

Bingara Gorge

Weed and Pest Eradication Management Plan - Western Precinct

NA82013043-11 Report 005

Prepared for
Lend Lease Pty Ltd

4 May 2016



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Document Information

| | |
|----------------|--|
| Prepared for | Lend Lease Pty Ltd |
| Project Name | Weed and Pest Eradication Management Plan - Western Precinct |
| File Reference | Report 005 - Weed and Pest Management Plan- Western Precinct Ver 2.docx |
| Job Reference | NA82013043-11 Report 005 |
| Date | 4 May 2016 |

| | |
|----------------|-------|
| Version Number | Ver 2 |
|----------------|-------|

| | |
|----------------|------------|
| Effective Date | 4 May 2016 |
|----------------|------------|

| | |
|----------------|------------|
| Date Approved: | 4 May 2016 |
|----------------|------------|

Document History

| Version | Effective Date | Description of Revision | Prepared by: | Reviewed by: |
|---------|----------------|-------------------------|--------------|--------------|
| 1 | 25/01/16 | Final Issue | RMH | AJL |
| 2 | 4/5/2016 | Minor edits | DMS | AJL |
| | | | | |
| | | | | |

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1 Background

1.1 Scope of Report

Cardno has been engaged by Lend Lease Pty Ltd to prepare a weed and pest eradication management plan as required by Wollondilly Shire Council in accordance with typical Development Consent condition for Bingara Gorge. In the past, separate plans have been prepared for each proposed stage of development. This plan is an update to the Weed and Pest Eradication Management Plan for the Western Precinct Wilton Parklands, Wilton which was prepared by HWR in 2006 and has the objective to address the relevant DA consent condition below.

Consent Condition typically states that:

A Weed Eradication and Management Plan is to be prepared by a suitable qualified and experienced person(s) for submission and approval by Council or a nominated Accredited Certifier prior to the issue of any Construction Certificate for the development and shall include:

- a) *An inventory of all Noxious and Environmental weeds on the development site and a site plan indicating the weed infestations with reference to the species and degree of infestation (i.e. low, medium, high).*
- b) *A treatment schedule in tabulated form, specifying for each species:*
 - *The method of treatment (mechanical, herbicide use or cultural such as pasture improvement or grazing);*
 - *The rates of application methods of all herbicide treatments;*
 - *The primary control treatment to achieve a minimum 70% kill and a secondary control treatment to achieve a minimum 90% kill; and*
 - *The timing of treatments.*
- c) *An annual weed maintenance program indicating the methods to be implemented to maintain a weed-free site.*
- d) *Details of any methods of disposal of weed material.*
- e) *Additional measures to control both Serrated Tussock - Class 4 and St Johns Wort - Class 4 which was evident onsite.*

2 Weed Management Context

2.1 Supporting Documentation

Weed management and maintenance has been ongoing across the Bingara Gorge Residential Development site for over 10 years. Cardno has reviewed the relevant reports and documentation describing the ecology of the site and these on-going weed management controls works to date. This includes:

- > Weed and Pest Eradication Management Plan for the Western Precinct Wilton Parklands, Wilton (HWR, 2006)
- > Vegetation Management Plan (Knox & Partners Landscape Architects, 2008)
- > Bingara Gorge Stage DA – Ecological Assessment (Eco Logical, 2013)
- > Ecohort Pty Ltd Noxious Weed Control Certification Letter – ‘Bingara Gorge Site’ (Ecohort, 2013)
- > Ecohort Pty Ltd Noxious Weed Control Certification Letter – ‘Fairways East’ (Ecohort, 2014a)
- > Ecohort Pty Ltd Noxious Weed Control Certification Letter – ‘Bingara Gorge Site’ (Ecohort, 2014b)
- > Ecohort Pty Ltd Noxious Weed Control Certification Letter – ‘Kirkwood Chase’ (Ecohort, 2014c)
- > Ecohort Pty Ltd Noxious Weed Control Certification Letter – ‘1M builders triangle’ (Ecohort, 2015)
- > Stage 1J Fairways East, Bingara Gorge – Flora and Fauna Assessment (EcoLogical, 2015).

Additional Noxious and Environmental Weeds identified within the relevant reports have been included in the Noxious and Environmental Weed Inventory for this plan (**Table 3-2**). Suggested control measures and techniques were also considered in the development of treatment methods and schedules (**Section 4**).

2.2 Current Condition of the Western Precinct

The Flora and Fauna Assessment for the Bingara Gorge Staged DA (EcoLogical, 2015) suggests the majority of the Western Precinct is comprised of Pasture with patches of SSTF situated in the Fairways East Stage 1J subdivision. Development works are largely unstarted in this precinct of the development area and so the occurrence of sealed and built up areas are uncommon. Weed maintenance works currently being undertaken in this precinct are part of the site wide maintenance works.

2.3 On-going Weed Control Works

In compliance with the Weed and Pest Eradication Management Plan for the Western Wilton Parklands (HWR, 2006), Ecohort Pty Ltd has undertaken ongoing noxious weed control works throughout the Bingara Gorge Residential Development site since 2006. Control works have involved periodic sweeps treating a range of weeds throughout the entire site and proposed development areas.

Noxious weeds such as Serrated Tussock, have been sprayed with an appropriate glyphosate herbicide solution at the recommended rate of 1:75. While treated weeds were left in-situ on site to decompose. Blackberry spot spraying was undertaken between flowering and fruiting, typically between December to April.

Ecohort Pty Ltd (2015) certify that ongoing follow-up control of noxious weeds including Blackberry, Serrated Tussock and St. John's Wort has been successful in achieving the Council's specified target of a minimum 90% kill rate. Ecohort recommend continuous on-going noxious weed control to inhibit the ability of the plants to spread.

2.4 Site Surveys

2.4.1 HWR Pty Ltd Weed and Pest Survey, March 2006

2.4.1.1 *Weed Survey*

HWR, 2006 undertook a survey of noxious and environmental weeds on the Stage 1 Wilton Parklands site between 2 March 2006 and 3 March 2006. No environmental weeds listed by the Council were identified during the survey, however, Blackberry a Class 4 Noxious Weed was recorded. During this period, Blackberry occurred in patches throughout the pasture areas. Five locally occurring weeds Narrow-leaved Carpet Grass, Couch Grass, Umbrella Sedge, Paspalum and Stinking Roger were also recorded in the Western Precinct.

2.4.1.2 *Vertebrate Pest Survey*

HWR 2006 completed an inventory of all vertebrate pest species located within the Western Precinct on 2nd March 2006 and 3rd March 2006. No vertebrate pest species were observed on the Western Precinct, however, HWR 2006 suggested ongoing monitoring is required to assess the likelihood of future infestations. HWR 2006 identified pest species which are likely to occur within the Western Precinct and outlined potential management options in the Weed and Pest Eradication Plan for the Western Precinct (HWR, 2006).

2.4.2 EcoLogical Field Survey's

2.4.2.1 *Fairways East Stage 1J, June 2013*

Ecological undertook a field survey on 23rd June 2013 within the Fairways East Stage 1J subdivision. A random meander technique was used to validate the existing vegetation community mapping for the area and to record visible flora species and fauna habitat throughout the site.

2.4.2.2 *Bingara Gorge Stage DA, September 2013*

A wider field survey was undertaken from the 23rd – 25th September 2013 for the entire Bingara Gorge development application. This survey involved the inspection of nine transects in search of threatened flora species. The vegetation survey focused on identifying flora species, targeting threatened fauna known to occur in the local area and recording habitat features with the potential to be utilised by threatened flora and / or fauna.

During both the June and September EcoLogical field surveys in 2013, 19 exotic species including three noxious weeds were identified. These species have been included in this plan as part of the inventory of noxious and environmental weeds for the Western Precinct as well as in the exotic species list for the Western Precinct located in **Appendix A**.

3 Legislative Context

3.1 Noxious and Environmental Weeds

Noxious weeds are plants that have been declared under the *Noxious Weeds Act 1993*, to have the potential to impact agriculture, animal or human health, as well as, to damage to the environment.

The term 'environmental weed' is not specifically defined in legislation and generally refers to plants which have become a threat to the survival of native plants and animals. Environmental weeds listed on the Wollondilly Shire Council website (2015) include Privet (*Ligustrum sinense*), Moth Vine (*Araujia sericifera*), Madeira Vine (*Anredera cordifolia*), Giant Reed (*Arundo donax*) and Balloon Vine (*Cardiospermum grandiflorum*). None of these have yet been identified on the site.

3.2 Noxious Weeds Act 1993

The *Noxious Weeds Act of 1993* declares, categorises and defines control actions for the various noxious weeds, according to their potential to cause harm to our local environment, human health, and as economic pests. It also defines the roles of government, councils, private landholders and public authorities in the management of noxious weeds.

Noxious weeds are those specifically gazetted by NSW Agriculture, although this may differ between local government areas due to differences in natural environments.

3.3 Noxious Weeds (Weed Control) Order 2014

The *Noxious Weeds (Weed Control) Order 2014* is published in the NSW Government Gazette, and details weeds declared noxious in New South Wales, Australia, under the *Noxious Weeds Act 1993*. The Order lists the weed names, the control class and the control requirements for each species declared in a Local Control Authority area. The Order itself describes the legal requirements for any weed.

Table 3-1 NSW noxious weed control orders as declared under the *Noxious Weeds Act 1993* No 11.

| Class | Category | Definition | Legal Requirements |
|-------|-----------------------------|--|---|
| 1 | State Prohibited Weeds | Plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent. | The plant must be eradicated from the land and the land must be kept free of the plant. The weeds are also "notifiable" and a range of restrictions on their sale and movement exist. |
| 2 | Regionally Prohibited Weeds | Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent. | The plant must be eradicated from the land and the land must be kept free of the plant. The weeds are also "notifiable" and a range of restrictions on their sale and movement exist. |
| 3 | Regionally Controlled Weeds | Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area. | The plant must be fully and continuously suppressed and destroyed * |
| 4 | Locally Controlled Weeds | Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area. | 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.* |
| 5 | Restricted Plants | Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State. | There are no requirements to control existing plants of Class 5 weeds. However, the weeds are "notifiable" and a range of restrictions on their sale and movement exists. |

Table 3-2 identifies the listed noxious weed which have been identified as occurring on the Bingara Gorge Residential Development Site.

Table 3-2 Inventory of all Noxious Weeds recorded in the subject site.

| Common Name | Scientific Name | Class | Legal Action Required | Source | Recorded Location |
|------------------|---------------------------------|--------|---|--------------------|----------------------|
| Blackberry | <i>Rubus discolor</i> | 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.* | HWR, 2006 | Weed Management Zone |
| Serrated tussock | <i>Nassella trichotoma</i> | 3 or 4 | The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed. | DA Condition, 2015 | Weed Management Zone |
| St. John's wort | <i>Hypericum perforatum</i> | 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.* | Ecological, 2015 | Stage 1J |
| Fireweed | <i>Senecio madagascariensis</i> | 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.* | Ecological, 2015 | Stage 1J |
| African Boxthorn | <i>Lycium ferocissimum</i> | 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.* | Ecological, 2015 | Stage 1J |

3.4 Wollondilly Shire Weed Management Strategy

The *Wollondilly Shire Weed Management Strategy* (the Strategy) was developed by the Council in May 2007 with the aim of providing an efficient and effective assessment, management and/or eradication approach for the Wollondilly Local Government Area (LGA).

The Strategy has 7 major aims:

1. Avoid the introduction or dispersal of new weed or potential weed species;
2. Minimise any further dispersal of established declared noxious weeds species;
3. Minimise the adverse effects of weed species upon the environment;
4. Undertake weeds management operations in an integrated manner;
5. Undertake weed management operations on a catchment basis;
6. Establish priorities in Weed Management activities and target species; and
7. Link Weed Management activities to the resources available in the community and Council.

The strategy details effective methods to manage weeds within the LGA and these methods have been utilised where practical within this plan.

4 Weed Management Control Measures

The Noxious and Environmental weed inventory developed by HWR, 2006 has been updated to include the noxious and environmental weeds identified by Ecohort Pty Ltd and Ecological, 2015 (see **Table 4-1** for the up to date inventory). Five 'Class 4' noxious weed species have been recorded within the subject boundary during the period beginning 2 March 2006 to September 2015. It is a requirement under the Noxious Weeds (Weed Control) Order 2014 that the growth and spread of these plants is controlled according to measures specified in a management plan published by the local control authority.

Based on previous surveys and the work that has been undertaken to date a Weed Management Zone Plan (**Figure 4-2**) has been developed to indicate the potential likelihood of the occurrence of weed infestations within the Western Precinct.

Table 4-1 Probability of Occurrence classes for the Weed Management Zone Plan in the Western Precinct of the Bingara Gorge Development Approval site (Figure 4-2).

| Probability of Occurrence | Description |
|---------------------------|--|
| Low | Areas considered low probability are areas of known rehabilitation works. |
| Medium | Areas which have had ongoing control works and require further weed management and/or are in the development stage. |
| High | High probability areas are regions which have had minimal weed management control works and the likelihood of weed presence is high. |

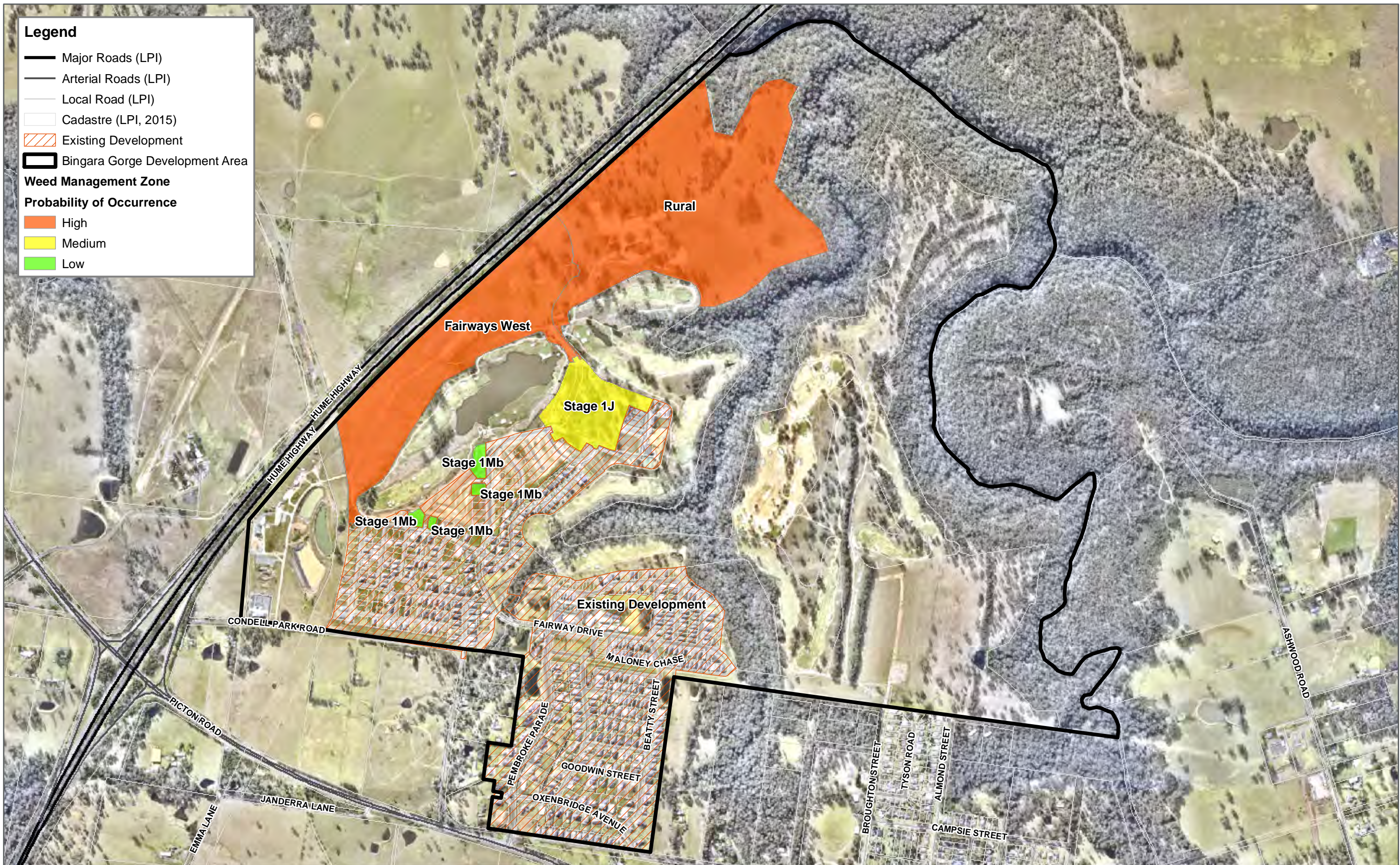


FIGURE 4-2
1:12,000 Scale at A3

Metres
0 250 500 750 1,000

Weed Management Plan Western Precinct BINGARA GORGE, NSW



Cardno
Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2016-01-22
Coordinate System: GDA 1994 MGA Zone 56
Project: NA82013043-11
Map: G11002_WeedManagement.mxd 01
Aerial imagery supplied by nearmap (June, 2015)



4.2 Weed Control

During the development of each stage within the Western Precinct a qualified weed management contractor will be engaged to utilise this plan in the undertaking of weed/pest control and maintenance works. Where noxious species are identified, the methodologies outlined in the sections below will be utilised where appropriate in the eradication and removal of these species.

Appendix A identifies a comprehensive list of locally occurring exotic species which have been identified across the Bingara Gorge Residential Development site. In the event that these species are identified during weed management works these species will be controlled utilising the following strategy as outlined in the Vegetation Management Plan – Bingara Gorge (Knox & Partners, 2008):

- Primary weeding through prescribed methods such a poisoning or hand removal
- Facilitation of natural resilience to bushland to maximise native regeneration and to minimise the potential of weed colonisation.

Table 4-2 provides an example of recommended control measures for locally occurring weed species within the Bingara Development.

Table 4-2 Recommended control methods for locally occurring weed species (Knox & Partners, 2008).

| Common Name | Scientific Name | Removal Technique | Description |
|------------------------------|--------------------------------|---|---|
| Crofton Weed | <i>Ageratina adenophora</i> | Hand pull, crown before fruiting | Bag seed heads and dispose; regrows after cool fire |
| Spear Thistle | <i>Cirsium vulgare</i> | Crown | If crowning unsuccessful spot spraying with MCPA at a rate of 1.5-2L/ha can be applied to actively growing rosettes |
| Couch Grass | <i>Cynodon dactylon</i> | Crown, cut and roll, spray 1:100 glyphosate | Regrowth after fire. |
| Kikuyu | <i>Pennisetum clandestinum</i> | Crown, cut and roll, spray 1:100 glyphosate | |
| Inkweed | <i>Phytolacca octandra</i> | Crown | Brittle tap root will reshoot if not removed, if unsuccessful spray with Tordon 75-D (500mL: 100L water). Seed germinate after fire and mechanical disturbance. |
| Blackberry Nightshade | <i>Solanum nigrum</i> | Hand pull | Seed germinate after fire and mechanical disturbance. |
| Stinking Roger | <i>Tagetes minuta</i> | Hand pull | Shallow taproot |
| Cobblers Pegs | <i>Bidens pilosa</i> | Hand pull, crown | Germinates after fire |
| Tall Fleabane | <i>Conzys albida</i> | Hand pull, crown before fruiting | Bag seed heads and dispose; germinates after fire |
| Fleabane | <i>Conzys bonariensis</i> | Hand pull, crown before fruiting | Bag seed heads and dispose; germinates after fire |
| Slender Pigeon Grass | <i>Setaria gracilis</i> | Crown, hand pull, cut and roll | Germinate after disturbance and fire; remove all rooted nodes |
| Paddys Lucerne | <i>Sida Rhombifolia</i> | Crown, scrape and paint | Coppices, deep tap root, regrows after fire |
| Japanese Honeysuckle | <i>Lonicera japonica</i> | Crown, cut and roll | Remove all parts and bag; regrows at nodes |

4.2.2 **Blackberry (*Rubus fruticosus* agg.)**

Blackberry is recognised as a Class 4 species which requires that its growth and spread must be controlled according to measures specified by the local control authority (Noxious Weeds (Weed Control) Order 2014, pp.735 - 736).

The control measures set out for blackberry in the Wollondilly Shire Council Weed Management Strategy (Wollondilly Shire Council, 2007) are to:

- > Reduce the number and distribution by 25% of the original infestation per growing season;
- > Prevent from producing seed and spreading; and
- > The plant may not be sold, propagated or knowingly distributed.

Managing Blackberry is a long-term process and cannot be achieved using one method of control (DPI, 2009). An integrated approach which considers site conditions and degree of infestation is therefore essential. The available methods and their suitability are briefly discussed below:

Mechanical

- > Hand-weeding, using a mattock or shovel is suitable for very small infestations and may be appropriate for sensitive areas throughout the site. Care should be taken to remove the whole root system to prevent regrowth (CRC, 2003).
- > Mechanised removal, using large earth-moving equipment is effective but results in substantial ground disturbance which can favour further weed infestation.
- > Slashing is a short-term option and reduces the above-ground biomass but does not kill the plants, although frequent repeated slashing may eventually reduce the size and vigour of the plant (DPI, 2009).

Chemical

- > Spraying herbicide is highly effective for controlling blackberry and produces the best results when the plants are healthy and growing (CRC, 2003);
- > Herbicides used for blackberry control absorb through the foliage and stems but can also remain active in the soil and affect non-target species;
- > Many methods are available for the application of herbicide including spray, cut-stump and granule or gel application (DPI, 2009);
- > Granule herbicide is applied to the soil surface and useful where spray applications are impractical or undesirable (DPI, 2009);
- > 'Cut-stump' application is labour intensive and used for scattered plants in sensitive areas or as a follow-up treatment (DPI, 2009).

Biological

- > Blackberry Leaf Rust (*Phragmidium violaceum*) is only effective on the European species of blackberry and has been more successful at higher altitudes (Bruzzeze et al., 2000).
- > Rust is most useful in areas of large infestation where access is limited (DPI, 2009);
- > Grazing by goats is an effective control method as they preferentially graze blackberry over improved pasture species.
- > Areas where blackberry has been controlled are often planted with desirable species to increase competition (CRC, 2003).

Blackberry in the Western Precinct occurs as isolated plants scattered throughout large pasture areas. Direct chemical control is considered to be the most appropriate method in this situation. However, spraying in dry conditions is less effective as the plants lack vigour due to water stress.

The recommended management for Blackberry on the site is summarised in **Table 4-3**.

Table 4-3 Weed management strategy for the control of Blackberry (*Rubus fruticosus*) (Wollondilly Shire Council, 2007; Knox & Partners, 2008).

| Blackberry (<i>Rubus fruticosus</i>) | | |
|--|-----------------------------------|---|
| Recommended Method | Chemical | |
| Primary Control | Herbicide | Glyphosphate + metsulfuron (Cut-out) |
| | Rate | 1 measured pack in 100L of water |
| | Application method | Apply when bushes are actively growing. Do not apply to bushes with mature fruit. |
| | Timing | January to April |
| Secondary Control | Need | If regrowth is apparent 12 months after primary treatment |
| | Herbicide | metsulfuron methyl (e.g. Brushoff®, Ally®) |
| | Rate | 10g per 100 mL of water |
| | Application method | Spray remaining / new growth. |
| | Timing | October to March |
| Maintenance | Regular inspections for regrowth. | |

4.2.3 **Serrated Tussock (*Nassella trichotoma*)**

Serrated Tussock is a Class 4 species which requires its growth and spread to be controlled according to measures specified by the local authority (Noxious Weeds (Weed Control) Order 2014, pp.735 - 736). The species is also a Weed of National Significance and is regarded as one of the more problematic weeds in Australia due to its ability to spread as well as its economic and environmental impacts.

The control measures for the Serrated Tussock are outlined in the Appendix C of the adopted Strategy (Wollondilly Shire Council, 2007), Regional Weed Management Plan for Sydney-wide Grasses Management Plan ("The Big Four") (DPI, 2011) and the National Best Practice Management Manual – Serrated Tussock (Osmund et al., 2008).

The objectives of the serrated tussock Sydney-wide Grasses Management Plan (DPI, 2011) are to:

- > To identify, inspect and record infestations and at risk sites of the Big Four grasses (i.e. sites that are at risk of having new incursions)
- > To strategically reduce known infestations and prevent the spread of the Big Four grasses
- > To increase the awareness, identification and control skills among Council/state agency staff and contractors
- > To increase the awareness, identification and control skills among Bushcare/ Landcare volunteers, and private landholders.

The Class 4 Management Plan (Wollondilly Shire Council, 2007) specifies a specific control measure for Serrated Tussock to:

- > Reduce the number by 25% of the original infestation per growing season; and
- > Prevent from producing seed and spreading.

In the Wollondilly LGA, isolated infestations of Serrated Tussock have been identified along the Hume Highway corridor and found by Ecohort Pty Ltd along the gas line easement and open paddock areas of the Western Precinct.

Depending on the level of infestation, Serrated Tussock can be managed in a variety of ways. The available methods and their suitability are discussed below:

Mechanical

- > Chipping with a mattock to remove scattered individual plants before they seed;
- > Tussocks chipped in full flower should be disposed of by burning;
- > Soil clods should be removed when chipping in wet weather; and
- > If there is soil disturbance, scatter pasture seed and fertiliser to provide competition.

Chemical

- > The most widely used registered herbicides for the control of Serrated Tussock include herbicides that contain either glyphosate or flupropanate (Osmond et al., 2008);
- > Herbicide rate and application is dependent upon size and density of infestation; and
- > Native and introduced pasture species vary in their ability to tolerate herbicides therefore pasture species should be identified prior to control works (DPI, 2011).

Biological

- > No biological control agents are available for serrated tussock (DPI, 2014b).

4.2.3.1 Best Practice Control Measures for Serrated Tussock

The *National Best Practice Management Manual – Serrated Tussock* (Osmond et al, 2008) suggests the following control measures for all infestations levels within Urban Areas and should be used for the Western Precinct:

- > Learn to correctly identify serrated tussock;
- > Kill serrated tussock plants by chipping or spot spraying with glyphosate or flupropanate, using a carefully directed spray, or alternatively wick wipe. Where soil disturbance has occurred, broadcast pasture seed and fertiliser to increase desirable vegetation levels;
- > Slash or mow only as a short-term solution to delay the flowering of serrated tussock;
- > Use methods that will reduce seed spread, such as fencing off reserves, private land and roadsides and practice machinery and vehicle hygiene procedures; and
- > Regularly monitor infestation levels and carry out follow up control activities.

The recommended rate of application of herbicide treatments for Serrated Tussock on the site is summarised in **Table 4-4**.

Table 4-4 Rates of application of herbicide treatments for Serrated Tussock (*Nassella trichotoma*) (Wollondilly Shire Council, 2007).

| Situation | Herbicide | Rate | Comments |
|---|---|---|---|
| Spot spray from September to may | Flupropanate | 2.0L per hectare or 200ml in 100L of water | Boom application, spot spray |
| June to August for boom or aerial application or September to march for wick wiping application | Flupropanate 745g/L | 1.5-2.0 L per hectare or 150-200ml in 100L of water or 1:20 mixture in water | Boom and aerial application, June to August inclusive |
| General purposes | Glyphosphate 360g/L | 1L in 2L of water | Wick wiping application |
| Actively growing stress free plants | Glyphosphate 360g/L (Roundup Bioactive) | 4.0 to 6.0L per ha | Spray topping application |
| Maintenance | | Regularly monitor infestation levels and carry out follow up control activities such as chipping. | |

4.2.4 **St. John's wort (*Hypericum perforatum*)**

St. John's Wort is a Class 4 species which requires its growth and spread to be controlled according to measures specified by the local authority (Noxious Weeds (Weed Control) Order 2014, pp.735 - 736).

The control measures for the St. John's Wort are outlined in the Appendix C of the adopted Strategy (Wollondilly Shire Council, 2007), NSW WeedWise – St. John's Tussock profile and the *Best Practice Management Guide for Environmental Weeds – St. John's Wort* (Briese et al., 2000).

The Class 4 Management Plan (Wollondilly Shire Council, 2007) specifies a specific control measure for St. John's Wort to:

- > Reduce the number by 25% of the original infestation per growing season.
- > Prevent from producing seed and spreading.

Depending on the location and level of infestation, an integrated management system incorporating a variety of control measures should be used to effectively reduce the population to an acceptable level. Best results are usually obtained by moving from areas of light infestation towards heavier infestation. The available methods and processes are briefly discussed below:

Prevention

- > Keep uninfested areas clear of the species by methods such as quarantining an area;
- > Care should be taken to avoid the transport of seed in machinery and vehicles.

Manual Control

- > Pulling or chipping can remove isolated plants, but all roots must be removed or the plant will regenerate.

Chemical

- > For the control of small to large infestations of St. John's Wort registered herbicides such as fluroxypyr, triclopyr + picloran and glyphosate may be used.
- > Differing herbicides can be used to selectively remove the species, kill all legumes or severely damage all species.
- > Herbicides can be applied through methods such as spot spraying, boom-spraying or rotary wipers (see **Table 4-5** for rates of application and treatments).

The recommended rate of application of herbicide treatments for St. John's Wort on the site is summarised in **Table 4-5**.

Table 4-5 Rates of application of herbicide treatments for St. John's Wort (*Hypericum perforatum*) (Wollondilly Shire Council, 2007).

| Situation | Herbicide | Rate | Comments |
|--|--|---|---|
| Full leaf to ripe fruit prior to leaf fall | Triclopyr + picloram | 350 or 500ml in 100L of water, or 2.0-4.0L per hectare | Use higher rate on bushes over 1.5 metres high |
| Spring to mid-summer application | Fluroxypyr 200g/L | 500ml in 100L of water or 3.0L per hectare | Boom application, observe withholding period |
| Flowering to post flowering | Glyphosphate 360g/L | 500ml in 100L of water or 3.0L per hectare | Apply November to May |
| Before flowering | 2,4-D ester 800g/L | 280-400ml in 100L of water or 2.8-4.0L per hectare | Apply October to December when the plants are less than 40cm high |
| Before flowering | 2,4-D LV ester 400g/L | 5.5 to 8.7L per hectare | October to December |
| Actively growing | Glyphosphate + metsulfuron | 1 measured pack in 100 L of water | Spring to summer |
| | Metsulfuron methyl + Glyphosphate 360g/L | 10g + 200ml in 100L of water | Spray to wet but not to cause runoff |
| Maintenance | | Follow-up control after initial treatment is important to control regrowth and seedling germination in the long term. | |

4.2.5 Fireweed (*Senecio madagascariensis*)

Fireweed is a Class 4 species which requires its growth and spread must be controlled according to measures specified by the local authority (Noxious Weeds (Weed Control) Order 2014, pp.735 - 736). The species was declared noxious after the development of the Strategy, therefore the local control authority has not specified operational control measures for this species. Treatment rates set out by NSW DPI have been provided as appropriate control measures (**Table 4-6**) (DPI, 2014a). The species is also listed by the Australian governments as a WoNs.

The Best Practice Management Guide for Australian Landholders – Fireweed (Sindel & Coleman, 2012) and the Weed Management Guide - Fireweed (Wicks, 2010) suggest a new or small isolated infestation such as that described in the Western Precinct should be managed through a combination of:

- > Site hygiene;
- > Hand weeding; and
- > Spot spraying with selective herbicide.

The best approach is dependent upon the severity of the fireweed infestation. Hand weeding is appropriate when infestations are very small or isolated, however all parts of the plant, especially the flowers, should be bagged and destroyed appropriately (Wicks, 2010). The use herbicide treatment to minimise the establishment of fireweed populations is best applied in autumn (Sindel & Coleman, 2012). Chemical control can be effective in reducing the density of fireweed infestation for more than a year.

Fireweed was identified by EcoLogical (2015) during a field survey of the Stage 1J Fairway East stage at the site (**Figure 4-2**). If Fireweed is identified during weed control works, a combination of hand weeding and chemical control is considered to be the most appropriate method of management.

The recommended rates and timing of application for Fireweed is summarised in **Table 4-6** and **Table 4-7**.

Table 4-6 Suggested herbicide strategies for areas south of Sydney (DPI, 2014a).

| Explanation | Most plants are established by end of May. Herbicides effective up to the end of July rapidly decline in effectiveness up to the end of August. | | | | | | Generally too late for herbicides | | | On-farm planning for next autumn | |
|-----------------------|---|--|---|-----|-----|--|-----------------------------------|-----|--|----------------------------------|------|
| Plant growth stages | Dead | Increasing germination events and seedling establishment | | | | Seedlings established growth (slow growth in July) towards flowering | | | Flowering and senescence | | Dead |
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov |
| Best herbicide option | Avoid herbicide use | | Bromoxynil and Jaguar® most useful in pastures with legumes. Metsulfuron-methyl suitable for pastures without legumes | | | Bromoxynil and Jaguar® most useful in pastures with legumes. Metsulfuron-methyl suitable for pastures without legumes. | | | Herbicide use not ideal, earlier kill preferred, however Grazon® Extra, metsulfuron-methyl and Hotshot® (spot spray only) can be used to target flowering plants. Success and evaluation period; plan implementation strategies for next year. | | |
| Maintenance | | | Follow-up spot spraying of more mature or flowering plants in spring. | | | | | | | | |

Table 4-7 Rates of application methods of herbicide treatments for Fireweed (*Senecio madagascariensis*) (DPI, 2014a).

| Situation | Herbicide | Rate | Comments |
|------------------------|-----------------------------|--|----------|
| Spot spray application | Metsulfuron-methyl 600 g/kg | 10 g in 100 L of water | |
| Maintenance | | Regularly monitor infestation levels and carry out follow up control activities. | |

4.2.6 African Boxthorn (*Lycium ferocissimum*)

African Boxthorn is a Class 4 species which requires its growth and spread to be controlled according to measures specified by the local control authority (Noxious Weeds (Weed Control) Order 2014, pp.735 - 736).

The control measures for African Boxthorn are outlined in Appendix C of the adopted Strategy (Wollondilly Shire Council, 2007) and the Weed Management Guide - African Boxthorn (CRC, 2007) and aim to:

- > Reduce the number by 25% of the original infestation per growing season; and
- > Prevent from producing seed and spreading.

Effective management of this species requires an integrated management approach utilising a combination of mechanical removal, cultivation, herbicide application, replacement and regular monitoring (DPI, 2015).

Depending on the level of infestation, African Boxthorn can be managed in a variety of ways. The available methods and their suitability are discussed below:

Mechanical

- > Methods such as stick raking, dozing and blade ploughing are the most cost-effective way to control mature thickets (Wollondilly Shire Council, 2007);
- > All plant material must be destroyed after removal as broken fragments may sucker and produce new growth (CRC, 2007);
- > Follow-up work must be carried out to ensure regrowth appropriately managed;

- > The removed weed should be replaced with appropriate vegetation to ensure long-term control.

Chemical

- > Highly effective but must be carefully chosen and selectively applied to minimise regrowth (CRC, 2007);
- > Main herbicide treatments include foliage spray, cut-stump, stem injection and basal bark application (DPI, 2015).
- > Most appropriate herbicide treatment is dependent upon the location, size and maturity of the infestation (see **Table 4-8** for suggested rates of application and herbicide treatments).

Biological

- > No biological control agents have been identified for this species (CRC, 2007).

African Boxthorn was identified by EcoLogical, 2015 during a field survey of the Stage 1J Fairway East stage at the site (**Figure 4-2**). If African Boxthorn is identified during weed control works, direct mechanical removal and chemical control is considered to be the most appropriate method of management.

The recommended rates of application for African Boxthorn on the site is summarised in **Table 4-8**.

Table 4-8 Rates of application of herbicide treatments for African Boxthorn (*Lycium ferocissimum*) (Wollondilly Shire Council, 2007).

| Situation | Herbicide | Rate | Comments |
|---|----------------------|---|--|
| Apply when bushes have good leaf cover, growth and no leaf fall | Triclopyr + picloram | 500ml in 100L of water | |
| Apply at any stage | Access | 1.0L in 60L of diesel | Apply as a basal bark/ cut stump application |
| Small bushes only | Picloram +2,4-D | 1.3L in 100L of water | Spray soils to drip line. Thorough Situation Herbicide Rate Comments coverage is essential |
| Young and mature bushes | Glyphosphate 360g/L | 700ml to 1.0L in 100L | Low rate on young bushes and high water rate on mature bushes |
| All year round | Triclopyr | 1.0L in 30L of diesel | Cut stump/ basal bark application |
| All year round | Tebuthiuron | 2g per square metre | Do not apply near desirable trees |
| Bushes up to 3m tall | Hexazinone | 4ml per spot | One spot per metre height. Do not apply near desirable trees |
| Maintenance | | Regularly monitor infestation levels to ensure root fragments or germinating seedlings are removed. Follow-up herbicide treatment or cultivation. | |

4.3 Weed Minimisation and Disposal

Weed Disposal

There are unlikely to be large amounts of weeds requiring disposal during the construction phase of the development. If blackberry becomes established in the development area during construction, removal by mattock may be necessary. Any weed material removed shall be disposed of to landfill with Wollondilly Shire Council being consulted with as necessary. Weed control activities should not result in the production of any other waste material. All fruits, seed and flowers of noxious weeds are to be immediately removed and placed in durable bags before disposal at landfill sites.

Re-use of Weed Infested Topsoil

Topsoil is a valuable resource which could be retained for use in rehabilitation, although care needs to be taken to avoid transporting weeds and establishing new infestations. Noxious and environmental weeds should be treated, as described above, before commencement of earthworks. Stockpiled topsoil should be treated as described below, and should be inspected periodically to detect any establishment of noxious and environmental weeds. Landscaped areas should also be periodically inspected to ensure no infestations of noxious and environmental weeds (this last recommendation should form part of landscaping contracts).

Stockpile Treatments

Wherever possible, weed infested stockpiles should be covered with a heavy duty non-permeable plastic enclosed by erosion control fencing. The non-permeable material (e.g. plastic) will promote composting and over time the heat will destroy a large proportion of the living material present (e.g. seeds, roots/rhizomes, spores) including weeds which is the desired outcome of this procedure.

5 Pest Eradication

5.1 Pest Species

The NSW Vertebrate Pest Control Manual (DPI, 2014c) details best practice vertebrate pest management within NSW and nationally. The manual details the potential for pest animals to result in impacts including:

- > Agricultural – damage to crops, predation of livestock, pasture competition, land degradation, soil erosion, stream turbidity and the spread of weeds.
- > Environmental – competition for food and shelter, habitat destruction and predation.
- > Social – being a nuisance, damaging infrastructure or culturally important sites, causing traffic accidents and social and psychological effects on primary producers and their families.
- > Disease – vertebrate pest animals may act as reservoirs and spread mechanisms for diseases that affect native wildlife, livestock or people.

Within NSW local land holders have a responsibility to manage rabbit, feral pig and wild dog populations in accordance with the Pest Control Order issues under the *Local Land Services Act 2013*. Other pests such as foxes, hares, feral cats, feral goats, feral horses, feral donkeys and non-native rats and mice are not required to be managed through obligation under this Act. Management of these species is however encouraged to ensure impacts described above do not occur.

5.2 Vertebrate Pest Survey

An inventory of all vertebrate pest species within the Western Precinct was undertaken between the 2nd March 2006 and 3rd March 2006 including the environmental protection lands and along the boundaries of the site.

No vertebrate pest species were observed on the Western Precinct of the Wilton Parklands project. Future development and construction for residential purposes in these areas is identified as being likely to prevent the establishment of vertebrate species in this area.

Various surveys undertaken since 2006 have failed to identify an occurrence of vertebrate pests. Should these be identified in future surveys the eradication method below will be utilised.

While no vertebrate pest species were observed during surveys, ongoing opportunistic monitoring will be required to determine if it will become a problem in the future. **Section 5.3** provides a discussion of pest species which are considered likely to occur given the proximity to rural areas and residential development, and potential management options if they become problematic.

5.3 Pest Species Eradication and Control

5.3.1 Hares and Rabbits

Rabbits are recognised as a Key Threatening Process due to the negative effects of this species on native species through competition for resources, altering vegetation structure and composition as well as increasing land degradation processes (e.g. erosion). As such eradication is required to control rabbit populations. High populations of rabbit's supports elevated populations of its predators, feral cats and foxes, however care must be taken in managing populations such that rabbit numbers don't drop so dramatically that its predators are forced to switch to native species for food supply.

Management Recommendations

Given the relatively flat nature of the site, bait stations and ripping of burrows may be the most appropriate management strategies if rabbits become problematic, particularly as this area is to be developed for residential purposes. Any baiting should be done with permission and in conjunction with the Rural Protection Board or Council.

5.3.2 **Foxes**

Foxes travel between areas depending upon food availability and season, but can extend more than five square kilometres (NSW NPWS, 1999). A study of the diet of foxes found that rabbits were the principle food source for foxes which may then have management implications for the control of feral cats (Risbey et al 1999 and Read & Bowen, 2001). In the absence of rabbits foxes become opportunistic scavengers often prey upon invertebrates (Read & Bowen, 2001) which are often a key indicator in their faeces.

Traditional methods of fox control have included poisoning of foxes with 1080 from bait stations, shooting, fumigation, fencing, soft-jawed traps and fertility control. Each method has their advantages and disadvantages but is yet to provide effective means of control. The most commonly used method is bait stations which require stations to be established well before poisoning to monitor what species are taking the baits and ensuring that only when foxes are the only animals regularly taking the free feed that a 1080 bait is laid in that station. Fox poisoning with 1080 is regulated in NSW by the *Pesticide Act 1978* and can be carried out only under the conditions specified in the current Off-label Permit, the Rural Lands Protection Boards prepare and supply 1080 baits for use by landholders.

Management Recommendations

Given the relatively flat nature of the Western Precinct the ripping of burrows may be the most appropriate management strategies if foxes become problematic. Baiting is unlikely to occur across the site given the area is to be developed for residential purposes. Any baiting of the surrounding bushland should be done with permission and in conjunction with the Rural Protection Board. Residents should also be notified.

5.3.3 **Feral Cats**

Feral cats have become a significant predator of native fauna in Australia and have been linked to 40% of the historical declines in native mammals weighing less than 350 grams (Short et al, 2002). A study of the dominant food source of feral cats was found to be rabbits which may then have management implications for the control of feral cats (Risbey et al, 1999 and Read & Bowen, 2001). In the absence of rabbits cats prey upon a wide variety of small vertebrates (Read & Bowen, 2001).

The trapping and taking of bait by feral cats is reported to be extremely difficult (Molsher 2001 and Risbey et al 1997) and appears to vary with food availability. Short et al (2002) found that trap success was greater when prey abundance was low compared to when prey abundance was high. Short et al (2002) found that cage traps were effective at capturing scavenging cats, but less successful in capturing hunting cats. Molsher (2001) found capture efficiencies were low 1.3 per 100 trap nights and that the majority of feral cats captured were male, which is probably a result of behaviour bias. Molsher (2001) recommends that trapping of feral cats is best in late autumn and early winter.

Management Recommendations

Given that much of the Western Precinct will be developed for residential purposes feral cats are unlikely to utilise the area. Any baiting of the surrounding bushland should be done with permission and in conjunction with the Rural Protection Board. A community awareness program should be developed to encourage responsible pet ownership for future residents.

5.3.4 **Feral Dogs**

Feral dogs are generally regarded as purebred dingoes, dingo hybrids and domestic dogs living in the wild. Feral dogs have a number of impacts on natural environments including the predation of native fauna, competition with native fauna, and may increase the risk and spread of diseases and parasites.

Feral dog control has included trapping, shooting, fencing, poisoning and the use of guard dogs to protect valuable stock. A combination of these methods which considers feral dog behaviour will enable effective management. Commercial lures and 1080 poison baits are the most economic, efficient, humane and effective method of controlling wild dogs, especially in inaccessible or extensive areas. Baits can be laid quickly in large numbers by hand, from vehicles and from aircraft.

Management Recommendations

Given that much of the Western Precinct will be developed for residential purposes feral dogs are unlikely to utilise the area. Any baiting of the surrounding bushland should be done with permission and in conjunction with the Rural Protection Board. A community awareness program should be developed to encourage responsible pet ownership for future residents.

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Weed and Pest Eradication
Management Plan - Western Precinct

APPENDIX

A

EXOTIC SPECIES IDENTIFIED AT
THE BINGARA GORGE SITE

Table 6-1 All exotic species identified in the Western precinct of the Bingara Gorge Development site.

| Common Name | Scientific Name | Source |
|----------------------------|---------------------------------|------------------|
| Cobbler's Pegs | <i>Bidens pilosa</i> | EcoLogical, 2013 |
| | <i>Centaurea</i> sp. | EcoLogical, 2013 |
| | <i>Facelis retusa</i> | EcoLogical, 2013 |
| Cat's Ear | <i>Hypochaeris radicata</i> | EcoLogical, 2013 |
| Fireweed | <i>Senecio madagascariensis</i> | EcoLogical, 2013 |
| Common Sowthistle | <i>Sonchus oleraceus</i> | EcoLogical, 2013 |
| Dandelion | <i>Taraxacum officinale</i> | EcoLogical, 2013 |
| Proliferous Pink | <i>Petrorhagia nanteuillii</i> | EcoLogical, 2013 |
| St. Johns Wort | <i>Hypericum perforatum</i> | EcoLogical, 2013 |
| Paddy's Lucerne | <i>Sida rhombifolia</i> | EcoLogical, 2013 |
| Plantain | <i>Plantago lanceolata</i> | EcoLogical, 2013 |
| | <i>Aira</i> sp. | EcoLogical, 2013 |
| Panic Veldtgrass | <i>Ehrharta erecta</i> | EcoLogical, 2013 |
| Whorled Pigeon Grass | <i>Setaria parviflora</i> | EcoLogical, 2013 |
| Capeweed | <i>Arctotheca calendula</i> | EcoLogical, 2013 |
| Carpet Grass | <i>Axonopus fissifolius</i> | EcoLogical, 2013 |
| Prairie Grass | <i>Bromus catharticus</i> | EcoLogical, 2015 |
| Shepherd's Purse | <i>Capsella bursa-pastoris</i> | EcoLogical, 2015 |
| Rhodes Grass | <i>Chloris gayana</i> | EcoLogical, 2015 |
| Couch | <i>Cynodon dactylon</i> | EcoLogical, 2015 |
| | <i>Geranium</i> sp. | EcoLogical, 2015 |
| African Boxthorn | <i>Lycium ferocissimum</i> | EcoLogical, 2015 |
| Black Medic | <i>Medicago lupulina</i> | EcoLogical, 2015 |
| Carolina Mallow | <i>Modiola caroliniana</i> | EcoLogical, 2015 |
| Caterpillar Grass | <i>Paspalum dilatatum</i> | EcoLogical, 2015 |
| Kikuyu | <i>Pennisetum clandestinum</i> | EcoLogical, 2015 |
| Ribwort | <i>Plantago lanceolata</i> | EcoLogical, 2015 |
| Slender Pigeon Grass | <i>Setaria parviflora</i> | EcoLogical, 2015 |
| Black-berry Nightshade | <i>Solanum nigrum</i> | EcoLogical, 2015 |
| Annual Sowthistle | <i>Sonchus oleraceus</i> | EcoLogical, 2015 |
| White Clover | <i>Trifolium repens</i> | EcoLogical, 2015 |
| Stinking Roger | <i>Tagetes minuta</i> | HWR, 2006 |
| Umbrella Sedge | <i>Cyperus eragrostis</i> | HWR, 2006 |
| Narrow-leafed Carpet Grass | <i>Axonopus fissifolius</i> | HWR, 2006 |