (12°C-22°C).

An opportunistic diurnal fauna survey and a nocturnal spotlighting survey were carried out. All of the bushland at Oakville Park was surveyed on foot, using an adaptation of the Random Transect Method described by Cropper (1993). The survey included targeted searches for likely-occurring threatened fauna species and an assessment of existing habitat. Approximately four (4) hours during the day and two (2) hours at night were spent searching for fauna, and evaluating the potential of the available habitat. Given the small area of bushland and the ease of access, it is considered that this length of time was sufficient to determine the diversity of habitats present and to assess its value to those fauna species observed, or considered likely to occur.

Diurnal and nocturnal fauna survey transects are shown in Figure 5.5.

Fauna species were either identified by direct sightings; or by calls while they inhabited or traversed the bushland area. Other signs of usage by native or introduced fauna species were noted, including tracks, shells, scratchings and scats. Sightings made during the survey are presented in Appendix 4, along with database results obtained from a search of the NPWS Atlas for a 10 km area centred on the subject land at Oakville Park.

The diversity, structure and value of habitats for previously recorded or potentially occurring species was documented with reference to those threatened species listed under the NSW *TSC Act* and Commonwealth *EPBC Act*. Targeted searches were undertaken in order to identify habitat features such as ground debris including leaf litter, fallen logs or urban refuse; known feed trees, mature trees with hollows, connectivity of fauna corridors, aquatic environments and other habitat features important to the life cycle needs of those threatened species known, or likely to occur in or close to the subject land at Oakville Park.

A targeted search was also conducted for the threatened Cumberland Plain Land Snail (*Meridolum corneovirens),* which has been recorded (NPWS 1999) in the 9.3 km² Scheyville National Park, centred about 3.5-km from the subject land at Oakville Park.

## 4.5 CONDITION OF BUSHLAND MAPPING

Field survey and weed mapping was undertaken by Judith Rawling ((BA, DipEd, DipEnvStud, MEnvStud) Debra Rothwell (DipC&LMngt)) and Toby Eastoe (BNatRes GradCertEnvMan], on 14 May 2007.

A Thales MobileMapper GPS unit was used to log data in the field, with locations being recorded in three (3) second increments. The MobileMapper is a hand-held unit, accurate of up to three (3) metres, and allowing for rapid translation of data into a Geographical Information System (GIS). Weed Polygons and Weed Points were defined to provide a logical basis for the sequence of weed management.

Infestations that covered an area larger than 10 sq metres in size were recorded as **'Weed Polygons'**. The location of each Weed Polygon was recorded using the Thales MobileMapper. The boundaries of each Weed Polygon were walked; with the MobileMapper logging in three (3) second increments.

The data recorded was downloaded from the MobileMapper into a GIS (MapInfo version 8.0) and additional field notes were added. This data was then used for the analysis and assessment of condition of vegetation, development of priority of works and map presentation.

For **Weed Polygons**, the abundance of each dominant target weed and the overall weed abundance of the polygon were recorded and mapped using the MobileMapper and hand-written field notes.

The composition and extent of the Weed Polygons recorded is presented in Table 5.2, and their positions are shown on Figure 5.4 (Condition of Bushland Map).

The bushland condition mapping system used in this VMP is an adaptation of the quantitative weed classification method developed by Ku-ring-gai Municipal Council (1995). This Method determines the degree of weed invasion in each stratum (or layer) of a plant community – i.e. the canopy, shrub and groundcover strata, and measures the percentage cover of weeds compared to native species in each stratum.

Each area is assigned a 'weed class', which is calculated from the recorded value of each stratum (for a full explanation of weed codes please see Appendix 6 – Ku-ring-gai Council Weed Mapping Method).

For grassed areas which are regularly mown, no weed mapping has been assigned. Such areas are described as 'non-bushland' and are labelled as such (e.g. oval and mown strip).

## 4.6 COMMUNITY CONSULTATION

A public meeting was held at the North Richmond Community Centre on 7 November 2006 in order to present the outcomes of the Community Lands Categorisation Project (UBMC for Council, 2007).

At this meeting, the categories recommended by the consultants – i.e. Natural Area (Bushland) and Sportsground were adopted for Reserve #203 Oakville Park. - were confirmed by the Community. Subsequently, Council determined to prepare a VMP for Oakville Park to more effectively manage the native vegetation on the site. It is anticipated that the draft VMP will be exhibited by Council for a period of 28 days, and public comment will be invited.

# 5 FIELD SURVEY RESULTS

## 5.1 FLORA

### 5.1.1 Vegetation Communities

Previous Mapping

The subject land lies on the Penrith Sheet of the 1:100 000 vegetation map series (Benson 1992). Benson mapped the subject land as 'cleared'. Shale Gravel Transition Forest was mapped within one (1) kilometre of the southern boundary of the subject land.

The NPWS has produced a series of vegetation maps for the Cumberland Plain (NPWS 2002). The NPWS (2002) mapped the vegetation within the subject land as **Shale-Gravel Transition Forest** (see Figure 5.1), which is listed as threatened under the NSW *TSC* Act, but is not listed under the Commonwealth *EPBC Act*.

A more recent survey by EcoLogical (Australia) Pty Ltd undertaken on behalf of Council (draft report 2005) has confirmed the presence of Shale-Gravel Transition Forest at Oakville Park.

Current Survey

The outcomes of the current field survey generally support the NPWS (2002) and EcoLogical (2005) mapping. A description of the native vegetation community located in the subject land, and the dominant plants within each vegetation layer (or stratum), is provided below. Native vegetation communities identified from the current survey are mapped on Figure 5.2.

Shale Gravel Transition Forest

**Structure and Density**

Moderate cover of canopy trees, up to approximately 20 metres in height with approximately one (1) tree per 36 metres$^2$ (~ six [6]-metres apart). The sub canopy is moderate (one shrub per 16 metres$^2$), reaching up to approximately 10 metres in height. The shrub layer is generally moderate to sparse (1 shrub per 1 metre $^2$), reaching up to approximately three (3) metres in height. The groundcover density is highly variable, (dense where there is an African Lovegrass infestation, and sparse to moderate in the remaining areas), averaging five (5) individuals per metre$^2$, and reaching up to approximately 0.8 metres in height.

**Common Species (* denotes exotic species)**

Canopy:

Dominated by Red Ironbark (*Eucalyptus fibrosa*), with large stands of Black She-oak (*Allocasuarina littoralis*), and some occurrences of Drooping Red Gum (*Eucalyptus parramattensis*).

Sub-canopy:

Dominated by tall shrubs such as White Feather Honeymyrtle (*Melaleuca decora)*, Parramatta Green Wattle (*Acacia parramattensis*) and Ball Honeymyrtle (*Melaleuca nodosa*) are also common.

Shrubs:

Dominated by younger Ball Honeymyrtle (*Melaleuca nodosa*) and by Gorse Bitter Pea (*Daviesia ulicifolia*), with common occurrences of Native Cranberry (*Lissanthe strigosa*) and the threatened plant *Dillwynia tenuifolia* also recorded.

Ground Layer:

African Lovegrass (*Eragrostis curvula**) dominated in areas surrounding the site perimeters, in clearings and along tracks. Other commonly occurring species included Berry Saltbush (*Einadia hastata*), Creeping Saltbush (*Atriplex semibaccata*), and *Goodenia hederacea subsp. hederacea*. Other common species included; *Xanthorrhoea minor*, Whiteroot (*Pratia purpurascens*) and Paroo Lily (*Dianella caerulea*). Bridal Creeper (*Asparagus asparagoides**) is a scrambling plant that is common throughout the Park's bushland.

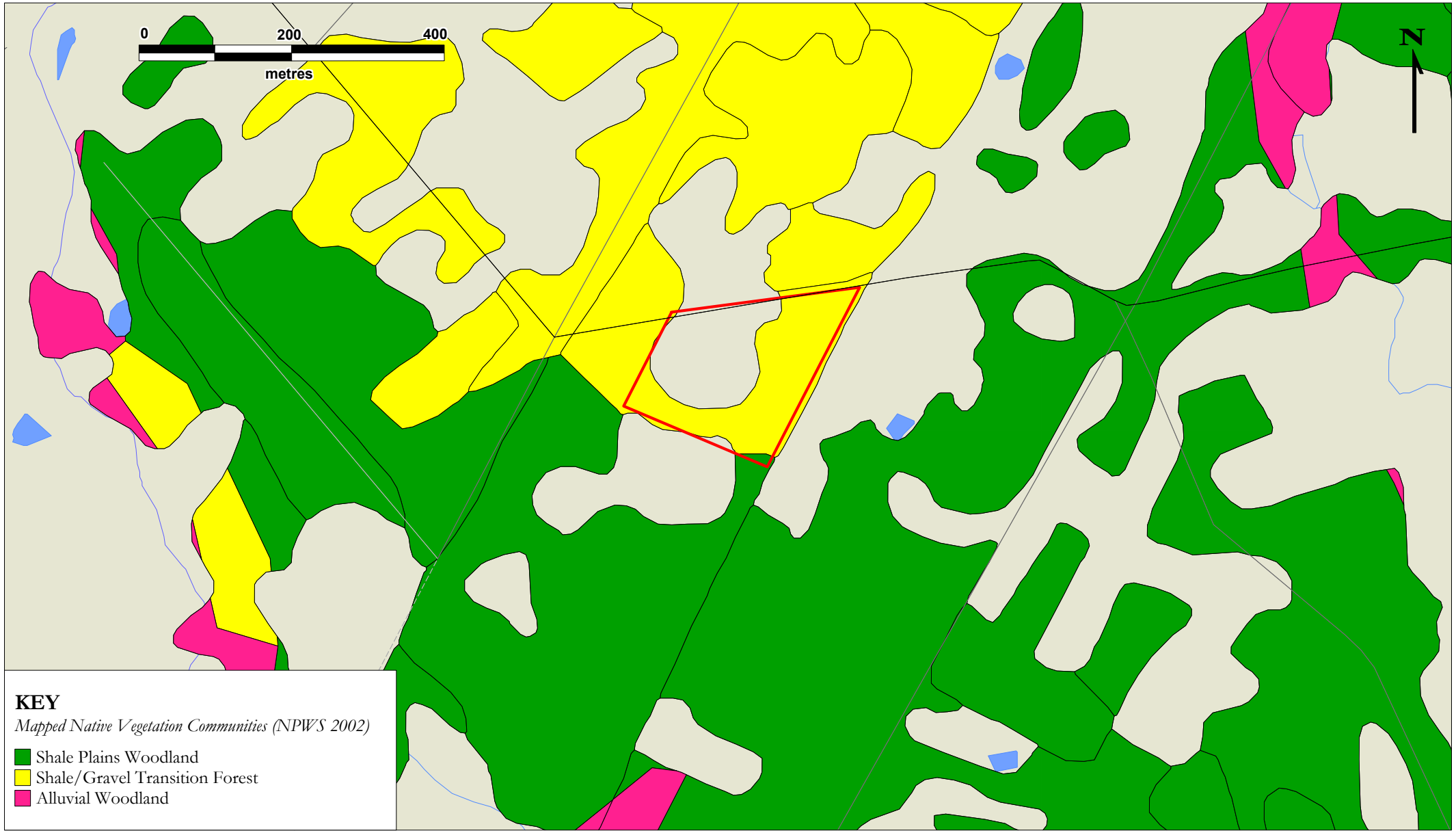


**Figure 5.1**
**Mapped Native Vegetation Communities (NPWS 2002)**

URBAN BUSHLAND
MANAGEMENT CONSULTANTS PTY LTD

*U:\UBMC\Consultancy\Oakville Park Oakville\Mapping\NPWS Mapping (2002).WOR*

### 5.1.2 Indigenous Flora Species

A list of plant species recorded within the Oakville Park Bushland is provided in Appendix 2, along with an indication of their relative abundance within the subject land. This is not intended to be a comprehensive list of all species present within the study area, and represents only those species that were recorded while undertaking targeted searches for native species of National or State conservation significance known for, or expected to occur, in the Region.

Three (3) threatened plant species were found in the Park's bushland. These were Downy Wattle (*Acacia pubescens*), *Pultenaea parviflora* and *Dillwynia tenufolia*.

*Acacia pubescens* was found in two (2) clustered locations (Figure 5.2). One group of approximately 55 individuals was located in the north-eastern corner near Oakville Road, and a second smaller clump of approximately five (5) individuals was found in the far south-western corner[3] (see Figure 5.2). This species is listed as 'vulnerable' under the *TSC Act* and the *EPBC Act* (Species Profile is provided in Appendix 1.

*Dillwynia tenuifolia* occurs widely throughout of the subject land (see Figure 5.2 for distribution). *Dillwynia tenuifolia* is listed as 'vulnerable' under the *TSC Act* and the *EPBC Act* (Final Determination is provided in Appendix 1). It is estimated that approximately 80 individuals are present within the subject land[4].

*Pultenaea parviflora* occurs in similar areas to *Dillwynia tenufolia*, although to a lesser extent throughout the subject land. Approximately 30 individuals were recorded within the subject land[5] This species is listed as 'endangered' under the *TSC Act* and as 'vulnerable' under the *EPBC Act* (Species Profile is provided in Appendix 1).

No other flora species of National or State conservation significance listed as a ROTAP (Rare or Threatened Australian Plant, Briggs and Leigh 1996), or listed on the Schedules of the *EPBC Act* or *TSC Act* were located during the field survey.

Table 5.1 lists the native species recorded in the Park's bushland which are considered to be 'inadequately represented' in conservation reserves in Western Sydney, and are therefore of regional conservation significance (NPWS 1997).

[3] This count is expected to be an underestimate of the true population size due to the reasons outlined in Section 4.3.

[4] This count is expected to be an underestimate of the true population size due to the reasons outlined in Section 4.3.

[5] This count is expected to be an underestimate of the true population size due to the reasons outlined in Section 4.3.


**Figure 5.2**
**Native Vegetation Communities and Location of Threatened Plants**

**URBAN BUSHLAND**
**MANAGEMENT CONSULTANTS PTY LTD**

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**Table 5.1: Regional Significance of Flora Species within the Subject Land (NPWS 1997)**

**KEY:**

**REG** = regionally significant

**C** = population reserved

**V1** = All regionally significant taxa and/or rare (5 or less records) taxa; **V2**= Vulnerable taxa which are uncommon (6-10 records); **V3** = Common to widespread taxa (>10 records). (NPWS 1997)

| SCIENTIFIC NAME | SIGNIFICANCE |
|---|---|
| *Acacia pubescens* | REGV1 |
| *Amyema gaudichaudii* | V3 |
| *Atriplex semibaccata* | V3 |
| *Bothriochloa macra* | V3 |
| *Carex inversa* | V3 |
| *Dillwynia tenufolia* | C |
| *Pterostylis rufa* | V1 |
| *Pultenaea parviflora* | C REG |
| *Oxalis perennans* | V3 |

### 5.1.3 Introduced/Exotic Flora Species

The following four (4) species listed as 'noxious plants' in the Hawkesbury River Local Control Area were recorded within the subject land:

- Bridal Creeper (*Asparagus asparagoides*);
- Prickly Pear (*Opuntia* sp);
- Mother of Millions (*Bryophyllum delagoense*); and
- Lantana (*Lantana camara*)

Of these, Bridal Creeper – a scrambling ground cover with a large underground corm - is the most widespread. The required actions for noxious weed control are outlined in Appendix 5. Noxious weed control is the responsibility of the landowner, here, Hawkesbury City Council (*Noxious Weeds Amendment Act 2005).*

Hawkesbury is one of four (4) constituent councils forming the Hawkesbury River County Council ('**HRCC**'), a single-purpose council responsible for undertaking noxious weed control on public lands. HRCC is funded in part by the NSW Department of Primary Industry and in part by its constituent councils. As such, HRCC is responsible for undertaking noxious weed control on public land within the LGA, including the Oakville Park Bushland.

In addition to the noxious weeds listed above, there are a number of environmental weeds present: the dominant species being African Lovegrass (*Eragrostis curvula*) – a pasture species originally introduced into the Hawkesbury for stock grazing purposes - Wandering Jew (*Tradescantia fluminensis*) - a succulent ground cover - and a number of other ornamental succulents have spread in bushland as the result of dumping of garden waste. The noxious woody weed Lantana (*Lantana camara*) was noted to be present in significant numbers on adjacent land, but only a few plants were observed in the Park's bushland.

A full list of noxious and environmental weeds has been presented as Table 7.1 (Section 7). Weed invasion as a management issue is discussed in Section 6.4 of the VMP, with weed ecology and weed control methods outlined in Sections 7.5 and 7.7 respectively.

## 5.2 CONDITION OF BUSHLAND

Figure 5.4 and accompanying Table 5.2 provide an indication of the general condition (or health) of the bushland by identifying areas of significant weed infestation.

This Table provides the results of the weed polygons surveyed in Management Zones 1, 2 and 3 (Zone 4 being a cleared car parking area). A number of weed polygons were surveyed in each Management Zone. Weed species present, abundance and a 'weed code' (see Section 3.6.3 Methods) are provided in this Table.

With the exception of African Love Grass and Bridal Creeper, which are widespread in the understorey throughout the Park's bushland - most weed infestations occur on edge sites, particularly at the interface between bushland and adjoining open areas.

Dumping of unwanted materials (garden waste, builder's rubble and construction refuse) in bushland along the illegal vehicle tracks, in clearings and around the car park creates a significant weed problem for the bushland and impacts negatively on local landscape values. Sites along these vehicle tracks and at the northern end of the bushland close to Oakville Road had higher weed densities recorded than those for the core bushland to the south.

**Note** the condition of bushland map (Figure 5.4) does not provide an indication of floristic diversity or structural integrity for the bushland, as it only illustrates the cover abundance of introduced (or weed) species occurring within the bushland.


**Fig 5.4**
**Condition of Bushland Map**

**URBAN BUSHLAND**
**MANAGEMENT CONSULTANTS PTY LTD**

*U:\UBMC\Consultancy\Oakville Park Oakville\Mapping\Weed Map.WOR*

**Table 5.2: Weed Species, Abundance and ID Code**

| Polygon Map ID | 1 | | 2 | | 3 | | 4 | |
|---|---|---|---|---|---|---|---|---|
| Management Zone | Zone 3 | | Zone 2 | | Zone 3 | | Zone 2 | |
| Area (sq m) | 179 | | 943 | | 25 | | 651 | |
| Ku-ring-gai Code | (1.1.3)2 | | (1.1.4)2 | | (1.1.3)2 | | (1.1.2)1 | |
| WEEDS | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) |
| | African Love Grass | 50 | African Love Grass | 100 | African Love Grass | 50 | Bridal Creeper | 10 |
| | | | Verbena | <10 | Bridal Creeper | <10 | | |
| | | | Cobblers Pegs | <10 | | | | |

| Polygon Map ID | 5 | | 6 | | 7 | | 8 | |
|---|---|---|---|---|---|---|---|---|
| Management Zone | Zone 2 | | Zone 2 | | Zone 2 | | Zone 2 | |
| Area (sq m) | 95 | | 487 | | 184 | | 135 | |
| Ku-ring-gai Code | (1.1.4)2 | | (1.1.3)2 | | (1.1.4)2 | | (1.1.4)2 | |
| WEEDS | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) |
| | African Love Grass | 100 | Paspalum | <10 | African Love Grass | 100 | Bridal Creeper | 40 |
| | Cobblers Pegs | <10 | Fireweed | <10 | | | Blackberry Nightshade | <10 |
| | | | Kikuyu | 20 | | | Morning Glory | <10 |
| | | | Blackberry Nightshade | <10 | | | Cobblers Pegs | <10 |
| | | | Bridal Creeper | 20 | | | Silky Oak | <10 |
| | | | Cobblers Pegs | <10 | | | | |

| Polygon Map ID | 9 | | 10 | | 11 | | 12 | |
|---|---|---|---|---|---|---|---|---|
| Management Zone | Zone 3 | | Zone 2 | | Zone 3 | | Zone 3 | |
| Area (sq m) | 22 | | 477 | | 14 | | 236 | |
| Ku-ring-gai Code | (1.1.1)1 | | (1.1.4)2 | | (1.1.1)1 | | (1.1.4)2 | |
| WEEDS | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) |
| | Prickly Pear | <10 | Bridal Creeper | 70 | Geranium | 1 individual | African Love Grass | 80 |
| | | | Moth Vine | <10 | Century Plant | 1 individual | | |

| Polygon Map ID | 13 | | 14 | | 15 | | 16 | |
|---|---|---|---|---|---|---|---|---|
| Management Zone | Zone 2 | | Zone 2 | | Zone 3 | | Zone 1 | |
| Area (sq m) | 106 | | 325 | | 16 | | 574 | |
| Ku-ring-gai Code | (1.1.4)2 | | (1.1.4)2 | | (1.1.2)1 | | (1.1.4)2 | |
| WEEDS | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) |
| | Pride of London | 20 | Wandering Jew | 95 | Aloe | 10 individuals | Pride of London | 20 |
| | Wandering Jew | 20 | | | | | Bridal Creeper | 30 |
| | Spanish Bayonet | 5 individuals | | | | | Aloe | 20 |
| | Bridal Creeper | <10 | | | | | Wandering Jew | 40 |
| | African Love Grass | 20 | | | | | Paddys Lucerne | <10 |
| | | | | | | | Silky Oak | <10 |

| Polygon Map ID | 17 | | 18 | | 19 | | 20 | |
|---|---|---|---|---|---|---|---|---|
| Management Zone | Zone 1 | | Zone 1 | | Zone 1 | | Zone 1 | |
| Area (sq m) | 88 | | 470 | | 1497 | | 810 | |
| Ku-ring-gai Code | (1.1.4)2 | | (1.1.4)2 | | (1.3.4)2 | | (1.1.4)2 | |
| WEEDS | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) | Weeds | Cover Abundance (%) |
| | African Love Grass | 100 | Aloe | 80 | Tree Aloe | 20 | African Love Grass | 100 |
| | Silky Oak | <10 | Bridal Creeper | <10 | Sedum sp. | 20 | Tree Aloe | 20 |
| | | | Passionfruit | 20 | Mother Of Millions | 20 | | |
| | | | | | Bridal Creeper | 20 | | |
| | | | | | Silky Oak | 20 | | |
| | | | | | Century Plant | 1 individual | | |
| | | | | | Madeira Vine | <10 | | |

**Note: Weed code as per Ku-ring-gai Method (see Section 3.6.3 Methods and Appendix 6)**

## 5.3 FAUNA

### 5.3.1 Fauna Species

The fauna survey conducted on the 16th May 2007 identified 18 diurnal bird species, two (2) species of reptile, and one (1) introduced mammal (results presented in Appendix 4).

All the bird species and reptiles observed during the survey are listed as "protected" by the NSW *National Parks and Wildlife Act* (1974). However, no species observed during the current survey are listed as 'threatened' under the Schedules of the NSW *TSC Act* or the Commonwealth *EPBC Act.*

The targeted search for the Cumberland Plain Land Snail (*Meridolum corneovirens)* involved overturning and searching among logs, debris-heaps, and among thick leaf litter at the bases of trees across the site intermittently during the survey period. No live individuals or shells were found in the four (4)-hour field survey.

### 5.3.2 Habitat Types

The field survey (May 2007) identified the primary habitat type present as Eucalypt Woodland, with some highly disturbed edge sites, and some areas of (managed) grassland. A map showing the different habitat types present in the Oakville Park Bushland has been included as Figure 5.5.

The Eucalypt Woodland comprises a discontinuous canopy of mature native trees, with a moderate to sparse native shrub stratum, and with varying densities of ground cover and varying amounts of leaf and debris litter present. There are no aquatic habitats on the subject land.

Eucalypt Woodland

The Eucalypt Woodland occurs as a continuous stand of vegetation along the eastern and southern boundaries of the subject land. Through reference to aerial photography, it was noted that the Eucalypt Woodland also extends west, beyond the limits of the subject land, but also that this Woodland is significantly fragmented and occurs mainly as disjunct stands retained on nearby rural properties and/or as roadside vegetation.

The tree canopy is between 15 and 18 metres in height, with the canopy being of medium density. The understorey or shrub stratum is between five (5) and eight (8)-metres in height and of medium density. The canopy and sub-canopy consists of mature and semi-mature Eucalypts and Black She-oak (*Casuarina littoralis*). Groundcovers are a mixture of introduced and native grasses, flowering forbs and small shrubs, these being of a moderate to low density, and 0.5 to one (1)-metre in height.

Ground debris, leaf litter and fallen logs are present. Where the bushland approaches the oval and the Park boundaries, swards of exotic grasses form the dominant ground cover.

The Eucalypt Woodland that occur within, and beyond the limits of the subject land at Oakville Park is considered to be important mainly for the local and regional occurrence of small bird species such as Honeyeaters (*Lichenostomus spp*) and Gerygone (*Gerygone spp*). Within this Woodland habitat, resources such as nesting, roosting and foraging sites are present, these being important for the life cycle requirements of these native species.

The dominant tree species in the Eucalypt Woodland was the Broad-leaved Ironbark (*Eucalyptus fibrosa*) which does not usually produce hollows suitable for the nesting or shelter of hollow dependent birds and mammals. Some gum trees (*Eucalyptus parramattensis* and *Angophora bakeri*) occur in the southern corner of the subject property and in adjoining properties which are more likely to have significant hollows. No significant hollows were recorded in these trees, although microbat species could utilise cracks in these trees and in the larger Ironbarks.

### 5.3.3 Wildlife Corridors

Based on a review of topographic maps and aerial photography, combined with a visual assessment undertaken at the time of the field investigation, it is noted that Oakville Park contains an area of bushland that creates a natural corridor for movement of wildlife within the site itself, but that the surrounding area of fragmented lands, semi-rural properties and new and existing urban development does not provide any significant vegetated corridors for fauna movement.

The closest area of significant undisturbed bushland is found in Scheyville National Park, which lies two (2)-km to the north-east, however no primary vegetated corridors exist between the subject land at Oakville and the National Park. While the Killarney Chain of Ponds lies only one (1)-km to the north, these waterbodies lack sufficient riparian vegetation to provide much in the way of corridor value.

Oakville Park is bounded to the north by Oakville Road, and while the adjoining properties to the south, west and east retain similar stands of Woodland, these only extend about 800 metres in any direction before the vegetation changes to managed grassland (paddock), or there are significant artificial barriers encountered, such as suburban development and/or main roads.

The only native fauna expected to be traversing the bushland in Oakville Park (other than arboreal species like birds and possums[6]) are those that are adapted to negotiating open spaces and urban infrastructure such as main and suburban roads – i.e. they are commonly occurring urban-tolerant species.

However, the bushland at Oakville Park and environs does provide some connectivity value to those birds with large ranges which regularly traverse the area; species such as the Brown Falcon (*Falco berigora),* and for local populations of smaller birds utilising the dense shrub layer for shelter and for seasonal foraging.

See Figure 5.5 for areas of fauna habitat mapped at Oakville Park and fauna transects covered in the survey.

[6] Although it is noted that now possums were recorded during nocturnal spot lighting sessions.

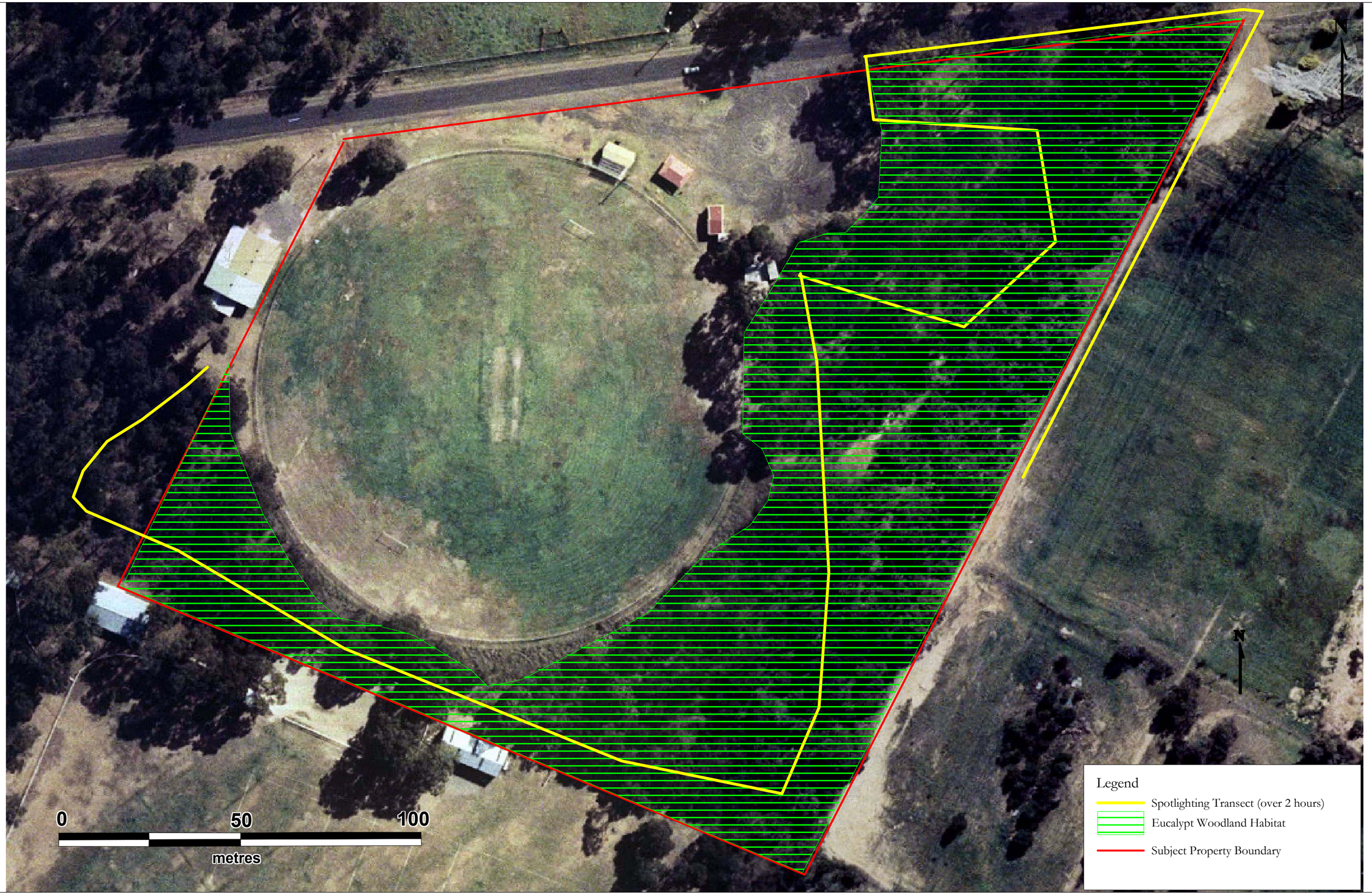


**Fig 5.5**
**Fauna Habitat and Survey Transect Location**

URBAN BUSHLAND
MANAGEMENT CONSULTANTS PTY LTD

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# 6 MANAGEMENT ISSUES & RECOMMENDATIONS

## 6.1 REQUIREMENTS OF THE THREATENED SPECIES LEGISLATION

Oakville Park supports an important remnant[7] of Shale-Gravel Transition Forest (**'SGTF'**) – an ecological community listed as 'threatened' under the Schedules of the NSW *TSC Act*. As an Endangered Ecological Community (**'EEC'**), SGTF has high conservation value at local, regional and State levels of significance.

In addition, a number of threatened flora species are known to occur in the locality and Region. In the Oakville Park Bushland threatened flora species are Downy Wattle (*Acacia pubescens*), *Dillwynia tenuifolia*, *Pultenaea parviflora* (see Table 5.1).

Approximately 80 individuals of *Dillwynia tenuifolia,* approximately 70 individuals of *Acacia pubescens*, and approximately 30 individuals of *Pultenaea parviflora*, were recorded within the subject property. A number of regionally significant flora species also occur.

Management objectives for the Oakville Park Bushland include:

i) The development of proactive land management policies for the remnant Shale-Gravel Transition Forest ecological community within the subject land; and

ii) The establishment of practical and cost effect management strategies to assist in the conservation, regeneration and/or restoration of remnant native bushland (see Section 2.4).

Under the terms of the current environmental legislation, local government must assess the impacts of any activity proposed which might adversely impact on any threatened ecological communities, species or populations, and where these are likely to occur it must identify strategies to minimise such impacts. Unless carefully managed, even routine management activities such as grass mowing, weed control, bushfire hazard reduction, planting or infrastructure works, could have a detrimental effect on the conservation of these items.

In addition, development on adjoining land may also have a significant impact on the bushland's natural values, so that such activities must be carefully assessed by Council prior to development consent being granted.

Previously, under the terms of the *TSC Act*, the NPWS Division of DECC was required to prepare Recovery Plans for species, populations and endangered ecological communities within five (5) years of gazettal of the Final Determination. These Plans were designed to assist consent and determining authorities in the assessment of impacts on these entities, and for members of the public interested in becoming involved in conservation activities.

In 2004, reforms the *TSC Act* were made to better integrate threatened species management with land use planning, and improve the development assessment process. As part of the reform, the Threatened Species Priorities Action Statement ('**PAS**') was introduced. The PAS is currently in draft form, and can be viewed at www.threatenedspecies.environment.nsw.gov.au.

[7] Remant in this context, referring to a regrowth form of the original native vegetation community.

The PAS lists priority actions for threatened ecological communities, populations and species that should be considered when determining appropriate management activities for the subject land.

The PAS for SGTF includes implementing the *Cumberland Plain Reservation Strategy*, which endeavours to create a protected bushland network through targeted land acquisition as land becomes available, and by encouraging best practice management of EECs on private land. The PAS also stresses the importance of undertaking noxious weed and pest control programs in the EECs remaining on the Cumberland Plan, and of managing to best practice standards, areas of EECs which have conservation as a primary objective, or where conservation is compatible.

It is worth noting that the PAS also requires the management of EECs to be included in the conditions for Crown Land trusts, leases and licence holders.

All of the above-listed priority actions are relevant to the management of the remnant native bushland at Oakville Park.

**Recommendations:**

1. Take active measures to reduce impacts currently degrading the Oakville Park Bushland, specifically the exclusion of unauthorised vehicles, consolidation of fragmented bushland, removal of dumped rubbish and other material, and targeted weed control.
2. Design and implement weed control and other management strategies which take the presence of all significant species, populations and ecological communities into account, and avoid unnecessary damage to habitat.
3. Prior to undertaking weed clearance (whether hand clearing, machine clearing or herbicide application) in areas known to support threatened species or populations, a targeted search should be carried out, plant locations identified using a GPS, plants tagged (albeit temporarily) and protective measures set in place[8].
4. Threatened species' locations are to be marked on a scaled site map, and this map should be updated as required. All personnel undertaking on-grounds works are to be inducted to the site and provided with relevant information (species descriptions, location maps). It will be the responsibility of the contractors (though Council) undertaking works on the site to ensure that all personnel are fully informed.
5. Where unavoidable damage is likely to occur, contractors are to consult with Council's Manager, Land Management. Any work likely to result in damage to threatened species, populations or their habitats must not be undertaken without written permission from Council.
6. Where such unavoidable damage does occur, an approved restoration strategy must be set in place, and this strategy implemented at the earliest possible time.
7. Bush regeneration strategies must also consider the need to maintain (or create) suitable habitat for those native flora and fauna species know to occur within the Park's bushland. Where the (unchecked) growth of thicket-forming shrubs as *Bursaria spinosa* and *Melaleuca nodosa* which can displace understorey species (for example) threaten the integrity of such habitats, culling should be used to restore suitable site conditions (see Section 6.2).

[8] Mapping of the two (2) threatened Fabaceae *Dillwynia tenuifolia* and *Pultenaea parviflora* should be undertaken during the flowering season (usually in early spring) to increase accuracy of identification.

## 6.2 MANAGING FOR SIGNIFICANT FLORA SPECIES

Management objectives for the Oakville Park Bushland (see Section 2.4) include:

i) The management of the bushland regeneration process to ensure the retention of suitable habitat for those threatened and/or significant species present in the subject land.

Table 5.1 lists nine (9) species recorded within the subject land that are considered to be inadequately reserved in reserves in Western Sydney, and therefore are of regional conservation significance (NPWS 1997).

Of these, three (3) species are listed as 'threatened' under the Schedules of the NSW *TSC Act* and Commonwealth *EPBC Act*. These species are:

- *Dillwynia tenuifolia*
- *Acacia pubescens*
- *Pultenaea parviflora*

A short description of these significant flora species and their preferred habitat conditions follows.

*Dillwynia tenuifolia* is a small spreading shrub 40-100 cm high, and is uncommon in the area. It is found in the Castlereagh Woodlands, and on shale soils on the Cumberland Plain west of Sydney (Robinson 1991). In common with other significant species listed (Table 5.1), *Dillwynia tenuifolia* appears to favour open woodlands with a moderate amount of filtered sunlight. It is therefore imperative that unchecked regeneration of thicket forming shrubs (such as *Melaleuca decora* or *Bursaria spinosa*) is not allowed to 'swamp' or displace this significant species.

*Acacia pubescens* is a bushy or weeping shrub 1-3 metres high. It has a restricted distribution, being found only in a few locations in Inner Western Sydney (Robinson, 1991) *Acacia pubescens* prefers full sun, and is found mainly on gravely clay soils on Wianamatta Shale (Benson, 1996). Similarly to *Dillwynia tenuifolia*, it is important to manage the growth of *Melaleuca decora* surrounding the *Acacia pubescens* populations to enable sufficient light penetration. The high density of weeds surrounding one (1) recorded cluster of this species (north-eastern corner, on the roadside), should also be controlled to ensure that the weeds do not outcompete emerging individuals. Further, it would be beneficial to erect bollards on the road edge near this specific group of individuals to protect them from being damaged by vehicular incursion.

*Pultenaea parviflora* is a small shrub growing to about one (1) metre. It is found mainly from Penrith to Windsor, as well occurring in the Castlereagh Woodlands on predominantly clay soils (Robinson, 1991, Benson, 1996). This species prefers full sun to light shade environments, and should be managed in a similar fashion to *Acacia pubescens* and *Dillwynia tenuifolia*, i.e. ensure that open conditions and adequate light levels are maintained.

Figure 5.3 provides the locations of the three (3) significant flora species mapped in the subject land at Oakville Park (as determined by GPS).

**Recommendations:**

1. Undertake a targeted weed control program, with the primary aim of restoring suitable habitat in the understorey (i.e. small shrub and ground cover strata) for the listed flora species. In particular, removing the dense cover of African Love Grass and infestations of Bridal Creeper and Wandering Jew will allow for a significant improvement.
2. Where natural regeneration of native early successional shrubs such as *Bursaria spinosa* or *Melaleuca nodosa* threaten the survival of *Dillwynia tenuifolia* and other significant threatened species which require high to moderate light levels, undertake selective culling of these

shrubs to maintain the open habitat favoured by these species. Monitor shrub regrowth and remove unwanted seedlings as required.

3. Refrain from planting anything other than ground covers or low shrubs (e.g. < 1m) in the habitat of light-demanding flora species such as *Dillwynia tenuifolia, Acacia pubescens and Pultenaea parviflora.*
4. Actively manage native plant regeneration to maintain a *diversity of habitats* within the subject land, e.g. woodland, bordering and/or internal areas of open grassland to provide refuge sites, drainage lines and swales. In other words, manage the bushland restoration process to achieve the specified set of goals or objectives (as set out in Section 2.4).
5. Consider the installation of bollards (or another form of barrier) along the north-eastern section of Oakville Road where it abuts the stand of *Acacia pubescens* to provide additional security (particularly from vehicles) (see figure 6.2).
6. Given Council's obligation to manage all bushland reserves for their conservation and for their biodiversity values, consider the (limited) reintroduction of fire as a management tool to control weed grasses and unwanted shrubs, and to stimulate the natural regeneration of native grasses and ground covers.
7. Any Bushfire Hazard Reduction Plan prepared for the Park's bushland must identify the known or expected fire response of those threatened and significant flora species occurring, and design the fire regime accordingly.

## 6.3 MANAGING TO PROTECT BUSHLAND VALUES

### 6.3.1 Unauthorised Vehicular Access

The single-most damaging impact on the Oakville Park Bushland has been the unchecked incursion of vehicles, resulting in damage to vegetation and facilitating dumping and other acts of vandalism. Vehicular access is available from the gravel car park, from Oakville Road at a number of locations and by driving through the Scout Hall property. However, the eastern bushland has been most severely impacted with several main tracks traversing the core bushland (see Figure 6.2) as well as minor tracks and clearings created.

### 6.3.2 Tracking and Fragmentation

The creation of vehicular tracks, foot tracks and clearings has fragmented the core bushland, creating a large number of 'edge sites', which are susceptible to the drying effects of wind and sun and to weed invasion. The result is a series of bush 'islands', surrounded by heavily compacted soil on tracks and clearings, which in turn are subject to surface soil wash and erosion of topsoil.

### 6.3.3 Dumping, Vandalism and Inappropriate Activities

There is a very high incidence of dumping in the Park's bushland (much of it fairly recent), including construction materials, electrical cabling, plastic and timber, and (on the western boundary) horse manure and stable compost. This is perhaps because the core bushland in unsecured and is out of sight, having no immediate neighbours.

It would also appear that bushland near the toilet block is being used by a vagrant, with large amounts of rubbish strewn about the tent, and clothes and blankets hung on the boundary fence. Other inappropriate activities noted included tree felling and clearing for campfires (also showing evidence of illegal substance usage), the construction of trail bike jumps, and as previously mentioned, disposal of rubbish and builder's rubble (see Plates).

**Recommendations:**

1) Vehicular access should be blocked as a matter of priority. This will require construction of secure timber or metal barriers around the car park (see figure 6.2). The existing low earthen bund around the car park does nothing to discourage vehicles.
2) Prior to any bush regeneration program being undertaken, accumulated rubbish and other debris must be removed. This will require the use of small trucks (anticipated that at least 10 truck loads will be required) and a front end loader (or similar).
3) While machinery is being used to remove rubbish/debris, it is recommended that unwanted tracks and clearings be ripped to break up the heavily compacted soil and encourage natural regeneration (see Section 6.7).
4) Council is to investigate the illegal use of the Park by vagrants, and at the very least require the occupant(s) of the tent to remove all the accumulated rubbish strewn around the site.
5) Signage should be erected at the car park and Scout Hall prohibiting dumping but more importantly, providing an 'after-hours' emergency telephone number to allow Park users to report illegal activities to the appropriate duty officer at Council.
6) All local residents, neighbours (Pony Club) and Park users should be made aware of this emergency telephone number. The community is entitled to expect a rapid response after the emergency number is called, so if Council's procedures are changed, signage should be altered and residents informed.
7) Dumping will always be a problem, with some people refusing to co-operate. Signage will do little to change this attitude, so that where offenders can be identified (for example by searching through the debris or sighting are made), Council should immediately issue a 'notice' to the offender to remove the debris and an 'on the spot' fine should be imposed.
8) Illegal use of the Park's bushland by 4 X Drive vehicles and trucks, trail bike riders or horse riders should be policed with spot checks (but carried out consistently) by a Park Ranger, especially on weekends and during school holiday. The authors appreciate the difficulty of organising such out of hours supervision, but if inspections are restricted to office hours, there is little chance that offenders will be apprehended.
9) Damage to signage, fencing, edging or other Park infrastructure to be reported to Council immediately and, if contact cannot be made, a report made to the local Police Station.

## 6.4 MANAGING WEED INVASION

Of a total of 99 flora species recorded, 34 species (34%) are introduced (horticultural) species or weeds. Of these, four (4) species are woody weeds (or introduced natives), four (7) are vines or scramblers, and the remainder (23) are herbaceous species (grasses and flowering forbs (see Appendix 2).

As the Oakville district formed part of a large grazing lease (Pitt Town Common) for many years, pasture grasses and agricultural weeds are well represented, with African Love Grass (*Eragrostis curvula*) being the dominant herb form. Other agricultural introductions include Paspalum (*Paspalum dilatatum*), Pigeon Grass (*Setaria? gracilis*), Spear Thistle (*Circium vulgare*), Paddys lucerne (*Sida rhombifolia)* and Fireweed (*Senecio madagascariensis*).

There are few woody weeds in the bushland with the exception of a few Lantana bushes (invading from adjoining vacant land) and some Privets (*Ligustrum* spp) – the latter being found mainly in the degraded eastern sector of the Park (near the transmission lines). Weeds in the understorey include Bridal Creeper (*Asparagus asparagoides)* and succulents such as *Agave attenuata,* Mother of Millions (*Bryophyllum delagoense*) and Wandering Jew (*Tradescantia fluminensis*).

Four (4) species occurring are listed as 'noxious plants' for the Hawkesbury River County Council Control Area. However, no *significant* occurrences of Weeds of National Significance ('**WONS**') were recorded during recent field surveys.

Recommendations for targeted weed control have been made in Appendix 7. Target weeds are identified as those species declared as noxious plants in the Hawkesbury River Local Control Area, as well as keystone environmental weeds (see Sections 7.5.2 & 7.5.3).

The condition of the core bushland within the subject land is described as 'good' overall, except where there are infestations of African Love Grass, Bridal Creeper or Aloe spp – where the condition is described as 'Fair'. The condition of bushland is considered to be 'Fair' along the boundary of the oval and 'Poor in the north-eastern corner of the Park (see Figure 5.4).

**Recommendations:**

1. Consult with the local community during the public exhibition process in order to clearly explain the reasons for the recommendations made in the VMP and to gain support for the proposed bush regeneration/rehabilitation program. This process will be important as fencing or barriers are proposed to exclude unauthorised access to the bushland, which may offend some local residents.
2. Undertake a Bush Regeneration program, undertaking targeted weed control over all sites (as per priorities in Section 8.3).
3. Prioritise areas/management zones for targeted weed control. Consider first, the need to gain community support by working in high profile public areas (e.g. around the car park) and along boundaries; then focus efforts on the reinstatement of habitat for significant species[9] such as *Dillwynia tenuifolia*, *Pultenaea parviflora* and *Acacia pubescens*.
4. As a priority eradicate the limited infestations of woody weeds (mainly in the eastern bushland) and apply appropriate control methods to substantially reduce the keystone weeds (see Appendix 7), while at the same time considering the need to protect habitat for threatened species and maintain biodiversity.
5. Council is asked to urgently address significant impacts (e.g. vehicular incursion, rubbish dumping, disposal of rubble and construction material etc) which encourages weed growth and devalues landscape amenity.
6. Continue to maintain the grassed buffer between the oval fence and the bushland, but ensure that grass clippings are taken off-site, not disposed of in the bushland (as would seem to be the current practice).
7. Where this can be done without damaging threatened shrubs such as *Dillwynia tenuifolia* and *Pultenaea parviflora* (see Figure 5.2), establish a regular slashing routine to control African Love Grass (*Eragrostis curvula*) and other free seeding herbs (e.g. Fleabanes *Conyza* spp, Cobbler's Pegs *Bidens pilosa*) at the bushland/grass buffer and on track edges.
8. Slashing on track edges should be undertaken using a hand-held whipper snipper (not a machine-mounted slasher) and should be carried out monthly from late spring to mid-autumn, when this grass is seeding freely.
9. Control of African Love Grass in core bushland is best carried out by hand (removing seed and digging out tussocks) to avoid damaging the native understorey, but an alternative and

[9] It is possible that other herbaceous species such as orchids are also present in the Park's bushland; however becuase the survey was undertaken in late autumn, no such species were recorded.

cost-effective approach would be to apply a grass-selective herbicide such as Fusilade as a foliar spray. Fusilade should not be used where native grasses are growing amongst the weed grass, and the need for regular maintenance to control new seedlings is emphasised.

## 6.5 MANAGING FOR FAUNA HABITAT

### 6.5.1 Woodland Areas

Canopy

It is recommended that large trees be protected as important refuge for native fauna. Potential hollows or cracks in Ironbark spp within the canopy stratum are an important resource for microchiropterans bats and bird species.

*Note* that it is important to maintain and promote a range of age classes and structural diversity within the bushland in order to cater for a range of native fauna species.

Shrub Layer

The shrub layer of the Eucalypt Woodland is described as moderate, and was noted to be in competition with a variety of understorey weeds species – especially from aggressive tussock grasses such as African Love Grass, which would serve to reduce the survival rate of new shrub seedlings. The bushland is dissected by informal tracks that create 'islands' and disrupt the continuity of the shrub layer. It is recommended that strategies be adopted to allow the shrub layer to regenerate, and that the typical Eucalypt Woodland structure be reinstated.

It is also suggested that some small open grassland areas be promoted on edge site and (where possible) created internally (i.e. maintained as grassland and not planted out with shrubs), thus providing any of the smaller bird species migrating into the Park bushland with some refuge sites while foraging. Internal spaces are important for ground-feeding birds as they create 'patchiness', which enhances habitat niches.

Ground Cover

The Cumberland Plain Land Snail (*Meridolum corneovirens*) has been recorded within a 10-km radius of the subject land. The Snail is known to shelter under leaf litter, rocks, logs and debris. Therefore, excessive removal of leaf litter fallen branches, logs and rocks should be avoided, except where litter build up constitutes a fire hazard.

While no live individuals or shells where found during the targeted search, it was noted that the debris was considered to constitute suitable habitat for the Cumberland Land Snail but it was also noted that the subject land at Oakville occurs on the edge of the Snail's natural range[10].

In general, small fallen timbers and leaf litter should be maintained while bushland rehabilitation works are conducted. The use of fire as a management tool (if such is adopted) should be carried out in a mosaic fashion so that not all areas of the bushland are affected at any one time.

It is important to maintain structural diversity in the ground cover stratum (principally native grasses and forbs), and when enrichment planting is indicated, to create dense clumps or islands to provide shelter/protection for ground-dwelling fauna.

[10] It is possible that the Cumberland Land Snail does occur within the Oakville Park bushland, but current drought conditions may have reduced numbers and/or suitable habitat for the species has not been maintained.

Structural diversity within the understorey stratum should be encouraged, and this should include the retention of leaf litter and fallen branches. Household garbage and other rubbish should, however be removed as plastic and ring-pulls from drink cans are harmful to native fauna if ingested.

**Recommendations:**

1. At present the woodland provides mainly for canopy and shrub dwelling bird species. The prescribed regeneration of the natural shrub layer of the Eucalypt Woodland will be important in increasing bird species diversity and colonisation of other fauna species.
2. In core bushland, while considering the need to keep appropriate habitat for *Dillwynia tenuifolia* and the other threatened shrubs, maintain some shrub thickets for fauna habitat, but create large to medium discrete blocks, preferably in a circular or oval shape; avoiding long narrow thickets with a small core to edge ratio.
3. Ensure that a diversity of fauna habitats is maintained (or created) throughout the Bushland, and that appropriate management practices are integrated into bush regeneration and other management processes.
4. If planting native species in the bushland area, introduce nectar producing species to benefit present and potential use of protected and threatened honey eating bird species.
5. Wherever possible, and where this does not constitute a fire hazard or interfere with the walking track network, maintain some areas of uncut / 'untidy' native grass to provide foraging opportunities for birds and small reptiles.
6. Retain (or create) specialised fauna habitat sites e.g. retain fallen logs, habitat trees, while recognising the need to manage for public safety and bushfire hazard.
7. The control of rabbits can include fencing and ripping program undertaken in areas where degradation of the vegetation or soil structure has occurred. Ripping of warrens can be undertaken if the warren is accessible and the bushland vegetation will not be harmed by the required equipment. Most warrens were observed along the southern boundary where the rabbits are using the interface between the bushland and the pony club for foraging and protection. Fencing the southern boundary with chicken wire to the ground, similar to the eastern fence line, is recommended to deter easy access to the bushland from the foraging on the pony club fields. While rabbits cannot be excluded the damage to the bushland can be lessened.

## 6.6 MANAGING INTERFACE ZONES & BUFFERS

An interface zone (or buffer) is described as the strip of land between bushland and adjoining development –often a slashed firebreak, a boundary fence and/or a walking track. It is this interface zone that is most vulnerable to the impacts of urbanisation. Such impacts include weed invasion and colonization by introduced (exotic) garden plants, stormwater runoff, tracking and mower creep. Rubbish dumping and the disposal of garden waste and lawn clippings are commonplace, while remnant or planted trees are often damaged by mowers and slashers.

Interface zones are often by default considered to be *de facto* bushland, but their management regimes should be different to those applied to the conservation areas (i.e. core bushland). For example, the interface zone may be under-scrubbed or mown as a firebreak, maintained as open parkland by removing shrubs or small trees, or it may be landscaped with non-invasive 'fire retardant' species (at least those which are known to be less flammable). Bushland should never be encouraged to grow unchecked up to built structures or boundary fences.

The interface zone will also vary in width, depending on adjoining land uses. For example, it may contain a walking path or bicycle track, or include a picnic area or car park. Hard edges should always be established at the interface (e.g. sleepers or logs) to delineate the boundary and to prevent inadvertent 'mower creep'. In some sites, particularly those in rural or semi-rural locations sturdy exclusion barriers may be required to prevent unauthorised vehicular access into the bushland.

In the subject land at Oakville Park, there are four (4) major interface zones: around the car park, along the transmission line corridor, and on the western boundaries with the Vines Pony Club and the Scout Hall.

The car park next to the toilet block and other public facilities is surrounded by a low earthen bund, which does nothing to discourage vehicular access to the core bushland. Tracks have been made through the core bushland, which has allowed dumping to occur on a large scale (see Figure 2.1).

The transmission line corridor runs along the eastern Park boundary. The boundary is fenced but this has not been maintained in good repair. The interface zone is the most severely impacted part of the subject land, with dense stands of exotic plants originating from dumping of garden waste and piles of rubbish and other debris strewn through the bushland. A large stand of *Acacia pubescens* is also located in this part of the Park's bushland.

The mown grass strip or buffer between the oval fence and the bushland is maintained by Council. This buffer is ~ 15 wide at its narrowest point. Grass clipping were noted in bushland, as well as a number of garden escapes (mainly succulent species), which may have been planted.

The Vines Pony club and Oakville Scout Hall are located on the western and south-western Park boundaries respectively. There has been some damage to bushland on these boundaries, mainly comprising incursion into bushland by mowers where there is no fence, and some (minor) dumping of horse manure and stable compost.

While these interface or buffer zones present their own management problems, it is the core bushland which provides the majority of extended 'edge sites', as there are numerous tracks and clearing which serve to separate the bushland into blocks or (at worse) small 'islands'. The smaller the bush block, the higher the edge to core ratio, and consequently edge impacts will also increase.

**Recommendations:**

1) Interface zones and buffers should be maintained so that unwanted garden debris and dumped rubbish are removed quickly, as a matter of priority. Local residents and Park users are to be made aware of the negative aspects of current dumping practices, including increasing the fire risk and encouraging vermin.

2) Following on from the above, land adjacent to property boundaries (e.g. Vines Pony Club and Oakville Scout Hall) and in public view should be maintained for local landscape and amenity values, thus ensuring that the bushland is better valued and cared for by the Park users. An approach to both neighbouring property owners (as above) to ensure future co-operation is strongly recommended.

3) Avoid planting trees and shrubs in firebreaks or in open grasslands in a configuration which precludes access for grass slashing and other maintenance activities.

4) To provide a buffer to edge impacts, consider planting the first few metres of the interface zone with a dense cover of small shrubs (< 1 metre) and/or hardy native grasses. This will provide a rudimentary 'filter' to trap windblown rubbish and weed seed spread by water.

5) Plant edge sites more densely (where more light is available) than core sites, using fast-growing shrubs and hardy grasses to create an attractive visual buffer between the bushland restoration and public recreational areas. This is a 'bush landscaping' approach which may go some way to encouraging community support for the retention of this bushland.

6) The erection of permanent barriers (e.g. treated logs or bollards) to provide a 'spray or mowing edge' is strongly recommended at the bushland interface. Where practical, introduced turf grasses on edge sites should be eradicated (foliar spray), and replaced with native ground covers or (in the short term) by a band of chipped eucalyptus mulch.

7) Where edge sites are paved or gravelled, they are to be graded so that water drains away from the bushland, and runoff is directed into a catch drain.

8) Internal edges (around bush blocks or 'island') can be reduced by closing unwanted tracks and revegetating to link isolated patches of bushland. Clearing should also be reinstated.

9) As soil compaction is a problem on tracks and clearings these will have to be ripped before attempting revegetation, using a single or double tyned backhoe and ripping to a depth of 10-15 cm (see Section 6.7, below).

## 6.7 MANAGING RUNOFF & SOIL COMPACTION

The network of tracks allowing vehicular incursion has resulted in widespread soil compaction, with runoff during heavy rain eroding ground covers and creating patches of bare earth which have washed or 'scoured', removing much of the topsoil (and presumably depleting the soil seed bank).

There are several dry swales (low points in the topography), which generally flow from the oval on higher ground into the bushland. These swales are often quite bare of vegetation, and are similarly affected by surface scour.

The underlying soils formed on Wianamatta Shale geology are saline and are known to be highly dispersive when the protective vegetation is removed, so it is important that where bare soil sites are encountered that the surface cover is reinstated as a matter of priority. For example, when ripping clearings or other large areas, it may be prudent to scatter chipped leaf much over the exposed soil (~10 cm in depth).

**Recommendations:**

1. After rubbish and other debris is removed from the bushland, unwanted tracks and clearings are to be ripped and cross-ripped using a single or double tyned backhoe and ripping to a depth of 10-15 cm.
2. Rip lines should be 0.75 to 1 metre apart, and rip lines downslope of the oval should be made across the slope to intercept runoff water from higher ground.
3. Where ripping is difficult (e.g. where soil is shallow or the backhoe cannot access), the ground should be scarified using a rake hoe (or similar) to break the surface crust and encourage water penetration.
4. Ripping and/or scarification will intercept runoff water, improve water penetration, encourage the natural regeneration of seed remaining in the soil seed bank, and if brush matting or planting tubestock is being considered, it will assist in providing planting (or germination) sites.
5. To speed the recovery process, native seed may be scattered in the rip lines and watered in well, and/or a light much of chipped eucalyptus and leaf litter may be applied.

## 6.8 BUSHLAND INFRASTRUCTURE

The infrastructure requirements will depend on the intended long term use of the bushland area. The existing track network allows unauthorised access that is destructive to the bushland. The exclusion of vehicular access has been discussed in Section 6.3, recommending the closing and rehabilitation of some tracks, and the limiting access to vehicles by erecting fences and/or heavy duty barriers.

One of the main reasons the Park has been used for dumping is that it is a quiet, out of the way area with unlimited access. While barriers can be created to limit the larger incursions into the bushland, pedestrian access cannot be limited and may in fact be wanted if the Council requires passive recreational usage of the bushland area. However, pedestrian access can be contained by establishing a circular walking track system.

**Recommendations:**

1) The eastern side of the loop track and the track in the north-eastern corner of the bushland (Figure 6.2) should be cleaned of waste and then closed; the compacted soil cross-ripped and encouraged to regenerate. Alternatively, tubestock planting and seeding may be used to speed the recovery process[11].
2) At present the western side of the loop track and the vehicular track extending into the bushland are ~three (3) metre wide and are strewn with rubbish. After cleaning up the waste, the tracks can be ripped and regenerated so that the track is reduced to a one (1) metre wide pedestrian walking track. This will also help with surface erosion on the tracks as the exposed surface area is lessened.

[11] Ideally, brush matting would greatly assist the recovery process. However, other than *Melaleuca* spp there are few suitable species available in Oakville Park, and to use more than a little Melaleuca would probably result in the over abundance of these thicket formimg species.

3) Unwanted informal paths and tracks through the rest of the bushland should be closed and encouraged to regenerate. Similarly, open clearings should also be rehabilitated. It may be advisable to erect sturdy (although temporary) fencing around some areas while they are being rehabilitated.

4) If passive recreation access throughout the bushland area is proposed the one (1) metre wide track can be extended through the bushland to the western side of the property. Care must be taken to avoid located threatened species populations. The least destructive location for the track which also gives the threatened species populations a buffer zone is shown in figure 6.2.

5) Interpretative signage can be used to pass on historical or environmental aspects of the bushland, park or local area and to show the value of the bushland as natural heritage.


**Figure 6.2**
**Existing and Proposed Track Network**

**URBAN BUSHLAND**
**MANAGEMENT CONSULTANTS PTY LTD**

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# 7 BASIS FOR MANAGEMENT OF URBAN BUSHLAND

*The following section – Basis for Management – is largely generic in nature. It has been included in the VMP for the Oakville Park bushland to provide essential background information and a framework for the restoration of native bushland using a Bush Regeneration approach. Protocols for indigenous revegetation (planting) and weed control have also been included.*

## 7.1 GUIDING PRINCIPLES

The management of any natural area should be guided by the following broad principles:

- To **protect** bushland remnants from further loss and the effects of existing and future threatening processes;
- To **identify** all biodiversity and geo-diversity elements;
- To **conserve** significant items/areas by mitigating or removing threatening process and promoting those natural processes required to ensure long-term viability;
- To **enhance** species diversity in highly simplified or degraded remnants not capable of restoration and in non-remnant areas;
- To **provide** corridors and linkages between remnants to facilitate movement and to encourage the flow of genetic material; and
    - To **provide** opportunities for passive recreation in a controlled manner consistent with its ecological values.

In preparing the VMP for the Oakville Park Bushland each of the above-listed principles has been considered, and relevant management issues addressed.

## 7.2 BUSH REGENERATION

The most commonly used approach to the rehabilitation of native plant communities (bushland) is Bush Regeneration, which is defined by the Australian Association of Bush Regenerators (AABR) as:

> …*the practice of restoring bushland by focusing on reinstating and reinforcing the system's on-going natural regeneration processes* (AABR, no date).

The Bush Regeneration approach (basically removing weeds and encouraging native plant regeneration from *in situ* seed sources) is suitable only for those sites the soil seed bank is intact, where mature native plants occur in sufficient numbers to provide source material, and where there is sufficient species diversity to restore the major floristic and structural components of the vegetation community (i.e. each layer or stratum).

Representative species of each stratum – i.e. the canopy, shrub and groundcover – must be present in the soil seed bank for natural regeneration to function as the primary rehabilitation process. Such bushland is described as 'structurally intact', and conforms to the definition provided by *State Environmental Planning Policy No-19 – Bushland in Urban Areas*[12]. Regeneration of

[12] SEPP-19 definition of "bushland" means land on which there is vegetation that is either a remainder of the natural vegetation of the land or, if altered, is still representative of the structure and floristics of the natural vegetation.

the native plant community from existing seed sources cannot occur where the potential for regeneration (i.e. **'site resilience'**) is absent (see Section 7.3).

The Bush Regeneration approach incorporates a number of methodologies or strategies – the most commonly used are:

*Natural Regeneration* – which involves removing weeds; using a combination of hand weeding methods and the application of selective herbicides; then caring for the native seedlings which subsequently colonise the site.

*Assisted Natural Regeneration* – which combines traditional bush regeneration methods (e.g. weeding) with seed collection, propagation and planting of locally indigenous tubestock to supplement natural (unassisted) regeneration.

*Restoration* or *Reconstruction* – which is used where a native plant community has been completely lost, but where the biophysical attributes of the site (e.g. soil type, soil nutrient status, hydrological regime) are still within levels which remain tolerable to local native species. Reconstruction techniques centre on the planting of locally indigenous species in the proportions, range and densities similar to those present in the original (pre-disturbance) plant community.

*Fabrication* – which is used where the original native plant community is no longer present, and where the site's biophysical attributes have changed to the point where the original plant community cannot be reconstructed or recreated (i.e. where site conditions have changed so dramatically that simply replanting with local native species is impractical).

Fabrication of a new plant community will necessarily take place over a long period of time (up to 10-years). The timeframe for fabrication will depend on the feasibility of ameliorating site impacts and of course, on the resources available for on-ground works.

**In the subject land** – the Oakville Park Bushland – Natural Regeneration, possibly enhanced by selective replanting (Assisted Natural Regeneration), will be the primary strategy adopted for the rehabilitation of the bushland.

## 7.3 POTENTIAL FOR REGENERATION – ECOSYSTEM RESILIENCE

**Ecosystem resilience** is defined as "the degree, manner and pace of restoration of the structure and function of the original ecosystem after disturbance" (Westman 1978), or more simply, as the ability of an ecosystem to recover from disturbance.

When assessing site resilience, key indicators are the standing biomass of remaining native plants (particularly naturally regenerating indigenous seedlings), and the potential reservoir of propagative material (seeds, spores, rhizomes) in the soil seed bank, although the latter is difficult to assess accurately without extensive trials.

Resilience in some parts of the subject land (e.g. fill soil bunds/mounds and drainage lines) is expected to be 'low' - because of the impact of past land uses, including deposition of fill soils, replacement of native understorey with weeds and introduced grasses, runoff from the oval and the suppression of the natural fire regime, with a consequent loss of viability in the soil seed bank.

However, for the greater part of the subject land, especially those sites on the drier soils, resilience is expected to be 'high', particularly if the compacted soils are ripped and aggressive grasses like African Love Grass are removed.

Where ecosystem resilience is 'low' or 'absent', reconstruction of the native plant community through targeted weed control, followed by replacement planting will be required. If, after a period of (say) 12-18 months, natural regeneration is sparse (or absent), enrichment planting will be necessary to stabilise soils and to provide a native understorey to serve as habitat for native flora and fauna.

**In the subject land** – the Oakville Park Bushland – resilience is expected to be 'high to very high' in most parts of the core bushland. However, resilience on edge sites and in clearings where fill soils or rubble have been introduced, or the parent soils have been otherwise disturbed, resilience will be significantly reduced. It is possible that selective planting will be required to restore the full complement of understorey species previously found in this type of plant community.

## 7.4 CHOOSING THE MOST EFFECTIVE STRATEGY

The Bush Regeneration approach usually concentrates on the rehabilitation of sites classified as 'good to fair' (or moderate), relying on natural regeneration from *in situ* sources (existing native plants and seeds/root or rhizome fragments in the soil). Bushland in the 'good to fair' categories will most likely retain sufficient regenerative potential to re-establish the native plant community once weeds have been removed.

Even in sites identified as 'poor quality' or 'degraded', located on fill soils, or where the native vegetation has been cleared for many years, there are usually a few native plants remaining. In such areas, it is likely that the soil seed bank has been severely depleted (or is absent) – thereby greatly reducing the potential for natural regeneration. For such areas, other methods must be used.

In chronically degraded or totally cleared areas, the plant community must be recreated, not regenerated. This usually involves a broad scale and often expensive, planting program. Therefore, as a matter of economics if nothing else, every attempt should be made to stimulate natural *in situ* regeneration prior to undertaking a bushland restoration program via planting.

**In the subject land** – the Oakville Park Bushland - Natural Regeneration will be the primary strategy used to encourage the regeneration of locally indigenous species and restore the SGTF ecological community.

However, in sites where fill soils have been deposited, where soils have been heavily compacted or polluted by stormwater influx or deposition of polluted materials, or on edge sites where the impacts of urbanisation are most obvious, Assisted Natural Regeneration will be required to re-instate the floristic diversity and structural integrity of the bushland. Having said this, scalping of weedy or polluted soils and ripping of subsoils may serve to stimulate sufficient native seed in the underlying soil seed bank to re-establish a diverse bushland flora.

It is not envisaged that the abiotic traits of any area would have been altered to the extent that locally indigenous plants will not survive (thus requiring Fabrication) – assuming the instigation of an appropriate management regime.

## 7.5 WEED ECOLOGY

*The information provided in the following section, while again largely generic in nature, has been included in the VMP for the Oakville Park bushland to provide guidelines for weed control, indigenous revegetation (planting), and site maintenance.*

### 7.5.1 Definition

> *A plant is only a weed where it interferes with a man's use of the land for particular purposes, with his well being, or with the quality of his environment* (Moore 1975).

Invasion by unwanted plants is a major constraint on the conservation and management of habitat for native flora and fauna. Unwanted plants in a natural or man-made environment are generally called 'weeds'.

This generic term includes such diverse groups as:

- Plants harmful to agriculture, human health and the community (**'noxious weeds'**);
- Horticultural escapes from gardens and amenity plantings (**'environmental weeds'**);
- Plants introduced from other parts of Australia, or local native plants growing out of their normal range (**'alien'** or **'non-indigenous native plants'**);
- Plants commonly found in crops and pasture land (**'agricultural weeds'**); and
    - Plants that commonly grow in wasteland, on roadsides and in other disturbed areas (**'ruderal weeds'**).

### 7.5.2 Keystone (Target) Weeds

Some introduced species pose serious and immediate threats to the vegetation community they invade, eventually modifying the ecosystem to such a degree that many native plants are unable to survive. These ecosystem modifies are called 'keystone weeds' or 'primary target weeds', and they must be given priority in weed control program.

A keystone weed may have a legal designation as a 'noxious plant' (*Noxious Weeds Act 1993, Amended 2005*), or the species may be recognised as an 'environmental weed' in the local area – i.e. a plant that naturalises readily in bushland to the detriment of the native flora.

Typical keystone weeds in Western Sydney bushland, and represented in the subject land include Senna/Arsenic Bush *(Senna pendula*), Bridal Creeper (*Asparagus asparagoides*), Madeira Vine (*Anredera cordifolia*), Mother of Millions (*Bryophyllum delagoense*), Wandering Jew (*Tradescantia fluminensis*) and African Love Grass (*Eragrostis curvula*)

### 7.5.3 Secondary Weeds

Not all weeds constitute a threat to the plant communities they invade. Some annual weeds or herbaceous perennials may be naturalised in the plant community, and many are hardy pioneer species that establish in the early stages of recovery (succession). They are usually short-lived, and although they produce a copious amount of seed, these pioneering species will not survive once a shading canopy is re-established.

Because they are highly visible, often grow in dense thickets, and give an 'untidy' appearance to a rehabilitation site, secondary weeds are often targeted first – unfortunately to little benefit as they quickly recolonise bare soil sites created by weeding.

Unless unlimited resources are available, secondary weeds do not warrant early treatment in the weeding schedule, as there are other, far more environmentally damaging weeds to contend with, especially when resources are limited.

Secondary weeds in the subject land include (primarily) herbaceous species such as Ribwort /Plantain (*Plantago lanceolata*), Fleabanes *(Conyza* spp), Purpletop (*Verbena bonariensis*), and introduced grasses such as Veldt Grass (*Ehrharta* spp) and Paspalum (*Paspalum dilatatum*)

Non-indigenous natives such as Silky Oak (*Grevillea robusta*) and exotics such as Jacaranda (*Jacaranda mimosifolia*) are also considered to be secondary weeds unless they proliferate to the extent that they threatened to displace or otherwise suppress native species.

A list of keystone and secondary weeds identified in the Oakville Park bushland are listed in Table 7.1.

## 7.6 PRIORITY OF BUSH REGENERATION WORKS

Priority of works is to be determined according to the status of weeds present in each infestation. The following hierarchy is given to target weed infestations:

1. Weeds of National Significance ('WONS'); then
2. Noxious Weeds (Hawkesbury River County Council Local Control Area); then
3. Environmental Weeds – keystone species only.

A list of keystone (target) weeds present is provided in Appendix 7, along with recommended methods for the control for each species.

**Table 7.1: List of Target Weeds & Introduced Plants Identified in the Oakville Park Bushland**

| Botanic Name | Common Name | Location | Reason for Selection |
|---|---|---|---|
| *Agave americanum* | Century Plant | | Spreads vegetatively: sharp spines on leaves (dangerous to park users) |
| *Agave attenuata* | Spanish Bayonet | | Spreads vegetatively: sharp spines on leaves (dangerous to park users) |
| *Anredera cordifolia* | Madeira Vine | | One infestation only. Very aggressive, reproduces vegetatively: eradicate |
| *Araujia sericifera* | White Moth Plant | | Scrambling vine: potential to smother shrubs. Remove before fruiting. |
| *Asparagus aethiopicus* | Ground/Fern Asparagus | | Noxious in some LGAs – very invasive & competitive in ground stratum |
| *Asparagus asparagoides* | Bridal Creeper | | WONS/Noxious Weed. Co-dominant in understorey (with ALG). |
| *Bryophyllum delagoense*<br>*B. pinnatum* | Mother of Millions<br>Resurrection Plant | | Noxious weed: spreads rapidly, seed & fragmentation: drought tolerant |
| *Eragrostis curvula* | African Love Grass | | Dominant understorey species: highly competitive free-seeding tussock grass: control possible but not eradication |
| *Grevilla robusta* | Silky Oak | | One large tree (planted?): non-indigenous native species which spreads via birds |
| *Optuntia* sp. | Prickly Pear | | One infestation: possible to eradicate |
| *Paspalum dilatatum* | Paspalum | | Remove where it impact on native seedlings |
| *Pelagonium* sp. | Geranium | | Few stands (#256): possible to eradicate |

| Botanic Name | Common Name | Location | Reason for Selection |
|---|---|---|---|
| *Pennisetum clandestinum* | Kikuyu Grass | | Invasive and very competitive to new seedlings and plantings: eradicate with herbicide as foliar spray: repeat as required. |
| *Sedum* spp<br>*Crassula tetragona* | Pride of London<br>Crassula – a succulent | | Widespread but in large clumps. Invasive on dry soils: spread via dumped garden waste. |
| *Senecio madagascariensis* | Fireweed | | Occasional |
| *Senna pendula* | Cassia/ Arsenic Bush | | Scattered occurrence only |
| *Solanum nigrum* | Deadly Nightshade | | Berries are poisonous |
| *Tradescantia fluminensis* | Wandering Jew | | Widespread and forms dominant groundcover in eastern sector of Park |

## 7.7 WEED CONTROL

Weed control is only one of a number of strategies required to achieve the broader goals of conserving, rehabilitating and managing native bushland. The identification of keystone (target) weeds may vary between vegetation communities and between differing land use areas.

When planning a weed control program, factors that must be considered include:

- The degree of weed infestation;
- The length of time since weed establishment;
- The substrate (fill or natural soils);
- Soil stability and the potential for slippage or erosion;
- Site and local drainage conditions (hydrology); and
    - The condition (health) of nearby remnant vegetation, which will provide propagules for the natural regeneration of the site.

Weed control is only the first step to the recovery (or rehabilitation) of a more desirable plant community (whether native bushland or a plantation).

Of primary importance is the potential for the site to recover after disturbance i.e. 'site resilience'. In sites with 'low to moderate' weed density and/or those surrounded by good quality native bushland, the potential for recovery is good, with natural regeneration of natives species usually occurring from *in situ* sources (i.e. the soil seed bank) or volunteering from neighbouring bushland.

However, for those badly degraded sites or those that have suffered long-term or extensive disturbance, site resilience will usually be 'low to absent', so that attempts to achieve bush restoration will usually involve a broad-scale planting program.

Weeding to encourage the regeneration of native seedlings is the basis of the Bush Regeneration approach to the management of native plant communities. While Bush Regeneration is generally associated with the restoration of bushland remnants in the urban environment, there is some scope for some use of its low-impact methods in the rural environment, which historically has relied on grazing, slashing, burning, or the broad-scale application of herbicides to control weeds.

## 7.8 REVEGETATION

Revegetation in bush regeneration projects usually comprises 'enrichment' or supplementary planting in areas of low species diversity; and 'bush landscaping' on edge sites and buffer zones, or in landscaped garden beds to create an extended native habitat.

**Enrichment Planting** is carried out to increase existing species diversity by planting small shrubs, herbs, grasses and occasionally, new canopy trees. Enrichment planting can also be used to increase habitat for native fauna, and/or to re-introduce species which are known to have once *been part of the local plant community, but for some reason have now been lost.*

**Bush Landscaping** refers to the placement of new plants to in-fill clearings or gaps and link remnants, to establish buffer zones at the interface between bushland and developed areas, and to create complementary native gardens on adjoining sites.

**Indigenous Revegetation** – whether enrichment planting or bush landscaping – should attempt to utilise only plant material grown from local native species (i.e. indigenous species) in order to maintain the genetic integrity of the bushland remnant, but also to maintain 'local character'.

Revegetation methods and techniques appropriate indigenous revegetation in the Oakville Park Bushland are discussed in Section 8.5. A list of locally indigenous plants appropriate for planting may be sourced from the list provided in Appendix 1.

The planting list has been prepared with reference to the Final Determination for Shale-Gravel Transition Forest. Local knowledge has also been used to 'fine-tune' the planting list.

It is not anticipated that all of the species listed will be used, but a wide range of species has been included to provide some degree of choice (especially as some of the species recommended may not produce seed regularly and/or they .may be difficult to propagate).

*Note* that small or delicate herbaceous species have not been included in the planting list as they would not only difficult to propagate, but would most likely not be hardy under field conditions. Species such as orchids, vetches, glycines and the smaller lilies – although desirable - would require a great deal of after care, which is unlikely to occur.

If some of the less commonly occurring species can be made available over time (as locally collected seed or tubestock), these should be used to increase biodiversity values and enhance habitat for native fauna.

***Note* also** that threatened species such as *Dillwynia tenuifolia, Pultenaea parviflora* and *Acacia pubescens* should not be planted at any time.

# 8 IMPLEMENTATION & REVIEW

## 8.1 POLICY & PERFORMANCE

The policies established in this VMP provide a management framework consistent with the site's potential for bush restoration (as determined by ecological constraints), the availability of resources necessary for on-ground bush regeneration and related infrastructure works, and after consultation with the local community and Hawkesbury City Council.

The priority tasks to be carried out are outlined in Section 8.3, below. Unless adequate resources are available over the lifetime of the VMP, some of the objectives listed for the Oakville Park Bushland may not be realised.

## 8.2 REVIEW

This VMP for is designed to cover an initial five (5) year period. After this time, the Plan should be reviewed, outcomes of the bush regeneration program assessed using the Performance Indicators outlined in Section 8.9, and changes or adjustments made as necessary.

An updated flora survey should be commissioned, with the emphasis on identifying biodiversity values, with species densities and distribution evaluated in all Management Zones, and if applicable, actual or potential shifts in the floristic composition or structural integrity of the plant community identified or any obvious trends flagged.

A comprehensive fauna survey and evaluation of existing fauna habitats should also be undertaken at the end of the five (5) year timeframe. Analysis of survey results should be used to confirm or adjust the bushland management strategies set in place by the VMP.

## 8.3 WORK PRIORITIES

The following key tasks are listed in order of priority.

1. The VMP for the Oakville Park Bushland will be placed on public exhibition and comments invited from members of the community. As a result of this community consultation, all stakeholders will be fully informed about the key goals and objectives for the Park, what can be achieved given the current level of resources, the basic strategies and actions to be undertaken, and the timeframe for achieving these goals and objectives. Community consultation will also identify the responsible body/person for carrying out strategies and actions, and all stakeholders must agree to abide by this decision.
2. After community concurrence, Council to formally adopt the VMP for an initial period of five (5) years.
3. Council to take measures to exclude unauthorised vehicles from the bushland as a matter of priority. Council is to instigate a major clean-up program to remove accumulated rubbish and builder's rubble from the bushland.
4. A design for a circular walking track to be finalised: one main circular track retained and upgraded and other unwanted tracks closed. The latter are to be ripped and revegetated as part of the Bush Regeneration Program proposed.
5. Council to commit resources to allow for a comprehensive Bush Regeneration Program over a period of five (5) years. Strategies and actions are to comply with the recommendation of the VMP.

6. Grant funding should be sought from a variety of external sources to assist Council to meet the cost of the Program.
7. Council's Manager, Land Management and Bushcare Officer to jointly renew efforts to establish a local Bushcare Volunteer Group.
8. Site security to be upgraded. Unauthorised vehicles to be excluded: periodic visits by a Park Ranger to be undertaken and signage to be erected with emergency telephone numbers.

## 8.4 PROTOCOLS FOR WEED CONTROL

All plants declared As Weeds of National Significance ('WONS'), plants declared noxious in HRCC Local Control Area, to be removed as a matter of priority – this is described as 'targeted weed control'. This is to be followed by addressing the keystone environmental weeds recorded for the bushland.

The weeds identified in 7 have been identified as priority target weeds for the bush regeneration program in the Reserves.

Maintenance weeding will necessarily be on-going in all Management Zones after the conclusion of initial primary and follow-up weeding. The long-term nature of a bush regeneration program is stressed. Following completion of initial works, maintenance weeding will be required throughout the whole of the subject land at a *minimum* four (4) sessions/year in order to keep the bushland acceptably free of target weeds.

Management for species diversity (e.g. culling of dense native vegetation, selective replanting) and management of the bush fire hazard should be carried out yearly, and these tasks will require a further level of resources.

## 8.5 PROTOCOLS FOR REVEGETATION

*The following guidelines are basically generic in nature and are included in the VMP for the Oakville Park Bushland as an aid to implementing an indigenous planting program in bushland reserves in the urban and peri-urban environments.*

### 8.5.1 Site Preparation

Soil Conditions

The success of any planting program is largely dictated by site conditions, and particularly the structure and chemical composition of the site soils. Prior to planting, a series of basic soil tests should be carried out using one of the proprietary soil testing kids available commercially.

Despite the costs involved in carrying out basic soil tests, the whole program could fail if the soil proves to be unsuitable for planting with native species[13].

If the soil pH or salinity levels are outside the 'normal' range (read product label), advice on soil remediation should be sought from a qualified horticulturalist or landscape gardener. The local office of the NSW Department of Primary Industry may also be able to offer practical advice.

If imported (or fill) soils already *in situ* on the property are suspected of being contaminated in some way, soil samples should be sent to a professional laboratory for analysis. Similarly, if site soils are thought to contain asbestos or a similar macro-pollutant, contact Council's Environment Unit or the Health Department without delay.

[13] That is, soil may be too high in plant nutrients, particularly Phosphorus (P) or Nitrogen (N); too high in clay content, or it may contain micro or macro pollutants.

**On the subject land** – the Oakville Park Bushland - this will not apply unless the planting area is located on fill soils (mullock heaps), or where it is suspected that builder's rubble has been dumped (cement, bricks, asphalt, asbestos and the like).

### 8.5.2 Selection of Appropriate Flora Species

In selecting species for planting in native bushland, a number of issues must be considered. The species chosen should not simply be made from a broad selection of native plants known to occur in the locality but should be:

- Representative of the locally occurring native vegetation communities – in this case Shale-Gravel Transition Forest;
- Readily obtainable from a reputable plant nursery, or easily propagated by seed collected from existing local material;
- Niche-specific, i.e. suitable for planting in existing habitats and micro-habitats within the subject land;
- Hardy and tolerant of variable soil conditions, and easy to establish under open and exposed field conditions;
- Be of appropriate size (height/breadth) to achieve an appropriate balance in the proportion of trees and shrubs and groundcovers in the replicated vegetation community;
- Provide a range of habitat, foraging and shelter sites for native fauna (especially around high-usage sites such as waterbodies s and open grasslands);
- On edges and interface sites between bushland and development, be carefully selected so as to create an effective 'buffer' between designated bush regeneration areas and private property boundaries; and when
- Planting in buffers and interface sites, should utilise only fire-retardant species (or those with reduced flammability), with planting made at reduced densities and (where appropriate) with a simplified structural form[14].

### 8.5.3 Densities and Spatial Arrangement

The typical ratio of canopy trees: shrubs: ground cover in a pre-disturbance Cumberland Plain Woodland communities is (broadly) 20: 20: 60 (Watson pers. comm.)[15]. For a variety of reasons, including the absence or overuse of fire, changes to local drainage patterns and fragmentation, this ratio has been dramatically altered, with an over abundance of shrubs and a paucity of ground covers commonly observed in urban bushland reserves.

When revegetation programs are planned in urban reserves, this altered ratio is often taken as 'the norm', with the result that planting densities are skewed towards high numbers of shrubs and trees. This should not occur in a bushland regeneration program where the objective is to restore (as far as possible and practicable) a semblance of the original plant community.

Planting density should be based on the final size of the relevant species used and aim to recreate a naturalistic arrangement. For example, small-sized plants (generally less than 500 millimetres in

[14] See publications from the Rural Fire Service or view their website (www.rfs.nsw.gov.au).

[15] Also expressed as a % of the biomass in each stratum.

height) should be planted in groups at a density of approximately three (3) to five (5) units per square metre.

Larger species may also be planted in groups of three (3) to seven (7), but should be placed sufficiently close together to enable a sufficiently dense cover to form (where this is appropriate, and will not suppress light-demanding groundcovers).

It should be noted that any planting undertaken in and around the drainage lines must consider the need to maintain access for routine maintenance. It may be necessary to access these drains with a small machine or if this is not feasible, by using a wheelbarrow to remove silt, weeds and accumulated rubbish. Therefore, the planting arrangement should take this factor into consideration. Plants should be grouped or spaced to allow access for routine maintenance.

### 8.5.4 Planting Aids

Plant Fertilisers

A specially formulated native plant fertiliser low in phosphorus (such as Osmocote Purple) should be used when planting native tubestock. Regular applications of dilute fertiliser should be used twice yearly (spring and early autumn) or when plants show signs of yellowing or spindly growth (at least until the plants become established and drought hardy).

The use of a plant fertiliser is recommended to assist plant establishment in the first 6-12 months of the planting program. As the vegetation cover is re-established, and organic matter is re-cycled into the topsoil, there will be less need for supplementary nutrient input.

Complete native plant fertilisers are available in granular form or as tree tablets. Soluble fertilisers are preferable to granular forms, although tree tablets (or pellets) are useful at planting time.

Water Retaining Granules/Soil Wetters

Products such as Debco, Saturaid, Terracottem (or similar) should always be used in harsh conditions and/or where post-planting watering may be a problem, and they are particularly useful in free-draining or sandy soils. In current drought conditions, no planting should be undertaken without the use of water retaining granules or soil wetters.

These products are inert, and do not react with fertilisers or herbicides. If used at planting time, watering times can be reduced by up to 50%. Experience using such granules in bush regeneration sites in the Sydney Region has allowed a greater survival rate than previously achieved.

Mulching and Weed Matting

*Mulch* is crucial to the success of most planting projects as it keeps the soil cool and moist and suppresses weed growth. Mulching around planted tubestock can utilise chipped eucalypt mulch or if costs allow, commercial 'leaf mulch' may be used.

Chipped or mulch from woody weed sources are never acceptable. All imported mulch must be of known provenance and free of weeds. Alternatively, it is possible to foliar spray dense weed grasses with a selective herbicide (e.g. Fusilade) and to leave the dead thatch in place as mulch[16].

Mulch must be applied at the time of planting, after thorough soil wetting. When planting in large open areas, plants should be grouped to allow mulch to be applied around each 'planting island' or cluster. This reduces the edge effect (weed invasion, drying) and makes plant maintenance easier.

*Weed Matting* (such as Jutemaster, Enviromat, coconut fibre) is useful for retaining soil moisture and suppressing weed growth. Individual weed mats may be used around each plant at planting time, or broad-scale weed matting can be placed over a large area. If the latter approach is used, the matting must be firmly anchored with long metal pins.

***Note*** that weeds will grow in most types of mulch and on the surface of weed matting, but seeds beneath are prevented from germinating. Most grasses and bulb species have sharp leading shoots (new growth) that can pierce loosely spun weed mats and grow through them.

Mulch should never be used in bushland sites where natural regeneration from the soil seed bank is anticipated – i.e. where site resilience is moderate to high. Thick mulch will suppress the germination of many locally indigenous species, which in the main are sclerophyllous (hard-leaved), while favouring only those species with largest seed – these generally being native gully or mesic species such as Sweet Pittosporum *(Pittosporum undulate*). If used over a long period of time, the placement of thick mulch can impact on site floristics and encourage a shift to a mesic vegetation type, and inadvertently create optimal conditions for the growth of shade tolerant weeds such as Privet (*Ligustrum* spp)

*Note also* the importance of leaving bare soil on sites where natural regeneration is anticipated

### 8.5.5 Irrigation

It may not be possible to water the planting sites over a long period, therefore the planting program should be planned to coincide with the period of maximum (and regular) rainfall. In the Western Sydney Region, optimal planting time is middle to late autumn.

It is also important to ensure adequate watering at planting, applying 1-1.5 litres of water to each new plant. Additionally, the use of a water-retaining compound and some form of surface mulch are strongly recommended to retain soil moisture and decrease the need for on-going watering.

Plants should be soaked for at least 30 minutes prior to planting (before being removed from their pots), watered thoroughly at planting and thereafter, watered once each week for a period of four (4) weeks (weather conditions dictating frequency). After this period, watering comprising one (1) litre of water / plant each month will be required until the plants have established.

If current drought conditions prevail, a permanent watering period may have to be extended to ensure plant survival. A drip irrigation system is best and (unless regulations change) complies with Sydney Water restrictions on watering gardens. Watering is best carried out in the early morning (watering at dusk encourages fungal attack in some species).

[16] A systemic herbicide such as glyphosate is not recommended as a foliar spray to control grasses where other native plants are growing as this product is non-specific.

Alternatively, as plant establishment is dependent on good follow-up rains, it may be prudent to delay any planting until such time as climatic conditions improve.

### 8.5.6 Revegetation Methods

Tubestock Planting

Planting 'forestry tubes', hykos (small tubes) and/or advanced tubestock is the most reliable method of establishing woody native plants (trees, shrubs), and is also useful in establishing most of the native tussock grasses (e.g. *Themeda australis*, *Echinopogon* spp, *Poa* spp.).

Bushland restoration in degraded areas, in bare sites or in large clearings (> 10 sq metres) will generally rely on the placement of tubestock, wherever possible supplemented by other methods of revegetation. Other methods that can be used include hand broadcasting of seed, brush layering and transplanting seedlings and or leaf litter from nearby bushland areas. Such supplementary methods may also be used to 'fill in the gaps' between planted tubestock.

On the subject land, the planting of tubestock or advanced tubestock is strongly recommended, as these will establish rapidly with minimal care. Advanced plant stock (8" or 12" pots) may be used for specimen trees or shrubs in order to create an 'instant effect'. However, this approach is best reserved for landscaped areas (such as the garden beds or the Park), and not used where natural bush is being encouraged to regenerate naturally.

Hand Sowing

Seed of hardy pioneer species such as Wattles (*Acacia* spp) and *Dodonae*a spp (Hop Bush) may be collected from local bushland and scattered on bare (prepared) soil between tubestock plantings[17]. As hand sowing (or direct seeding) is wasteful of seed, seed collected from most other species should be propagated as tubestock.

If native grass seed is available, hand sowing between tubestock planting may also be used. Grasses such as Blady Grass (*Imperata cylindrica*), Longhair Plume Grass (*Dichelachne crinita*), Bordered Panic (*Entolasia marginata*), and sedges with large sized seed such as Knobby Club-rush (*Isolepis nodosa*); some of the local Cyperaceae, and *Juncus usitatus* (Soft Tussock Rush) would also be suitable for hand sowing. However, grasses with more precise germination requirements such as Kangaroo Grass (*Themeda australis*) are best established via tubestock or transplanting.

Brush Layering (Brush Matting)

The use of mulched timber as a soil cover and to provide microhabitat is a cheap and effective way of re-establishing vegetation if sufficient source material is available. If a source of local brush is available, it is strongly recommended that brush layering be used (possibly in addition to tubestock planting) as it provides a large amount of seed very cheaply and the brush itself provides extra protection for the new seedlings.

If brush layering is used, then plants must bear ripe fruit/cones, and the branches must be cut and spread over bare (prepared) soil before the seed drops. The stress of cutting will release seed, so that cut brush cannot be stored for long period of time. Brush is best used on the day it is cut.

[17] Acacia seed must be treated prior to sowing. ~50% of the seed should be treated by pouring boiling water over it. Seeds should be soaked for 1-2 minutes, drained and allowed to dry.

The potential to use brush layering in most CPW communities is limited because few appropriate species occur. Exceptions are *Leptospermum* (Teatree) and *Melaleuca* (Paperbarks), which retain hard seed capsules on the parent plant unless released by fire or damaged (felled or cut).

However, both *Leptospermum* and *Melaleuca* are known to germinate readily from cut brush and form dense thickets, which often exclude by shading or competition, native grasses and other important understorey species. Their use as brush matting in sites which already support such shrubs should be carefully considered, and if used, it may be that culling will have to be undertaken if and when habitat conditions are negatively impacted by uncontrolled growth.

## 8.6 WORKS PROGRAM

### 8.6.1 Licences and Permits Required

The undertaking of works in an endangered ecological community (weed control, seed collection, planting or other works) requires the issuing of a Section 132C licence from the NPWS Division of the NSW Department of Environment and Conservation.

Research or related studies which potentially impact on a threatened species, population or ecological community or their habitats (*TSC Act*), or on any protected species listed under the *National Parks & Wildlife Act* (1974) may only be carried out by suitably qualified workers holding a current Section 132C Scientific Licence from the DECC. The obtaining of a Scientific Licence is the responsibility of the individual worker. Workers seeking to trap, capture or collect native fauna are also required to obtain an Ethics Licence from Department of Primary Industry.

### 8.6.2 Implementation and Timing of Works

The long-term nature of a bush regeneration project is strongly emphasised. Priority actions set out in the Plan have been limited to a five (5) year timeframe, with a recommendation for review (and adjustment) at this time. However, after this period of time the bushland should continue to be managed in accordance with the principles and guidelines set out in this VMP.

Timing of on-ground works are summarised in Figure 8.1 (Gantt chart). This provides an indication of both the duration and the chronology of *each* item listed within the initial five (5) year program.

### 8.6.3 Site Maintenance

A regular maintenance program will be required for all planted areas after the completion of initial works. If professional bush regeneration contractors are used for initial primary weeding, and perhaps site preparation and planting, the Bushcare group can be of great assistance in taking on the maintenance phase of the project. However, if there are members of the community willing to undertake other tasks as well, then these can be built into the timetable of works.

Actions embedded within the maintenance program are:

- Regular weeding to remove competitive exotic plant species and control invasive natives;
- Care of planted areas (including watering, disease control, application of native plant fertilisers and replacement of lost or failed plants);
- Maintenance of plant bags and stakes (with removal once plants overtop the bags); and
    - Rubbish removal and care of edges and buffer zones.

Monitoring, evaluation and reporting are integral parts of the site maintenance program (see Section 8.8 and Appendix 8).

## 8.7 LABOUR AND RESOURCES

### 8.7.1 Contractors

Trained bush regenerators should continue to be used to work in environmentally sensitive areas where threatened species or remnant native vegetation could be harmed. A trained bush regenerator is one who has successfully completed the accredited Bushland Weed Control Certificate course offered by NSW TAFE (or interstate equivalent), and who has completed at least 350 hours in the field.

However, community volunteers are playing an increasingly important role in bushland management, and many councils (including Hawkesbury) successfully use a combined contractor/volunteer approach to bush regeneration. The joint effort undertaken by these groups have frequently achieved dramatic results within a relatively short time.

Long-term bush regeneration programs are usually carried out on a yearly contract basis. There are several dozen professional contractors operating in the Sydney area alone. Using a professional bush regeneration supervisor to train and co-ordinate the work of volunteers and employed grounds staff improves the quality of work, and allows the job to move forward far more quickly than would be the case if only untrained volunteers are used.

### 8.7.2 Community Volunteers

Hawkesbury City Council has an active community Bushcare Volunteer Program in place, incorporating a range of activities. However, it is understood that to date, no Bushcare groups have been formed in the Oakville area.

Where such groups are established, it must be stressed that the community volunteers must trained in bush regeneration techniques and be equipped with the right tools for the job. Good quality tools allow for more efficient and rewarding work.

The volunteers must also have good on-site supervision and adequate back-up facilities (e.g. help with planning, access to expert advice, regular rubbish collection, supply of herbicides (if applicable) and replacement of tools and materials). Volunteers should never be left to work on site alone; set to work in chronically degraded areas, or in sites with little potential for regeneration as the group may eventually lose its enthusiasm, and goodwill will be lost.

It is also stressed, that for maximum efficiency a regular Bushcare works program should be established and maintained. Without this regular attendance on-site, weeds can seed freely and invade areas which have recently been worked, or new weed invasions can escape notice.

Regular attendance (say monthly) also allows for volunteers to familiarise themselves with local flowering and seeding patterns, so that seed collection for the future propagation of tubestock can be maximised.

### 8.7.3 On-Site Supervision

The appointment of a supervising Project Manager within Council with experience in rehabilitating native landscapes is strongly recommended. It is anticipated that the Project Manager will be the Land Management Officer. The Project Manager will be the first point of contact for the matters relating to bushland issues.

The Project Manager will be responsible for implementation of each element of the VMP, for the review and assessment of methods and techniques employed, and will be responsible for 'sign off' at each stage (milestone) of the program.

## 8.8 MONITORING AND ASSESSMENT

A simple monitoring program is recommended to assess the success of the bushland restoration program. The bush regeneration contractor employed to carry out on-ground works should undertake monitoring, to the direction of the Project Manager. Monitoring should continue for a period *at least* equal to the lifespan of the current VMP. However, if reliable quantitative data is to be gained from the monitoring program, it should continue for a period of at least 10 years.

Monitoring procedures should be simple and straightforward, as well as inexpensive to implement. Monitoring should provide both qualitative (visual/photographs) and quantitative (statistical/quadrats) assessment. Reports should provide findings in a manner that is readily interpreted by all stakeholders.

Monitoring procedures, frequency and duration of survey, and reporting format should be agreed between the contractor and the client at the outset of the restoration project. Should the rehabilitation project itself extend beyond an initial five (5) year lifetime of the VMP, procedures should be reviewed and updated as required.

Assessments should preferably be quantitative in nature (although photo-points will also form part of the monitoring process) and these must be measured against the Performance Indicators set out in Section 8.9. Should monitoring and review indicate that the performance measures are not being met in a timely fashion, the strategies set out in the VMP should be reviewed, and the strategies set out in the Plan amended as necessary.

A generic guide to monitoring progress in bushland restoration projects has been included as Appendix 8.

## 8.9 PERFORMANCE INDICATORS

Performance Indicators are used to demonstrate that the program of implementation for the strategies outlined has been achieved. Among its primary goals, the VMP lists the enhancement of species diversity and provision of habitat for native flora and fauna.

Site-specific (or Zone focused) indicators should be set out in a detailed 'Works Plan' prepared at tender contracting stage. The works plan will set out individual tasks/area or site, provide a timetable of works over a designated period, and identify final implementation costs.

The bush regeneration contractor, in consultation with the Project Manager will prepare the works plan, which will include a basic monitoring program.

In the meantime, the following Performance Indicators have been developed to serve as a general guide to monitoring the progress of the bushland rehabilitation program.

1. An increase in the cover of indigenous vegetation in each layer or stratum (quantified via quadrat sampling –see 8).
2. An increase in floristic diversity in the Park bushland, measured by quadrat sampling.
3. No net loss of any indigenous plant species recorded, measured by quadrat sampling (particularly of ground cover species).
4. Natural regeneration of seedlings of each indigenous plant species recorded in the Park bushland.
5. Flowering and fruiting of each indigenous plant species recorded in the Park bushland.

6. No net loss of threatened, vulnerable or other significant flora species recorded in the Park bushland.
7. Increase in the diversity of fauna habitat types and niches available within the Park bushland (qualitative assessment suitable).
8. Floristic and structural diversity created and/or maintained in each habitat type (see Section 5.3.2).
9. Increase in the number of native fauna species recorded or observed within the Park bushland (optimum levels to be determined).
10. Increase in the number of small passerine birds utilising the Park bushland (measured via consecutive biennial fauna surveys).
11. Where bush regeneration contractors are employed, a decrease in the number of hours performing follow-up weed control and maintenance activities in each Management Zone (minimum level to be determined).
12. A decrease in the effect of each negative impact or threatening process (e.g. weed invasion and unwanted growth of vegetation, feral animal predation, soil erosion, dumping etc) recorded within the site overall (optimum levels to be determined).

**Figure 8.1: Proposed Timetable of Works**

| Item / Task | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| **Planning & Administration** | | | | | |
| VMP Adopted by Council: | | | | | |
| Liaison with Neighbours & Adjoining Landowners: Park Ranger /Bushcare Programs Established | | | | | |
| Resources Allocated for 5-year Program | | | | | |
| Call for tenders: Appoint Bush Regeneration Contractor | | | | | |
| **Infrastructure & Related Works** | | | | | |
| Council to Investigate Inappropriate Uses of Park & Take Action as Required | | | | | |
| Remove Rubbish & Builder's Rubble – Major Site Clean-up Undertaken | | | | | |
| Install Signage, Fencing & Bollards To Exclude Unauthorised Vehicles | | | | | |
| Rip Compacted Soil on Unwanted Tracks & in Clearings: Attention to Swales & Drainge Lines | | | | | |
| Determine Planting Needs & Organise for Indigenous Seed Collection & Propagation of Tubestock (12-18 months lead time) | | | | | |
| **Bush Regeneration Program** | | | | | |
| Primary Weeding to Conserve Habitat of Threatened Species<br>i) Target woody weeds | | | | | |

| Item / Task | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| ii) Target weeding of ALG – herbicide application and/or hand weeding<br>iii) Treat Bridal Creeper (winter months)<br>iv) Treat Wandering Jew /Other Succulents | | | | | |
| Primary Weeding (other) – as above<br>i) Boundaries<br>ii) Core Bushland | | | | | |
| Secondary/Follow-up Weeding (all sites, as required (incude 2 x yearly foliar spray of ALG) | | | | | |
| Maintenance Weeding | | | | | |
| **Enrichment Planting**<br>**dependent on natural regeneration* (2 x year planting program)- Clearings/Tracks | | | | | |
| Plant Maintenance Program (care of plants, watering, weeding, replacement planting) | | | | | |
| **Other** | | | | | |
| Monitoring Program & Annual Reporting | | | | | |
| Review of VMP & Revision/Extension of BR Program (a/r) | | | | | |

**Note:** annual blocks are divided into 6 month increments.

**Note also**: primary and follow-up and maintenance weeding will usually be undertaken concurrently, depending on the number of sites being regenerated.

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# 10 APPENDICES

## APPENDIX 1: FINAL DETERMINATIONS AND SPECIES PROFILES

### A: Shale Gravel Transition Forest- endangered ecological community listing

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Shale Gravel Transition Forest in the Sydney Basin Bioregion, as an ENDANGERED ECOLOGICAL COMMUNITY on Part 3 of Schedule 1 of the Act. Listing of Endangered Ecological Communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Shale Gravel Transition Forest in the Sydney Basin Bioregion is the name given to the ecological community characterised by the species assemblage listed in paragraph 2. All sites are within the Sydney Basin Bioregion.

2. Shale Gravel Transition Forest is characterised by the following assemblage:

| | | |
|---|---|---|
| *Acacia falcata* | *Eucalyptus fibrosa* | *Paspalidium distans* |
| *Acacia parramattensis* | *Eucalyptus moluccana* | *Pomax umbellata* |
| *Aristida vagans* | *Eucalyptus tereticornis* | *Poranthera microphylla* |
| *Austrodanthonia tenuior* | *Euchiton sphaericus* | *Pratia purpurascens* |
| *Brunoniella australis* | *Glycine clandestina* | *Themeda australis* |
| *Bursaria spinosa* | *Goodenia hederacea subsp. hederacea* | *Tricoryne elatior* |
| *Cheilanthes sieberi subsp. sieberi* | *Hardenbergia violacea* | *Vernonia cinerea var. cinerea* |
| *Daviesia ulicifolia* | *Hydrocotyle peduncularis* | *Wahlenbergia gracilis* |
| *Desmodium varians* | *Hypericum gramineum* | *Opercularia diphylla* |
| *Dianella longifolia* | *Laxmannia gracilis* | *Oxalis perennans* |
| *Dianella revoluta var. revoluta* | *Lepidosperma laterale* | *Panicum simile* |
| *Dichelachne micrantha* | *Lissanthe strigosa* | *Paspalidium distans* |
| *Acacia falcata* | *Lomandra filiformis subsp. filiformis* | *Pomax umbellata* |
| *Acacia parramattensis* | *Lomandra multiflora subsp. multiflora* | *Poranthera microphylla* |
| *Aristida vagans* | *Melaleuca decora* | *Pratia purpurascens* |
| *Dichondra repens* | *Microlaena stipoides var. stipoides* | *Themeda australis* |
| *Echinopogon caespitosus var. caespitosus* | *Opercularia diphylla* | *Tricoryne elatior* |
| *Echinopogon ovatus* | *Oxalis perennans* | *Vernonia cinerea var. cinerea* |
| *Entolasia stricta* | *Panicum simile* | *Wahlenbergia gracilis* |

3. The total species list of the flora and fauna of the community is considerably larger than that given in 2 (above), with many species present in only one or two sites or in very small quantity. The community includes invertebrates many of which are poorly known, as well as vertebrates. In any particular site not all of the assemblage listed above may be present. At any one time, some species may only be present as seeds in the soil seed bank with no above-ground individuals present. Invertebrate species may be restricted to soils or canopy trees and shrubs, for example. The species composition of the site will be influenced by the size of the site and by its recent disturbance history. The number of species and the above-ground composition of species will change with time since fire, and may also change in response to changes in fire frequency.

4. Shale Gravel Transition Forest is predominantly of open-forest structure, usually with trees of Eucalyptus fibrosa sometimes with E. moluccana and Eucalyptus tereticornis. Melaleuca decora is frequently present in a small tree stratum. A sparse shrub stratum is usually present with species such as Bursaria spinosa, Daviesia ulicifolia and Lissanthe strigosa. Ground-layer species include Microlaena stipoides subsp. stipoides, Cheilanthes sieberi subsp. sieberi, Themeda australis, Opercularia diphylla, Lomandra multiflora subsp. multiflora, Aristida vagans, Pratia purpurascens and Wahlenbergia gracilis.

5. Shale Gravel Transition Forest occurs primarily in areas where shallow deposits of Tertiary alluvium overlie shale soils but may also occur in association with localised concentrations of iron-indurated gravel. Shale Gravel Transition Forest grades into Cumberland Plain Woodland as alluvial and ironstone influences decline. On thicker deposits of Tertiary alluvium it grades into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland. South of the Tertiary alluvial deposits at Holsworthy, this community forms complex mosaics with shale/sandstone transitional communities.

6. Shale Gravel Transition Forest is described in NSW NPWS (2000a&b) which lists diagnostic plant species for the community. These species provide a guide to identification of the community, but care should be taken in the application and interpretation of diagnostic plant species because of sampling limitations; the reduction in species diversity in degraded sites; and the fact that some species may only be present at a site at some times as a soil seedbank or as dormant bud/tubers.

7. Shale Gravel Transition Forest is or has been known to occur in the Auburn, Bankstown, Baulkham Hills, Blacktown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta and Penrith Local Government Areas, but may occur elsewhere in the Sydney Basin Bioregion.

8. Disturbed Shale Gravel Transition Forest remnants are considered to form part of the community including where the vegetation would respond to assisted natural regeneration, such as where the natural soil and associated seedbank is still at least partially intact.

9. Shale Gravel Transition Forest has been cleared for agriculture and rural development. About 36% of the original distribution of about 7000 ha remains (NSW NPWS 2000a) and much of this is in a degraded state.

10. Shale Gravel Transition Forest occurs in Agnes Banks Nature Reserve, Castlereagh Nature Reserve, Scheyville National Park and Windsor Downs Nature Reserve. The area in these reserves is about 3% of the original distribution.

11. Much of the remaining area of Shale Gravel Transition Forest has been disturbed by clearing, tracks, weeds invasion and soil disturbance. Continuing threats include invasion of exotic species, illegal dumping, unauthorised access, fragmentation and clearing for urban, rural residential recreational and industrial development.

12. In view of the originally restricted distribution of this community, its inadequate representation within conservation reserves, the extensive disturbance and weed invasion that has occurred, and the threats from ongoing development, the Scientific Committee is of the opinion that Shale Gravel Transition Forest in the Sydney Basin Bioregion is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate and that the community is eligible for listing as an endangered ecological community.

Dr Chris Dickman
Chairperson Scientific Committee
Proposed Gazettal date: 19/04/02

## B: *Dillwyia tenuifolia* (a shrub) population - endangered population listing

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the population of *Dillwynia tenuifolia* Sieber ex D.C. at Kemps Creek as an ENDANGERED POPULATION on Part 2 of Schedule 1 of the Act.

Listing of Endangered Populations is provided for by Section 11 of the Act. The Scientific Committee has found that:

1. The population proposed for listing is the population of *Dillwynia tenuifolia* Sieber ex D.C. which occurs in the area bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek within Liverpool City Local Government Area.

2. *Dillwynia tenuifolia*, a member of the Fabaceae, is an erect shrub between 0.6 and 1.0 metre high. *Dillwynia tenuifolia* is listed as vulnerable on Schedule 2 of the Act, and thus the population is eligible for listing as an Endangered Population.

3. *Dillwynia tenuifolia* occurs mainly on the Cumberland Plain, but with a few outlying populations.

4. The area occupied by the Kemps Creek population is within a disjunct occurrence of Castlereagh Ironbark Forest and Castlereagh Woodland, and within the site is widespread through both communities.

5. The site of the population is a small and disjunct remnant of what was formerly a much more extensive area of Castlereagh Woodlands on the central Cumberland Plain, which would have previously provided habitat for *Dillwynia tenuifolia*. The area surviving represents about 7.5% of the original area of Castlereagh Woodlands between Kemps Creek and South Creeks.

6. The population is threatened by proposed development which would involve clearing of vegetation, and by rubbish dumping and weed invasion.

7. The population is near the southern limit of the distribution of *Dillwynia tenuifoli*a, and is of significance because of its size, the high density of individuals in parts of the site and the generally good condition of the remnants in which it occurs.

8. In the light of 1, 5, 6, and 7 above the Scientific Committee is of the opinion that the habitat of the population has been so drastically reduced that it is in immediate danger of extinction and is of significant conservation value, and meets the criteria for listing as an endangered population, and thus has made a final determination to list the population as endangered.

Dr Chris Dickman

Chairperson Scientific Committee

Gazetted: 28/11/97

## C: *Pultenaea parviflora* - species profile*

**Conservation status in NSW:** Endangered
**National conservation status:** Vulnerable

## Description

Usually a small erect branching shrub up to 1.8 m. Leaves are alternate, 2 - 6 mm long, 1 -1 .5 mm wide, Flowers occur towards the ends of the branchlets, and are 5 - 7 mm long, yellow and pea-like with reddish markings, single.

**Location and Habitat**

Distribution

Endemic to the Cumberland Plain. Core distribution is from Windsor to Penrith and east to Dean Park. Outlier populations are recorded from Kemps Creek and Wilberforce.

Habitat and Ecology

May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays.

May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.

*Eucalyptus fibrosa* is usually the dominant canopy species. *Eucalyptus globoidea*, *E. longifolia*, *E. parramattensis*, *E. sclerophylla* and *E. sideroxylon* may also be present or co-dominant, with *Melaleuca decora* frequently forming a secondary canopy layer.

Associated species may include *Allocasuarina littoralis*, *Angophora bakeri*, *Aristida spp. Banksia spinulosa, Cryptandra spp., Daviesia ulicifolia, Entolasia stricta, Hakea sericea, Lissanthe strigosa, Melaleuca nodosa, Ozothamnus diosmifolius* and *Themeda australis*.

Often found in association with other threatened species such as *Dillwynia tenuifolia, Dodonaea falcata, Grevillea juniperina, Micromyrtus minutiflora, Persoonia nutans* and *Styphelia laeta*

Flowering may occur between August and November depending on environmental conditions. Pollinators are unknown.

Current estimates are that reproductive maturity is not reached for 3-4 years, and peak reproduction until 5-6 years.

Killed by fire but re-establishes from soil-stored seed. There is no evidence of vegetative spread.

## Regional

This species is found in the following catchment management authority regions. Click on a region name to see more details about the distribution, vegetation types and habitat preference of the species in that region.

## Threats

Threats include clearance and fragmentation of habitat for residential, industrial and rural purposes, inappropriate fire regimes, uncontrolled vehicular access, fill and rubbish dumping and weed invasion.

## Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. The Department of Environment and Conservation has identified **6 priority actions** to help recover the *Pultenaea parviflora* in New South Wales.

## What needs to be done to recover this species?

Fire intervals of 10-15 yrs (where there are no needs for asset protection zones)

Protect areas of known and potential habitat from clearing and further fragmentation.

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* **Source:** DECC Threatened Species Website

## D *Acacia pubescens* – species profile*

**Conservation status in NSW: Vulnerable**
**National conservation status: Vulnerable**

### Description

A spreading shrub, 1 - 4 m high with brilliant yellow flowers, bipinnate leaves (divided twice pinnately) and conspicuously hairy branchlets.

### Location and habitat

Distribution

Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon.

Habitat and ecology

Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone.

Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland.

Longevity is unknown, but clonal species have been known to survive for many decades.

Flowers from August to October. Pollination of Acacia flowers is usually by insects and birds. The pods mature in October to December.

Recruitment is more commonly from vegetative reproduction than from seedlings. The percentage of pod production and seed fall for this species appears to be low.

Acacia species generally have high seed dormancy and long-lived persistent soil seedbanks. It is thought that the species needs a minimum fire free period of 5 - 7 years to allow an adequate seedbank to develop.

Regional Information

This species is found in the following catchment management authority regions.

Hawkesbury/Nepean
Sydney Metro

### Threats

- Habitat loss
- Habitat degradation (through weed invasion, mechanical damage, rubbish dumping, illegal track creation, and inappropriate fire regimes).
- Disease.
- Hybridisation.

### Recovery Strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. The Department of Environment and Conservation has identified 13 priority actions to help recover the Downy Wattle in New South Wales.

What needs to be done to recover this species?

- Remove hybrids.
- Protect known populations.
- Enhance existing habitat.
- Monitor the reproductive status of populations.

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* **Source:** DECC Threatened Species Website

## APPENDIX 2: FLORA SPECIES RECORDED IN THE OAKVILLE BUSHLAND

**KEY**

■ - Species of National or State conservation significance.

□ - Species of regional conservation significance (NPWS 1997).

* - Introduced or non-indigenous native species.

**Species Frequency of Occurrence within the Subject Land**

V - Very common (species covers 51-100% of the site).
C - Common (species covers 26-50% of the site).
O - Occasional (species covers 5-25% of the site).
R - Rare (species covers <5% of the site; scattered distribution).
L - Localised distribution only (species covers <5% of the site; clumped distribution).

| FAMILY | SCIENTIFIC NAME | COMMON NAME | STATUS | FREQUENCY |
|---|---|---|---|---|
| DICOTYLEDONS | | | | |
| Acanthaceae | *Brunoniella australis* | Blue Trumpet | | R |
| Adiantaceae | *Cheilianthes sieberi* | Mulga Fern | | R |
| Aloeaceae | *Aloe* sp. | Aloe | * | L |
| Apocynaceae | *Parsonsia straminea* | Common Silkpod | | L |
| Asclepiadaceae | *Araujia hortorum* | Moth Plant | * | R |
| Asteraceae | *Bidens pilosa* | Cobbler's Pegs | * | R |
| Asteraceae | *Brachyscome angustifolia* | | | R |
| Asteraceae | *Cirsium vulgare* | Spear Thistle | * | R |
| Asteraceae | *Hypochaeris radicata* | Catsear | * | R |
| Asteraceae | *Ozothamnus diosmifolius* | White Dogwood | | R |
| Asteraceae | *Senecio madagascariensis* | Fireweed | * | R |
| Asteraceae | *Sonchus oleraceus* | Common Sowthistle | * | L |
| Basellaceae | *Anredera cordifolia* | Madeira Vine | * | R |
| Bignoniaceae | *Tecoma stans* | Tecoma | * | R |
| Boraginaceae | *Echium plantagineum* | Patterson's Curse | * | R |
| Brassicaceae | *Brassica* sp. | | * | L |
| Cactaceae | *Opuntia* sp. | Prickly Pear | * | R |
| Casuarinaceae | *Allocasuarina littoralis* | Black Sheoak | | O |
| Chenopodiaceae | *Atriplex semibaccata* | Saltbush | □ | R |
| Chenopodiaceae | *Einadia hastata* | Berry Saltbush | | O |
| Commelinaceae | *Tradescantia fluminensis* | Wandering Jew | * | L |
| Convolvulaceae | *Dichondra repens* | Kidney Weed | | R |
| Convolvulaceae | *Ipomoea indica* | Morning Glory | * | R |
| Crassulaceae | *Brophyllum delagoense* | Mother of Millions | * | L |
| Crassulaceae | *Sedum* sp. | Pride of London | * | R |
| Ericaceae | *Lissanthe strigosa* | Peach Heath | | O |
| Euphorbiaceae | *Phyllanthus hirtellus* | | | R |
| Fabaceae (Caesalpinioideae) | *Senna pendula* var. *glabrata* | | * | R |
| Fabaceae (Faboideae) | *Daviesia ulicifolia* | Gorse Bitter Pea | | O |
| Fabaceae (Faboideae) | *Dillwynia tenuifolia* | | ■ | O |
| Fabaceae (Faboideae) | *Dillwynia sieberi* | | | R |
| Fabaceae (Faboideae) | *Pultenaea parviflora* | | ■ | O |
| Fabaceae (Faboideae) | *Pultenaea villosa* | | | R |
| Fabaceae (Mimosoideae) | *Acacia binervia* | Coast Myall | | R |
| Fabaceae (Mimosoideae) | *Acacia falcata* | | | R |

| FAMILY | SCIENTIFIC NAME | COMMON NAME | STATUS | FREQUENCY |
|---|---|---|---|---|
| Fabaceae (Mimosoideae) | *Acacia floribunda* | White Sally | | R |
| Fabaceae (Mimosoideae) | *Acacia parramattensis* | Parramatta Wattle | | O |
| Fabaceae (Mimosoideae) | *Acacia pubescens* | Downy Wattle | ■ | L |
| Geraniaceae | *Geranium molle* subsp. *molle* | Cranesbill Geranium | * | R |
| Goodeniaceae | *Goodenia hederacea subsp. hederacea* | | | R |
| Lauraceae | *Cassytha glabella* | | | R |
| Liliaceae | *Laxmannia gracilis* | Slender Wire Lily | | R |
| Lobeliaceae | *Pratia purpurascens* | Whiteroot | | R |
| Loranthaceae | *Amyema gaudichaudii* | A Mistletoe | □ | R |
| Malvaceae | *Sida rhombifolia* | Paddy's Lucerne | * | R |
| Myrtaceae | *Angophora bakeri* | | | R |
| Myrtaceae | *Eucalyptus fibrosa* | Red Ironbark | | C |
| Myrtaceae | *Eucalyptus parramattensis* | Drooping Red Gum | | R |
| Myrtaceae | *Leptospermum trinervium* | | | R |
| Myrtaceae | *Melaleuca decora* | White Feather Honeymyrtle | | C |
| Myrtaceae | *Melaleuca nodosa* | Ball Honeymyrtle | | C |
| Oxalidaceae | *Oxalis perennans* | | □ | R |
| Passifloraceaceae | *Passiflora caeulea* | Blue Passion Flower | | R |
| Pittosporaceae | *Bursaria spinosa* | Native Blackthorn | | R |
| Plantaginaceae | *Plantago lanceolata* | Lamb's Tongues | * | R |
| Proteaceae | *Grevillea robusta* | Silky Oak | * | R |
| Proteaceae | *Hakea dactyloides* | Finger Hakea | | R |
| Proteaceae | *Hakea sericea* | Needlebush | | R |
| Proteaceae | *Persoonia linearis* | Narrow-leaved Geebung | | R |
| Rubiaceae | *Pomax umbellata* | Pomax | | R |
| Santalaceae | *Exocarpos cupressiformis* | Native Cherry | | R |
| Santalaceae | *Exocarpos strictus* | Dwarf Cherry | | R |
| Scrophulariaceae | *Veronica plebia* | Trailing speedwell | | R |
| Solanaceae | *Solanum mauritianum* | Wild Tobacco Bush | * | R |
| Solanaceae | *Solanum nigrum* | Black-berry Nightshade | * | R |
| Solanaceae | *Solanum prinophyllum* | Forest Nightshade | | R |
| Thymelaeaceae | *Pimelea linifolia* | | | R |
| Verbenaceae | *Verbena* sp. | Verbena | * | R |
| MONOCOTYLEDONS | | | | |
| Agavaceae | *Agave americana* | Century Plant | * | L |
| Agavaceae | *Yucca aloifolia* | | * | R |
| Asparagaceae | *Asparagus aethiopicus* | Asparagus Fern | * | R |
| Asparagaceae | *Asparagus asparagoides* | Florist's Smilax | * | O |
| Commelinaceae | *Tradescantia fluminensis* | Wandering Jew | * | L |
| Cyperaceae | *Cyathochaeta diandra* | | | R |
| Cyperaceae | *Carex inversa* | | □ | R |
| Cyperaceae | *Lepidosperma laterale* | Handsome Flat Pea | | O |
| Lomandraceae | *Lomandra confertifolia* | | | R |
| Lomandraceae | *Lomandra glauca* | Pale Mat-rush | | R |

| FAMILY | SCIENTIFIC NAME | COMMON NAME | STATUS | FREQUENCY |
|---|---|---|---|---|
| Lomandraceae | *Lomandra longifolia* | Spiny-headed Mat-rush | | R |
| Lomandraceae | *Lomandra multiflora subsp. multiflora* | Many-flowered Mat-rush | | O |
| Lomandraceae | *Lomandra obliqua* | | | R |
| Luzuriagaceae | *Eustrephus latifolius* | Wombat Berry | | |
| Orchidaceae | *Pterostylis rufa* | Rusty Hood | □ | O |
| Phormiaceae | *Dianella caerulea* | Blue Flax-lily | | O |
| Phormiaceae | *Dianella longifolia* | | | R |
| Poaceae | *Aristida vagans* | Threeawn Speargrass | | R |
| Poaceae | *Austrodanthonia tenuior* | | | R |
| Poaceae | *Chloris gayana* | Rhodes Grass | * | R |
| Poaceae | *Echinopogon caespitosus var. caespitosus* | Tufted Hedgehog Grass | | R |
| Poaceae | *Entolasia stricta* | | | R |
| Poaceae | *Ehrharta erecta* | Panic Veldtgrass | * | R |
| Poaceae | *Eragrostis curvula* | African Lovegrass | * | C |
| Poaceae | *Microleana stipoides var. stipoides* | Weeping Rice Grass | | R |
| Poaceae | *Paspalum dilatatum* | Paspalum | * | R |
| Poaceae | *Pennisetum clandestinum* | Kikuyu Grass | * | R |
| Poaceae | *Setaria? gracilis* | Slender Pigeon Grass | * | R |
| Xanthorrhoeaceae | *Xanthorrhoea media* | Forest Grass Tree | | O |
| Xanthorrhoeaceae | *Xanthorrhoea minor subsp. minor* | | | O |

## APPENDIX 3: FLORA SPECIES OF STATE OR NATIONAL CONSERVATION SIGNIFICANCE OCCURRING WITHIN THE REGION.

**Source of Records**

1 = Department of Environment and Climate Change (2007); search area 10 x 10 kilometres centred on study area

2 = Department of the Environment and Water Resources (2007); search area 5 kilometre radius centred on study area

| NAME | SOURCE | STATUS | SOURCE | STATUS |
|---|---|---|---|---|
| | 1 | | 2 | |
| *Acacia pubescens* | ✓ | Vulnerable | ✓ | Vulnerable |
| *Dillwynia tenuifolia* | ✓ | Vulnerable | ✓ | Vulnerable |
| *Grevillea juniperina subsp. juniperina* | ✓ | Vulnerable | | |
| *Micromyrtus minutiflora* | ✓ | Endangered | ✓ | Vulnerable |
| *Persoonia hirsuta* | ✓ | Endangered | ✓ | Endangered |
| *Persoonia nutans* | ✓ | Endangered | ✓ | Endangered |
| *Pultenaea parviflora* | ✓ | Endangered | ✓ | Vulnerable |
| *Tetratheca glandulosa* | ✓ | Vulnerable | ✓ | Vulnerable |

## APPENDIX 4: FAUNA SPECIES RECORDED OR KNOWN TO OCCUR IN THE VICINITY OF THE SUBJECT PROPERTY AT OAKVILLE PARK, OAKVILLE

**Key**

**A** - indicates species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

**B** - indicates species listed under the NSW *Threatened Species Conservation Act 1995*.

**F** – migratory. Family listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

• - indicates species of regional conservation significance (Western Division)

**#** - indicates species of regional conservation significance (Brigalow Belt South region)

**∇** - indicates species of regional conservation significance (Eastern/Sydney Division)

***** - indicates introduced species.P - preliminary determinations to the NSW *Threatened Species Conservation Act 1995*.

**N** - nominations for listing under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

**Source of Records**

1 = Species recorded during present study.

2 = DEC (2007)

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | | MAMMALS | | | |
| | | | **Tachyglossidae** | | |
| | | ∇ Short-beaked Echidna | *Tachyglossus aculeatus* | | √ |
| | | | **Phascolarctidae** | | |
| | x | • Koala | *Phascolarctos cinereus* | | √ |
| | | | **Petauridae** | | |
| | | • Sugar Glider | *Petaurus breviceps* | | √ |
| | | | **Pseudocheiridae** | | |
| | | Common Ringtail Possum | *Pseudocheirus peregrinus* | | √ |
| | | | **Phalangeridae** | | |
| | | • Common Brushtail Possum | *Trichosurus vulpecula* | | √ |
| | | | **Macropodidae** | | |
| | | ∇ Eastern Grey Kangaroo | *Macropus giganteus* | | √ |
| | | ∇ • Swamp Wallaby | *Wallabia bicolor* | | √ |
| | | | **Pteropodidae** | | |
| x | x | Grey-headed Flying Fox | *Pteropus poliocephalus* | | √ |
| | | • Little Red Flying Fox | *Pteropus scapulatus* | | √ |
| | | | **Vespertilioidae** | | |
| x | x | Large-eared Pied Bat | *Chalinolobus dwyeri* | | √ |
| | | Gould's Wattled Bat | *Chalinolobus gouldii* | | √ |
| | | • Chocolate Wattled Bat | *Chalinolobus morio* | | √ |
| | x | Eastern False-Pipistrelle | *Falsistrellus tasmaniensis* | | √ |
| | x | Eastern Bentwing Bat | *Miniopterus schreibersii oceanensis* | | √ |
| | x | Large-footed Myotis | *Myotis adversus* | | √ |
| | | Lesser Long-eared Bat | *Nyctophilus geoffroyi* | | √ |
| | | • Gould's Long-eared Bat | *Nyctophilus gouldi* | | √ |
| | x | Greater Broad-nosed Bat | *Scoteanax rueppellii* | | √ |
| | | Eastern Broad-nosed Bat | *Scotorepens orion* | | √ |

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | | Southern Forest Bat | *Vespadelus regulus* | | √ |
| | | Little Forest Bat | *Vespadelus vulturnus* | | √ |
| | | | **Molossidae** | | |
| | x | Eastern Freetail Bat | *Mormopterus* sp. 2 | | √ |
| | | Freetail Bat | *Mormopterus* sp. | | √ |
| | | White-striped Freetail Bat | *Nyctinomus australis* | | √ |
| | | | **Muridae** | | |
| | | * House Mouse | *Mus musculus* | | √ |
| | | Bush Rat | *Rattus fuscipes* | | √ |
| | | * Black Rat | *Rattus rattus* | | √ |
| | | | **Canidae** | | |
| | | Dingo | *Canis lupus dingo* | | √ |
| | | * Fox | *Vulpes vulpes* | | √ |
| | | * Dog | *Canis familiaris* | | √ |
| | | | **Felidae** | | |
| | | * Feral Cat | *Felis catus* | | √ |
| | | | **Leporidae** | | |
| | | * Rabbit | *Oryctolagus cuniculus* | √ | √ |
| | | * Brown Hare | *Lepus capensis* | | √ |
| | | | **Equidae** | | |
| | | * Horse | *Equus caballus* | | √ |
| | | | **Bovidae** | | |
| | | * Goat | *Capra hircus* | | √ |
| | | * European Cattle | *Bos taurus* | | √ |
| | | **BIRDS** | | | |
| | | | **Phasianidae** | | |
| | | ∇ Stubble Quail | *Coturnix pectoralis* | | √ |
| | | ∇ • Brown Quail | *Coturnix ypsilophora* | | √ |
| | | | **Turnicidae** | | |
| | | ∇ • Painted Button-quail | *Turnix varia* | | √ |
| | | | **Pelecanidae** | | |
| | | • Australian Pelican | *Pelecanus conspicillatus* | | √ |
| | | | **Anhingidae** | | |
| | | • Darter | *Anhinga melanogaster* | | √ |
| | | | **Phalacrocoracidae** | | |
| | | Pied Cormorant | *Phalacrocorax varius* | | √ |
| | | Little Pied Cormorant | *Phalacrocorax melanoleucos* | | √ |
| | | Great Cormorant | *Phalacrocorax carbo* | | √ |
| | | Little Black Cormorant | *Phalacrocorax sulcirostris* | | √ |
| | | | **Podicipedidae** | | |

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | | Hoary-headed Grebe | *Poliocephalus poliocephalus* | | √ |
| | | Australasian Grebe | *Tachybaptus novaehollandiae* | | √ |
| F | | | **Anatidae** | | |
| | | Black Swan | *Cygnus atratus* | | √ |
| | | Plumed Whistling-duck | *Dendrocygna eytoni* | | √ |
| | | Australian Shelduck | *Tadorna tadornoides* | | √ |
| | | Pacific Black Duck | *Anas superciliosa* | | √ |
| | | * Mallard | *Anas platyrhynchos* | | √ |
| | | Grey Teal | *Anas gracilis* | | √ |
| | | Chestnut Teal | *Anas castanea* | | √ |
| | | Australasian Shoveler | *Anas rhynchotis* | | √ |
| | | Pink-eared Duck | *Malacorhynchus membranaceus* | | √ |
| | | Hardhead | *Aythya australis* | | √ |
| | | Australian Wood (Maned) Duck | *Chenonetta jubata* | | √ |
| | x | • # Freckled Duck | *Stictonetta naevosa* | | √ |
| | | | **Rallidae** | | |
| | | • Buff-banded Rail | *Gallirallus phillippensis* | | √ |
| | | Baillon's Crake | *Porzana pusilla* | | √ |
| | | Spotless Crake | *Porzana tabuensis* | | √ |
| | | Black-tailed Native-hen | *Gallinula ventralis* | | √ |
| | | Dusky Moorhen | *Gallinula tenebrosa* | | √ |
| | | Purple Swamphen | *Porphyrio porphyrio* | | √ |
| | | Eurasian Coot | *Fulica atra* | | √ |
| | | | **Ardeidae** | | |
| | | White-necked Heron | *Ardea pacifica* | | √ |
| | | White-faced Heron | *Egretta novaehollandiae* | | √ |
| x | | • Cattle Egret | *Ardea ibis* | | √ |
| x | | ∇ • Great Egret | *Ardea alba* | | √ |
| | | Little Egret | *Egretta garzetta* | | √ |
| | | Intermediate Egret | *Egretta intermedia* | | √ |
| | | ∇ Nankeen (Rufous) Night Heron | *Nycticorax caledonicus* | | √ |
| | x | • # Australasian Bittern | *Botaurus poiciloptilus* | | √ |
| | | | **Threskiornidae** | | |
| | | ∇ Glossy Ibis | *Plegadis falcinellus* | | √ |
| | | Australian White (Sacred) Ibis | *Threskiornis molluca* | | √ |
| | | • Straw-necked Ibis | *Threskiornis spinicollis* | | √ |
| | | • Royal Spoonbill | *Platalea regia* | | √ |
| | | Yellow-billed Spoonbill | *Platalea flavipes* | | √ |
| | | | **Ciconiidae** | | |

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | x | • # Black-necked Stork | *Ephippiorhynchus asiaticus* | | √ |
| F | | | **Scolopacidae** | | |
| | | ∇ Little Curlew | *Numenius minutus* | | √ |
| | | ∇ Wood Sandpiper | *Tringa glareola* | | √ |
| | | ∇ Common Sandpiper | *Actitis hypoleucos* | | √ |
| | | ∇ Common Greenshank | *Tringa nebularia* | | √ |
| | | ∇ Marsh Sandpiper | *Tringa stagnatilis* | | √ |
| | | ∇ • Latham's Snipe | *Gallinago hardwickii* | | √ |
| | x | • # Black-tailed Godwit | *Limosa limosa* | | √ |
| | | ∇ Bar-tailed Godwit | *Limosa lapponica* | | √ |
| | | ∇ Sharp-tailed Sandpiper | *Calidris acuminata* | | √ |
| | | Pectoral Sandpiper | *Calidris melanotus* | | √ |
| | | ∇ Long-toed Stint | *Calidris subminuta* | | √ |
| | | ∇ Curlew Sandpiper | *Calidris ferruginea* | | √ |
| | | ∇ Ruff | *Philomachus pugnax* | | √ |
| | | | **Glareolidae** | | |
| | | Australian Pratincole | *Stiltia isabella* | | √ |
| | | | **Rostratulidae** | | |
| x | x | • # Painted Snipe | *Rostratula benghalensis* | | √ |
| | | | **Jacanidae** | | |
| | x | • Comb-crested Jacana | *Irediparra gallinacea* | | √ |
| F | | | **Charadriidae** | | |
| | | Masked Lapwing | *Vanellus miles* | | √ |
| | | Banded Lapwing | *Vanellus tricolor* | | √ |
| | | ∇ Grey Plover | | | √ |
| | | Lesser Golden Plover | *Pluvialis dominica* | | √ |
| | | # Red-kneed Dotterel | *Erythrogonys cinctus* | | √ |
| | | Double-banded Plover | *Charadrius bicinctus* | | √ |
| F | | | **Recurvirostridae** | | |
| | | Black-winged Stilt | *Himantopus himantopus* | | √ |
| | | Red-necked Avocet | *Recurvirostra novaehollandiae* | | √ |
| | | | **Laridae** | | |
| | | Silver Gull | *Larus novaehollandiae* | | √ |
| | | • Whiskered Tern | *Chlidonias hybrida* | | √ |
| | | Caspian Tern | *Sterna caspia* | | √ |
| | | Gullbilled Tern | *Sterna nilotica* | | √ |
| F | | | **Accipitridae** | | |
| | | ∇ Pacific Baza | *Aviceda subcristata* | | √ |
| | | Black-shouldered Kite | *Elanus axillaris* | | √ |

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | | Black Kite | *Milvus migrans* | | √ |
| | | ∇ Whistling Kite | *Haliastur sphenurus* | | √ |
| x | | ∇ White-bellied Sea-eagle | *Haliaeetus leucogaster* | | √ |
| | | ∇ Little Eagle | *Hieraaetus morphnoides* | | √ |
| | | Brown Goshawk | *Accipiter fasciatus* | | √ |
| | | Collared Sparrowhawk | *Accipiter cirrhocephalus* | | √ |
| | | ∇ Grey Goshawk | *Accipiter novaehollandiae* | | √ |
| | | Spotted Harrier | *Circus assimilis* | | √ |
| | | Swamp Harrier | *Circus approximans* | | √ |
| F | | | **Falconidae** | | |
| | | • Black Falcon | *Falco subniger* | √ | √ |
| | | ∇ Peregrine Falcon | *Falco peregrinus* | | √ |
| | | Australian Hobby | *Falco longipennis* | | √ |
| | | Brown Falcon | *Falco berigora* | | √ |
| | | Nankeen Kestrel | *Falco cenchroides* | | √ |
| | | | **Columbidae** | | |
| | | * Rock Dove | *Columba livia* | | √ |
| | | * Spotted Turtle-dove | *Streptopelia chinensis* | | √ |
| | | ∇ Brown Cuckoo-dove | *Macropygia amboinensis* | | √ |
| | | Peaceful Dove | *Geopelia striata* | √ | √ |
| | | ∇ Common Bronzewing | *Phaps chalcoptera* | | √ |
| | | Crested Pigeon | *Ocyphaps lophotes* | | √ |
| | | Wonga Pigeon | *Leucosarcia melanoleuca* | | √ |
| | | | **Cacatuidae** | | |
| | x | • # Glossy Black-Cockatoo | *Calyptorhynchus lathami* | | √ |
| | | Yellow-tailed Black Cockatoo | *Calyptorhynchus funereus* | | √ |
| | x | Gang-gang Cockatoo | *Callocephalon fimbriatum* | | √ |
| | | Galah | *Eolophus roseicpilla* | | √ |
| | | Little Corella | *Cacatua sanguinea* | | √ |
| | x | • # Major Mitchell's Cockatoo | *Cacatua leadbeateri* | | √ |
| | | Sulphur-crested Cockatoo | *Cacatua galerita* | √ | √ |
| | | | **Psittacidae** | | |
| | | Rainbow Lorikeet | *Trichoglossus haematodus* | | √ |
| | | Scaly-breasted Lorikeet | *Trichoglossus chlorolepidotus* | | √ |
| | | Musk Lorikeet | *Glossopsitta concinna* | | √ |
| | | Little Lorikeet | *Glossopsitta pusilla* | | √ |
| | | Australian King Parrot | *Alisterus scapularis* | | √ |
| x | x | • # Superb Parrot | *Polytelis swainsonii* | | √ |
| x | x | • # Swift Parrot | *Lathamus discolor* | | √ |

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | | # Crimson Rosella | *Platycercus elegans* | | √ |
| | | • Eastern Rosella | *Platycercus eximius* | | √ |
| | | Red-rumped Parrot | *Psephotus haematonotus* | | √ |
| | | | **Cuculidae** | | |
| | | Pallid Cuckoo | *Cuculus pallidus* | | √ |
| | | # Brush Cuckoo | *Cuculus variolosus* | | √ |
| | | Fan-tailed Cuckoo | *Cuculus flabelliformis* | | √ |
| | | ∇ Black-eared Cuckoo | *Chrysococcyx osculans* | | √ |
| | | Horsfield's Bronze-Cuckoo | *Chrysococcyx basalis* | | √ |
| | | • Shining Bronze-Cuckoo | *Chrysococcyx lucidus* | | √ |
| | | Channel-billed Cuckoo | *Scthrops novaehollandiae* | | √ |
| | | | **Centropodidae** | | |
| | | ∇ Pheasant Coucal | *Centropus phasianinus* | | √ |
| | | | **Strigidae** | | |
| | x | • # Powerful Owl | *Ninox strenua* | | √ |
| | | Southern Boobook | *Ninox novaeseelandiae* | | √ |
| | x | • # Barking Owl | *Ninox connivens* | | √ |
| | | | **Tytonidae** | | |
| | | Barn Owl | *Tyto alba* | | √ |
| | | | **Podargidae** | | |
| | | Tawny Frogmouth | *Podargus strigoides* | | √ |
| | | | **Aegothelidae** | | |
| | | Australian Owlet-nightjar | *Aegotheles cristatus* | | √ |
| | | | **Apodidae** | | |
| x | | ∇ White-throated Needletail | *Hirundapus caudacutus* | | √ |
| | | | **Alcedinidae** | | |
| | | • # Azure Kingfisher | *Alcedo azurea* | | √ |
| | | Laughing Kookaburra | *Dacelo naxaeguineae* | | √ |
| | | | **Meropidae** | | |
| x | | Rainbow Bee-eater | *Merops ornatus* | | √ |
| | | | **Coraciidae** | | |
| | | Dollarbird | *Eurystomus orientalis* | | √ |
| | | | **Neosittidae** | | |
| | | • Varied Sittella | *Daphoenositta chrysoptera* | | √ |
| | | | **Climacteridae** | | |
| | | • White-throated Treecreeper | *Cormobates leucophaeus* | | √ |
| | x | ∇ • Brown Treecreeper | *Climacteris picumnus* | | √ |
| | | | **Maluridae** | | |
| | | Superb Fairy-wren | *Malurus cyaneus* | | √ |
| | | Variegated Fairy-wren | *Malurus lamberti* | | √ |

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | | | **Pardalotidae** | | |
| | | Spotted Pardalote | *Pardalotus punctatus* | √ | √ |
| | | Striated Pardalote | *Pardalotus striatus* | | √ |
| | | | **Acanthizidae** | | |
| | | White-browed Scrubwren | *Sericornis frontalis* | | √ |
| | x | ∇ • # Speckled Warbler | *Chthinicola sagittata* | | √ |
| | | Weebill | *Smicrornis brevirostris* | √ | √ |
| | | White-throated Gerygone | *Gerygone olivacea* | √ | √ |
| | | Brown Gerygone | *Gerygone mouki* | √ | √ |
| | | Brown Thornbill | *Acanthiza pusilla* | | √ |
| | | Yellow Thornbill | *Acanthiza nana* | √ | √ |
| | | Striated Thornbill | *Acanthiza lineata* | √ | √ |
| | | ∇ • Buff-rumped Thornbill | *Acanthiza reguloides* | | √ |
| | | ∇ • Yellow-rumped Thornbill | *Acanthiza chrysorrhoa* | | √ |
| | | | **Meliphagidae** | | |
| | | Red Wattlebird | *Anthochaera carunculata* | | √ |
| | | Little (Brush) Wattlebird | *Anthochaera chrysoptera* | | √ |
| | | Striped Honeyeater | *Plectorhyncha lanceolata* | | √ |
| | | • Noisy Friarbird | *Philemon corniculatus* | | √ |
| x | x | • # Regent Honeyeater | *Xanthomyza phrygia* | | √ |
| | | Blue-faced Honeyeater | *Entomyzon cyanotis* | | √ |
| | | Bell Miner | *Manorina melanophrys* | √ | √ |
| | | Noisy Miner | *Manorina melanocephala* | √ | √ |
| | | Lewin's Honeyeater | *Meliphaga lewinii* | | √ |
| | | Yellow-faced Honeyeater | *Lichenostomus chrysops* | √ | √ |
| | | White-eared Honeyeater | *Lichenostomus leucotis* | | √ |
| | | • Yellow-tufted Honeyeater | *Lichenostomus melanops* | | √ |
| | | ∇ Fuscous Honeyeater | *Lichenostomus fuscus* | √ | √ |
| | | White-plumed Honeyeater | *Lichenostomus pencillatus* | | √ |
| | x | ∇ • # Black-chinned Honeyeater | *Melithreptus gularis* | | √ |
| | | • Brown-headed Honeyeater | *Melithreptus brevirostris* | | √ |
| | | White-cheeked Honeyeater | *Phylidonyris nigra* | | √ |
| | x | • # Painted Honeyeater | *Grantiella picta* | | √ |
| | | Eastern Spinebill | *Acanthorhynchus tenuirostris* | | √ |
| | | Scarlet Honeyeater | *Myzomela sanguinolenta* | | √ |
| | | | **Petroicidae** | | |
| | | Rose Robin | *Petroica rosea* | | √ |
| | | ∇ Scarlet Robin | *Petroica multicolor* | | √ |
| | | ∇ • Red-capped Robin | *Petroica goodenovii* | | √ |

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | | • Eastern Yellow Robin | *Eopsaltria australis* | √ | √ |
| | | ∇ • Jacky Winter | *Microeca fascinans* | | √ |
| | | | **Pachycephalidae** | | |
| | | ∇ • # Crested Shrike-tit | *Falcunculus frontatus* | | √ |
| | | Grey Shrike-thrush | *Colluricincla harmonica* | | √ |
| | | • Golden Whistler | *Pachycephala pectoralis* | √ | √ |
| | | • Rufous Whistler | *Pachycephala rufiventris* | | √ |
| | | | **Dicruridae** | | |
| | | Grey Fantail | *Rhipidura fuliginosa* | | √ |
| | | Rufous Fantail | *Rhipidura rufifrons* | | √ |
| | | Willie Wagtail | *Rhipidura leucophrys* | | √ |
| | | Leaden Flycatcher | *Myiagra rubecula* | | √ |
| | | # Satin Flycatcher | *Myiagra cyanoleuca* | | √ |
| | | ∇ • Restless Flycatcher | *Myiagra inquieta* | | √ |
| | | Magpie Lark | *Grallina cyanoleuca* | √ | √ |
| | | | **Oriolidae** | | |
| | | • Olive-backed Oriole | *Oriolus sagittatus* | | √ |
| | | | **Campephagidae** | | |
| | | Black-faced Cuckoo-shrike | *Coracina novaehollandiae* | √ | √ |
| | | ∇ White-bellied Cuckoo-shrike | *Coracina papuensis* | | √ |
| | | Cicadabird | *Coracina tenuirostris* | | √ |
| | | ∇ White-winged Triller | *Lalage sueurii* | | √ |
| | | | **Artamidae** | | |
| | | White-breasted Woodswallow | *Artamus leucorynchus* | | √ |
| | | # Masked Woodswallow | *Artamus personatus* | | √ |
| | | • # White-browed Woodswallow | *Artamus superciliosus* | | √ |
| | | • Dusky Woodswallow | *Artamus cyanopterus* | | √ |
| | | Grey Butcherbird | *Cracticus torquatus* | | √ |
| | | Pied Butcherbird | *Cracticus nigrogularis* | | √ |
| | | Australian Magpie | *Gymnorhina tibicen* | | √ |
| | | Pied Currawong | *Strepera graculina* | | √ |
| | | | **Corvidae** | | |
| | | Australian Raven | *Corvus coronoides* | | √ |
| | | | **Corcoracidae** | | |
| | | ∇ White-winged Chough | *Corcorax melanorhamphos* | | √ |
| | | | **Hirundinidae** | | |
| | | # White-backed Swallow | *Cheramoeca leucosternus* | | √ |
| | | Barn Swallow | *Hirundo rustica* | | √ |
| | | Welcome Swallow | *Hirundo neoxena* | | √ |

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | | Tree Martin | *Hirundo nigricans* | | √ |
| | | Fairy Martin | *Hirundo ariel* | | √ |
| | | | **Motacillidae** | | |
| | | Australian Pipit | *Anthus australis* | | √ |
| | | | **Alaudidae** | | |
| | | Skylark | *Alauda arvensis* | | √ |
| F | | | **Sylviidae** | | |
| | | ∇ Rufous Songlark | *Cincloramphus mathewsi* | | √ |
| | | ∇ Brown Songlark | *Cincloramphus cruralis* | | √ |
| | | Australian Reed-warbler | *Acrocephalus australis* | | √ |
| | | • Golden-headed Cisticola | *Cisticola exilis* | | √ |
| | | Tawny Grassbird | *Megalurus timoriensis* | | √ |
| | | Little Grassbird | *Megalurus gramineus* | | √ |
| | | | **Passeridae** | | |
| | | * House Sparrow | *Passer domesticus* | | √ |
| | | | **Fringillidae** | | |
| | | * European Goldfinch | *Carduelis carduelis* | | √ |
| | | | **Estrildidae** | | |
| | | Double-barred Finch | *Taeniopygia bichenovii* | | √ |
| | | ∇ Zebra Finch | *Taeniopygia guttata* | | √ |
| | | Red-browed Finch | *Neochmia temporalis* | | √ |
| | | * Nutmeg Mannikin | *Lonchura puntulata* | | √ |
| | | ∇ Chestnut-breasted Mannikin | *Lonchura castaneothorax* | | √ |
| | | | **Dicaeidae** | | |
| | | Mistletoebird | *Dicaeum hirundinaceum* | | √ |
| | | | **Zosteropidae** | | |
| | | Silvereye | *Zosterops lateralis* | | √ |
| | | | **Pycnonotidae** | | |
| | | * Red-whiskered Bulbul | *Pycnonotus jocosus* | | √ |
| F | | | **Muscicapidae** | | |
| | | * Common Blackbird | *Turdus merula* | | √ |
| | | | **Sturnidae** | | |
| | | * Common Starling | *Sturnus vulgaris* | | √ |
| | | * Common Myna | *Acridotheres tristis* | | √ |
| | | | **Ciconiidae** | | |
| | x | Black-necked Stork | *Ephippiorhynchus asiaticus* | | |
| | | | | | |
| | | **REPTILES** | | | |
| | | | **Chelidae** | | |
| | | • Eastern Snake-necked Turtle | *Chelodina longicollis* | √ | √ |

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | | | **Gekkonidae** | | |
| | | Wood Gecko | *Diplodactylus vittatus* | | √ |
| | | | **Pygopodidae** | | |
| | | ∇ Common Scaly-foot | *Pygopus lepidopodus* | | √ |
| | | | **Agamidae** | | |
| | | Jacky Lizard | *Amphibolurus muricatus* | | √ |
| | | Eastern Water Dragon | *Physignathus lesueurii* | | √ |
| | | ∇ Bearded Dragon | *Pogona barbata* | | √ |
| | | | **Varanidae** | | |
| | | ∇ Lace Monitor | *Varanus varius* | | √ |
| | | | **Scincidae** | | |
| | | Wall Skink | *Cryptoblepharus virgatus* | | √ |
| | | Striped Skink | *Ctenotus robustus* | | √ |
| | | Copper-tailed Skink | *Ctenotus taeniolatus* | | √ |
| | | Yellow-bellied Skink | *Eulamprus tenuis* | | √ |
| | | • Eastern Water Skink | *Eulamprus quoyii* | | √ |
| | | Dark Flecked Sun Skink | *Lampropholis delicata* | √ | √ |
| | | Garden Skink | *Lampropholis guichenoti* | | √ |
| | | Weasel Skink | *Saproscincus mustelinus* | | √ |
| | | Eastern Blue-tongued Lizard | *Tiliqua scincoides* | | √ |
| | | ∇ Rainbow Litter Skink | *Lygisaurus foliorum* | | √ |
| | | | **Typhlopidae** | | |
| | | Blind or Worm Snake | *Ramphotyphlops nigrescens* | | √ |
| | | | **Elapidae** | | |
| | | Yellow-faced Whip Snake | *Demansia psammophis* | | √ |
| | | ∇ Red-naped Snake | *Furina diadema* | | √ |
| | | • Red-bellied Black Snake | *Pseudechis porphyriacus* | | √ |
| | | Eastern Brown Snake | *Pseudonaja textilis* | | √ |
| | | **AMPHIBIANS** | | | |
| | | | **Myobatrachidae** | | |
| | | Common Eastern Froglet | *Crinia signifera* | | √ |
| | | Striped Marsh Frog | *Limnodynastes peronii* | | √ |
| | | Spotted Grass Frog | *Limnodynastes tasmaniensis* | | √ |
| | | ∇ Brown Toadlet | *Pseudophryne bibronii* | | √ |
| | | ∇ Smooth Toadlet | *Uperoleia laevigata* | | √ |
| | | | **Hylidae** | | |
| x | x | Green and Golden Bell Frog | *Litoria aurea* | | √ |
| | | ∇ • Green Tree Frog | *Litoria caerulea* | | √ |
| | | Bleating Tree Frog | *Litoria dentata* | | √ |

| | B | COMMON NAME | SCIENTIFIC NAME | 1 | 2 |
|---|---|---|---|---|---|
| | | Eastern Dwarf Tree Frog | *Litoria fallax* | | √ |
| | | Broad-palmed Frog | *Litoria latopalmata* | | √ |
| | | Peron's Tree Frog | *Litoria peronii* | | √ |
| | | Verreaux's Tree Frog | *Litoria verreauxii* | | √ |
| | | **INVERTEBRATES** | | | |
| | | | **Camaenidae** | | |
| | x | Cumberland Plain Land Snail | Meridolum corneovirens | | √ |

## APPENDIX 5: LISTED NOXIOUS WEEDS WITHIN HAWKESBURY RIVER COUNTY COUNCIL

(Hawkesbury River County Council includes Baulkham Hills, Blacktown, Hawkesbury and Penrith Local Government Areas). Those species in **bold** were recorded in the Oakville Park Bushland during the current survey (April/May 2007). The actions required for each category of weed are described below.

| COMMON NAME | BOTANICAL NAME | CLASS |
|---|---|---|
| African boxthorn | *Lycium ferocissimum* | 4 |
| African feathergrass | *Pennisetum macrourum* | 5 |
| African turnipweed | *Sisymbrium runcinatum* | 5 |
| African turnipweed | *Sisymbrium thellungii* | 5 |
| Alligator weed | *Alternanthera philoxeroides* | 3 |
| Anchored water hyacinth | *Eichhornia azurea* | 1 |
| Annual ragweed | *Ambrosia artemisiifolia* | 5 |
| Arrowhead | *Sagittaria montevidensis* | 5 |
| Artichoke thistle | *Cynara cardunculus* | 5 |
| Athel tree | *Tamarix aphylla* | 5 |
| Bathurst/Noogoora/Californian/cockle burrs | *Xanthium* species | 4 |
| Black knapweed | *Centaurea nigra* | 1 |
| Blackberry | *Rubus fruticosus* aggregate species | 4 |
| **Bridal creeper** | ***Asparagus asparagoides*** | **5** |
| Broomrapes | *Orobanche* species. Includes all Orobanche species except the native *O. cernua* variety *australiana* and *O. minor* | 1 |
| Burr ragweed | *Ambrosia confertiflora* | 5 |
| Cabomba | *Cabomba caroliniana* | 5 |
| Cayenne snakeweed | *Stachytarpheta cayennensis* | 5 |
| Chilean needle grass * | *Nassella neesiana* | 4 |
| Chinese violet | *Asystasia gangetica* subspecies *micrantha* | 1 |
| Clockweed | *Gaura lindheimeri* | 5 |
| Clockweed | *Gaura parviflora* | 5 |
| Columbus grass | *Sorghum x almum* | 4 |
| Corn sowthistle | *Sonchus arvensis* | 5 |
| Crofton weed | *Ageratina adenophora* | 4 |
| Dodder | *Cuscuta* species. Includes All Cuscuta species except the native species C. australis, C. tasmanica and C. victoriana | 5 |
| East Indian hygrophila | *Hygrophila polysperma* | 1 |
| Espartillo | *Achnatherum brachychaetum* | 5 |
| Eurasian water milfoil | *Myriophyllum spicatum* | 1 |
| Fine-bristled burr grass | *Cenchrus brownii* | 5 |
| Fountain grass | *Pennisetum setaceum* | 5 |
| Gallon's curse | *Cenchrus biflorus* | 5 |
| Giant Parramatta grass * | *Sporobolus fertilis* | 3 |

| COMMON NAME | BOTANICAL NAME | CLASS |
|---|---|---|
| Glaucous starthistle | *Carthamus glaucus* | 5 |
| Golden thistle | *Scolymus hispanicus* | 5 |
| Green cestrum | *Cestrum parqui* | 3 |
| Harrisia cactus | *Harrisia* species | 4 |
| Hawkweed | *Hieracium* species | 1 |
| Horsetail | *Equisetum* species | 1 |
| Hygrophila | *Hygrophila costata* | 2 |
| Hymenachne | *Hymenachne amplexicaulis* | 1 |
| Johnson grass | *Sorghum halepense* | 4 |
| Karoo thorn | *Acacia karroo* | 1 |
| Kochia | *Bassia scoparia* | 1 |
| Lagarosiphon | *Lagarosiphon major* | 1 |
| **Lantana** | ***Lantana* species** | **5** |
| Long-leaf willow primrose | *Ludwigia longifolia* | 4 , 5 |
| Ludwigia | *Ludwigia peruviana* | 3 |
| Mexican feather grass | *Nassella tenuissima* | 1 |
| Mexican poppy | *Argemone mexicana* | 5 |
| Miconia | *Miconia* species | 1 |
| Mimosa | *Mimosa pigra* | 1 |
| Mossman River grass | *Cenchrus echinatus* | 5 |
| **Mother-of-millions** | ***Bryophyllum* species and hybrids** | **3** |
| Onion grass | *Romulea* species. Includes all Romulea species and varieties except *R. rosea* var. *australis* | 5 |
| Oxalis | *Oxalis* species and varieties. Includes all Oxalis species and varieties except the native species *O. chnoodes, O. exilis, O. perennans, O. radicosa, O. rubens,* and *O. thompsoniae* | 5 |
| Pampas grass | *Cortaderia* species | 4 |
| Parthenium weed | *Parthenium hysterophorus* | 1 |
| Paterson's curse, Vipers bugloss, Italian bugloss | *Echium* species | 4 |
| Pellitory | *Parietaria judaica* | 4 |
| Pond apple | *Annona glabra* | 1 |
| Prickly acacia | *Acacia nilotica* | 1 |
| Prickly pear | *Cylindropuntia species* | 4 |
| **Prickly pear** | ***Opuntia* species except *O. ficus-indica*** | **4** |
| Privet (Broad leaf) | *Ligustrum lucidum* | 4 |
| Privet (Narrow-leaf/Chinese) | *Ligustrum sinense* | 4 |
| Red rice | *Oryza rufipogon* | 5 |
| Rhus tree | *Toxicodendron succedanea* | 4 |
| Rubbervine | *Cryptostegia grandiflora* | 1 |
| Sagittaria | *Sagittaria platyphylla* | 5 |
| Salvinia | *Salvinia molesta* | 3 |

| COMMON NAME | BOTANICAL NAME | CLASS |
|---|---|---|
| Sand oat | *Avena strigosa* | 5 |
| Senegal tea plant | *Gymnocoronis spilanthoides* | 1 |
| Serrated tussock | *Nassella trichotoma* | 4 |
| Siam weed | *Chromolaena odorata* | 1 |
| Smooth-stemmed turnip | *Brassica barrelieri* subspecies *oxyrrhina* | 5 |
| Soldier thistle | *Picnomon acarna* | 5 |
| Spiny burrgrass | *Cenchrus incertus* | 4 |
| Spiny burrgrass | *Cenchrus longispinus* | 4 |
| Spotted knapweed | *Centaurea maculosa* | 1 |
| St. John's wort | *Hypericum perforatum* | 4 |
| Texas blueweed | *Helianthus ciliaris* | 5 |
| Water caltrop | *Trapa* species | 1 |
| Water hyacinth | *Eichhornia crassipes* | 3 |
| Water lettuce | *Pistia stratiotes* | 1 |
| Water soldier | *Stratiotes aloides* | 1 |
| Willows | *Salix* species. Includes all Salix species except *S. babylonica, S. x reichardtii, S. x calodendron* | 5 |
| Witchweed | *Striga* species. Includes all Striga species except native species and *Striga parviflora* | 1 |
| Yellow burrhead | *Limnocharis flava* | 1 |
| Yellow nutgrass | *Cyperus esculentus* | 5 |

**Actions Required For Noxious Weed Classes**

**1** The plant must be eradicated from the land and the land must be kept free of the plant

**2** The plant must be eradicated from the land and the land must be kept free of the plant

**3** The plant must be fully and continuously suppressed and destroyed

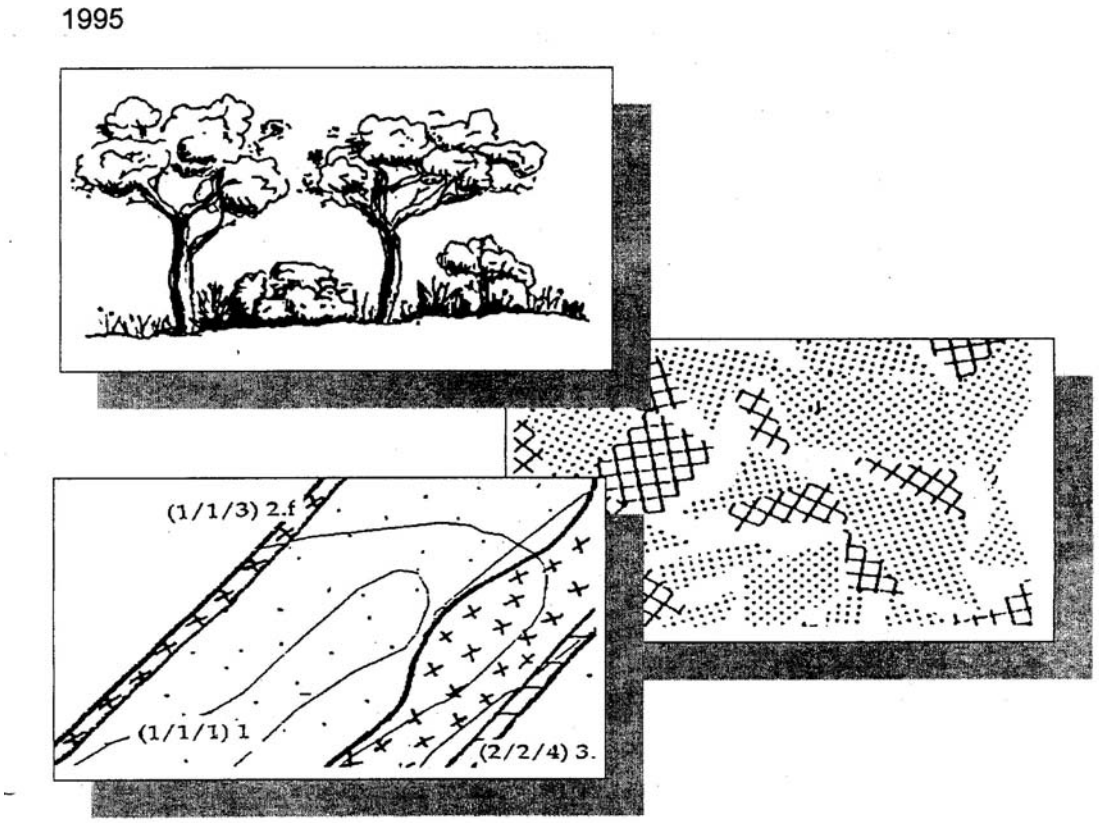
**4** The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed

**5** The requirements in the Noxious Weeds Act 1993 (as amended 2005) for a notifiable weed must be complied with

## Parks & Landscape Services

# Bushland Weed Assessment Guidelines

## Ku-ring-gai Municipal Council



*First published in 1995 by*
*Ku-ring-gai Municipal Council*
*818 Pacific Highway Gordon NSW 2072*

# Contents

# 1. Introduction

These guidelines have been developed for the purposes of making quantitative assessments of the level of weeds in bushland areas. This method has been formulated to assist Council staff, contract bush regenerators and Bushcare volunteers who are involved in site assessment and rehabilitation strategies within the Ku-ring-gai Municipal Council area.

The following weed classification provides an indication of the level and type of weed invasion. Basically, it measures the percentage cover of weeds compared to native species. In doing this, the reporting also indicates the position of weeds within the vegetation community and their impact on the native vegetation.

This information can assist rehabilitation by enabling areas to be prioritised for treatment. For example, it is common practice for strategies to commence work in areas of low weed infestation and progressively move towards those of high infestation. In addition, those weeds which are present in the canopy pose a more immediate threat to the community than weeds in other stratums.

Weed assessment can also provide information on the rate of weed invasion, the response after treatment or the regeneration over time. This information is extremely useful for the monitoring and evaluation of programs.

This method of weed classification has been designed so as to minimise individual interpretation by persons carrying out weed surveys, and to enable the surveys to be carried out in the field using basic skills.

The method is applicable to all types of native vegetation communities found in Ku-ring-gai which range from tall forests to low woodland and heath.

# 2. Weed Classification Procedure

The weed classification procedure outlined in Sections 2.1 to 2.5 produces a "weed class" ranging from 1 to 4 (low to high). This method can be applied to all areas of bushland with varying levels of weed. Figure 2.1 below demonstrates the five steps involved in calculating and recording the weed class of an area.

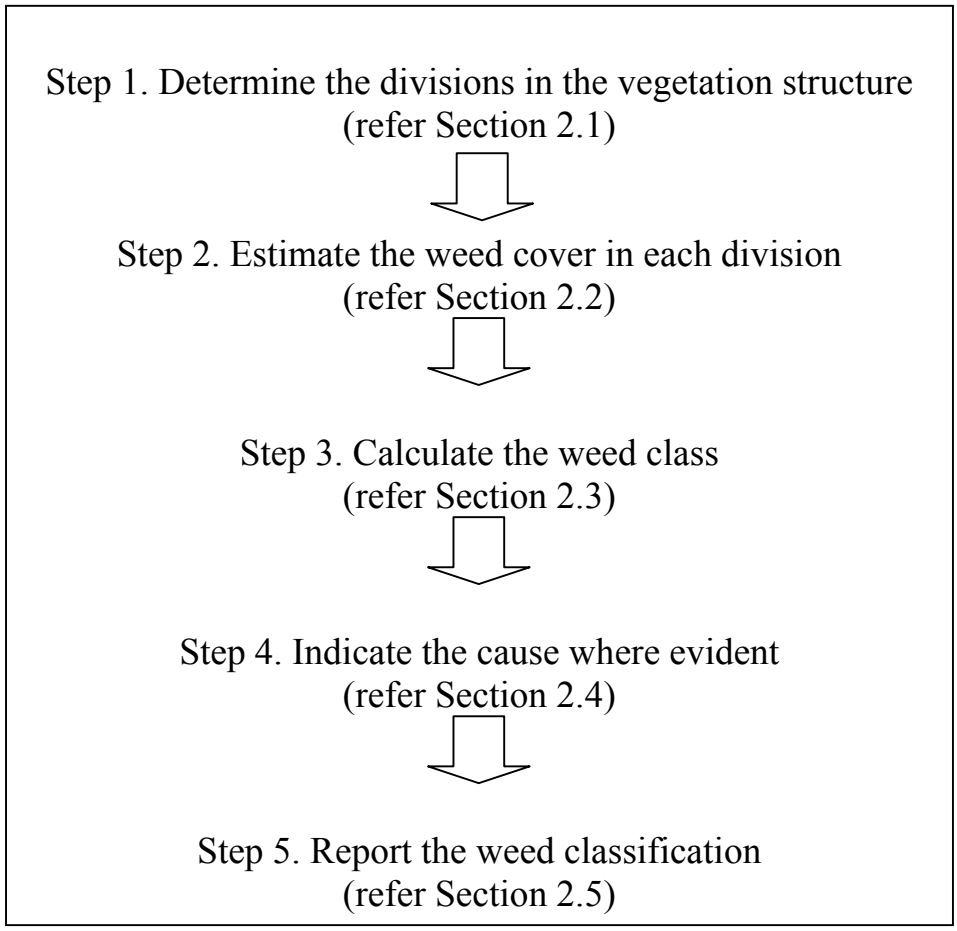



**Figure 2.1 Procedure for Classifying Weed Infestations**

## 2.1 Step 1. Determine the Vegetation Structure Divisions

This step provides an indication to the position of weeds within the structure of the vegetation community. The vegetation community is visually divided into three structural divisions, namely upper, middle and lower, as demonstrated below in Figure 2.2.

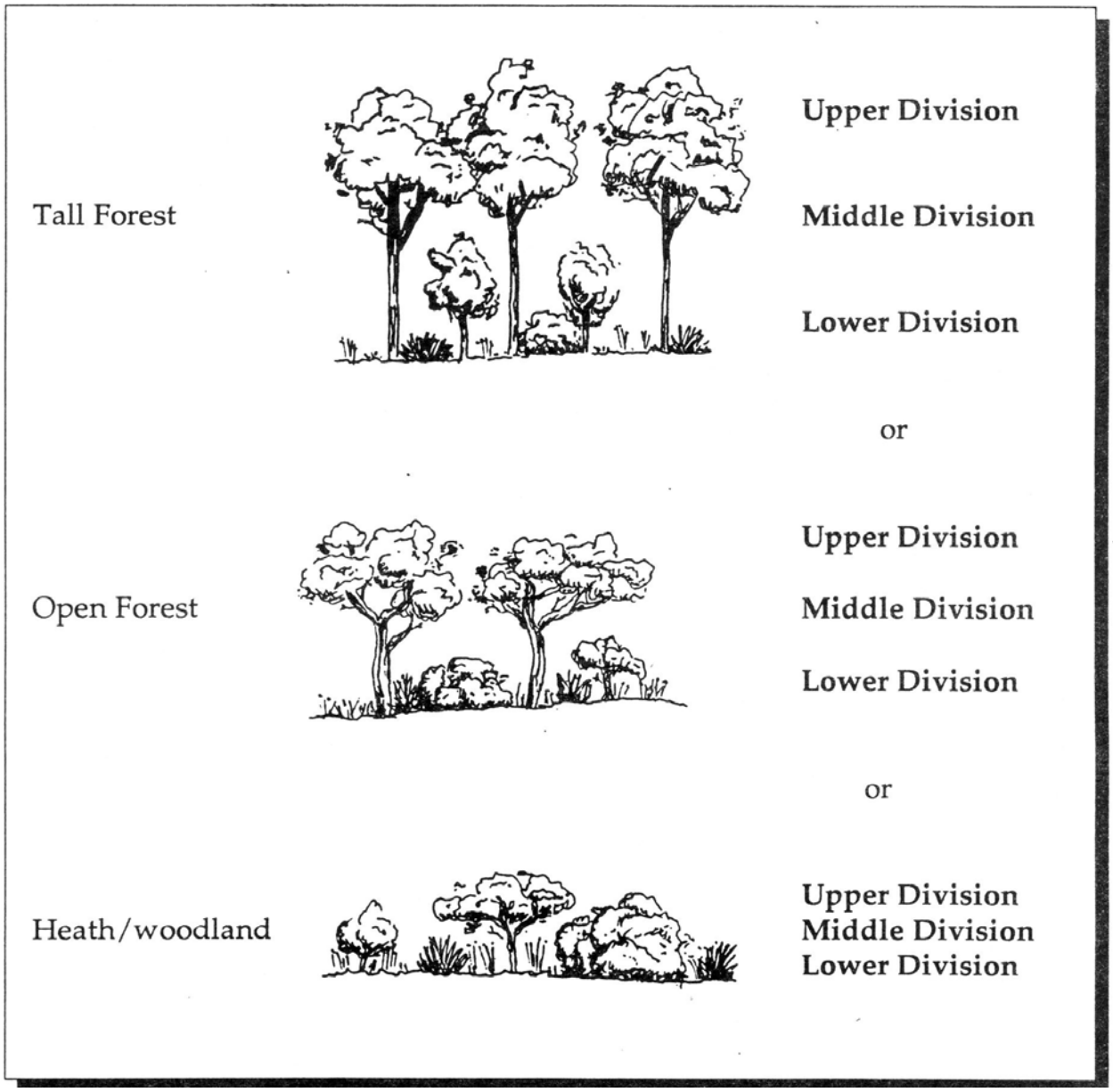



**Figure 2.2 Vegetation Structure Divisions**

## 2.2 Step 2. Estimate the Weed Cover in Each Division

After visually dividing the vegetation community (Step 1), estimate the percentage of weeds compared to native species within each division. For each division, record the corresponding scale (1- 4). The keys in Section 3.0 Appendix can be referred to for assistance in this calculation.

| Structural Division | Weed Cover % | **Scale** |
|---|---|---|
| Upper | < 10% | **1** |
| | 10%-30% | **2** |
| | 31%-60% | **3** |
| | > 60% | **4** |
| Middle | < 10% | **1** |
| | 10%-30% | **2** |
| | 31%-60% | **3** |
| | > 60% | **4** |
| Lower | < 10% | **1** |
| | 11%-30% | **2** |
| | 31%-60% | **3** |
| | > 60% | **4** |

The scale should be recorded for each structural division as:

"Upper Scale / Middle Scale / Lower Scale ".

**For example:** "1/3/2"

## 2.3 Step 3. Calculate the Weed Class

The weed class is calculated from the recorded scales of each division (Step 2), to give an overall rating.

This calculation takes into account the impact the weeds have on the vegetation community. Weeds in the upper division can strangle and destroy the dominant native species. Weeds in the middle division generally compete with native species whilst weeds in the lower division can significantly alter the ground conditions, preventing the regeneration of native species. Therefore a weighting factor is applied to each division to represent the relative impact on the vegetation community.

**The equation:**

| **Division** | **Scale** | **Weighting Factor** | | |
|---|---|---|---|---|
| Upper | | x 0.5 | = | + |
| Middle | | x 0.2 | = | + |
| Lower | | x 0.3 | = | + |
| | | | | Calculated Class (total) |

To determine the Weed Class, round off the Calculated class to the nearest integer, (eg.<1.5 = 1, 1.5 or >1.5 = 2).

**For example:**
A weed cover scale of 1/3/2 is calculated as demonstrated below.

| **Division** | **Scale** | **Weighting Factor** | | |
|---|---|---|---|---|
| Upper | 1.00 | x 0.5 | = | 0.5+ |
| Middle | 3.00 | x 0.2 | = | 0.6+ |
| Lower | 2.00 | x 0.3 | = | 0.6+ |
| | | | | 1.70 |

**Weed Class = 2**
When recording the weed class, each scale should also be indicated:
"(Upper Scale / Middle Scale / Lower Scale) Weed Class".
For example: "(1/3/2) 2."

## 2.4 Step 4. Indicate the Cause (where evident)

Where the major cause of weed infestation is evident, one of the categories given in Table 2.1 should be chosen. This information can prove useful in addressing the causes of weed invasion and in determining the most appropriate methods of rehabilitation. This step is optional as it is recognised that the cause of weed infestation is not always obvious and can be a combination of causes.

**Table 2.1 Major Categories for the Causes of Weed Invasion**

| CAUSE | DESCRIPTION | CRITERIA |
|---|---|---|
| s | Physical disturbance of soil | Weeds established on natural bare soil resulting from physical disturbance. |
| f | Imported soil fill | Weeds established on imported soil, often containing weed seed and altered nutrient status. |
| d | Dumped garden refuse | Weeds established by dumped garden refuse containing weed seed and/or propagules. |
| v | Physical disturbance of vegetation | Weeds established by physical disturbance of native vegetation (for example mowing, trampling, fire). |
| r | Impacts from stormwater run off | Weeds established in areas of increased soil nutrients and/or moisture. |

The Indicated Cause category should be recorded in the following manner:

(Upper Scale / Middle Scale / Lower Scale) Weed Class. Indicated Cause

For example: "(1/3/2) 2.r"

## 2.5 Step 5. Report the Weed Classification

The weed classification procedure encompasses all of the previous steps. However, depending on the use or purpose of the information, often not all the criteria need to be shown.

Surveys and detailed maps should report all the criteria in the following form:

(Upper Scale / Middle Scale / Lower Scale)  Weed Class. Indicated Cause

For example: **"(1/3/2) 2.r"**

Appendix B provides a mapped example using this technique.

Management plans or rehabilitation procedures may not need to refer to all the criteria. When this is the case they may exhibit only:

Weed Class. Indicated Cause

For example: **"2.r" or "2"**

If the latter is the case, then a reference to the determination of the weed classification is necessary. This reference will be indicated as WAG (Weed Assessment Guidelines).

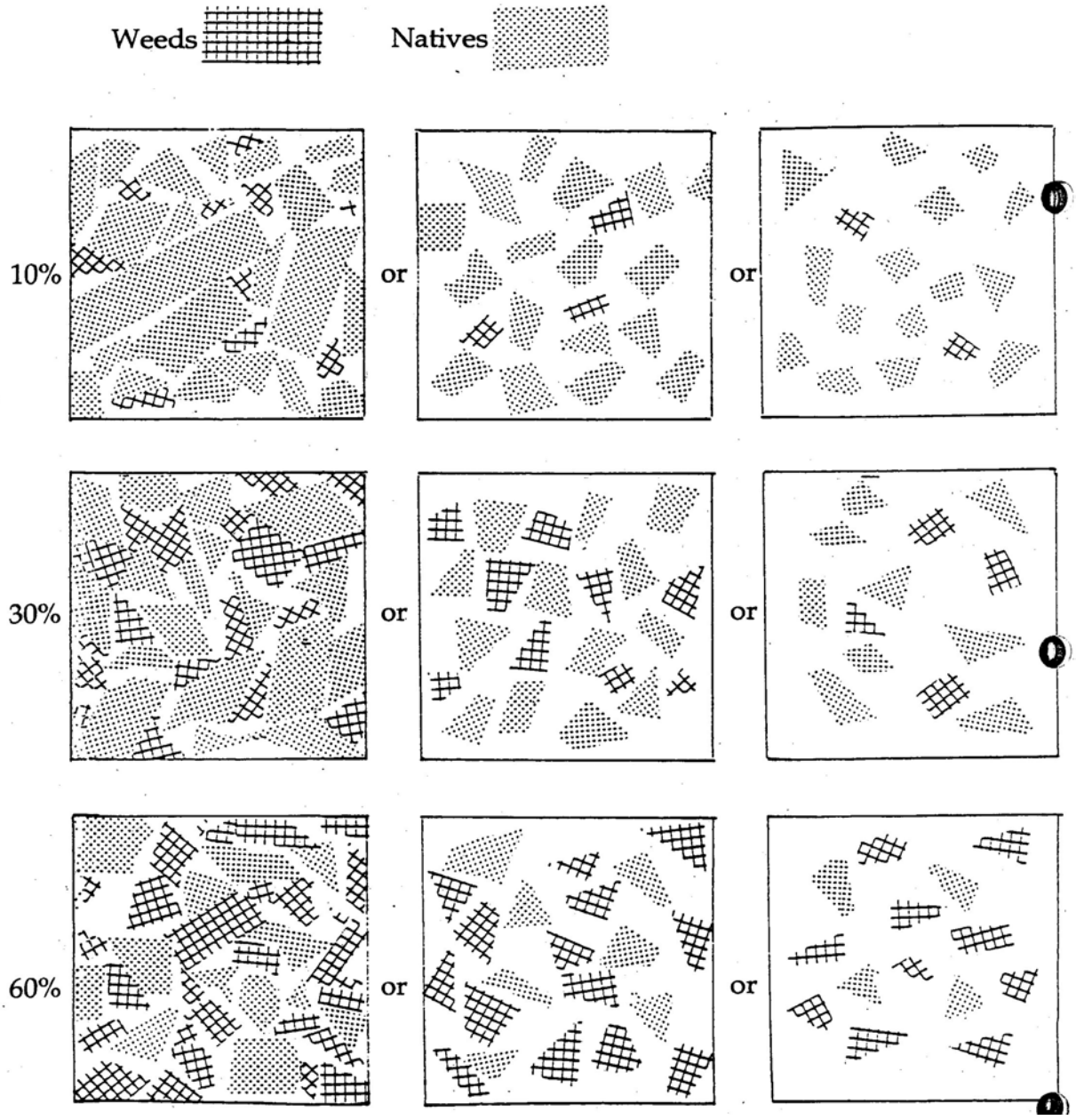
Where colour mapping and reproducing is available, the standard industry colours given below should be used.

Weed Class 1 - green
Weed Class 2 - blue
Weed Class 3 - yellow
Weed Class 4 - red

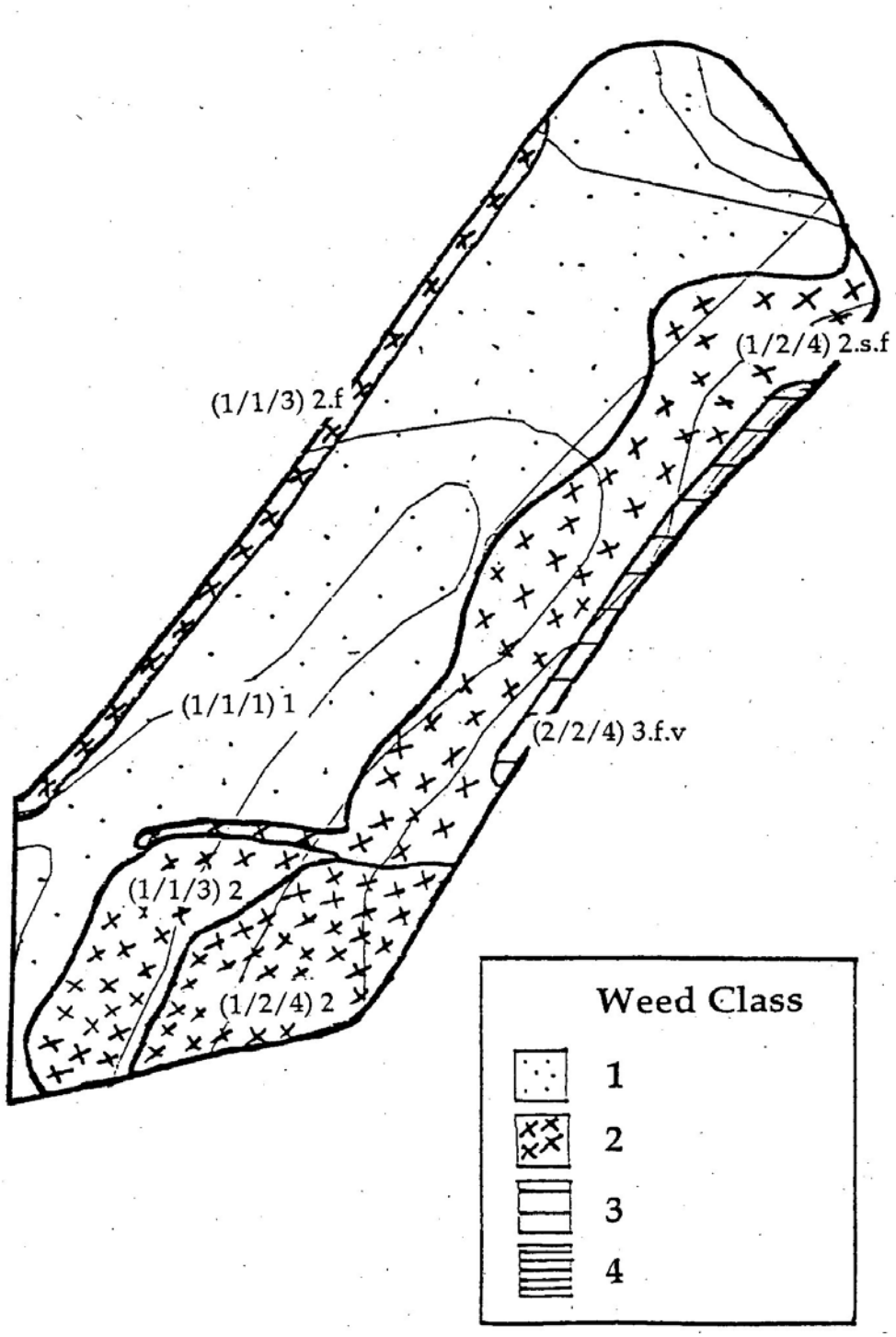
# Appendix A. Weed Percentage Keys

The following keys are designed to assist in estimating the percentages of weeds to native species.

**Percentage of Weeds to Natives:**



# Appendix B. Mapping Example



## APPENDIX 7: TARGET WEEDS RECORDED AT OAKVILLE PARK & RECOMMENDED CONTROL METHODS

| Species | Common Name | Status / Comments | Method of Control | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hand Weeding | | | Herbicide Application | | | | Comments |
| | | | Hand removal | Rake & pile | Dig out | Cut stump & poison | Drill & poison | Scrape & poison | Spot spray | |
| **Woody Weeds** | | | | | | | | | | |
| *Grevillea robusta* | Silky Oak | Garden escape | | | | ✓ | ✓ | | | |
| *Lantana camara* | Lantana | WONS/Noxious weed | | | ✓ young plants | ✓ | | ✓ | | Few plants: mostly on adjoining land |
| *Senna pendula* | Arsenic Bush | Environmental weed | | | ✓ young plants | ✓ | | | | |
| *Sida rhombifolia* | Paddy's Lucerne | Agricultural weed | | | ✓ | ✓ | | | ✓ | Long taproot: remove all material and dispose off-site. |
| **Herbaceous Weeds** | | | | | | | | | | |
| *Asparagus aethiopicus* | Ground/Fern Asparagus | Environmental weed, but noxious elsewhere | | | ✓ | | | ✓ | ✓ | Hand removal – remove corms in toto<br>Foliar spray -use Brushoff in early spring (preferably) |
| *Bidens pilosa* | Cobblers Pegs | Agricultural/Ruderal weed | ✓ | | ✓ | | | | ✓ | Will eventually be shaded out as regeneration proceeds |
| *Bryophyllum delagonese,*<br>*B. pinnatum* | Mother of Millions<br>Resurrection Plant | Noxious weed<br>Environmental weed | ✓ | | ✓ | | | | ✓ | Remove ALL material from bushland, including underlying soil: use surfactant with glyphosate or Brushoff (as label directions) |
| *Cirsium vulgare* | Spear Thistle | Agricultural weed | ✓ | | ✓ | | | | ✓ | Sharp spines: wear gloves |

| Species | Common Name | Status / Comments | Method of Control | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hand Weeding | | | Herbicide Application | | | | Comments |
| | | | Hand removal | Rake & pile | Dig out | Cut stump & poison | Drill & poison | Scrape & poison | Spot spray | |
| *Conyza* spp. | Fleabanes | Ruderal weed | ✓ | | | | | | | As for Bidens, above |
| *Cynodon dactylon* | Common Couch Grass | Turf grass | | | | | | | ✓ | Retain to stabilise soils where necessary: keep away from new native seedlings |
| *Ehrharta erecta* | Perennial Veldt Grass | Environmental weed | ✓ | | | | | | ✓ | Over plant or mulch thickly. Persistent weed. |
| *Eragrostis curvula* | African Love Grass | Pasture Grass Environmental Weed | | | ✓ | | | | ✓ | Slash before seeding if possible (repeat monthly in summer)<br>Use Fusilade as a foliar spray (grass selective herbicide) |
| *Opuntia* sp | Prickly Pear | Noxious weed | | | ✓ | | | | | Dispose of material at landfill site. |
| *Paspalum dilatatum* | Paspalum | Pasture Grasses | | | ✓ | | | | ✓ | Avoid herbicide spray near water: dig out in drains |
| *Pelagonium* sp | Geranium | Garden escape | | | ✓ | | | | ✓ | |
| *Pennisetum clandestinum* | Kikuyu Grass | Turf grass – environmental weed | | | ✓ | | | | ✓ | Scalp soil after foliar herbicide or burn individual tussocks if possible. |
| *Plantago lanceolata* | Plantain | Agricultural/Ruderal weed | | | ✓ | | | | | |
| *Senecio madagascariensis* | Fireweed | Environmental weed, but noxious elsewhere | ✓ | | ✓ | | | | ✓ | Will regenerate again after any disturbance to soil. |
| *Solanum nigrum* | Deadly Nightshade | Environmental weed | ✓ | | ✓ | | | | ✓ | |
| *Sonchus oleraceus* | Sow Thistle | Agricultural weed | ✓ | | ✓ | | | | ✓ | |

| Species | Common Name | Status / Comments | Method of Control | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hand Weeding | | | Herbicide Application | | | | Comments |
| | | | Hand removal | Rake & pile | Dig out | Cut stump & poison | Drill & poison | Scrape & poison | Spot spray | |
| *Sporobolus virginicus* | Parramatta Grass | Agricultural weed | | | ✓ | | | | | |
| *Succulents (Sedums, Crassula)* | succulents | Garden escapes | | | ✓ | | | | | Concentrated infestations |
| **Vines / Scramblers** | | | | | | | | | | |
| *Anredera cordifolia* | Madeira Vine | Environmental weed | | | ✓ | | | ✓ | | Remove all aerial & underground tubers. One location only. |
| *Araujia sericifera* | White Moth Plant | Environmental weed | | | ✓ | | | | | |
| *Asparagus asparagoides* | Bridal Creeper | Noxious weed | | | ✓ | | | | ✓ | Hand removal – remove corms in toto<br>Foliar spray - use Brushoff in early spring (preferably) |
| *Tradescantia fluminensis* | Wandering Jew | Environmental weed, but noxious elsewhere | ✓ | ✓ | | | | | ✓ | Foliar spray – use glyphosate early spring when leaf growth is new and soft.. Alternatively, use Starane any season. |

*Note*: not all weeds recorded in the subject land are listed above. Some secondary and/or insignificant weeds have not been targeted for control. However, significant secondary weeds are listed for targeted control actions.

*Note also* that it is entirely possible that other weeds will regenerate after clearing provides additional growing sites.

## APPENDIX 8: A GENERIC GUIDE TO MONITORING PROGRESS OF WORKS IN BUSHLAND REHABILITATION PROGRAMS

The set up of a simple monitoring program at the outset of the restoration project is of high importance. Monitoring will provide an objective measurement of progress and record the slow and often subtle changes. A monitoring program will enable the project manager and bush regeneration contractor to assess the Performance Indicators listed in Section 7.10 this report.

As many changes are not readily visible in the short-term, it is recommended that monitoring events be carried out every six (6) months. However data should be collected over a number of years so that trends can be determined. A simple generic guide to monitoring the progress of bushland rehabilitation projects has been included below.

**Note** that a project-specific monitoring program should be designed for each bush regeneration and rehabilitation site prior to commencement of work.

### ESTABLISHING PERMANENT TRANSECTS AND QUADRATS

This method is the traditional way to measure changes in plant community structure and diversity. The simplest way to record changes is to count the numbers and types of seedlings regenerating in a measured plot over a period of time.

*Establishing permanent transects and quadrats will be sued to monitor Performance Indicators 1, 2, 3, 5, 6, and 7.*

In the absence of more specific guidelines in Recovery Plans, for all Management Units, at least one permanent quadrat will be established (as per Threatened Species Survey & Assessment Guidelines NPWS). Sampling is to occur on at least once a year (but monthly for the first six (6) months after treatment).

In addition to the NPWS guidelines, information recorded will include indigenous plant species including the number of naturally regenerating seedlings and cover (using the Braun- Blanquette method).

Baseline data will be collected in each quadrat before the commencement of any ecological restoration works. Sampling will allow for comparison between areas with different soil seedbank treatments, including areas that have not been treated.

Recording of all ecological restoration works will use standard NPWS recording sheets, and will include hours of weed control performed per bushland management zone or sub-zones.

### CHOOSING THE PLOT SIZE

This is often the hardest decision to make: the area has to be large enough to take in the major life forms and small enough to be manageable. In grassland a plot of one (1) $m^2$ is adequate to gain a representative sample; for shrubs – three (3) $m^2$ is adequate, but in a treed area, plots of 10 $m^2$ or larger may be necessary.

### ASSEMBLING FLORA LISTS

The assembly of flora lists is basic to all bushland projects. The purpose of the bush regeneration project is not to accumulate an ever-increasing list of new species, but rather to record the diversity and abundance of the existing plant community and to monitor any changes that take place as the project proceeds.

Flora lists should be updated regularly and the location(s) of any unusual, rare or threatened species should be marked on the base map and the relevant authorities should be informed (eg. National Herbarium, NPWS).

In addition to the information recorded in permanent quadrats, comprehensive lists of plant species will be maintained and updated for each management zone. This will be performed as per Threatened Species Survey & Assessment Guidelines NPWS.

**ASSEMBLING FAUNA LISTS**

The recording of fauna follows the same guidelines as for flora and is of equal importance. In the first instance a simple list of fauna sighted (or evidence of) can be used.

Ultimately, comprehensive (both exotic and native) fauna lists will be compiled and maintained. Data will be collected as per NPWS Wildlife Atlas Format.

*Data collected will be used to monitor Performance Indicators 8 and 9.*

**ASSEMBLING A LIST OF FLOWERING & FRUITING TIMES**

For the native species, a long-term project will be useful since this project calls for local seed collection and propagation.

Adapting weed-clearing activities to coincide with natural seeding times and germination patterns of desirable natives is advised, as clearing weed growth increases germination sites and increases seedling survival chances.

For each indigenous plant species, the flowering and fruiting period will be recorded each year as a week of year figure (i.e. 1 to 52). This is to monitor for pollination and seed set.

Keeping a record of flowering and fruiting times for local weed species can make weed control easier. For example, if it is known that Pampas Grass flowers and as the seed ripens locally between March and May, plan to treat Pampas Grass well before that time. If berry-fruited weeds like Cotoneaster, Lantana or Privet are present, remove the plants before the berries are ripe and attractive to birds.

It is recommended that quantitative measurement be used within each management zone in order to provide information relating to:

- Type and % cover of weed species before and after bush regeneration work;
- Type and % cover of native plant species before and after weed removal; and
    - Type and % cover of native plants species regenerating after regeneration.

**MONITORING SOIL SEEDBANK TRIALS**

These trials will allow the testing of a range of strategies designed to stimulate native plant regeneration.

Quadrats will be monitored every three (3) months for 12 months. Results will be quantified by measuring % cover using Braun-Blanquet (see Moore & Chapman 1986), visual analysis and photographs taken from a series of fixed photo-points.

**THREATENING PROCESSES**

All threatening processes operating within the bushland, including key threatening processes listed under *TSC Act* must be noted, and relevant data collected.

Monitoring of any Threatening Processes that occur will be consistent with the relevant Threat Abatement Plans.

*Monitoring a decrease in each of the key threatening processes identified for the site is a requirement of Performance Indicator 11.*

## PHOTOGRAPHS

Taking photographs is an easy way to record changes in vegetation structure. A photograph captures the subtle changes that are often missed when working closely on a site over time. Photographs are useful in recording sequence shots at various stages in the project to illustrate the techniques used and the results obtained, and are also valuable teaching tools.

Photography in the bushland environment is not particularly easy for amateurs, as plants cast shadows and without the correct lens filters, everything looks 'green'. Obtain professional advice about ASA ratings and take photographs early in the morning or when conditions are overcast.

A number of permanent photo-points will be selected and marked with a short wooden stake. The location of these photo-points will be recorded on a base map. Photographs will be taken from the same spot every six (6) months.

## OTHER MONITORING VARIABLES

Other useful variables recommended include:

**Temperatures -** These can be recorded using a wet-dry bulb thermometer. Data may be graphed to show that as the canopy re-forms (regardless of height above the ground) fluctuations of temperature become less extreme. Changes in temperature can be related to the type and numbers of native plants regenerating. Recording sites (marked and recorded on a base map) can be selected and regular soil temperature readings taken with the bulb just under the soil surface (e.g. 2-4 mm) and air temperature readings taken about two (2) metres above the ground.

**Light readings -** These may be taken using a light meter, first at ground level, and again at a height of two (2) m. Relate the light intensity to the type and number of native plants regenerating and/or to those already growing on the site. The lowering of the light levels in a rainforest/closed forest (by reforming the canopy) promotes the regeneration of rainforest canopy species, but reducing light levels in dry sclerophyll woodland or heath decreases the diversity and numbers of indigenous species and promotes the growth of wet gully species and frequently of exotic moisture-loving weeds. Light readings can be taken in correlation with the soil temperature readings set out above. Readings should be taken both in clearings or light gaps and under the tree canopy.

**The health of the litter layer -** This can be recorded by observing the cyclical build-up and breakdown of the fallen leaves, the appearance of the soil (whether compacted or friable), the presence of small animals in the litter layer and the production of soil fungi, as indicated by fruiting bodies on the surface and thread-like mycelia in the soil. Simple measurements such as the depth of litter or percentage of groundcover are important. This information will provide clues to other processes occurring on the site over time.

**Rainfall readings -** These can be obtained from the local meteorological station or taken on site. Determine the local rainfall pattern. Avoid weeding in hot weather when the soil is hard or in the wet season when the ground is so boggy that mud is churned up. Very dry periods are reflected in the survival rate of seedlings, so if tubestock planting is planned, defer planting until regular rains are expected.

## APPENDIX 9: GLOSSARY

| | |
|---|---|
| **Aeolian** | Wind blown or transported by wind, as in aeolian sand dunes |
| **Aquifer** | Porous soil or geological formation capable of being permeated by water, which holds and yields ground water. |
| **Assisted Natural Regeneration** | Bush regeneration approach combining traditional weeding methods with supplementary (or enrichment) planting |
| **Biodiversity (biological diversity)** | The variety of all life forms, comprising genetic diversity (within species), species diversity and ecosystem diversity. The variability among living organisms from all sources (including terrestrial, marine and other aquatic ecosystems) and the ecological complexes of which they are part. |
| **Biological control** | The control of weeds and pests through the use of other organisms (predators, herbivores, parasites and disease-producing organisms). |
| **Biomass** | Total living matter in a specific area. |
| **Blow-out sites** | A depression caused by wind erosion. May result in the exposure of the lower soil horizons. |
| Buffer | An area of land between two conflicting land-uses, for example a nature reserve and an intensive development. |
| **Bushland** | Land on which there is vegetation that is either a remainder of the natural vegetation of the land or if altered, is still representative of the structure and floristics of the natural vegetation (As defined in *SEPP-19*).<br>For the purposes of the VMP – any area which is dominated by locally indigenous, naturally occurring species. |
| **Bush regeneration** | The practice of restoring bushland by focusing on reinstating and reinforcing the system's on-going natural regeneration processes. |
| Catchment | The land area drained by a river and its tributaries. |
| **Community land** | Land that is classified as community land under Division 1 of Part 2 of Chapter 6 of the *LG Act 1993*.<br>There are two classifications of public land (land under the control of the council) under the *LG Act 1993* – community and operational. Areas classified as community land are kept available for use by the general public and cannot be sold (except in limited defined circumstances). They cannot be leased or licensed for more than 21 years. |
| Condition | The state of health of the native vegetation community: degree to which it has been degraded, simplified or otherwise altered. |
| Conservation | The processes and actions of looking after a place so as to retain its natural significance and always includes protection, maintenance and monitoring. In the VMP monitoring is used to measure the progress of work and evaluate the rehabilitation program. |
| Contaminant | An undesirable or harmful impurity. |
| Contaminated site | Land which has harmful contaminants caused by previous land use. |
| Corridor (wildlife) | Areas of native vegetation that link larger areas of remaining native vegetation. |
| **Critical habitat** | Habitat declared to be critical under Part 3 of the *TSC Act 1995*. For the purposes of the *TSC Act 1995* and other Acts as amended by the *TSC Act 1995*, critical habitat is the whole or any part or parts of an area or areas of land comprising the habitat of an endangered species, an endangered population or an endangered ecological community that is essential for the survival of the species, population or ecological community. |
| **Cut-stump** | Method of weed eradication used for woody weeds whereby the stem is cut close to ground level and undiluted glyphosate applied within 30 seconds. |
| **Desire lines** | Routes people instinctively take through an open space. |
| **Diversity** | Consists of 2 components: species richness and relative abundance |

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| **Ecologically sustainable development** | Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased. Also referred to as 'Environmentally Sustainable Development'. |
| **Ecosystem** | Communities of organisms and their physical environment interacting as a unit. |
| **Ecosystem processes** | The numerous interactions between different components (both living and non-living) of an ecosystem that support the biological elements of the system. These processes include the storage and recycling of nutrients and minerals, disturbance, competition, weathering and succession, and are generally necessary for maintaining the balance between interconnected elements of the ecosystem; for instance, green plants capture and process solar energy, which is then distributed throughout the ecosystem along food webs by animals. |
| **Ecosystem resilience** | The degree, manner and pace of restoration of the structure and function of the original ecosystem after disturbance, or more simply, the ability of an ecosystem to recover from disturbance. |
| **Edge effects** | Habitat conditions (such as degree of humidity and exposure to light or wind) created at or near the interface of bushland and open areas |
| **Eight-part test** | An eight-part test under Section 5A of the *EP&A Act 1979* is designed to determine 'whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats' listed on the Schedules of the *TSC Act 1995*, and consequently whether a Species Impact Statement is required. |
| **Endangered species** | Those likely to become extinct unless action is taken to remove the factors that threaten their survival. |
| **Environmental weed** | Species which have been introduced into the habitat, which naturalise from their point of introduction, displace native species and/or otherwise modify the natural environment. |
| Exotic species | An introduced species, especially one that is not of Australian origin. |
| Fabrication | A form of bushland regeneration used when the sites biophysical attributes have changed to the point where the original plant community cannot be reconstructed or recreated. |
| Feral animal | Wild exotic animal, usually a domesticated animal which has become wild. |
| **Fire regime** | The history of fire events in an area including the frequency, intensity and season of burning (season in this context refers to the time of the year in which the fire occurred). |
| **Foliar spraying** | Diluted glyphosate applied to the leaves by wand or spot spraying. Useful for the control of unwanted grasses and herbaceous weeds. |
| Fragmentation (habitat/ecosystem) | The division of natural areas by vegetation clearance, isolating the remnants and the species within them and limiting genetic flow. |
| **Generalist species** | Species that can survive and tolerate a broad range of environmental conditions. |
| **Genetic Diversity** | The variety of genetic information contained in the total genes of individual plants, animals and microorganisms of a place. |
| **Geodiversity** | The natural range (diversity) of geological, geomorphological and soil features, assemblages, systems and processes. |
| **Gross pollutant trap** | Device designed to trap debris and sediments in watercourses. |
| **Habitat** | The living space of a species or community, providing a particular set of environmental conditions. |
| **Heath** | A plant community dominated by small closely spaced shrubs, most of which have stiff and often small leaves. |
| Herbicide | Chemical substance used for killing plants. |
| Hydrology | The chemistry and physics of water and water movement. |
| **Indigenous species** | A species naturally distributed within a specific region, native to a particular locality. A species that occurs at a place within its historically known natural range and that |

| | |
|---|---|
| | forms part of the natural biodiversity of a place. |
| **Key threatening process** | Schedule 3 of the *TSC Act 1995* provides for the listing of key threatening processes. Key threatening processes are processes that adversely affect 2 or more threatened species or which could cause a species to become threatened. |
| **Keystone weeds** | Major or dominant weeds in a community which pose serious and immediate threats because of their ability to change the structure and floristic composition of a plant community over time. Also referred to as 'primary target weeds' or 'ecosystem modifiers'. |
| **Life cycle** | The series of forms that an organism takes as it lives and reproduces. |
| **Life cycle requirements** | The elements required by an organism to complete its life cycle. Eg sites for feeding, roosting and breeding and corridors for dispersal and foraging. |
| **Maintenance weeding** | Denotes low-key and infrequent weeding sessions. An area is said to be 'on maintenance' only after a diverse/healthy native plant community has been established. |
| **Mesic** | A plant with soft leaves and little fibrous tissue. |
| **Monotypic** | Having only one representative, eg a genus or family with a single species. |
| **Mosaic burning** | A pattern of burning that provides a mosaic of fire intervals that mitigates wildfire spread and provides a diversity of fire age classes |
| **Native species** | Normally used to refer to a species indigenous to NSW, but is also sometimes used to refer to a locally indigenous species. |
| **Native vegetation** | Vegetation that is indigenous to NSW, that is, of species that existed in NSW before European settlement. |
| Naturalised | An exotic plant that is established and reproducing as though native. |
| **Natural Integrity** | The degree to which a place or ecosystem retains its natural biodiversity and geodiversity and other natural processes and characteristics. |
| **Natural Regeneration** | Response of site to weed removal and other measures designed to stimulate soil in the soil seed bank (i.e. without planting) |
| **Noxious weed** | Weeds declared under the *Noxious Weeds Act 1993*. A plant that causes serious economic loss, or one that has a detrimental effect on man, animals or the environment. |
| **Nurse crop** | Planted species that grow fast and densely, with the aim of stabilising the soil, providing organic matter, nutrients and shelter for native seedlings. They are often sterile and/or annual species that die-out after a short period, creating space for natives to naturally seed and grow. |
| **Obligate seeders** | Species which have seeds that are dependent on fire for germination. |
| **Operational land** | Land that is classified as operational land under Division 1 of Part 2 of Chapter 6 of the *LG Act* 1993 (see *community land*).<br>Areas classified as operational land have no restrictions on the sale or long-term lease of the land. |
| **Opportunistic species** | A species that can take advantage of adverse conditions and thrive in locations where more sensitive species will not survive. |
| **Passive recreation** | Recreation activities that require limited physical exertion on behalf of the participant. Examples of passive recreation activities include bird watching, walking or photography. |
| Pesticide | Any substance used to kill pest organisms. |
| pH | **A** measure of the degree of acidity or alkalinity; expressed on a logarithmic scale of 1 to 14: 1 is most acid, 7 neutral and 14 most alkaline. |
| **Pile burns** | Used for the disposal of weed waste by burning material in piles. The heat and smoke produced by the fire may also stimulate native regeneration. |
| **Pioneer (early successional) species** | Plant species that are the first to colonise a disturbed environment. They are characterised by their ability to disperse and germinate, rapid growth, high photosynthetic capacity and short life span. |

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| **Plant community** | A unit of vegetation with a relatively uniform species composition and physical structure. Plant communities also tend to have characteristic environmental features such as bedrock geology, soil type, topographic position, climate, and energy, nutrient, and water cycles. |
| **Primary weeding** | Denotes weeding through an area for the first time only, may involve target weeding of selected species only or a thorough weeding of all invasive species. |
| **Propagules** | Any part of a plant that is able to produce a new plant when dispersed eg. Spore, seed, cutting, root or stem fragments. |
| **Protection** | The taking care of a place by managing impacts to ensure that natural significance (biodiversity/geodiversity) is retained. |
| **Recovery plan** | A plan prepared under Part 4 of the *TSC Act 1995* or Part 7A of the *Fisheries Management Act 1994* providing for the recovery of threatened species, populations or ecological communities. |
| **Regeneration** | The *natural* recovery of natural integrity from disturbance of a community of organisms or an ecosystem: from soil seed bank (*in situ*), vegetative reproduction or via recruitment from external sources. |
| **Rehabilitation** | To re-establish the original or repair damage. |
| **Reinstatement** | To introduce to a place one or more species or elements of habitat or geodiversity that are known to have existed there naturally at a previous time, but that can no longer be found in that place. |
| **Relative abundance** | Amount of each species present at a site |
| **Remnant** | Usually a small patch of vegetation containing at least part of the original plant community floristics and structure. |
| **Restoration** | Returning existing habitats to a known or past state or to approximate the original natural condition by repairing degradation, removing exotic species, reinstatement or allowing recovery.<br>For the purposes of the F&FMP – planting, using local native species to restore diversity and community structure. |
| **Restoration ecology** | The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. |
| **Revegetation** | The process of returning plant life to an area eg. planting tubestock, direct seeding, hydro-mulching, brush matting. |
| **Rhizome** | An underground stem, usually horizontal, producing leafy shoots and new stems eg Couch grass, Iris, Pampas grass (adj. Rhizomatous) |
| **Run-off** | The portion of precipitation (rain, hail, snow) which flows across the ground surface as water; major agent of water erosion. |
| **Scalping** | Mechanical removal of weeds and ground debris that exposes favourable mineral soil for planting. |
| **Scarification** | A method of seedbed preparation which consists of loosening the soil surface by a physical disturbance. |
| **Sclerophyll** | Plants with hard, stiff and tough leaves (typical in low rainfall areas). |
| **Secondary weeding** | Denotes weeding through an area the second time around, usually carried out 3-6 months after primary weeding. |
| **Secondary weeds** | Weeds not constituting a significant threat to the communities they invade: generally herbaceous and/or pioneer species. |
| **Seed bank** | The seed naturally available at a site; most of the seed bank is generally stored in the soil, but some may be stored in fruits, such as Banksia cones. |
| **Selective herbicide** | Herbicide is more toxic to some species than others, at specified concentrations. |
| **Senescence** | The growth phase in a plant or plant part (eg a leaf) from full maturity to death. |
| **Scrub** | A general definition of a plant community dominated by shrubs, including thickets: colonising open ground: 2-8 metres: often a single species. |

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| **Shrub** | A multi branched woody plant less than 8 metres high and usually with many stems. |
| **Soil coherence** | The degree to which soil material is held together at different moisture levels. |
| **Soil profile** | The vertical sequence of layers (horizons) in the soil. |
| **Species diversity** | A measure of the number of individuals and their relative abundance in a site: comprising both species richness and relative abundance. The *variety* of species in a place. |
| **Species richness** | The number of species present at a site |
| **Spot fires** | Isolated fires started ahead of the main fire front by sparks, embers or other ignited material, sometimes to a distance of several kilometres. |
| **Stakeholder** | A person with an interest in an issue. |
| **Stormwater** | Water which runs off urban and agricultural catchments, which may carry rubbish, animal droppings, sewage overflows, grass clippings and heavy metals. This untreated water is carried in stormwater channels and discharged directly into creeks, rivers, harbours and oceans. |
| **Target weeding** | Weeding process that concentrates on eradication of certain species. |
| **Threatened species** | "A species listed in Part 1 or 4 of Schedule 1 or in Schedule 2 of the *TSC Act 1995*. More generally, threatened species is a plant or animal generally considered as vulnerable or endangered under various threatened species conservation laws. It is used to indicate that there is some level of threat as to the species viability in the wild. (Nature Conservation Council) |
| **Tree injection** | Method of weed eradication whereby holes are drilled into the stem (below the bark but NOT into the heartwood) and herbicide injected into each hole. |
| **Tubestock** | The growing of plant material in tubes or small pots. |
| **Urban bushland** | Bushland is defined in *SEPP-19* as meaning "land on which there is vegetation which is either a remainder of the natural vegetation of the land or, if altered, is still representative of the structure and floristics of the natural vegetation". |
| **Urbanisation** | The process of altering land uses to create and further develop urban centres. |
| Visual amenity | The views and visual aesthetics offered by a particular site. |
| **Vulnerable species** | A species specified in Schedule 2 of *TSC Act 1995*. More generally, vulnerable species that may soon become endangered if causal factors (habitat destruction, over-exploitation, other environmental disturbances) continue (EPA) |
| **Woodland** | A plant community dominated by trees with crowns relatively close to the ground (usually eucalyptus species) that are separated from each other and with grasses and other herbs forming a more or less continuous ground cover between them. |

## References


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## APPENDIX 10: PLATES

Rubbish dumped on the cleared 3m dirt vehicle track.

Weeds found throughout the Subject Land.

Small group of *Acacia pubescens*.

Oval in the subject land.

Area with *Pultenaea parviflora* and *Dillwynia tenuifolia* individuals..

Bushland extending south past Oakville Park.