



mainroads
WESTERN AUSTRALIA

Roe Highway Extension

Arum Lily Control Program



Prepared for
Main Roads Western Australia
by Strategen

December 2015



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Appendix 1 GPS coordinates of Arum Lily monitoring sites

1. Introduction

Main Roads Western Australia (Main Roads) proposes to construct the Roe Highway Extension (the Project, Figure 1) as part of the Perth Freight Link Project. The proposed extension to Roe Highway is largely located within a primary regional road reserve which adjoins Beeliar Regional Park. A portion of this road reserve will not be required for the proposed extension and management of this area will be transferred to Department of Parks and Wildlife (Parks and Wildlife) as part of Beeliar Regional Park as an environmental offset for the Project (Figure 2).

The area to be transferred is known to contain high densities of the exotic weed species *Zantedeschia aethiopica* (Arum Lily) which will be managed prior to the transfer of responsibility for management to Parks and Wildlife taking place. This document presents the Arum Lily Control Program (ALCP) designed to eradicate and manage occurrences of the weed in this part of road reserve prior to its transfer into Beeliar Regional Park (Figure 2).

1.1 Background

The Project is located approximately 14 km south of Perth within the Swan Coastal Plain Bioregion. The Project is largely contained within the City of Cockburn, however, parts of the design extend northward in to the City of Melville along Murdoch Drive and Kwinana Freeway. Generally, the proposed Project is oriented east-west largely, within a road reserve that was set aside in the Metropolitan Region Scheme (MRS) in 1963. The alignment is between North and Bibra Lakes, which are part of the Eastern Chain of the Beeliar Wetlands.

The Project will consist of a dual carriageway with two lanes in each direction, separated by a concrete barrier in place of a median strip. The preferred design was selected following an extensive options analysis and consultative process. Once selected, the preferred design was optimised to avoid and minimise environmental impacts to the maximum extent possible.

In 2009 the Project was referred to the Environmental Protection Authority (EPA) under the Environmental Protection Act 1986 (EP Act), and to the then Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), now the Department of the Environment (DotE), under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The Project was set a level of assessment of Public Environmental Review (PER) and the bilateral agreement between the State and Commonwealth governments was enacted. The PER was released on the 20 June 2011 for a 12 week public review period.

The Project was approved by the Minister for Environment in July 2015, with the release of Ministerial Statement 1008 (Statement 1008) establishing conditions for the Project implementation.



Figure 1: Project development envelope

Scale 1:30,000 at A4
 0 200 400 600 800 1,000 Meters
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 13/11/2015
 Author: DWhite
 Source: Aerial image: ESRI, approx. 2010, Project development envelope: Client 2015; Wetlands: DPaW 2015.



Legend

- Project development envelope
- Wetlands

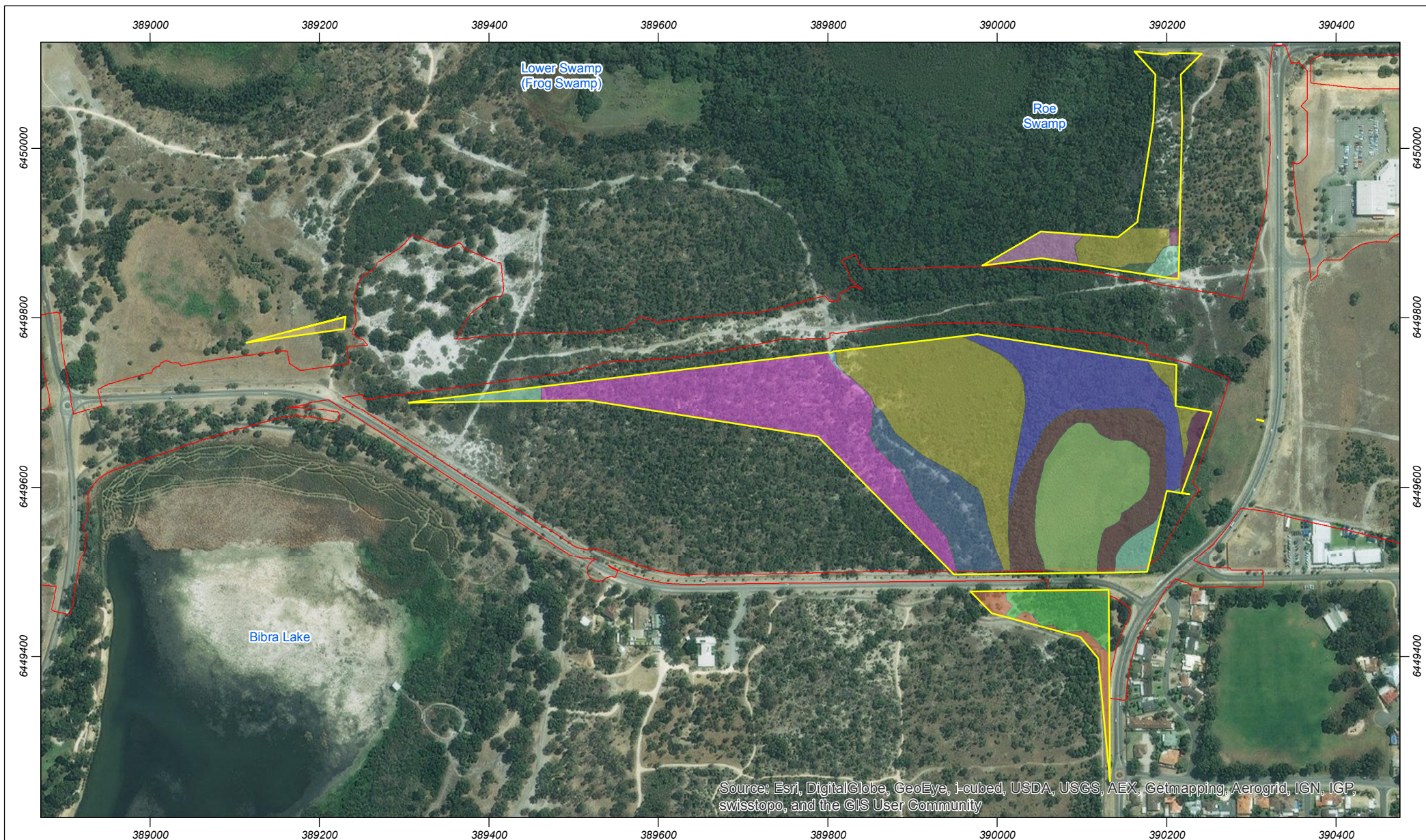


Figure 2: Arum Lily Control Area and vegetation communities

Scale 1:6,100 at A4
 0 50 100 150 200 250 Meters
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 13/11/2015
 Author: DWhite
 Source: Aerial image: ESRI, approx. 2010.



Legend

- Arum Lily Control Area
- Project development envelope

Vegetation community

- | | | | | | |
|--|---|--|---|---|---|
| AfBKgS | BHhW | CcBKgS | ErMpAfS | EtKgS | TBS |
| AfKgS | BXpW | EmKgS | ErMpGeS | MpBaS | |
| | BiSiH | ErCtS | ErMpH | MpKgS | |

1.2 Purpose and scope of document

1.2.1 Statement 1008

This ALCP has been prepared on behalf of Main Roads to address the requirements under Conditions 12-11 and 12-12 of Statement 1008, as outlined in Table 1.

Table 1: Relevant Statement 1008 condition 12 requirements

Condition	Requirement	Section
12-11	Prior to commencement of construction, or as otherwise agreed by the CEO, the proponent shall prepare an Arum Lily Control Program for the land referred to in condition 12-10 to the requirements of the CEO.	N/A – refers to this document
12-12	The Arum Lily Control Program required by condition 12-11 must include details on:	Section 4.2
	1. an assessment and mapping of the existing Arum Lily infestation.	
	2. activities to be undertaken.	Section 4.4
	3. timeframes for undertaking management activities.	Section 4.4
	4. roles and responsibilities.	Section 4.4 and 7
	5. funding arrangements for implementation of the program.	Section 7.1
	6. monitoring and reporting requirements.	Section 5 and 8
	7. completion criteria.	Section 6
12-13	The proponent shall commence implementation of the Arum Lily Control Program, within twelve (12) months of completion of the proposal, until the CEO advises implementation may cease.	Section 4.1

1.2.2 Previous documentation

This ALCP also includes commitments and management actions for Arum Lily control as outlined in the following documents:

- PER and relevant appendices (Southmetro Connect 2011)
- Proponent Response to Submissions and relevant appendices (South Metro Connect 2013)
- EPA Report 1489 (EPA 2013)
- Flora, Vegetation and Fauna Management Plan (AECOM 2012a)
- Rehabilitation Strategy (AECOM 2012b).

1.2.3 Objectives

The environmental objectives of this ALCP are to:

- ensure compliance with Statement 1008 Conditions 12-11, 12-12 and 12-13
- control the Arum Lily population within the 14.5 ha of land proposed to be transferred into Beeliar Regional Park.

This plan will be made publically available in a manner approved by the Chief Executive Officer (CEO) of the EPA.

1.3 Relationship to existing management plans

In addition to the preparation of the ALCP, Statement 1008 also requires the preparation of a:

- Flora and Vegetation Monitoring and Management Plan (FVMMP, Condition 10).

The ALCP is designed to be implemented in combination with the FVMMP to provide an integrated vegetation monitoring program.

1.4 Consultation

As part of the preparation of the ALCP, consultation was undertaken as detailed in Table 2.

Table 2: Stakeholder consultation

Stakeholder	Date	Outcome
Department of Parks and Wildlife (DPaW)	26 May 2015	Methods for Arum Lily control outlined in this document are consistent with those used by DPaW in wetland areas.

2. Program description

This document has been prepared to satisfy Conditions 12-11, 12-12 and 12-13 of Statement 1008.

2.1 Reason for program

As part of the environmental offsets for the Project Main Roads will transfer ownership of approximately 14.5 ha of MRS road reserve, not required for construction of the Project, to Beeliar Regional Park to achieve a net gain in the size of Beeliar Regional Park.

As part of this environmental offset Main Roads will also assist in the eradication of Arum Lily, which is a declared pest under s 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2014), from within this portion of the road reserve.

2.2 Biology of Arum Lily

Arum Lily (*Zantedeschia aethiopica*) is a perennial herb arising from a tuberous rhizome. It has a tuft of dark green, shiny, somewhat succulent leaves arising annually from perennial tuberous roots. The large leaf blades are heart-shaped to arrow-shaped and usually about 250 mm long on a stalk almost as long. It is easily recognised in late winter to early summer by its conspicuous large, white, funnel-like 'flower', approximately 100 mm across, which has a central, orange, pencil-like column of minute male and female flowers (Plate 1). Following flowering, the tiny female flowers at the base of this column are replaced by orange-yellow berries. Poisonous to most stock, pets and humans, symptoms include a severe burning sensation and swelling of lips, tongue, and throat; stomach pain and diarrhoea are possible. Ingestion of the plant may be fatal. The toxicity is due to sequestering of calcium oxalate crystals and possibly other toxic compounds by the plant.



Plate 1: Arum Lily (Western Australian Herbarium 1998-)

3. Environmental setting

The PER (Southmetro Connect 2011) details the existing environment within the Project development envelope (development envelope). Environmental values of relevance to the 14.5 ha area of land identified in this ALCP for transfer to Beeliar Regional Park (the control area) are outlined below.

3.1 Flora and Vegetation

3.1.1 Regional

Regional vegetation mapping within the development envelope and adjacent land indicates that the control area is part of the Bassendean vegetation complex (Hedde et al. 1980) and is summarised as:

- Woodland of *Eucalyptus marginata* – *Corymbia calophylla* with well defined second storey of *Calytrix fraseriana* and *Banksia grandis* on the deeper soils and a closed scrub on the moister sites. The understorey species reflect similarities with the adjacent vegetation complexes.

3.1.2 Previous studies

A Level 2 flora and vegetation survey of the development envelope was undertaken in spring 2009 and spring 2010 (AECOM 2009; 2010) in accordance EPA Guidance Statement No. 51, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004). Additional targeted flora surveys were undertaken after the preparation of the PER for the Project. A review of vegetation condition within the development envelope was carried out in accordance with advice from then DEC in March 2012 and it was determined that the condition of some areas of vegetation were under-rated in the original survey (South Metro Connect 2013). Vegetation condition ratings were revised in accordance with a condition rating scale adapted from Keighery (1994) and the Braun-Blanquet scale of cover abundance. Subsequently, the revised portions of the condition mapping were field verified on 16 March 2012. A summary of the results from all flora surveys undertaken for the Project regarding the control area are presented below.

Flora

A total of 434 species from 244 genera and 80 families were recorded within the development envelope from the baseline assessment and subsequent seasonal monitoring events. Families with the highest representation were Myrtaceae, Fabaceae, Asteraceae and Poaceae, a floristic composition typical for the Swan Coastal Plain. A total of five Priority flora species were recorded within the development envelope of the Project and are displayed in Table 3.

Table 3: Flora values within the development envelope

Flora	Priority	% of individuals to be impacted	No. of individuals to be impacted
<i>Dampiera triloba</i>	3	75.8	5404
<i>Cyathochaeta teretifolia</i>	3	6.5	38
<i>Jacksonia gracillima</i>	3	7.5	15
<i>Eryngium pinnatifidum</i> subsp. <i>palustre</i>	3	25.4	16
<i>Dodonaea hackettiana</i>	4	0.5	1

Three declared plants listed under *Biosecurity and Agricultural Management Act 2007* were also recorded within the development envelope including:

- **Zantedeschia aethiopica* (Arum Lily)
- **Asparagus asparagoides* (Bridal Creeper)
- **Moraea flaccida* (One-leaf Cape Tulip).

Vegetation

Vegetation within the control area is predominantly comprised of *Banksia* woodland and areas of wetland vegetation with varying levels of disturbance and integrity. Thirteen of the 40 vegetation communities recorded by (AECOM 2009; 2010) exist within the control area which are detailed below in Table 4 and displayed in Figure 2.

Table 4: Vegetation communities found in the control area

Code	Vegetation community description
BiSiH	Low open woodland of <i>Banksia ilicifolia</i> over a tall open shrubland of <i>Kunzea glabrescens</i> over an open herbland of <i>Scholtzia involucreata</i> and <i>*Carpobrotus edulis</i> on grey sand.
BXpW	Low open woodland of <i>Banksia attenuata</i> and <i>Banksia menziesii</i> with occasional <i>Eucalyptus marginata</i> over an open heath of <i>Hibbertia hypericoides</i> and <i>Xanthorrhoea preissii</i> over an open sedgeland of <i>Mesomelaena pseudostygia</i> on grey sand.
AfBKgS	Low Woodland of <i>Allocasuarina fraseriana</i> , <i>Banksia menziesii</i> , <i>Banksia attenuata</i> and <i>Banksia ilicifolia</i> over a Low Open Shrubland of <i>Kunzea glabrescens</i> over an Open Herbland of <i>Phlebocarya ciliata</i> , <i>Dasyopogon bromeliifolius</i> and <i>Loxocarya cinerea</i> on grey sand.
CcBKgS	Low open forest of <i>Corymbia calophylla</i> , <i>Banksia attenuata</i> and <i>Banksia ilicifolia</i> over a tall shrubland of <i>Kunzea glabrescens</i> over a low shrubland of <i>Xanthorrhoea preissii</i> with occasional <i>Macrozamia riedlei</i> over a herbland of <i>Lomandra</i> sp. and <i>Dasyopogon bromeliifolius</i> on grey sand.
MpKgS	Low open woodland of <i>Melaleuca preissiana</i> and occasional <i>Eucalyptus rudis</i> over a closed tall scrub of <i>Kunzea glabrescens</i> over occasional <i>Lepidosperma</i> sp. over an Open Herbland of <i>*Zantedeschia aethiopica</i> over <i>*Aira caryophylla</i> and <i>*Gallium murale</i> on brown sandy-loam.
ErCtS	Low woodland to open forest of <i>Eucalyptus rudis</i> , <i>Banksia attenuata</i> and <i>Melaleuca preissiana</i> over low open shrubland of <i>Taxandria linearifolia</i> , <i>Gastrolobium ebracteolatum</i> and <i>Pteridium esculentum</i> over closed sedgeland of <i>Cyathochaeta teretifolia</i> (P3) on brown sandy loam.
MpBaS	Open Forest of <i>Corymbia calophylla</i> , <i>Eucalyptus rudis</i> and <i>Banksia littoralis</i> over a Tall Shrubland of <i>Melaleuca preissiana</i> and <i>Kunzea glabrescens</i> with occasional <i>Melaleuca raphiophylla</i> over a Closed Sedgeland of <i>Baumea articulata</i> fringing wetlands on brown sandy loam.
TBS	Closed Sedgeland of <i>*Typha orientalis</i> , <i>Baumea vaginalis</i> and <i>Baumea articulata</i> on brown sandy loam.
EmKgS	Low woodland of <i>Eucalyptus marginata</i> with occasional <i>Corymbia calophylla</i> and <i>Banksia menziesii</i> over a tall shrubland of <i>Kunzea glabrescens</i> with occasional <i>Allocasuarina fraseriana</i> over a closed herbland of <i>*Carpobrotus edulis</i> on grey sand.
AfKgS	Open Forest of <i>Eucalyptus rudis</i> with occasional <i>Corymbia calophylla</i> over Tall Open Scrub of <i>Agonis flexuosa</i> with occasional <i>Kunzea glabrescens</i> and <i>Astartea scoparia</i> over Tall Shrubland of <i>Melaleuca preissiana</i> over introduced species.
BHhW	Low Open Woodland of <i>Banksia attenuata</i> and <i>Banksia menziesii</i> with occasional <i>Eucalyptus marginata</i> and <i>Nuytsia floribunda</i> over a Shrubland of <i>Allocasuarina humilis</i> and <i>Hibbertia hypericoides</i> with occasional <i>Allocasuarina fraseriana</i> and <i>Jacksonia furcellata</i> over a Grassland of <i>*Ehrharta calycina</i> and <i>Mesomelaena pseudostygia</i> on pale brown sand.
ErMpAfS	Low open forest of <i>Eucalyptus rudis</i> and <i>Melaleuca preissiana</i> over a tall open shrubland of <i>Astartea fascicularis</i> and <i>Kunzea glabrescens</i> over an open shrubland of <i>Pteridium esculentum</i> over a sedgeland of <i>Lepidosperma</i> sp. on brown clayey-loam flats.
ErMpGeS	Low Open Forest of <i>Eucalyptus rudis</i> and <i>Melaleuca preissiana</i> with occasional <i>Banksia attenuata</i> over a Tall Shrubland of <i>Gastrolobium ebracteolatum</i> and <i>Kunzea glabrescens</i> over a Low Open Shrubland of <i>Taxandria linearifolia</i> over a Sedgeland of <i>Baumea preissii</i> subsp. <i>laxa</i> on black clay flats.

None of the vegetation communities recorded within the control area have been determined to be equivalent to State Threatened Ecological Communities (TECs) under the DPaW listings or Commonwealth TECs protected under the EPBC Act. , In addition, determination of the Floristic Community Types relevant to the recorded vegetation communities did not suggest that Priority Ecological Communities (PECs) are supported by the control area...

Vegetation condition within the control area ranges from 'Excellent' to 'Completely Degraded' with majority of vegetation rated as 'Very Good'¹. Current densities of Arum Lily within the control area have not been determined. Section 4.1 outlines an assessment methodology which will determine the level of Arum Lily infestation prior to the commencement of control measures.

¹ Includes sub-ratings of Very Good – Excellent and Good – Very Good.

4. Control program

The ALCP has been developed in order to effectively control the occurrence and the spread of the Arum Lily in the area of road reserve proposed to be transferred to Beeliar Regional Park (Figure 2). Direct and indirect impacts on native vegetation, stock, pets and human are intended to be managed as a part of this control program. To achieve this, this plan details:

- current extent and density the existing Arum Lily infestation (section 4.1)
- control activities to be undertaken (section 4)
- timeframes for undertaking management activities (section 4)
- roles and responsibilities (section 7)
- funding arrangements for the implementation of the program (section 7.1)
- monitoring and reporting requirements (section 5 and section 8)
- completion criteria (section 6).

4.1 ALCP implementation timing

Implementation of this ALCP must commence within twelve (12) months of completion of the Roe Highway extension project to ensure compliance with condition 12-13 of Statement 1008. Completion of the Roe Highway extension project will be when construction activities are complete.

This ALCP must continue to be implemented until the CEO advises implementation may cease, as stated in condition 12-13 of Statement 1008.

4.2 Assessment and mapping of the existing Arum Lily infestation

An Arum Lily survey was undertaken within the control area by Ecoscape (2015) on the 21 and 22 October 2015. The purpose of the survey was to:

- identify the extent and density of Arum Lily infestations within the control area
- locate areas of access to the infestation
- determine the locations for 'spraying in progress' warning signs
- determine avoidance areas for herbicide applications (e.g. wetlands and significant plant species).

Arum Lily cover ranged from 0 to 100% within the control area, with 14.5% of the control area having greater than 5% Arum Lily cover (Table 5, Figure 3). Approximately 5.6% of the control area was considered inaccessible due to a high density of native vegetation and high water levels. Arum Lily cover was found to correspond with soil moisture and shade, with areas containing high soil moisture and shade recording higher percentage cover, compared to areas with dry soil and direct sun, or saturated soils (Ecoscape 2015).

Table 5: Arum lily cover infestation within the control area

Percentage cover	Area (ha)	Area (%)
None	4.1	33.1
Rare	0.4	3.2
Trace	3.3	26.6
>5%	2.1	16.9
5-25%	0.5	4.0
25-50%	0.9	7.3
50-75%	0.3	2.4
75-100%	0.1	0.8
Inaccessible	0.7	5.6
TOTAL	12.4	100

As part of the Arum Lily survey three herbicide avoidance areas were identified based on the presence of waterways. These areas are shown in Figure 4 and include:

- the wetland near the intersection of Hope Road and Bibra Drive
- the wetland near the proposed gate on Bibra Drive
- a drain occurring in the northern section of the control area near Farrington Road.

The control program detailed below will take into consideration these avoidance areas.

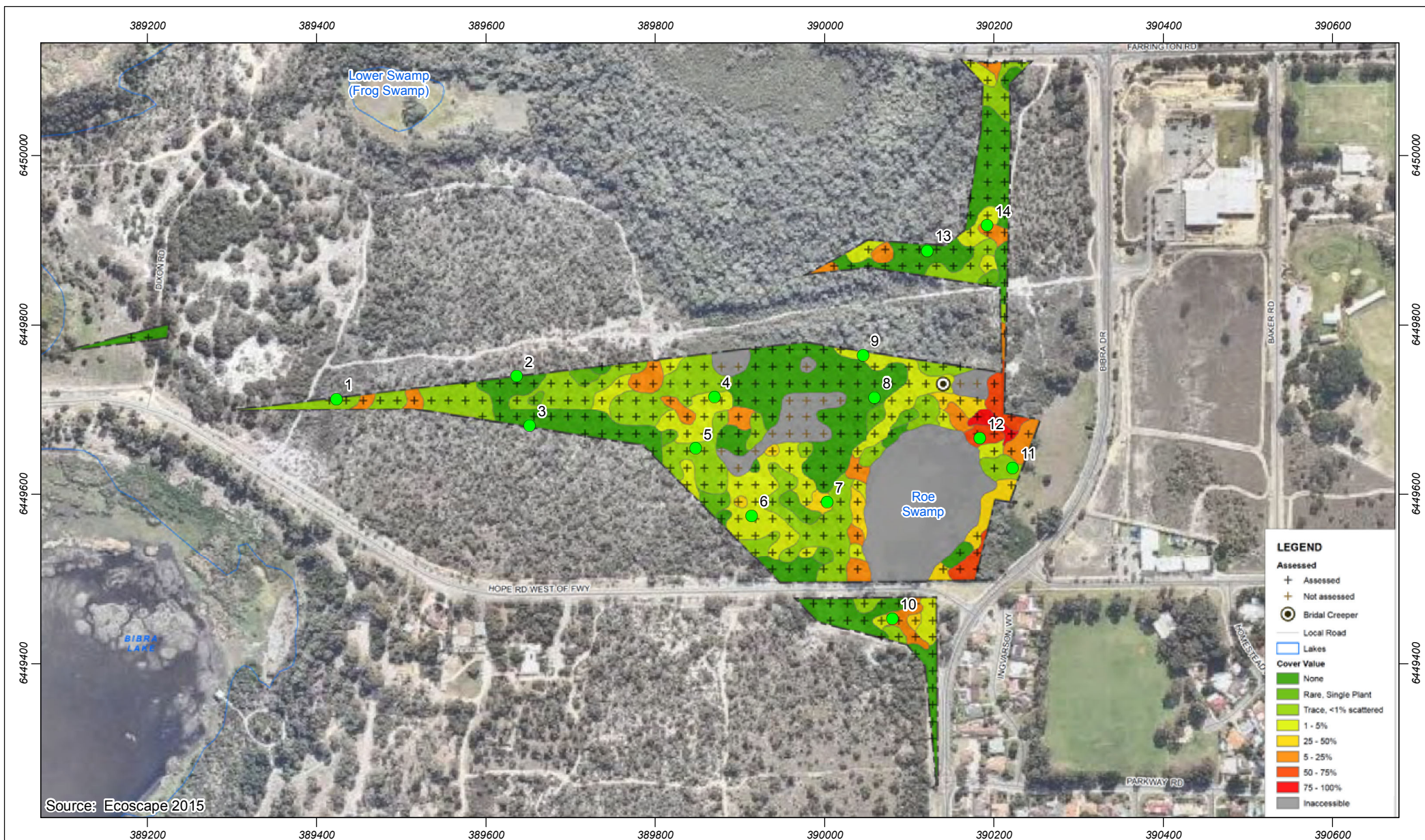


Figure 3: Arum Lily cover and monitoring sites

Scale 1:6,100 at A4
 0 50 100 150 200 250 Meters
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 16/12/2015
 Author: DWWhite

Legend
 ● Monitoring sites



Source: Ecoscape (2015)

Figure 4: Access, recommended signage locations and avoidance areas

4.3 Recommended methods of control

In consultation with DPaW, herbicides were selected as the preferred treatment to control Arum Lily.

Given the target site contains wetland vegetation which provides habitat for frogs (South Metro Connect 2011), DPaW have advised that the best option for this ALCP is to use Roundup Biactive® which is a Glyphosate based herbicide which is poorly absorbed along the digestive tract and does not bio accumulate with low toxicity to bees, fish and aquatic organisms. Metsulfuron Methyl will be used as the preferred alternative to Roundup Biactive. Other herbicides that may also be used, in consultation with DPaW, include Glyphosate, 2,4-D amine, Chlorsulfuron, Metsulfuron and Paraquat which have been recommended as a control method for Arum Lily by the DPaW and/or the Department of Agriculture and Food Western Australia. Herbicide application will be undertaken as per the label by a mixture of three techniques:

- hand spraying
- motorised pump
- wiping.

4.4 Management actions

Management actions required to implement this ALCP successfully are outlined in the sections below and are summarised in Table 6.

4.4.1 Herbicide application

The exact method of herbicide application will be determined during control activities. A variety of different methods may need to be used within the control area due to site conditions. These are, application via:

- directed motorised pump to targeted areas from four-wheel-drive vehicle: in areas with existing vehicle access tracks and areas of sparse vegetation (Figure 4 illustrates existing 4WD vehicle tracks)
- backpack spray equipment: in areas where four-wheel-drive access is not possible and will be undertaken in quadrats by a team of 3-4 personnel working approximately 5 m apart
- wiping with a 'wand': in areas where there is surface water present and/or for very sensitive areas where four-wheel-drive and backpack methods cannot be used.

Herbicide application will be undertaken at the following approximate intervals over the course of the program:

- initial treatment – July every year depending on the start of the flowering season
- second treatment – approximately 4 weeks after initial treatment every year
- follow up – approximately 4 weeks after second treatment every year.

4.4.2 Expertise

The safe and effective application of the herbicide to eradicate the Arum Lily requires relevant training and expertise. These measures are outlined below:

1. All personnel undertaking control activities will have plant identification skills – both native and introduced species.
2. All personnel undertaking control activities will have a WA Pest Management Technicians Licence issued under the Health (Pesticides) Regulations 2011.
3. The contractor undertaking control activities must be a registered pest management business in accordance with the Health (Pesticides) Regulations 2011.
4. The contractor undertaking control activities shall place signs at all entrances to public access ways and around the perimeter of the treatment area at no more than 200 m intervals. Warning signs must be as per the Health (Pesticides) Regulations 2011. The proposed locations of these warning sign are presented in Figure 4.

Table 6: Management actions

Item	Management actions	Purpose	Timing	Responsibility
<i>Site preparation</i>				
1	Undertake a pre-control survey to establish baseline conditions at ongoing monitoring quadrats (refer to Section 5 for detail).	To understand where herbicide application activities should be targeted	Prior to herbicide application	Main Roads
1	Wash down all vehicles and equipment prior to entering the control area.	To prevent introduction of dieback and weeds into Beeliar Regional Park	Prior to entering the control area	Weed control contractor
<i>Hygiene control measures</i>				
1	Wash down all vehicles and equipment prior to entering the control area.	To prevent introduction of dieback and weeds into Beeliar Regional Park	Prior to entering the control area	Weed control contractor
<i>Safety and environmental harm</i>				
2	Ensure all herbicide spray operators have a WA Pest Management Technicians Licence issued in accordance with the Health (Pesticides) Regulations 2011.	To ensure all operators are suitably qualified in the application of herbicides	At all times	Weed control contractor
3	Apply a non-toxic, water-soluble, biodegradable coloured dye to the herbicide spray mix to ensure the mixture will be clearly visible for at least 48 hours after the herbicide application.	To allow for thorough herbicide application, to minimise double spraying of herbicide and to make public aware of where herbicide has been used	During herbicide application	Weed control contractor
4	Demarcate the boundaries of avoidance areas illustrated on Figure 4 to ensure no herbicide application is used with these areas.	To protect sensitive areas	During herbicide application	Weed control contractor
5	Ensure no wetting agent is used within a drain or within 20 m of any water body.	To prevent impact of herbicide on surrounding wetlands and water bodies	During herbicide application	Weed control contractor
6	Ensure that the pressure of application is kept to a level that prevents excessive spray drift.	To prevent impact on surrounding native vegetation, persons and property	During herbicide application	Weed control contractor
7	Ensure weather conditions are suitable for the spray technique, site and chemicals to be used (i.e. wind are less than 10 km per hour, temperatures are less than 35 degrees Celsius, rain is not forecast or anticipated within 4 hours, vegetation is not wet with dew or rain).	To ensure successful and safe application of the herbicide	Throughout program – prior to spraying	Weed control contractor
8	Erect signage stating that herbicide application is in progress (or similar) at all major entrances and access ways as illustrated in Figure 4.	To ensure successful and safe application of the herbicide	Throughout program – prior to spraying	Weed control contractor
9	Use measuring containers for all liquid herbicides and scales for accurately measuring granulated herbicides.	To ensure successful and safe application of the herbicide	Throughout program – prior to spraying	Weed control contractor
10	Ensure the identity of any Threatened or Priority species known to occur in the area is clearly understood by operators (refer to mapping outlined in Section 4.2).	To ensure successful and safe application of the herbicide	Throughout program – prior to spraying	Weed control contractor

Item	Management actions	Purpose	Timing	Responsibility
11	Ensure the presence/absence of susceptible, non-target species is clearly understood by operators (refer to mapping outlined in Section 4.2).	To ensure successful and safe application of the herbicide	Throughout program – prior to spraying	Weed control contractor
12	Ensure the locations of sensitive habitats are clearly understood by operators (refer to mapping outlined in Section 4.2).	To ensure successful and safe application of the herbicide	Throughout program – prior to spraying	Weed control contractor
13	Inspect all chemical containers daily for leaks to avoid the possibility of environmental or cross contamination.	To prevent hazardous material spills	Ongoing - daily	Weed control contractor
14	Transfer contents of any leaking containers immediately to an intact empty container of the same type, or if none is available, a thoroughly rinsed container which is then clearly labelled and used as soon as possible.	To prevent hazardous material spills	Ongoing	Weed control contractor
15	Ensure Attapulgate, a shovel and a recovery drum is present on all vehicles.	To clean up any hazardous material spills	Ongoing	Weed control contractor
16	Report any chemical spill involving more than 1 L of concentrate chemical or 10 L of mixed chemicals to the Department of Health.	To prevent impact on surrounding native vegetation, persons and property	During herbicide application	Weed control contractor
<i>Methodology</i>				
17	Ensure all operators flag off areas that have been treated each day.	To ensure all Arum Lily plants are treated	During herbicide application	Weed control contractor
18	Undertake herbicide application using one or all of the following techniques as suits site conditions: <ul style="list-style-type: none"> • Vehicle with mounted motorised pump • backpack spray • wiping with a wand. 	To undertake Arum Lily control activities	<ul style="list-style-type: none"> • initial treatment –July every year depending on the start of the flowering season • second treatment – approximately 4 weeks after initial treatment every year • follow up – approximately 4 weeks after second treatment every year 	Weed control contractor

5. Monitoring program

The monitoring program described in this section covers monitoring of the Arum Lily population within the control area in order to determine if a reduction in population size is occurring through the management measures outlined in section 4.

5.1 Monitoring methodology

Monitoring of the Arum Lily population within the control area will be undertaken via the formal establishment of permanent quadrats within the site (see Figure 3 for specific locations). A total of fourteen 10 m x 10 m quadrats will be established within the control area (at a rate of approximately one per hectare) and the total number of Arum Lily individuals within each quadrat will be counted. Specific quadrat locations were been determined (Figure 3, Appendix 1) following the assessment and mapping of existing Arum Lily infestations outlined in Section 4.1. Data collected from each quadrat will include:

- GPS location
- number of Arum Lily individuals
- representative photograph from the northwest corner of each quadrat.

A series of rapid assessment areas will also be established within the control area (at a rate of approximately one per hectare) and will be recorded using GPS to enable relocation of the points. These areas will be established to enable a broad assessment of the visual appearance of control area. The rapid assessment will be established in areas not already identified as monitoring quadrats.

- distribution of Arum Lily sub-populations
- a photograph taken at a designated point that can be compared to subsequent and/or previous photographs, to assess the visible distribution of Arum Lily individuals.

Rapid assessments are aimed at identifying areas within the control area that require a priority for further weed control. Rapid assessments will be conducted twice a year.

Informal monitoring of Arum Lily infestations will also occur more broadly across the site during the second and third annual rounds of herbicide application activities, by the appointed contractor. Informal monitoring will involve visual assessment of effectiveness of control across the Arum Lily sub-populations within the control area and noting areas requiring potential additional control on a map, to inform follow up herbicide application activities.

5.2 Timing

Quadrats will be monitored once during the prime flowering period for the species (June-October) prior to Arum Lily control activities commencing to establish baseline data. Ongoing monitoring will occur once per annum prior to the first control event in each year from commencement of the initial herbicide application event until the handover of the control area to Parks and Wildlife for management as part of Beeliar Regional Park. Informal monitoring will be undertaken during herbicide application activities.

Table 7 provides monitoring actions to enable assessment of the effectiveness of the ALCP management.

Table 7: ALCP monitoring program

Item	Parameters	Purpose	Frequency	Location
1	Quadrat monitoring <ul style="list-style-type: none"> • total number of Arum Lily individuals • GPS location • representative photograph NW corner. 	Effectiveness of control program	Annually prior to the first control event in each year	14 10 m x 10 m quadrats in control area

Item	Parameters	Purpose	Frequency	Location
2	Rapid assessment areas: <ul style="list-style-type: none">• distribution of Arum Lily sub-populations.	To determine priority areas for weed control	Twice yearly	One per hectare within control area
3	Informal monitoring: <ul style="list-style-type: none">• Arum Lily sub-populations.	Opportunistic visual check of effectiveness of control program	During the second and third annual rounds	Broadly across site

6. Completion criteria

The ALCP will be considered successful and thus complete when Arum Lily numbers within the control area (measured by quadrat and informal monitoring) are 80% lower than baseline levels or as otherwise agreed by the CEO of the OEPA or DPaW. Once this criteria is met, management of the 14.5 ha extent of the control area will be transferred to DPaW, on its agreement.

7. Responsibilities

This section provides a summary of the key personnel involved in implementation of the ALCP and their roles and responsibilities.

Table 8: Roles and responsibilities

Role	Responsibility
Main Roads	<ul style="list-style-type: none"> • Main Roads has the overall responsibility for the implementation of this ALCP • the roles below may be delegated to a contractor by Main Roads • if the roles are delegated, Main Roads has the responsibility to audit compliance and ensure any contingency actions are implemented • responsible for organising handover of the control area to Parks and Wildlife.
Environmental manager	<ul style="list-style-type: none"> • overall accountability for auditing and compliance assessment with this ALCP to ensure it is maintained and meets objectives and targets • provide technical support to all Project personnel to ensure this ALCP is implemented correctly and complied with • implement and maintain this ALCP, review its effectiveness and review the implementation as required • undertaking ongoing monitoring and documenting monitoring results • assess the performance against triggers • liaise with stakeholders and technical advisors for advice and resolution of management aspects/objectives as required • review and close out any contingency actions • report as required to regulating authorities • may delegate all or part responsibility to an appropriately qualified person • providing data to Main Roads for inclusion in the annual compliance report.
Contractors	<ul style="list-style-type: none"> • support the proponent's Arum Lily management initiative and culture • comply with all legal requirements and the requirements of this ALCP • ensure staff employed are adequately trained in Arum Lily management • ensure all personnel involved in the project will adhere to ALCP requirements • seek advice from proponent when in doubt about requirements.
All personnel	<ul style="list-style-type: none"> • must receive induction prior to commencement of work on site • comply with all legal requirements and the requirements of this ALCP • report incidents to their Supervisor or Site Environmental Coordinator • attend environmental inductions and any other training required • participate in toolbox meetings and suggest improvements to management practices.

7.1 Funding arrangements for implementation of the program

Funding for implementation of the ALCP will be provided to the appointed contractor by Main Roads for the duration of the program.

8. Review and reporting

8.1 Review and revision

The ALCP will be formally reviewed on an annual basis. If monitoring results shows no reduction in Arum Lily numbers against baseline data, management actions will be reviewed and revised. Any proposed amendments to the plan will be provided to the CEO of the OEPA for approval prior to implementation. Informal monitoring results will also be discussed after each application of herbicide.

8.2 Reporting

A brief summary report will be produced following each formal monitoring event with a final report summarising the results of the entire program produced prior to handover of the control area to DPaW.

Each report will contain the following:

- Arum Lily control activities undertaken between reporting intervals
- number of Arum Lily individuals within each quadrat
- a comparison of Arum Lily numbers within each quadrat to baseline data and data from the previous monitoring event
- a representative photograph from the northwest corner of each quadrat
- a summary of the findings of informal monitoring activities.

9. References

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Appendix 1
GPS coordinates of Arum Lily
monitoring sites

Table A 1: Coordinates of Arum Lily monitoring sites

Site ID	Corresponding site FVMMP ID	Coordinates	
		Easting	Northing
1	24	389423.3	6449712.4
2	22	389636.4	6449739.5
3	21	389651.8	6449681.2
4	19	389870	6449714.9
5	N/A	389847.9	6449654.27
6	N/A	389914.04	6449574.59
7	N/A	390003.16	6449590.8
8	17	390059.2	6449714.5
9	18	390045.3	6449764.5
10	N/A	390080.13	6449453.06
11	47	390222.1	6449631
12	46	390183.5	6449666.3
13	13	390121.4	6449887.8
14	N/A	390192.22	6449917.59