

WESTERN SPRINGS PINE STAND RESTORATION AND ACCESSIBILITY PLAN



 providing
outstanding
ecological
services to
sustain
and improve our
environments



Wildlands

R3421a

WESTERN SPRINGS PINE STAND RESTORATION AND ACCESSIBILITY PLAN

Contract Report No. 3421a

May 2016

Project Team:

Nick Goldwater - Field survey, report author

Jamie MacKay - Field survey

Steve Rate – Peer review

Prepared for:

Auckland Council

Parks, Sports and Recreation

Level 8

8 Hereford Street

Auckland

CONTENTS

1. INTRODUCTION	1
2. VISION	2
3. METHODS	2
3.1 Vegetation and pine management	2
3.2 Bats	2
4. ECOLOGICAL CONTEXT	3
5. SITE DESCRIPTION	3
6. ECOLOGICAL VALUES	4
7. ASSESSMENT OF POTENTIAL EFFECTS	6
7.1 Potential effects of removing the pine trees	6
7.2 Potential effects of not removing the pine trees	6
8. OPTIONS FOR PINE MANAGEMENT	7
8.1 Overview	7
8.2 Minimising disturbance to indigenous fauna	7
8.3 Minimising disturbance to indigenous vegetation	7
8.4 Pine material as potential habitat	7
8.5 Opportunities to engage with the public	7
9. RECOMMENDED APPROACH TO PINE MANAGEMENT	8
9.1 Other considerations	9
10. ENVIRONMENTAL PEST PLANTS	9
10.1 Pest plant priorities	9
10.2 Pest plant management	10
11. PROPOSED PLANTING METHODOLOGY	11
11.1 Overview	11
11.2 Site preparation	11
11.3 Disposal of material	12
11.4 Plant selection and sourcing	12
11.5 Planting methods	12
11.6 Ongoing maintenance of planting and weed control	12
11.7 Plant schedules	13
12. PEST ANIMALS	15
12.1 Overview	15
12.2 Recommendations for the control of pest mammals	15
13. RECOMMENDED WORK PROGRAMME	15

14. INDICATIVE COSTS	17
ACKNOWLEDGMENTS	17
REFERENCES	18
Appendix	
1. Site Photographs	19
2. Visual Concept Plans Prepared by LASF Landscape Architects	23
3. Recommended Herbicide Treatments	26

Reviewed and approved for release by:



Steve Rate
Senior Ecologist
Wildland Consultants Ltd

© *Wildland Consultants Ltd* 2016

This report has been produced by Wildland Consultants Ltd for Auckland Council. All copyright in this report is the property of Wildland Consultants Ltd and any unauthorised publication, reproduction, or adaptation of this report is a breach of that copyright.

1. INTRODUCTION

Auckland Council engaged Wildland Consultants Ltd to provide an ecological management plan for an existing area of mature pine (*Pinus radiata*) forest in Western Springs Park, Western Springs. The pine forest is part of a larger area of local vegetation that is scheduled as Significant Ecological Area (SEA) C05-23 “Western Springs/Zoo Forest” under Plan Change 88 in the Isthmus section of the Operative District Plan and the Proposed Auckland Unitary Plan. Western Springs/Zoo Forest is scheduled for its podocarp/broadleaved forest and coastal forest types, and its value as habitat for indigenous fauna (Roper 2008).

The pines were planted in 1923 and once comprised a densely stocked forest. Over time, however, the pines have thinned significantly; many trees are senescing and are becoming increasingly vulnerable to windfall. As such, the risk to public safety, particularly to adjoining properties in Westview Road, is an increasing concern. There is also the potential for pine trees to fall directly onto the zoo fence, which presents a significant security breach. Whilst the pines are exotic, it is likely that the process of pine removal will damage indigenous vegetation in the sub-canopy and understorey tiers. The clearance of indigenous vegetation in an SEA is a restricted discretionary activity; therefore resource consent is required prior to the removal of the pines.

The purpose of this report is to provide guidance for the future management of the forest, with a view to returning the site to indigenous forest. The report will also serve as a discussion document during presentations to Council officers and the Local Board.

Specifically, the report addresses the following:

- Assessment of existing ecological values and future potential (including bat survey).
- Investigation of potential management options for existing old age pines. This may include their removal to mitigate possible risks to boundaries.
- Developing restoration methodologies and site preparation options within the context of potential damage associated with removal of existing pines.
- Definition of planting zones for the site and indigenous forest restoration planting requirements within these zones.

The original version of this report was prepared in August 2014. It described a range of options for pine management at the site, largely relating to methodologies to fell and remove pines in the most ecologically sensitive manner. These methodologies have since been refined by arborists Greenscene NZ Ltd in consultation with Auckland Council, and are presented in this revised version of the report. The current approach does not include the option of using helicopters to remove felled material from the site. Even though removal by helicopter would significantly reduce the damage caused to the indigenous understorey during the works, it is prohibitively expensive and the disturbance caused to the neighbours and the animals in the zoo would be considerable.

With regards to track design and landscaping, Wildland Consultants have been working alongside Simon Ferrick (LASF Landscape Architects) to produce visual concepts of how the forest might look following pine removal and the construction of new walking tracks. LASF landscape plans have been appended to this report (Appendix 2).

Additional works that may be required and which are outside of the scope of this report include:

- Determining appropriate track design, alignment and connection requirements.
- Assistance with the preparation of a resource consent application for pine removal and associated land disturbance activities.

2. VISION

To return exotic pine-dominated vegetation to floristically diverse indigenous mixed podocarp-broadleaved species forest that will provide important habitat for indigenous fauna and significantly enhance the ecological and amenity values of Western Springs Park and surrounding areas.

3. METHODS

3.1 Vegetation and pine management

Site visits were undertaken on 29 April 2014 and 5 May 2014 together with the client, Simon Ferrick, and two arborists, David Stejskal and Simon Cook, who will oversee the removal of the pines. A general description of the vegetation was recorded and representative site photographs were taken (Appendix 1). The location and abundance of environmental pest plants was also recorded during the survey. A subsequent visit was undertaken on 15 April 2016 with Greenscene NZ Ltd in order to discuss the revised pine felling and removal methodologies presented in this report.

3.2 Bats

The study area contains habitat that could potentially support long-tailed bats (*Chalinobulus tuberculata*), an endemic species that is ranked as 'Threatened-Nationally Vulnerable' by O'Donnell *et al.* (2013). Automatic bat boxes (ABMs) were used to detect long-tailed bats by recording bat echolocation at a frequency of 40kHz. Five ABMs were deployed in the forest on 29 April 2014 and left in the field for five nights of fine weather. Once the ABMs were retrieved, the recorded data was analysed using Bat Search software. A dusk walk-through survey of the study site was also undertaken on 1 May 2014 (5.30 pm to 7 pm) using a hand-held Bat Box. The average temperature did not fall below 10° C during each of the five survey nights.

4. ECOLOGICAL CONTEXT

The Tamaki Ecological District (ED) covers approximately 59,904 hectares and is occupied by New Zealand's largest urban centre, Auckland City. The ED includes the low-lying hills, pumice and volcanic deposits of the North Shore, the Auckland isthmus and South Auckland. It also incorporates all the catchments that drain into the Waitemata Harbour. The ED extends to the foothills of the Waitakere Ranges to the west and the Hunua Ranges to the east. It is bordered in the west by the Waitakere ED, in the north/northwest by Rodney ED and to the south and east by the Manukau and Hunua EDs (Lindsay *et al.* 2009).

The original forest of Tamaki ED is assumed to have been the characteristic northern North Island lowland forest type dominated by kauri and abundant puriri (*Vitex lucens*) and taraire (*Beilschmiedia tarairi*), with pohutukawa (*Metrosideros excelsa*) forest near the coast. The lowland hills and Waitakere foothills supported conifer-dominated stands with kauri (*Agathis australis*) and tanekaha (*Phyllocladus trichomanoides*) being the major species. Broadleaved lava forest occupied boulderfields on volcanic cones and extensive areas of tidal flats and mangroves (*Avicennia marina* subsp. *australica*) were also present around the coastline. There was also a network of freshwater wetlands and lakes formed by the blockage of drainage patterns by volcanic activity (Julian 1995; Myers 2005).

Currently, only c.6.9% of the Tamaki ED remains in indigenous cover. The vegetation has been highly modified, initially by clearing during early Polynesian occupation and subsequently by urban development. Some kauri remnants with hard beech (*Fuscospora truncata*) remain on the North Shore and very small patches of volcanic boulderfield remain on volcanic cones. In city parks there are remnants of lowland forest and fringes of pohutukawa are present on coastal cliffs. Mangroves have been reduced from their former extent but are still present in estuaries (Julian 1995; Myers 2005).

The study site is located in the residential suburb of Western Springs approximately 4 km west of the Auckland CBD. Motions Creek originates from springs within the Park and flows a short distance in a northwesterly direction before emptying into estuarine habitat on the east side of Meola Reef. In pre-human times, the site is likely to have supported a diverse assemblage of broadleaved and podocarp species. This would have been connected to a vast area dominated by lava rock forest that would have covered much of what is now Three Kings, Sandringham, Mt Albert and Western Springs.

5. SITE DESCRIPTION

The study site comprises a c.3.2 ha block of radiata pine forest on moderate to steep southwest-facing slopes. The forest is bounded by Motion Creek along its western boundary and residential properties along some of its northeast margin. It is contiguous with mixed indigenous-exotic forest within Auckland Zoo to the north and a small amount of kanuka (*Kunzea ericoides*) forest to the east (adjacent to Western Springs Stadium).

The 35-40 m tall canopy of pine has progressively thinned over recent years, leaving the remaining trees vulnerable to wind-throw. This in turn has allowed the development of a sub-canopy and understorey dominated by indigenous plant species. A mixture of ponga (*Cyathea dealbata*), mapou (*Myrsine australis*), mahoe (*Meliccytus ramiflorus*) and karo (*Pittosporum crassifolium*) occurs in the sub-canopy, with lesser amounts of cabbage tree (*Cordyline australis*) and mamaku (*C. medullaris*) (Plate 1). In the understorey, kawakawa (*Piper excelsum*) occurs frequently with hangehange (*Geniostoma ligustrifolium*), while on the forest floor turutu (*Dianella nigra*), shining spleenwort (*Asplenium oblongifolium*), panic grass (*Oplismenus hirtellus*), hooked sedge (*Uncinia uncinata*) and meadow rice grass (*Microlaena stipoides*) occur. Much of the forest floor is covered in pine needles.

Environmental pest plants were once common throughout the understorey of the pine forest, the most common of which included tradescantia (*Tradescantia fluminensis*), wild ginger (*Hedychium gardnerianum*) and mile-a-minute (*Dipogon lignosus*) (N. Goldwater, pers. obs.). Recent weed control activity, however, has significantly reduced the density and abundance of all pest plant species. Pest plants are currently localised along the northern boundary of the site (refer Section 8), adjacent to residential properties on Westview Road (Plate 2).

A small intermittent tributary to Motions Creek occurs in a steeply incised gully at the northern end of the site (Figure 1). The upstream reach of the tributary is piped. Mature pine and indigenous shrub buffer most of the open reaches.

6. ECOLOGICAL VALUES

Together with contiguous areas of the Zoo Forest, the study site comprises one of the largest remaining forest remnants in central Auckland. It not only has significance as habitat for local indigenous fauna, it also provides important 'stepping stone' habitat for birds travelling across the isthmus. The Lakeside Park Plan developed in 1995 for Western Springs, identifies the area as a wildlife corridor linking north, south and west Auckland.

The forest supports a range of common indigenous forest birds such as tui (*Prosthemadera novaeseelandiae*), grey warbler (*Gerygone igata*), and silvereye (*Zosterops lateralis*), together with several species of exotic birds. The site is likely to support a good diversity of indigenous invertebrates, and may provide habitat for indigenous skink species such as copper skink (*Oligosoma aeneum*) and ornate skink (*Oligosoma ornata*), but the presence of geckos is considered unlikely. The presence of small pools in the tributary suggests the stream could occasionally support indigenous fish such as banded kokopu (*Galaxias fasciatus*) and eels (*Anguilla* spp.), the latter of which are present in large numbers in Motions Creek and the main lake in Western Springs Park (N. Goldwater, pers. obs.). Mature radiata pines provide potential roosting habitat for long-tailed bats; however, most of the pines within the project area lack the holes, cracks and fissures favoured by bats. Long-tailed bats were not recorded during the survey, but this does not necessarily preclude their presence.



The diversity of indigenous flora is limited, which is likely due to the availability of seed sources and the acidic nature of the soil caused by pine needles accumulating on the forest floor. No nationally 'Threatened' or 'At Risk' plant species as per de Lange *et al.* (2013) or regionally threatened and uncommon plant species as per Stanley *et al.* (2005) are known from the forest. The forest contains numerous species of lichens and fungi, although it is not known if any threatened species are present.

7. ASSESSMENT OF POTENTIAL EFFECTS

7.1 Potential effects of removing the pine trees

The felling and removal of the pines will result in the damage and destruction of some indigenous vegetation in the sub-canopy and understorey. Other effects associated with the loss of indigenous vegetation include reduced roosting, feeding and nesting habitat for birds and loss of habitat for other fauna such as skinks and invertebrates. Although long-tailed bats were not detected in the initial survey, it is still possible that bats may be roosting in the project area at the time of pine removal. It is also possible that white-faced heron (*Ardea novaehollandiae novaehollandiae*) nest in the pines (as they do in Cox's Bay, c.1.4 km from the site), although this is considered unlikely given the general lack of foliage and exposed nature of the trees. Felling and removing pines within the true right riparian margin of Motions Stream have the potential to result in sediments entering the water. In addition, proposed access track into the forest from the south-western corner of the site runs close to Motions Creek and construction of this track may result in sediment entering the water. Increased levels of sediment can adversely affect aquatic and marine organisms.

7.2 Potential effects of not removing the pine trees

An alternative to actively felling and removing the pine trees is to allow the trees to continue to senesce, die and fall. Given that this would most likely take place over a number of years (possibly decades), any impacts on the indigenous understorey would be minor. Plants that are crushed or damaged by falling limbs and trees will be replaced by those regenerating in light gaps created by dead pines, subject to ongoing pest plant control. The main concerns about adopting this approach are the risks to public safety (i.e. people using the walking track; residents of adjacent properties) and the zoo (i.e. trees falling on the fence constitute a serious security breach). Gerald Collett, in a memorandum dated 9 April 2014, states that "trees within falling reach of the adjacent residential properties, the zoo, the stadium grounds and City Parks Services depot need to be removed promptly. Of particular concern are several very large leaning trees within falling reach of the residential dwellings and buildings along west View Road" (Geotree Ltd 2014). The memorandum also claims that "the trees have deteriorated to such an extent that the likelihood of entire trees toppling (or trunks snapping) and falling onto high-risk targets is now very high, with this failure scenario applying to a very large number of trees".

8. OPTIONS FOR PINE MANAGEMENT

8.1 Overview

There is a range of possible measures by which to fell and remove the pines, each of which needs to be assessed in terms of cost, efficiency, safety and predicted levels of disturbance to vegetation and resident fauna. Minimising disturbance to indigenous vegetation will be crucial in achieving the vision for this site (Section 2).

8.2 Minimising disturbance to indigenous fauna

To minimise disturbance to fauna, all tree works should take place outside of the bird breeding and nesting season (August-February). A follow-up survey for long-tailed bats is also recommended immediately prior to tree works, preferably in spring or summer.

8.3 Minimising disturbance to indigenous vegetation

One of the most practical and cost-effective options to minimise disturbance is to leave a significant amount of the pine material *in situ*. This can be achieved through a combination of (i) directionally felling pines and leaving them in rows, preferably in areas with little to no indigenous understory (Plate 3), and (ii) by cutting off the top 20 m or so of each tree and leaving the bulk of the structurally robust trunk standing ('totem poles'). These trunks are impervious to high winds and will gradually break down over time. The upper portions of the trees can be taken off-site and/or mulched and spread on-site. These methods have already been put to good use at the site in order to deal with senescing and wind-thrown trees. Planting of indigenous species would be staged in line with pine removal.

8.4 Pine material as potential habitat

There is an opportunity to utilise standing trunks and felled logs to provide habitat for invertebrates, epiphytic plants and fungi. Simple measures such as drilling holes into stumps and logs will attract invertebrates such as weta and spiders, whilst also helping to enhance fungal activity (and speed decomposition) through the retention of water. It is desirable, however, to avoid leaving too much pine material on-site as this could impede natural regeneration and reduce available space for planting indigenous species.

8.5 Opportunities to engage with the public

Interpretation signs could be installed along the walking track once the works to fell the pines have finished. The signs would act as an effective means by which to educate and engage with the public in terms of the vision for the site. For example, there could be information on how felled logs and 'totem poles' with holes drilled in them provide habitat for a range of invertebrates, lichens and fungi. The aim should be to impart a sense of these pines still playing a part in a dynamic ecosystem where very little goes to waste. Other information could include the history of the pine forest and what the forest might look like in fifty years (following planting).

9. RECOMMENDED APPROACH TO PINE MANAGEMENT

Recommendations for pine management have incorporated aspects of reports prepared by Geotree Ltd and Treescape Ltd together with the most recent methodologies proposed by Greenscene NZ Ltd. Access to the site from the zoo would be permitted during the tree works. It was noted in the report by Geotree Ltd (2014) that there is a high probability that the removal of trees from high-risk zones will significantly increase the rate of failure among the remaining trees, most of which lean toward and within falling range of the walking track. If not removed at the same time as the high-risk trees a large proportion of the remaining trees are likely to promptly topple across or along the track (Geotree Ltd 2014). It is therefore recommended that most - if not all - pines are felled in one operation, if sufficient resources are available.

Taking into consideration the above-mentioned options, together with constraints such as costs and site access, a revised approach is outlined below:

An eight metre-wide access road will be established from the south-eastern side from the old City Parks depot. This will require cutting through a knoll to facilitate access for machinery and vehicles. The road will head in a be as close to Motions Creek as possible outside of the 10m buffer in order to take advantage of the relatively flat floodplain. Best practice sediment control will be implemented in order to prevent sediments from entering Motions Creek (Stacy Collyer, Greenscene NZ, pers. comm.).

The access road will run in a north-westerly direction towards the zoo with three skid sites along the route; the skid sites will range in width from 20-40 meters. It is proposed to fell the majority of the trees in such a way that the crowns land on the skid sites or the road so vegetation disturbance is limited to the trunk width, i.e. directional felling. Crowns will be mulched on-site and the majority of logs will be dragged out onto the skid site, sectioned and then removed via the access road.

Branches and trunks can be left as required; however, in order to reduce the risk of fire woody debris should be evenly distributed across the forest floor rather than left in piles.

In order to reduce damage to the existing indigenous vegetation, some woody material can be left on site to break down, either as logs lying on the ground or as 5-6 m high 'totem poles'. For instance, in the area north of the track (bisected by the intermittent stream) the majority of pine material can be left on site given there are no formal public walking tracks through this area and it is largely out of view (Plate 4). This also applies to other parts of the site that are not directly visible by the public or neighbouring residents. It is anticipated that indigenous vegetation existing in the 'canopy landing area' will get damaged but, in general, not removed. All damaged vegetation will be pruned once the felling and extraction works have been completed.

Felling operations will avoid damaging the intermittent stream channel in the northern part of the site, i.e. trees will be felled away from the stream.

Felled logs that are left on site will not be piled on top of each other. Piled logs will take much longer to breakdown and they also create a potential fire risk.

9.1 Other considerations

As mentioned in Section 8.5, all felled logs to be left on site should be frilled with a chainsaw and/or drilled to allow rain water to enter the woody material, thus helping to speed up decomposition. Holes should be drilled into the standing poles to create habitat for invertebrates.

Chipped pine material should be stockpiled on site, which can later be used as a weed-suppressing mulch once indigenous tree and shrubs have been planted.

A recommended work programme for pine removal and ecological restoration is outlined in Section 13. Cost estimates for pine tree management are included in Section 14.

10. ENVIRONMENTAL PEST PLANTS

10.1 Pest plant priorities

Ten environmental pest plant species were identified within the project area. Environmental pest plants can be prioritised using the three categories in the Auckland RPMS (ARC 2007): (i) Total Control Pest Plants, (ii) Containment Pest Plants, and (iii) Surveillance Pest Plants. One additional class is used in this report: (iv) Environmental pest plants not currently included in the RPMS (ARC 2007). Overviews of each environmental pest plant species are provided below, within their respective categories.

(i) Total Control Pest Plants

Total Control pest plants have a limited distribution or density within the Auckland Region, or defined parts of the Region. They are considered to pose high potential threats to the Region, and Auckland Council assumes full responsibility for funding and implementing appropriate management programmes for these species. The aim is to eradicate these plants from the Region or defined areas of the Region, over a period of time, which may exceed the life of the current RPMS (ARC 2007).

No Total Control Pest Plants were recorded in the project area.

(ii) Containment Pest Plants

Containment pest plants are those that are abundant in certain habitats or areas in the Auckland Region. Landowners/occupiers are required to control these plants whenever they appear on their land. All containment pest plants are banned from sale, propagation, distribution, and exhibition through the entire Region (ARC 2007).

One Containment Pest Plant was recorded in the project area:

Moth plant (<i>Araujia sericifera</i>)	Removal (Waitakere and Hunua Ranges Weed Control Zones, specified coastal mainland sites and Hauraki Gulf Islands only)
--	---

(iii) Surveillance Pest Plants

Surveillance pest plants include species that have been identified as having significant impacts on the biosecurity values of the Auckland Region. The ARC seeks to prevent their establishment or spread by prohibiting their sale, propagation, distribution, and exhibition (ARC 2007).

Four Surveillance Pest Plants were recorded during the survey:

- Crack willow (*Salix fragilis*)
- Himalayan honeysuckle (*Leycesteria formosa*)
- Queen of the night (*Cestrum nocturnum*)
- Tradescantia (*Tradescantia fluminensis*)

(iv) Environmental Pest Plants not in the RPMS 2007-2012

Environmental pest plant species that are present in small to moderate infestations within the project area and are not identified in the RPMS (ARC 2007).

Five species in this category were recorded in the project area.

- Fruit salad plant (*Monstera deliciosa*)
- Garden nasturtium (*Tropaeolum majus*)
- Inkweed (*Phytolacca octandra*)
- Prunus (*Prunus* sp.)
- Shrub balsam (*Impatiens sodenii*)

10.2 Pest plant management

All environmental pest plants- Classes (ii)-(iv): containment, surveillance, and non-RPMS pest plants - recorded within the project area should be removed, with the exception of certain areas infested by gorse (see below).

As previously discussed, recent pest plant control has significantly reduced the abundance of environmental pest plants throughout the site. Currently, environmental pest plants are locally common on the northeast boundary of the site, most of which have spread from neighbouring residences into the recently cleared forest margins. Shrub balsam (*Impatiens sodenii*) (Plate 5) and Himalayan honeysuckle (*Leycesteria formosa*) occur in the largest quantities (Plate 6), while species such as tradescantia (*Tradescantia fluminensis*), inkweed (*Phytolacca octandra*), fruit salad plant (*Monstera deliciosa*) and garden nasturtium (*Tropaeolum majus*) are scattered throughout.

Pest plants such as mature crack willow (*Salix fragilis*) are scattered along the floodplain of Motions Creek.

Control methods for environmental pest plants species are presented in Appendix 3. It is recommended that all environmental pest plant control operations be undertaken in line with the Agrichemical Users' Code of Practice, NZS 8409 2004: The Management of Agrichemicals, and any relevant Auckland Council policies and procedures, such as herbicide reduction strategies.

Ongoing monitoring for environmental pest plants should be maintained throughout the project area on at least an annual basis, particularly for wetland habitat and bush margins. Other pest plant species encountered during the annual pest plant control operation should also be controlled.

11. PROPOSED PLANTING METHODOLOGY

11.1 Overview

Four broad planting areas have been identified and mapped (Figure 1). Planting Area A encompasses the majority of the forest (mid to lower slopes); Planting Area B comprises the upper north-eastern slopes bordering residential houses on West View Road; Planting Area C contains the incised riparian margins of the intermittent stream at the northern end of the site; and Planting Area D encompasses the true right floodplain along Motions Creek, which would also benefit from some weed control, e.g. crack willows.

Plant schedules for the site have been compiled based on the physical site characteristics, existing vegetation cover, and species that would occur naturally on sites with these characteristics. Other factors considered include the selection of species that are likely to have a relatively high growth and survival rates.

11.2 Site preparation

Site preparation will be a key factor in the successful implementation of this project. All pest plants should be controlled prior to undertaking planting. Exotic grass species such as cocksfoot (*Dactylus glomerata*) and Veldt grass (*Erhrarta erecta*) occur frequently in open areas throughout the forest, while exotic herbs such as creeping buttercup (*Ranunculus repens*) occur locally in damper floodplain habitat. All of these species have the potential to spread rapidly following the felling and removal of pines, given that numerous light gaps will be created. These grass and herb species, as well as plantain (*Plantago* spp.) and dock (*Rumex* spp.), can be blanket-sprayed with a herbicide mix appropriate to the species being targeted. Extra care should be taken to avoid spraying the indigenous grass *Microlaena stipoides*, which occurs locally on the track margins.

Some herbicides have a residual effect which may mean they need to be applied at least six weeks prior to planting (e.g. Metsulfuron-Methyl), but others - e.g. glyphosate-based herbicides - can be applied immediately beforehand. Plants can then be planted into sprayed rank grass, which will then create a natural 'mulch' as it decomposes.

11.3 Disposal of material

All environmental pest plant infestations can be dealt with *in situ* removing the need for disposal. Many seedlings (e.g. woolly nightshade and pine) can be controlled by hand-pulling and left to rot on site. It is essential that plant seeds, tubers, and fragments are not dispersed from the current infestation areas. Many species (e.g. crack willow, tradescantia) can easily be spread by seed or fragments.

Where cut vegetation is to be left on site, seed heads should be removed wherever possible and disposed of carefully to avoid new infestations establishing. Suitable weed hygiene procedures should be followed at all times.

11.4 Plant selection and sourcing

- Species have been selected on their proven survivability and relatively rapid plant growth, to ensure effective establishment on restoration sites.
- All plants should be sourced from the Tamaki Ecological District to avoid genetic contamination of distinctive populations, and because local plants tend to be better suited to local conditions. Plants should generally be grown from seed (as opposed to, for example, cuttings), so that the variability within local populations is preserved.
- A combination of half litre (0.5L), 1.5 litre, one litre (1L), and PB5 grade stock are recommended for the species to be planted in the revegetation planting areas.
- All plants brought onto the site should be free of weeds, especially any potentially troublesome species.

11.5 Planting methods

- Planting should be undertaken at densities appropriate for the species being used. Restoration planting densities for half litre grades (woody species only) should be at 1.4 m centres (5,100 stems per ha). This will achieve relatively rapid 'canopy closure' and reduce opportunities for weed establishment.
- While plants should be spaced at 1.4 m centres overall, large tree species (e.g. kahikatea and totara) within plantings should be planted at least 5 m apart from one another.

11.6 Ongoing maintenance of planting and weed control

- Plantings should be inspected monthly for 12 months following planting operations, to identify any management that may be required.
- Plantings generally need to be released from pest plant and non-pest plant competition 2-3 times a year for the first two years, and once or twice thereafter for another two years or so. Releasing needs to be undertaken until canopy closure is achieved and/or the survival or vigour of the plantings is no longer affected by weeds. Depending on site conditions and plant growth, some parts of the site, and plantings undertaken with planter bag sized stock, may only require releasing for the first two years.

- Infill planting¹ may be required in the second planting season if significant numbers of plants die, e.g. as a consequence of severe frosts or droughts. Infill plants should be of at least PB3 or 1 litre grade. Infill planting requirements should be identified in February/March prior to the upcoming planting season.
- Favourable growing conditions for plants can also promote the growth and survival of weeds, and events such as droughts or fire can facilitate their reinvasion. Ongoing monitoring and control of weeds will be required for at least the duration of the maintenance period.

11.7 Plant schedules

Plant schedules for the four planting zones are listed in Tables 1-4.

Table 1: Planting zone A (central forested area).

Species	Common Name	Grade	Spacing (m)	%
<i>Agathis australis</i> ¹	Kauri	PB5	5	2.5
<i>Beilschmiedia tarairi</i> ¹	Tarairi	PB5	5	2.5
<i>Coprosma robusta</i>	Karamu	0.5 litre	1.4	15
<i>Cordyline australis</i>	Ti kouka, cabbage tree	0.5 litre	3	10
<i>Corynocarpus laevigatus</i> ¹	Karaka	PB5	5	2.5
<i>Dacrydium cupressenum</i> ¹	Rimu	PB5	5	2.5
<i>Dacrycarpus dacrydioides</i> ¹	Kahikatea	PB5	5	2.5
<i>Dysoxylum spectabile</i> ¹	Kohekohe	PB5	5	2.5
<i>Hedycarya arborea</i>	Pigeonwood	0.5 litre	3	5
<i>Hoheria populnea</i>	Houhere, lacebark	1.5 litre	3	5
<i>Kunzea ericoides</i>	Kanuka	0.5 litre	1.4	10
<i>Melicactus ramiflorus</i>	Mahoe	1.5 litre	3	15
<i>Piper excelsum</i>	Kawakawa	0.5	1.4	5
<i>Pittosporum tenuifolium</i>	Kohuhu	0.5 litre	1.4	10
<i>Podocarpus totara</i> ¹	Totara	PB5	5	5
<i>Sophora chatamica</i> ¹	Kowhai	PB5	5	2.5
<i>Vitex lucens</i> ¹	Puriri	PB5	5	2.5
Total				100

¹ Infill planting is required on sites where there are gaps in the planting because of plant mortality or where initial stocking rates were too low.

Table 2: Planting zone B (upper slopes adjacent to residential properties).

Species	Common Name	Grade	Spacing (m)	%
<i>Beilschmiedia tarairi</i> ¹	Tarairi	PB5	5	5
<i>Coprosma robusta</i>	Karamu	0.5 litre	1.4	15
<i>Cordyline australis</i>	Ti kouka, cabbage tree	0.5 litre	3	10
<i>Corynocarpus laevigatus</i> ¹	Karaka	PB5	5	5
<i>Hoheria populnea</i>	Houhere, lacebark	1.5 litre	3	5
<i>Kunzea ericoides</i>	Kanuka	0.5 litre	1.4	15
<i>Meliccytus ramiflorus</i>	Mahoe	1.5 litre	3	15
<i>Phormium tenax</i>	Harakeke	0.5 litre	1.4	10
<i>Pittosporum tenuifolium</i>	Kohuhu	0.5 litre	1.4	10
<i>Sophora chatamica</i> ¹	Kowhai	PB5	5	5
<i>Vitex lucens</i> ¹	Puriri	PB5	5	5
Total				100

Table 3: Planting zone C (northern intermittent stream).

Species	Common Name	Grade	Spacing (m)	%
<i>Carex lessoniana</i> ²	Rautahi	0.5 litre	0.5	25
<i>Carpodetus serratus</i>	Putaputaweta, marbleleaf	1.5 litre	3	10
<i>Cordyline australis</i>	Ti kouka, cabbage tree	0.5 litre	3	15
<i>Hoheria populnea</i>	Houhere, lacebark	1.5 litre	3	10
<i>Leptospermum scoparium</i>	Manuka	0.5 litre	1.4	20
<i>Phormium tenax</i>	Harakeke	0.5 litre	1.4	20
Total				100

Table 4: Planting zone D (true right of Motions Creek).

Species	Common Name	Grade	Spacing (m)	%
<i>Alectryon excelsa</i>	Titoki	PB5	5	2.5
<i>Carex lessoniana</i> ²	Rautahi	0.5 litre	0.5	12.5
<i>Carex virgata</i> ²	Purei	0.5 litre	0.5	20
<i>Carpodetus serratus</i>	Putaputaweta, marbleleaf	1.5 litre	3	8
<i>Coprosma robusta</i>	Karamu	0.5 litre	1.4	10
<i>Cordyline australis</i>	Ti kouka, cabbage tree	0.5 litre	3	10
<i>Dacrycarpus dacrydioides</i>	Kahikatea	PB5	5	2.5
<i>Hoheria populnea</i>	Houhere, lacebark	1.5 litre	3	5
<i>Laurelia novae-zelandiae</i>	Pukatea	PB5	5	2.5
<i>Leptospermum scoparium</i> ¹	Manuka	0.5 litre	1.4	12.5
<i>Meliccytus ramiflorus</i> ³	Mahoe	1.5 litre	3	10
<i>Sophora chatamica</i> ¹	Kowhai	PB5	5	2.5
<i>Syzygium maire</i> ³	Swamp maire	PB5	5	2
Total				100

1. Plant after three years once sufficient shelter is available from surrounding plants.
2. Plant along the stream edge and on floodplain
3. Plant in permanently damp areas with high light

12. PEST ANIMALS

12.1 Overview

The usual suite of mammalian pests is likely to be present at the study site, including ship rats (*Rattus rattus*), Norway rats (*R. norvegicus*), mice (*Mus musculus*), brushtail possums (*Trichosurus vulpecula*), hedgehogs (*Erinaceus europaeus*), and potentially mustelids (*Mustela* spp.). Possums, rats, and mice are likely to be adversely affecting vegetation condition through browsing of foliage and seed predation. All of these mammalian pests are likely to reduce the fauna values of the site through the predation of birds, lizards, and invertebrates.

12.2 Recommendations for the control of pest mammals

A pest-control contractor should be commissioned to establish a bait station and trap network throughout the project area (Figure 2). Bait stations should be spaced approximately 50 m apart on a grid pattern. Toxic baits should be distributed twice a year in early winter and late spring with different bait formulations being used during each baiting session to avoid the risk of bait shyness developing. Ideally, possum baits should be distributed two weeks after rat baits to reduce levels of rat interference with possum baits.

DOC 150 or 200 traps can be used control mustelids, rats and hedgehogs, although their use may raise issues regarding public safety and the probability of theft or interference. If traps are deployed, they should be baited with whole eggs or Erayz™ attractant and checked at least once a month.

In terms of toxins, rodents can be effectively controlled using ground bait stations filled with brodifacoum, Contrac™ (bromadiolone), Feracol™ (cholecalciferol, Vitamin D3) Ditrac™ and Ratabate™ (diphacinone). Bromadiolone, dipachinone, and cholecalciferol are less persistent in the environment than brodifacoum, and as such pose less of a secondary poisoning risk to morepork (*Ninox novaeseelandiae*). Cholecalciferol is effective for controlling possums, and it is more humane than brodifacoum.

13. RECOMMENDED WORK PROGRAMME

A recommended four-year work plan is outlined below. Timing is based on the Auckland Council financial year of 1 July to 30 June and assumes that pine tree removal will commence in 2016 and be carried out in one operation. The exact operational details will be developed by Greenscene NZ in consultation with Wildlands and Auckland Council.



Year 1 (2016/17)

Task	Timing
1. Pine removal (not to coincide with bird breeding season).	June-July 2016
2. Initial pest plant control (MU1 and MU2)	September-October 2016
3. Animal pest control (establish bait station grid).	October-November 2016
4. Site preparation for planting areas	March-April 2017

Year 2 (2017/2018)

Task	Timing
1. Animal pest control	April 2017
2. Planting	May-August 2017
3. Animal pest control	August-September 2017
4. Ongoing follow up pest plant control and monitoring (twice per year)	October 2017, March 2018
5. Maintenance of plantings	October 2017, March 2018
6. Animal pest control	April 2018

Year 3 (2018/2019)

Task	Timing
1. Infill planting (here required)	May-August 2018
2. Animal pest control	August-September 2018
3. Ongoing follow up plant pest control and monitoring (twice per year)	October 2018, March 2019
4. Maintenance of plantings	October 2018, March 2019
5. Animal pest control	April 2019

Year 4 (2019/2020 onwards)

Task	Timing
1. Animal pest control	August-September 2019
2. Ongoing follow up plant pest control and monitoring	October 2019, March 2020
3. Maintenance of plantings	October 2019, March 2020
4. Animal pest control	April 2020

14. INDICATIVE COSTS

Assuming 0.5 litre grade stock is to be used for the bulk of the planting, the costs of site preparation, plants, planting, and maintenance for 5 years are approximately \$35,000 per hectare if plants are spaced at 1.4m centres. Based on an area of c.3.2 ha, the total costs would be approximately \$112,000, although this is likely to be significantly less given that felled pines trees and mulch will cover some of the project area together with existing indigenous vegetation.

ACKNOWLEDGMENTS

Grant Burke (Auckland Council) provided client liaison. David Stejskal (Auckland Council) and Stacy Colyer (Greenscene NZ Ltd) provided technical advice.

REFERENCES

- de Lange P.J., Galloway D.J., Blanchon D.J., Knight A., Rolfe J.R., Crowcroft G.M. & Hitchmough R. 2012: Conservation status of New Zealand lichens. *New Zealand Journal of Botany* 50:3, 303-363.
- de Lange P.J., Rolfe J.R., Champion P.D., Courtney S.P., Heenan P.B., Barkla J.W., Cameron E.K., Norton D.A. and Hitchmough R.A. 2013: Conservation status of New Zealand vascular plants, 2012. *New Zealand Threat Classification Series 3*. Department of Conservation, Wellington.
- Geotree Ltd 2014: Draft memorandum for Auckland Council arborists. Sent to Grant Burke (Auckland Council) on 9 April 2014.
- Julian A. 1995: Prehistoric and pre-European vegetation of the Tamaki Ecological District unpublished report prepared for Waitakere City Council.
- Lindsay H., Wild C., Byers S. 2009: Auckland Protection Strategy. A report to the Nature Heritage Fund Committee. Published by the Nature Heritage Fund. Wellington.
- Myers S. (Ed.) 2005: North Shore City Ecological Survey. North Shore City Council and Auckland Regional Council. Auckland.
- O'Donnell C.F.J., Christie J.E., Lloyd B., Parsons S., and Hitchmough R.A. 2013: Conservation status of New Zealand bats, 2012. *New Zealand Threat Classification Series 6*. Department of Conservation, Wellington. 8 pp.
- Robertson H.A., Dowding J.E., Elliot G.P., Hitchmough R.A., Miskelly C.M., O'Donnell C.F.J. Powlesland R.G., Sagar P.M., Scofield R.P., and Taylor G.A. 2013: Conservation status of New Zealand birds. *New Zealand Threat Classification Series 4*. Department of Conservation, Wellington. 22 pp.
- Roper E. 2008: Auckland Council Memorandum re: LUC20080514201: 859 Great North Road, Grey Lynn - Western Springs Reserve. 15 December 2008.
- Stanley R., de Lange P., and Cameron E.K. 2005: Auckland Regional Threatened and Uncommon Vascular Plants List. *Auckland Botanical Society Journal* 60(2): 152-157.

SITE PHOTOGRAPHS



Plate 1: View of indigenous understorey from the main walking track.
25 May 2014.



Plate 2: North-eastern boundary of the forest where steep banks are covered in exotic plant species and household rubbish. 25 May 2014.



Plate 3: Directionally felled mature pine left to break down in the central part of the forest. 5 May 2014.



Plate 4: View across the northern end of the forest where mature pines are less numerous than the central region. 30 May 2014.



Plate 5: Large infestation of shrub balsam, inkweed and garden nasturtium on the north-eastern boundary of the site. 30 May 2014.



Plate 6: Large infestation of Himalayan honeysuckle on the north-eastern boundary of the site. 30 May 2014.

VISUAL CONCEPT PLANS
PREPARED BY LASF
LANDSCAPE ARCHITECTS

LOCATION PLAN



PLANTING AREAS

ENHANCEMENT PLANTING AREA A:
Proposed planting within areas left void of vegetation as a result of the removal of the Pine trees including:
Agathis australis, Beilschmiedia tarairi, Coprosma robusta, Cordyline australis, Corynocarpus laevigatus, Dacrydium cupressinum, Dacrycarpus dacrydioides, Dysosyllum spectabile, Hedyocarya arborea, Hohenia populnea, Kunzea ericoides, Melicytus ramiflorus, Piper excelsum, Pittosporum tenuifolium, Podocarpus totara, Sophora chatamica and Vitex lucens.

ENHANCEMENT PLANTING AREA B:
Proposed planting within upper slopes adjacent to residential properties on West View Road:
Beilschmiedia tarairi, Coprosma robusta, Cordyline australis, Corynocarpus laevigatus, Hohenia populnea, Kunzea ericoides, Melicytus ramiflorus, Phormium tenax, Pittosporum tenuifolium, Sophora chatamica and Vitex lucens.

ENHANCEMENT PLANTING AREA C:
Proposed planting within northern intermittent stream zone including:
Carex lessonianna, Carpodetus serratus, Cordyline australis, Hohenia populnea, Leptospermum scoparium and Phormium tenax.

ENHANCEMENT PLANTING AREA D:
Proposed planting along riparian edge of Motions Creek including:
Alectryon excelsus, Carex lessonianna, Carex virgata, Carpodetus serratus, Coprosma robusta, Cordyline australis, Dacrycarpus dacrydioides, Hohenia populnea, Laurelia novae-zelandiae, Leptospermum scoparium, Melicytus ramiflorus, Phormium tenax, Sophora chatamica and Syzygium maire.

LANDSCAPE ARCHITECTS
PO BOX 60-164 AUCKLAND
PHONE 09 8176252 NZ



LEGEND:



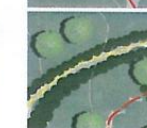
EXISTING BUSH AREA TO HAVE PINE TREES FELLED AND REVEGETATED WITH NATIVE SPECIES



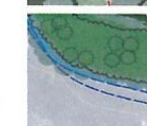
A, B, C, & D INDICATES THE PROPOSED SPECIES OF REVEGETATION FOLLOWING THE REMOVAL OF THE PINE TREES



EXISTING TRACK TO BE UPGRADED TO PROVIDE A EVEN & SAFE WALKING TRACK. SOME EDGE PLANTING TO BE UNDERTAKEN AS REQUIRED



PROPOSED NEW METAL PEDESTRIAN TRACKS WITH EDGE PLANTING TO PROVIDE AN APPROPRIATE AMENITY EDGE



RIPIARIAN EDGE OF MOTIONS CREEK WITH ADDITIONAL PLANTING TO FILL GAPS



EXISTING BRIDGE CROSSING TO BE ENHANCED WITH EDGE PLANTING & IMPROVE SIGNAGE

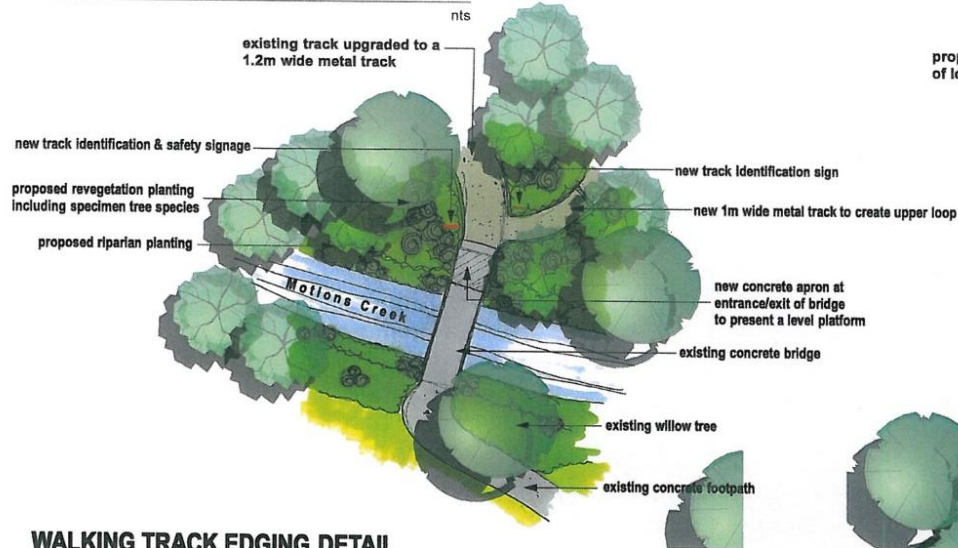
OVERALL DEVELOPMENT PLAN

scale 1:1000 do not scale from this drawing

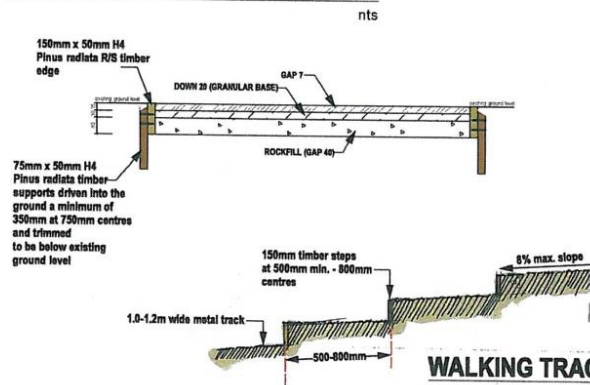
WESTERN SPRINGS PARK A U C K L A N D ECOLOGICAL RESTORATION PLAN

ISSUE	DATE	REVISION	PROJECT #
PROJECT			WESTERN SPRINGS PARK
CLIENT			AUCKLAND COUNCIL
DWG			ECOLOGICAL RESTORATION PLAN
DATE #	25.6.14	DWG #	WS01
SCALE @ A1		DRAWN	SJF
		CHKD	MS
		REVISION	

EXISTING BRIDGE ENTRY/EXIT DETAIL



WALKING TRACK EDGING DETAIL



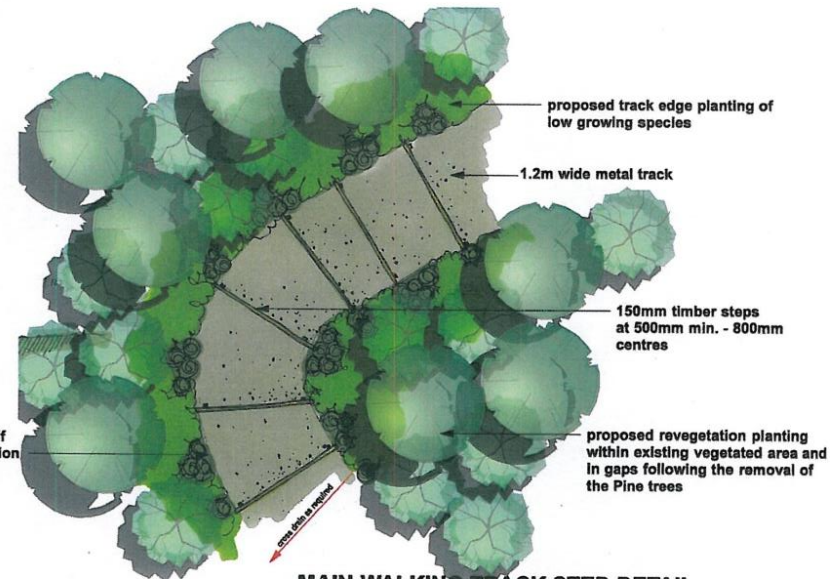
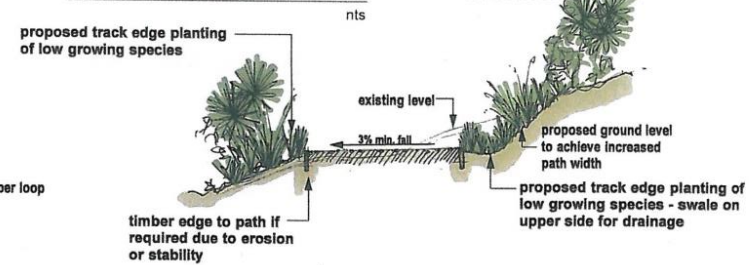
WALKING TRACK SECTION

WESTERN SPRINGS PARK

A U C K L A N D

ECOLOGICAL RESTORATION PLAN

WALKING TRACK EDGE DETAIL - LOOSE AGGREGATE FINISH



MAIN WALKING TRACK STEP DETAIL - LOOSE AGGREGATE FINISH

scale 1:400

LASF landscape architects
po box 60-164 auckland
phone 09 8176252 nz

ISSUE	DATE	REVISION	PROJECT #
PROJECT	WESTERN SPRINGS PARK		
CLIENT	AUCKLAND COUNCIL	DATE # 25.6.14 SCALE @ A3	DWG # WS02
DWG	ECOLOGICAL RESTORATION PLAN	DRAWN SJF CHKD MS	REVISION

RECOMMENDED HERBICIDE TREATMENTS

Pest Plant	Control Method(s)	Chemical(s)	Application Rate	Timing	Remarks
Crack willow (<i>Salix fragilis</i>)	Cut and treat stumps	Metsulfuron	5g/1 litre water, plus 2 ml surfactant	October-April	
	Drill and inject/frill and spray	Metsulfuron	5g/1 litre water, plus 2 ml surfactant	October-April	Preferred option as leaving the tree standing avoids broken twigs/branches resprouting on ground.
Fruit salad plant (<i>Monstera deliciosa</i>)	Hand pull seedlings/small plants			Year round	
	Cut and treat stump	Triclopyr	60ml/1 litre water	October-March	
Garden nasturtium (<i>Tropaeolum majus</i>)	Knapsack - foliar spray	Metsulfuron	5g/10 litres water	November-March	Pull vines away from non-target vegetation before spraying.
Himalayan honeysuckle (<i>Leycesteria formosa</i>)	Knapsack - foliar spray	Metsulfuron	5g/10 litres water	November-March	Take care to avoid spraying over water.
	Cut and treat stump	Metsulfuron	5g/1 litre water	October-April	
Inkweed (<i>Phytolacca octandra</i>)	Knapsack - foliar spray	Metsulfuron	5g/10 litres water + 20ml penetrant/10 litres water	November-March	Take care to avoid spraying over water.
	Cut and treat stumps close to the ground	Metsulfuron	1g/1 litre water	October-April	
Moth plant (<i>Araujia sericifera</i>)	Hand pull seedlings/ small vines (if small numbers)			Year round	Dispose of off in a safe manner.
	Cut and treat stump	Triclopyr	60ml/1 litre water	October-March	Leave cut vegetation in host to die off. Remove seed pods if possible and dispose of safely.
	Cut and treat stump	Picloram (Vigilant gel)	Apply gel to cut stem	October-March	Leave cut vegetation in host to die off. Remove seed pods if possible and dispose of safely.
Prunus (<i>Prunus</i> spp.)	Cut and treat stumps	Triclopyr	60ml/10 litres water	November-March	
Queen of the night (<i>Cestrum nocturnum</i>)	Cut and treat stumps	Triclopyr	100ml/1 litre water	Year round	
	Knapsack - foliar spray	Triclopyr	6ml/litre water + 2ml surfactant per litre water	November-March	
Shrub balsam (<i>Impatiens sodonii</i>)	Foliar spray	Metsulfuron	5g/10 litres water	Year round	
Tradescantia (<i>Tradescantia fluminensis</i>)	Knapsack - foliar spray	Triclopyr	10ml/litre water + 2ml surfactant per litre water	November-March	



Call Free 0508 WILDNZ
Ph: +64 7 343 9017
Fax: +64 7 3439018
ecology@wildlands.co.nz

99 Sala Street
PO Box 7137, Te Ngae
Rotorua 3042,
New Zealand

Regional Offices located in
Auckland, Hamilton, Tauranga,
Whakatane, Wellington,
Christchurch and Dunedin

ECOLOGY RESTORATION BIODIVERSITY SUSTAINABILITY

www.wildlands.co.nz