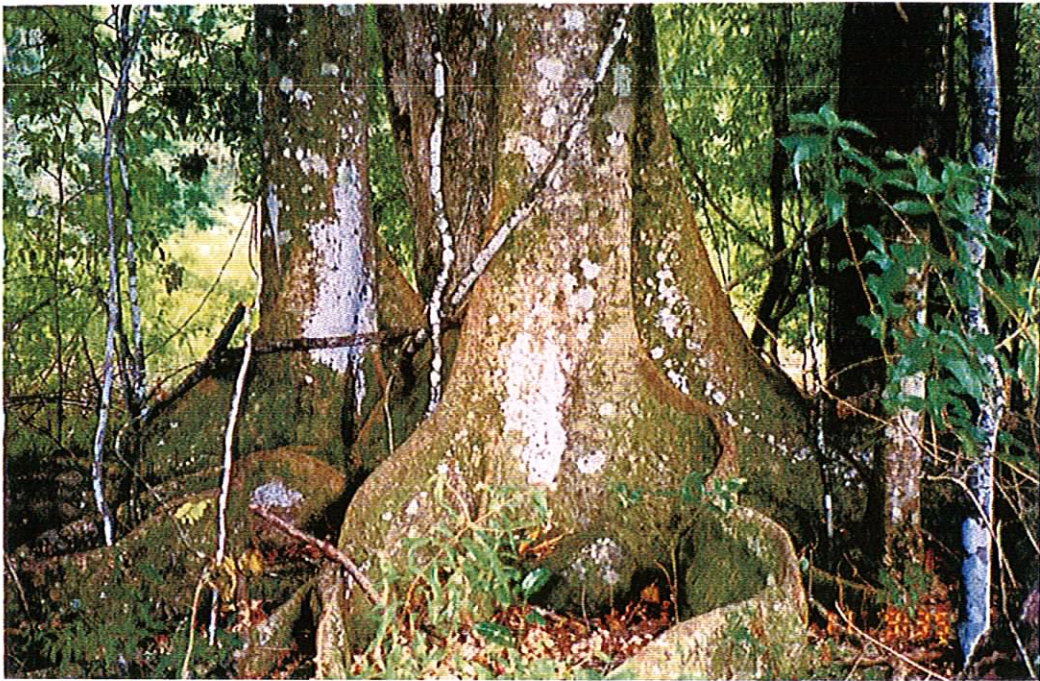




High Conservation Value (HCV) Vegetation Restoration

Action Plan Duck Creek



Prepared by Jen Ford of EnviTE NSW as part of works funded
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1. Background

Duck Creek is an area of High Conservation Value (HCV) vegetation near Alstonville. Vegetation restoration works will be undertaken on the site funded by a Natural Heritage Trust (NHT) contract for the Big Scrub area.

The site is owned and managed by Ballina Shire Council. Duck Creek was recommended for restoration as part of the NHT HCV contract due to its conservation values.

Jen Ford (EnviTE) has prepared this Action Plan. Discussions with, and material provided by Rhonda James have also contributed to the content and layout of this plan.

2. Project Aims and Objectives

The aim of this action plan is to provide practical guidelines to restore of an area along Duck Creek. These works will:

- Strengthen the resilience and regenerative capacity of the riparian zone,
- Improve the forest structure and re-instate natural processes that have been halted due to weed invasion,
- Provide a suitable habitat for resident and migratory fauna,
- Improve water quality in the long-term, and
- Assist in reducing the degradation of downstream areas by controlling Madeira Vine infestations.

The specific objectives of this plan and its recommended works are:

- To provide information on restoration techniques and the control of all weed species,
- To systematically control weed species from described work zones,
- To make recommendations for the long-term regeneration of the native vegetation, and
- To conduct site monitoring and evaluation.

3. Site Location and Description

3.1 Location, Tenure and Size

The site is situated on the southern side of the Bruxner Highway, Alstonville and borders a portion of Duck Creek to both the east and west. The site is surrounded by private property. Access to the area is via the Dewhurst's property. Ownership and management of the site has previously been the responsibility of Rous Water. Ballina Shire Council will now take over the management of this site.

The total size of the site outlined in the aerial photograph (Figure 1) is 7.3 hectares. The area is listed with Ballina Shire Council as three separate DP numbers. The northern portion is DP 013/375//729060, the eastern 013/144//123653 and the western side is DP013/144//92773. The majority of this plan covers the 5.7 hectare area in the southern portion though additional areas along the riparian strip in the north are incorporated.

3.2 Site History

The Duck Creek site was once part of the vast Big Scrub, which was approximately 75,000 hectares of subtropical rainforest associated with the Mount Warning volcanics. The Big Scrub covered the area between east Lismore, Alstonville, St Helena and Dunoon (Holmes 1987, Floyd 1990a, Mezzatesta 1992, Lott & Duggin 1993).

By the early 1900's much of the Big Scrub had been reduced to a series of isolated remnants that comprise less than 1% (or 300 ha.) of the original vegetation (Frith 1976, Floyd 1990a, Lott & Duggin 1993, Adam 1994).

The vegetation and the hydrology of this area would have further been altered when the weir was built.

3.3 Site Description

The site includes the riparian and immediate up-slope vegetation along a section of Duck Creek approximately 300 metres in length. The width of the site extends to more than 100 metres from the creek in some of the areas including an alluvial flat on the western side of the southern portion (Zone 2).

Other areas along the creek are steep, narrower and covered in large boulders. Vegetation includes a mix of primary rainforest and weed species. In the more open and degraded areas along the riparian zone the width of the work zones becomes narrower due to a lack of vegetation, cattle access and lack of structure. The old weir in the southern zone, is situated approximately 45 metres from the southern boundary. The vegetation community immediately around the weir along approximately 40 metres of creek below it are more open and disturbed. Figure 1 details the site location and main features.

4. Site Assessment

4.1 Vegetation Description, Condition & Conservation Value

The vegetation is predominantly old-growth riparian sub-tropical rainforest. The area is best classified according to Floyd's structural-physiognomic-floristic classification method (Floyd, 1990a). It falls under Suballiance No. 4 *Elaeocarpus angustifolius* (previously *E. grandis*), Blue Quandong. A comprehensive native plant species list is detailed in Appendix 1.

Some areas have undergone clearing in the past. The varying degrees of disturbance over the site is indicative of selective logging, clearing for cattle farming, clearing for the building and use of the weir. Exotic species have further degraded the forest, altering natural processes.

The site ranges from complex rainforest with 100% canopy and good rainforest structure, to open areas along the creek that are completely dominated by Lantana and Madeira Vine. Also present are large gaps in the forest that are either completely dominated by weed such as Lantana and Madeira Vine or have been further increased in size by the collapse of trees under the weight of native vines such as *Flagellaria*.

The site overall displays excellent resilience, contains a great diversity of native plant species from all age classes, threatened species, and is connected to other areas of high conservation value via the creek system. The site has been divided into six zones and each zone is described and recommendations for vegetation restoration are provided. Figure 2 indicates the management zones for the Duck Creek site.

4.1.1 Zone 1

Zone 1 follows Duck Creek and extends to between three and five metres either side of the waters edge. The varying levels of disturbance are most obvious in this zone. Some areas are almost pristine in their appearance, though requiring some weed control in the lower stratum. Other areas are extremely degraded in structure and are almost completely dominated by Madeira Vine (*Anredera cordiflora*).

Madiera Vine is a highly invasive plant and is present throughout most of the zone at varying levels. Degradation due to Maderia Vine is obvious in the immediate riparian zone. Substantial numbers of other weed species such as Wandering Creeper, Mistflower, Blue Billygoat Weed, Small-leaved Privet and Lantana present in the area.

Figure 1: Aerial Photo image of Duck Creek remnant

Duck Creek (Reserve) remnant

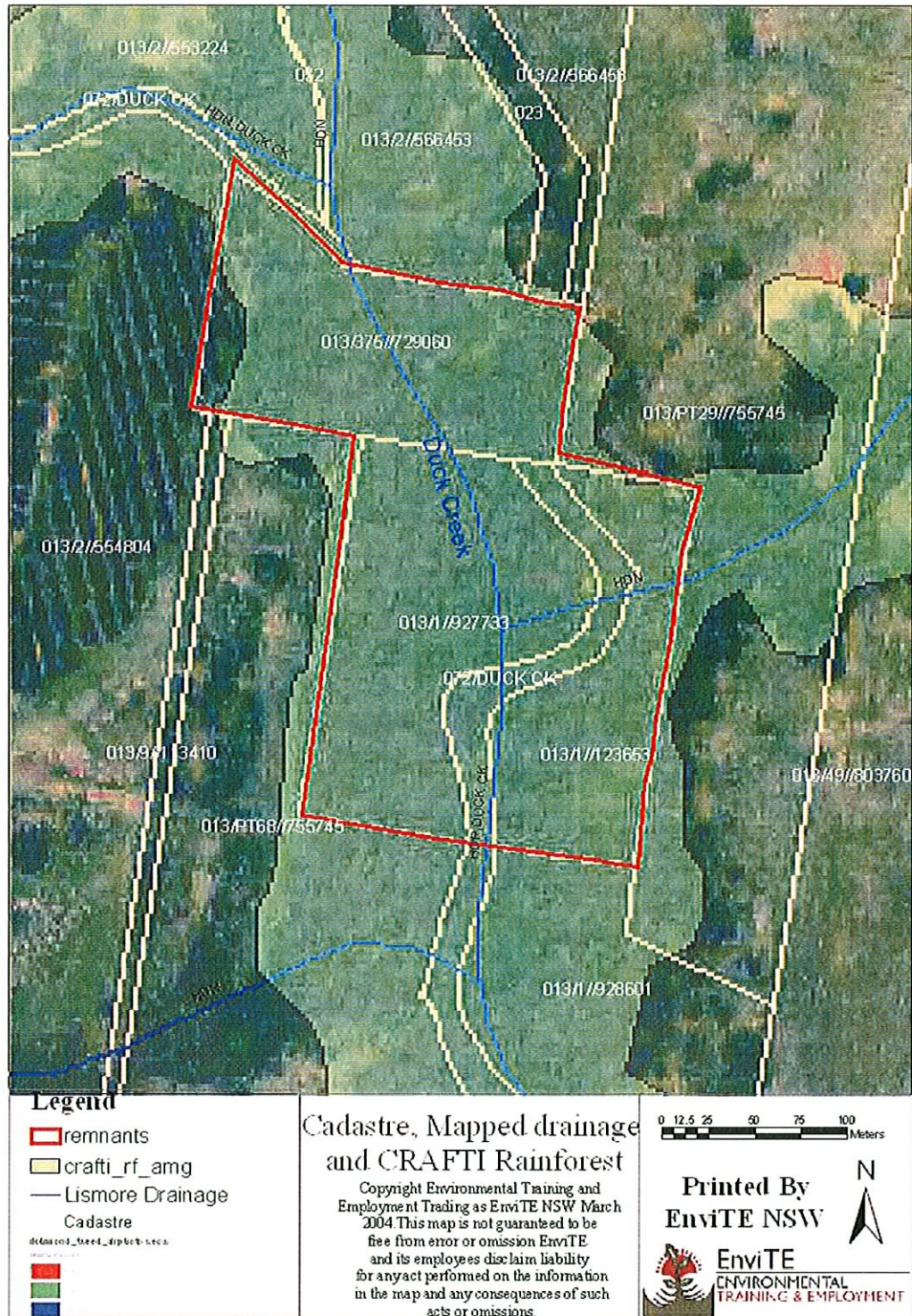
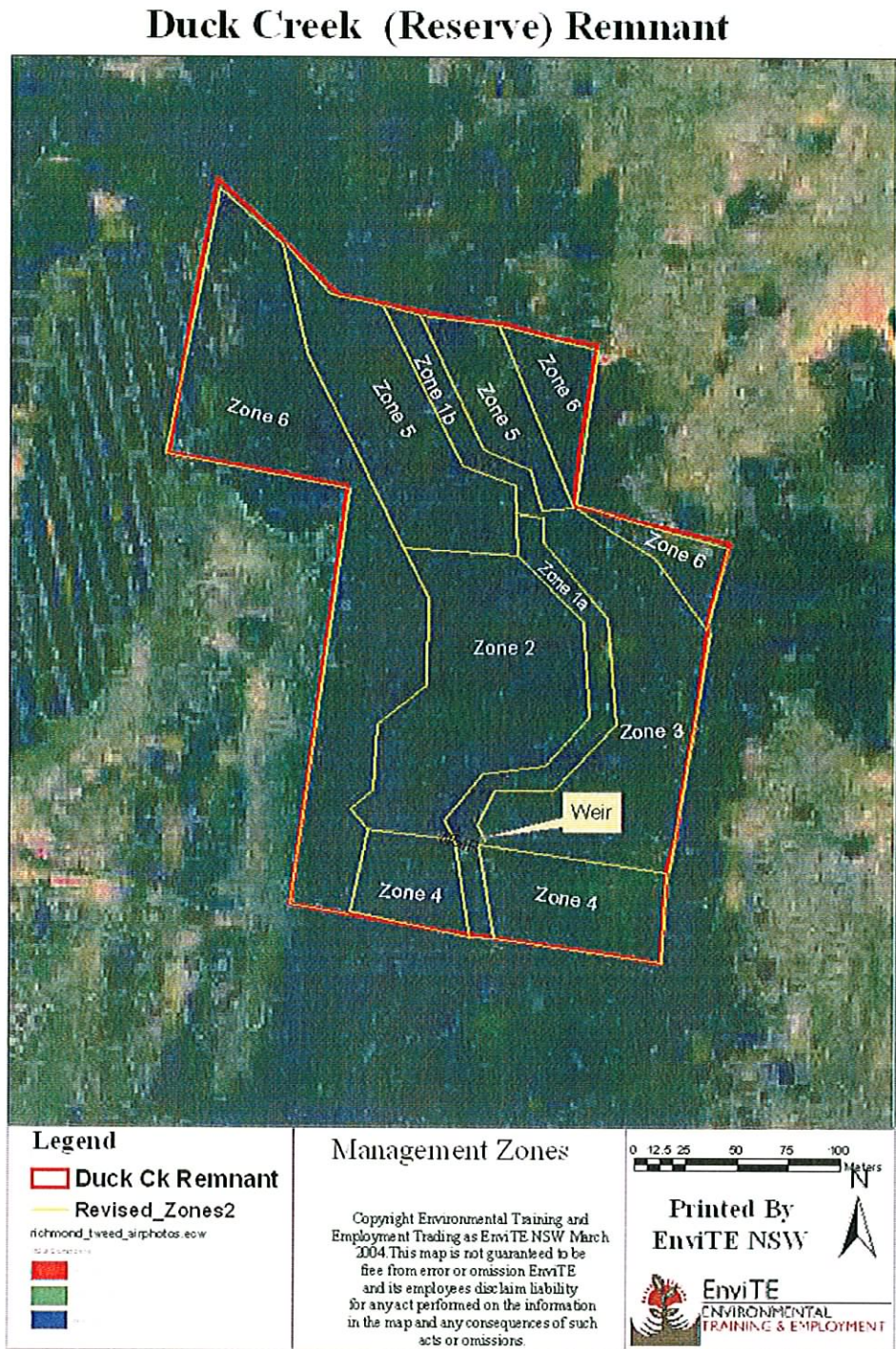


Figure 2: Management Zones for the Duck Creek remnant



4.1.2 Zone 2

Zone 2 covers the flat area to the west of the weir and extends to approximately 80 metres in width bordering the riparian strip of Zone 1 and the weir (Figure 2). This area, of mostly remnant vegetation, displays some of the highest diversity and sound rainforest structure along Duck Creek.

There are some pockets that contain mature infestations of Madeira Vine, reaching to the canopy, and gaps in the forest that have been dominated by Lantana, native vines and Madeira Vine. The entire zone contains varying levels of other exotic species including *Tradescantia*, Small-leaved Privet, Mistflower, Crofton Weed and Broad-leaved Paspalum, but the largest threat to the longevity of this area is the presence of Madeira Vine.

4.1.3 Zone 3

Zone 3 is the area to the east of Duck Creek in the southern portion of the site bordering Zone 1 (Figure 2). The level of weed infestation varies throughout the zone, as does the health of the forest structure. Some areas are dominated by Lantana and Madeira Vine while other areas support mostly sound rainforest. The degree to which some of the areas have undergone disturbance and are dominated by Madeira Vine is extreme. These areas require a long-term restoration project.

4.1.4 Zone 4

Zone 4 is a more open area to the south of the weir. It extends to the edges of the forest in both an easterly and westerly direction and to the southern boundary, approximately 45 metres downstream.

This area has previously been cleared and the lighter conditions have made it easier for weeds such as Lantana, Mistflower, Crofton Weed, Blue Billygoat Weed and exotic grasses to dominate. Madeira Vine is also present and a number of infestations reach to the canopy. This zone does display some good regrowth of native species including a good diversity of pioneer species. The resilience of this zone is strengthened by the health of the surrounding vegetation and the likelihood of seed recruitment along this rich area of Duck Creek.

4.1.5 Zone 5

Zone 5 is situated in the northern portion of the site and runs adjacent to the creek and Zone 1b (Figure 2). This zone again varies greatly in the diversity of native species, the health of the forest structure and the degree of weed infestation affecting a particular area. Remnant trees and stands of native forest as well as larger woody weeds such as Camphor Laurel provide good structure and diversity to aid the recovery of this disturbed area. Weeds such as Madeira Vine, Lantana, Wandering Creeper, Small-leaved Privet and Mistflower threaten the future health of this ecosystem.

4.1.6 Zone 6

Zone 6 runs adjacent to Zone 5 on both sides of the creek and has not been surveyed due to the scope and size of this action plan. Restoration of Zones 1 to 5 is a long-term project. Any further recommendations for restoration areas will require a more comprehensive management plan.

4.2 Threats and Impacts

The main threat to the diversity and health of native vegetation as well as the long-term restoration of this site is the types of weeds present and the level of weed invasion occurring.

The distribution and abundance of weed species throughout the site is high and the level of infestation of such a damaging weed as Madeira Vine will require long-term attention.

Additional infestations of Madeira Vine and other problematic weeds also occur upstream and are likely to continue to re-infest this site via the flow of the creek.

The steady increase in nutrients and possible pollutants from surrounding farms is likely to degrade water quality over time and, as conditions alter, the environment becomes more suitable to the growth of weeds.

Another threat to the health of native vegetation is the over abundance of native vines in some of the gaps and along some of the edges including that of the immediate riparian zone. As this zone has a large edge to area ratio, light levels have increased making the environment more suitable to the growth of vines. They are out-competing native plants, damaging the structure of native vegetation by collapsing it under its weight, halting any expansion of the edge and preventing the supporting species from flowering and fruiting normally.

5. Native Fauna and Habitat Assessment

5.1 Value of Fauna Habitat

No formal fauna assessment has been carried out but it is considered that this area of Duck Creek would be a host to a large variety of resident and migratory avifauna. The species germinating, diversity of native species present, the connectivity to other areas of high conservation forest via the creek system and other stands of vegetation, and the current forest structure suggest a good range of avifauna, reptiles, amphibians and mammals use the site.

The diversity of habitat available also suggests that a range of fauna would visit or be resident to the site. Habitat features include mature trees, good development of lower rainforest stratum, vine thickets, rocks, logs, intermittent watercourses, pools, leaf litter, open grassy areas, fleshy-fruited trees/shrubs, Lantana and forest gaps.

5.2 Habitat Considerations

In the case of pruning native vines considerations such as the flowering and fruiting times and loss of habitat need to be considered before any action is taken. Considerations should also include not over-clearing Lantana, the time of year work is carried out and nearby available habitat for relocation.

5.3 Threatened Species

There are five threatened plant species known to occur at this site which are listed under the Threatened Species Act (1995). The names and schedule are listed below.

<i>Floydia praealta</i>	Ball Nut	Vulnerable
<i>Ochrosia moorei</i>	Southern Ochrosia	Endangered
<i>Macadamia tetraphylla</i>	Macadamia Nut	Vulnerable
<i>Syzygium hodgkinsoniae</i>	Red Lilly Pilly	Vulnerable
<i>Tinospora tinosporoides</i>	Arrow-head Vine	Vulnerable

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The fact that other threatened species such as *Rhodamnia maideniana* (Maidens Blush) and *Cryptocarya foetida* (Stinking Cryptocarya) occur in other parts of Duck Creek, suggest that its likely other species will be found or recruitment/germination will occur once restoration work commences. In addition to the above species the following threatened species are known from a 5km buffer around the site; *Archidendron hendersonii* (White Lace Flower), *Arthraxon hispidus* and *Sophora fraseri*. The following threatened fauna species are known from a 5km buffer around the remnant.

Table 1: Threatened fauna species in known from a 5km radius around remnant

Faunal Group	Scientific Name	Common name	Status
Birds	<i>Erythrotriorchis radiatus</i>	Red Goshawk	E1
Birds	<i>Anseranas semipalmata</i>	Magpie Goose	V
Birds	<i>Coracina lineata</i>	Barred Cuckoo-shrike	V
Birds	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E1
Birds	<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V
Birds	<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V
Birds	<i>Menura alberti</i>	Albert's Lyrebird	V
Birds	<i>Amaurornis olivaceus</i>	Bush-hen	V
Birds	<i>Tyto capensis</i>	Grass Owl	V
Birds	<i>Tyto tenebricosa</i>	Sooty Owl	V
Frogs	<i>Assa darlingtoni</i>	Pouched Frog	V
Mammals	<i>Planigale maculata</i>	Common Planigale	V
Mammals	<i>Thylogale stigmatica</i>	Red-legged Pademelon	V
Mammals	<i>Phascolarctos cinereus</i>	Koala	V
Mammals	<i>Pteropus alecto</i>	Black Flying-fox	V
Mammals	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V
Mammals	<i>Nyctophilus bifax</i>	Eastern Long-eared Bat	V
Reptiles	<i>Coeranoscincus reticulatus</i>	Three-toed Snake-tooth Skink	V

5.3.1 Legislative Requirements

A section 132C scientific licence (No. S11189) has been obtained from the Department of Environment and Conservation (previously NPWS). All EnviTE staff are familiar with the licence application, associated checklists and related operation procedures if threatened species are encountered on site.

5.3.2 Threatened Species Considerations

Care must be taken whilst working around or near threatened species. All works must be documented on a Daily Record Sheet (Appendix 6) particularly when using herbicides. Considerations for possible threatened fauna species include not over-clearing Lantana, the time of year work is carried out and nearby available habitat for relocation. In the case of pruning native vines considerations such as the flowering and fruiting times and loss of habitat also need to be considered.

6. Recommendations

6.1 Work Zones

For the purpose of this action plan the site has been divided into six zones (see Figures 2 & 3).

- Zone 1 has been divided into two sub-zones due to the size of the area and to assist with access and the order of works. Zone 1a is the riparian zone in the southern portion. It is approx 150m in length and between 3-5m wide on each side of the creek. This variation in width depends on the accessibility, the structure of existing weeds and natives and the species of weeds present. Zone 1b covers the riparian strip in the northern portion of the site approximately 150m in length.
- Zone 2 is the flatter area to the west of the weir and borders zones 1 and 4.
- Zone 3 is situated in the southern portion of the site and borders zone 1a on the eastern side of the creek.
- Zone 4 incorporates the area downstream of the weir to the southern boundary approximately 45m in length and to the east and west of the creek.
- Zone 5 is the strips of land to the east and west of the creek in the northern portion of the site adjacent zone 1b.
- Zone 6 covers all outside strips of vegetation over the entire site until the boundaries.

6.2 Direction of Work

Works are to begin in Zone 1 and start around the weir moving up stream in a northerly direction until the end the zone is reached approximately 300 metres up the creek. Once the first zone has been stabilised, work can then continue into Zone 2 and then only after the first two zones have been consolidated, should work begin in Zone 3 and later in Zones 4 and 5. The exception to this rule is that as works continue and stabilise in Zone 1b, work can commence in Zone 2, particularly targeting Madeira Vine.

It is essential that professional bush regenerators carry out these works due to the complexity and status of this site.

Ensure all works are documented on the Daily Record Sheets including any observations such as large numbers of germinating species, significant changes to the site and any obvious fauna activity. See Appendix 6 for the Daily Record Sheet.

6.2.1 Zone 1

- Work from the access point near the weir on the eastern side of the creek and head upstream on both sides of the creek.
- Primary works will include preparing the area for spraying, cutting Lantana to expose Madeira vines and controlling other smaller woody weeds using the cut, scrape and paint (C-S-P) method.
- Tagging Madeira vines as they are encountered will assist workers in relocating vines.
- As access up and down the creek is necessary for spraying and maintenance it is essential to prepare this zone first.
- Woody weeds requiring control at this time will include Lantana, Small-leaved Privet, Camphor Laurel, and Smooth Senna. NB. Workers are to try and avoid treading in Madeira tubers or Wandering Creeper as primary works are carried out.
- Once access is easier to parts of the creek, spray programmes targeting Madeira, Wandering Creeper, Mistflower, weed seedlings such as Small-leaved Privet, and other

exotic groundcovers can commence. A buffer zone of 1-2m wide next to the creek should be avoided. See Appendix 5 for rates of control.

- The more mature Madeira vines can then be treated using the scrape and paint method outlined in the following section.
- Where possible areas that contain carpets of Madeira tubers on the forest floor and are accessible should be sprayed before scraping the vines. This will ensure that a large proportion of the tubers occupying the floor will be controlled and not be trodden in to re-shoot later. Tubers will need to be collected and either deposited at a compost site away from the creek or if possible taken off site to be disposed of. **NB.** Vines should not be cut and it is essential that all Madeira areas be regularly followed up to avoid quick reinfestation of this rapidly growing plant.
- Hand weed Mist Flower and other weeds from the immediate creek zone to at least 1m past the edge, and from around rock pools, native seedlings and ferns in this zone. Ensure they are hung up off the ground to avoid re-shooting or if it is Wandering Creeper place it off the ground away from the waters edge.
- Control other weed vines by cutting them off host trees at head height leaving the stems in the canopy to dry out and fall over time.
- Then treat the base of the plant by either the C-S-P method, hand-pulling though care will need to be taken on the steeper more unstable slopes, or by crowning. Weeds likely to be encountered at this stage of the regeneration project, is Climbing Asparagus Fern, Edible Passionfruit and White Passionflower. The method of control will depend on the root system of the plant and the stability of the slope. See the Appendix 5, Treatment Methods for Weeds, for more detail.
- Continue along the riparian strip conducting primary works as above and carrying out spray maintenance always consolidating on previous works until the end of the zone is reached.
- Once the lower stratas in this zone have been stabilised, the stem injection of the larger Small-leaved Privets and some of the Camphor Laurels surrounding the weir can commence. Start by injecting those next to native trees. This will ensure that light levels are kept stable and that maintenance regimes are manageable.
- Continue follow-up spraying

6.2.2 Zone 2

- Work from the edges of Zone 1 in 10m strips following the line of the creek in a northerly direction. The control of Madeira Vine is always a priority. As infestations are encountered, prepare the area by first spraying the ground if possible and then cutting away other weed species and in some cases pruning native vines, so access to vines for scraping is made possible. **NB.** Many Madeira tubers litter the ground throughout this zone and control will sometimes be a challenge amongst patches of *Callamus* (Wait-a-while)
- Control Madeira vines by scraping as much stem as possible in 1m lengths on alternate sides & painting it with 100% glyphosate. Larger tubers in the ground should be gouged and painted. Bag tubers and dispose/compost.
- The spraying of previous zones and the ground weeds in this zone should continue in conjunction with primary works.
- Continue to work through the zone in 10m strips using the already worked area as the line to follow.
- C-S-P woody weeds such as Lantana, Smooth Senna, Tobacco Bush and Small-leaved Privet, leaving cut pieces on the ground to compost. Suspending larger pieces of Lantana and Small-leaved Privet will reduce the amount of weeds re-shooting. Leave the larger specimens of Privet species to stem inject at a later date.
- At the same time control any weed vines encountered such as White Passionflower and Climbing Asparagus Fern.

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- Work from the edge of the forest into the edges of the gap dominated by Lantana on the western side of the zone (Figure 2). Cut the Lantana away from the edge of the forest and from Madeira vines. Ensure a gap of two metres is left between the forest and the Lantana gap to allow for access and further weed control. This large forest gap can be gradually over-sprayed to allow for easier maintenance of the area.
- Manually weed any exotic groundcovers such as Mist Flower from areas dense in native seedlings or ferns. Hang plants off the ground to avoid them re-shooting.
- Stem-inject woody weeds above three metres in height. Start with those specimens that are next to native trees or those larger specimens of Small-leaved Privet that are under existing canopy. Isolated specimens of Small-leaved Privet can be left until later when other native species have germinated.
- Before moving onto Zone 3 it is essential that all areas have been stabilised in terms of weed growth, germination of weed seedlings and in particular the areas dominated by Madeira Vine.
- Professional regenerators will need to be contracted for all activities. Ensure all works are documented on the Daily Record Sheets and that monitoring and evaluation continues.

NB. A number of threatened species occur in this zone and care must be taken at all times when working around these species.

6.2.3 Zone 3

- Work should follow the already worked area of Zone 1 on the eastern side of the creek (refer to site map Figure 2 for clarification of zones).
- Primary works in this zone should include the control of woody weeds below 3m using the C-S-P method and the control of Madeira Vines using the scrape and paint method. Bag tubers and dispose.
- Continue with follow up spraying in all previously worked zones as well as those areas almost completely dominated by Madeira Vine that are now accessible.
- An area approximately 50+m upstream from the weir, 70m in length and width falls into this category. Major spray programmes will need to be applied to control this infestation. See Appendix 5 for rates of control.
- Larger areas dominated by Lantana can be over-sprayed where it is safe to do so. This will reduce the amount of labour required to control this weed whilst retaining habitat for many species.
- Hand-weed exotic groundcovers amongst ferns, along watercourses and where the germination of native seedlings is dense.
- Continue spray regime controlling Madeira Vine and weedy groundcovers such as *Tradescantia*, Mist Flower, Blue Billygoat Weed, Crofton Weed and Broad-leaved Paspalum. At the same time, spot spray those weeds that have re-shot.
- Systematically stem-inject larger woody weeds in this zone once works have stabilised. Start with those weed trees that are situated next to native trees.
- Continue with spray maintenance and documenting all works on a Daily Record Sheet.
- Carry out regular monitoring and evaluation according to the guidelines in Section 8.

6.2.4 Zone 4

- Work from the weir following the creek to the southern boundary controlling weeds to 3m either side of the creek.
- Cut tracks through the Lantana from either the creek or the edges around the weir to access Madeira Vine infestations. In some outbreaks, vines reach the canopy and require control using the scrape and paint method outlined in the table below. Bag the tubers.
- Spot spray ground infestations of Madeira Vine as well as other groundcovers such as *Tradescantia*, Mistflower and *Ageratum*. In the more open area directly to the east of the weir where it is very wet, spray weedy groundcovers with a rate of 100:1 and no

surfactant to ensure the health of amphibians is maintained. Some preparation of hand weeding maybe required around native sedges in this soak.

- Hand weed Mist Flower and other weeds from the immediate creek zone to at least 1m past the edge of the water, and from around seedlings and ferns in this zone. Ensure they are hung up off the ground to avoid re-shooting or if it is *Tradescantia* place it off the ground away from the waters edge and flood zone.
- Work this zone in 5-10m strips moving out from the line created down the creek. Control woody weeds such as Camphor Laurel, Small-leaved Privet and Smooth Senna using the C-S-P method. Suspend larger stems of Lantana and Small-leaved Privet off the ground.
- Some pruning of native vines is required as they are out-competing regenerating species. See the section on habitat considerations before undertaking this task.
- Continue to maintain this zone with follow up spraying paying particular attention to Madeira Vine tubers and Wandering Creeper (*Tradescantia*).
- Systematically stem-inject larger woody weeds such as Camphor Laurel once the zone has been stabilised.
- Ensure all documentation is carried out including additional threatened species that may have been encountered and additions to species lists.
- Carry out regular monitoring and evaluation.

6.2.5 Zone 5

- Continue working in 5-10m strips up the creek to the northern boundary following the regenerating area of Zone 1b on either side of the creek.
- Spot spray Madeira Vine, Wandering Creeper, weed seedlings and exotic groundcovers as work progresses, and where possible prior to controlling woody weeds using the C-S-P method. See Appendix 5 for the rates of control.
- Continue working in strips until both the eastern and western boundaries of Zone 6 is met.
- Stem-inject larger woody weeds according to the recommendations outlined in previous zones.
- Continue with spray maintenance and documenting all works on a Daily Record Sheet.
- Carry out regular monitoring and evaluation according to the guidelines set out in Section

6.2.6 Zone 6

This zone has not been surveyed but it is anticipated that if work reaches these outer zones that it should continue by working from the areas of regenerating bush towards the outer edges. This is probably best achieved by working the smaller areas in the southern portion of the site before moving onto the northern sections. It is also suggested that any infestations of Madeira Vine be targeted and that the understorey be controlled of weeds before attempting to control those larger weeds in the canopy.

6.3 Additional Recommendations

- Liase with Ballina Shire Council and the Big Scrub Rainforest Landcare Group to assist in acquiring further funding. This would enable a more comprehensive management plan of the site and surrounding area to be done and greatly assist restoration works, as the rehabilitation of this site is a long-term project.
- Liase with surrounding landowners so access to the site at various points can be obtained. Workers are to check their boots for tubers before walking off site to prevent infestation to other areas.

7. Estimated Costs and Timeframe of Works

Table 2: Estimated costs and timeframe of works

Task	Grant Amount \$	Inkind Amount \$	Number of Person days	TimeLine (to be completed by)
Monitoring and Evaluation	386		1.8	Jan 2005
Bush Regeneration				
• Primary Weed Control	5786		28	Dec 2004
• Secondary Weed Control	1543		7.4	Jan 2005
• Maintenance Weed Control				
Revegetation works				
Fencing				
Training & Skills development				

8. Monitoring and Evaluation

Three types of monitoring and evaluation will be occurring during restoration, including photo points, transects and daily record sheets. A number of photo points will need to be set up to document 'before and after shots'.

Thirty metre transect belts will be set up to scientifically document the changes in vegetation and its structure over time. Data will be taken before rehabilitation works begin and at 6 monthly intervals. Information gained will include individual species occurring below 1 metre in height, those occurring between 1-3 metres, species above 3m in height, the projected foliage cover according to Specht's system of classification (1970), and the percentage ratio of weeds to natives on the forest floor.

Daily record sheets will also be filled out at the end of each working day. Information recorded will include the date, personnel, weather conditions, weeds controlled, methods, herbicide, amounts and rates used, any evidence of fauna, threatened species and works that were carried out around or near them, and any other observations. A mud map of the site will be on the reverse side of the page and the area worked that day will be highlighted (see Figure 3 below). See Appendix 6 for Daily Record Sheet.

9. Conclusion

This Action Plan provides practical guidelines for the restoration of the vegetation communities at Duck Creek near Alstonville. The plan provides information on the condition of native vegetation and associated habitat values at the site. Details of restoration techniques and the control of weed species are provided. The site has been divided into work zones and a systematic program for regeneration works is detailed for these areas. Recommendations are made for the long-term regeneration of the native vegetation. An estimated cost and timeframe for works is provided. A program of monitoring and evaluation is detailed.

The Duck Creek site displays excellent resilience, contains a great diversity of native plant species from all age classes, threatened species, and is connected to other areas of high conservation value via the creek.

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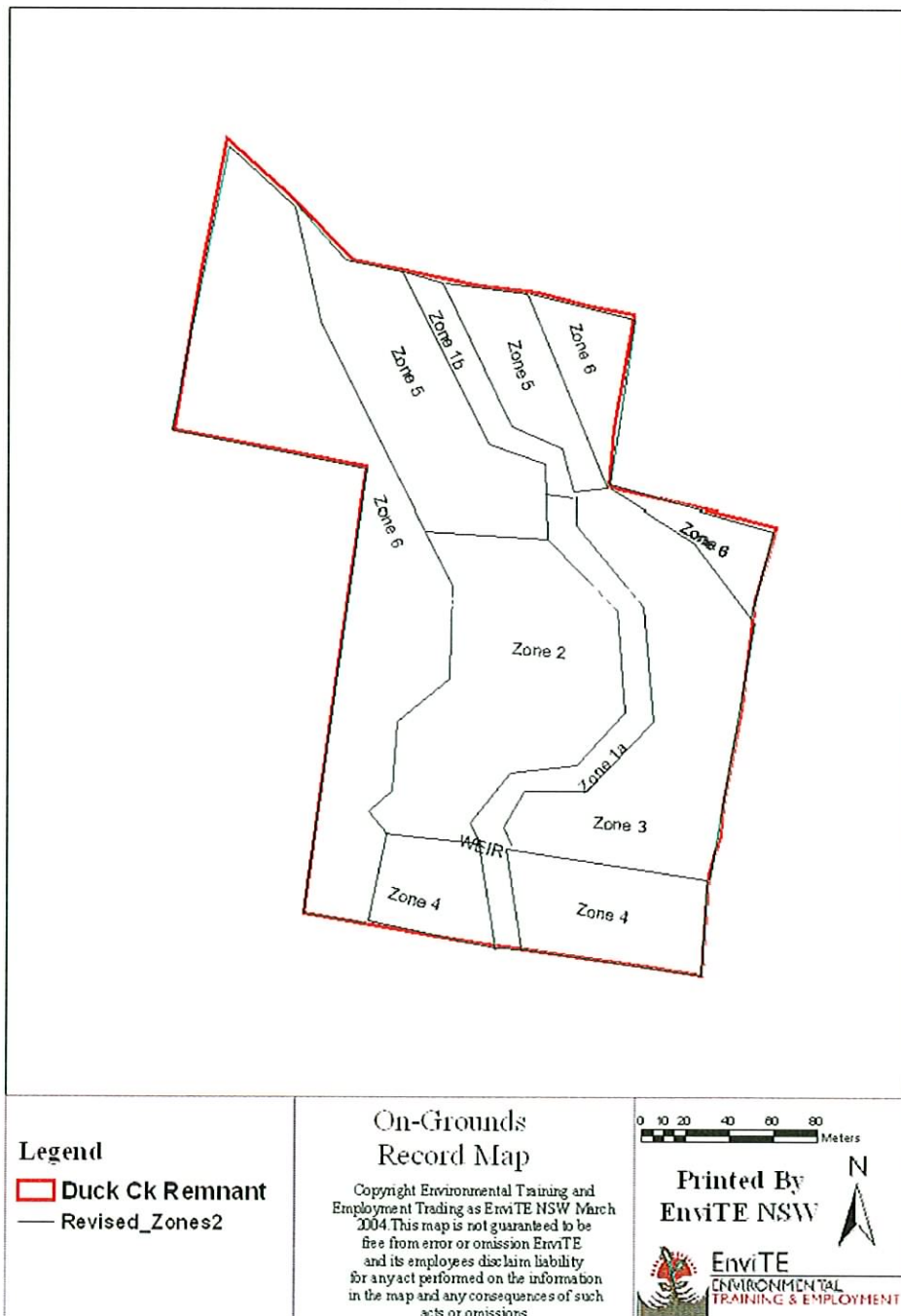
If degradation is halted and sensitive regeneration is implemented and maintained, positive environmental outcomes will include:

- the conservation of Big Scrub rainforest in a landscape dominated by agricultural land,
- improved habitat for migratory and resident fauna species especially those already listed as threatened and,
- improving the general amenity of the area for recreational, aesthetic and educational purposes.

This will be a long-term process involving intensive weed control and will often be a balance between primary and secondary works. The less intensive secondary weed control that follows will need to be incorporated with regular monitoring and follow up treatment on a permanent basis.

Figure 3: On-ground Work recording map for Duck Creek remnant

Duck Creek (Reserve) Remnant



10. References

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Appendix 1: Native Plant Species List

Trees and Shrubs

FAMILY	Botanical name	Common Name
AKANIACEAE	<i>Akania bidwillii</i>	Turnipwood
ALANGIACEAE	<i>Alangium villosum</i> subsp. <i>polyosmoides</i>	Muskwood
ANACARDIACEAE	<i>Euroschinus falcata</i> var. <i>falcata</i>	Ribbonwood
APOCYNACEAE	<i>Alyxia ruscifolia</i>	Prickly Alyxia
APOCYNACEAE	<i>Tabernaemontana pandacaqui</i>	Banana Bush
ARALIACEAE	<i>Polyscias elegans</i>	Celery Wood
ARECACEAE	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm
ASTELIACEAE	<i>Cordyline rubra</i>	Red-fruited Palm Lily
BORAGINACEAE	<i>Ehretia acuminata</i>	Koda
CAPPARACEAE	<i>Capparis arborea</i>	Brush Caper Berry
EBENACEAE	<i>Diospyros pentamera</i>	Myrtle Ebony
ELAEOCARPACEAE	<i>Elaeocarpus angustifolius</i>	Blue Quandong
ELAEOCARPACEAE	<i>Elaeocarpus obovatus</i>	Hard Quandong
ELAEOCARPACEAE	<i>Sloanea australis</i>	Maiden's Blush
ELAEOCARPACEAE	<i>Sloanea woollsi</i>	Yellow Carabeen
EUPHORBIACEAE	<i>Actephila lindleyi</i>	Actephila
EUPHORBIACEAE	<i>Baloghia inophylla</i>	Scrub Bloodwood
EUPHORBIACEAE	<i>Briedelia exaltata</i>	Scrub Ironbark
EUPHORBIACEAE	<i>Cleistanthus cunninghamii</i>	Cleistanthus
EUPHORBIACEAE	<i>Glochidion ferdinandi</i>	Cheese Tree
EUPHORBIACEAE	<i>Mallotus discolor</i>	Yellow Kamala
EUPHORBIACEAE	<i>Mallotus philippensis</i>	Red Kamala
EUPOMATIACEAE	<i>Eupomatia bennettii</i>	Small Bolwarra
EUPOMATIACEAE	<i>Eupomatia laurina</i>	Bolwarra
FABACEAE	<i>Castanospermum australe</i>	Black Bean
FLACOURTIACEAE	<i>Scolopia braunii</i>	Flintwood
LAURACEAE	<i>Beilschmedia elliptica</i>	Grey Walnut
LAURACEAE	<i>Cinnamomum oliveri</i>	Oliver's Sassafras
LAURACEAE	<i>Cinnamomum virens</i>	Red-barked Sassafras
LAURACEAE	<i>Cryptocarya glaucescens</i>	Jackwood
LAURACEAE	<i>Cryptocarya micronuera</i>	Murrogun
LAURACEAE	<i>Cryptocarya obovata</i>	Pepperberry
LAURACEAE	<i>Endiandra pubens</i>	Hairy Walnut
LAURACEAE	<i>Litsea australis</i>	Brown Bolly Gum
LAURACEAE	<i>Neolitsea australiensis</i>	Green Bolly Gum
LAURACEAE	<i>Neolitsea dealbata</i>	White Bolly Gum
MELIACEAE	<i>Anthocarapa nitidula</i>	Incense Cedar
MELIACEAE	<i>Dysoxylum fraserianum</i>	Rosewood
MELIACEAE	<i>Dysoxylum mollissimum</i>	Red Bean
MELIACEAE	<i>Dysoxylum rufum</i>	Hairy Rosewood
MELIACEAE	<i>Melia azedarach</i> var. <i>australasica</i>	White Cedar
MELIACEAE	<i>Toona ciliata</i>	Red Cedar
MIMOSACEAE	<i>Acacia melanoxylon</i>	Sally Wattle
MIMOSACEAE	<i>Pararchidendron pruinosum</i> var. <i>pruinosum</i>	Snow-wood
MONIMIACEAE	<i>Daphnandra</i> sp. A	Socketwood
MONIMIACEAE	<i>Wilkiea huegeliana</i>	Veiny Wilkiea
MONIMIACEAE	<i>Wilkiea macrophylla</i>	Large-leaved Wilkiea
MORACEAE	<i>Ficus coronata</i>	Creek Sandpaper Fig

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MORACEAE	<i>Ficus fraseri</i>	White Sandpaper Fig
MORACEAE	<i>Ficus watkinsiana</i>	Strangler Fig
MORACEAE	<i>Stebulus brunonianus</i>	Whalebone Tree
MYRTACEAE	<i>Acmena ingens</i>	Red Apple
MYRTACEAE	<i>Acmena smithii</i>	Lilly Pilly
MYRTACEAE	<i>Austromyrtus bidwillii</i>	Python Tree
MYRTACEAE	<i>Pilidiostigma glabrum</i>	Plum Myrtle
MYRTACEAE	<i>Rhodamnia rubescens</i>	Scrub Turpentine
MYRTACEAE	<i>Rhodomyrtus psidioides</i>	Native Guava
MYRTACEAE	<i>Syzygium australe</i>	Scrub Cherry
MYRTACEAE	<i>Syzygium francisii</i>	Giant Water Gum
MYRTACEAE	<i>Syzygium hodgkinsoniae</i>	Red-fruited Lilly Pilly
OLEACEAE	<i>Notelaea johnsonii</i>	Veinless Mock Olive
PITTOSPORACEAE	<i>Hymenospermum flavum</i>	Native Frangipani
PITTOSPORACEAE	<i>Pittosporum multiflorum</i>	Orange Thorn
PITTOSPORACEAE	<i>Pittosporum undulatum</i>	Sweet Pittosporum
PROTEACEAE	<i>Floydia praealta</i>	Ball Nut
PROTEACEAE	<i>Grevillea robusta</i>	Silky Oak
PROTEACEAE	<i>Helicia glabriflora</i>	Smooth Helicia
PROTEACEAE	<i>Macadamia tetraphylla</i>	Macadamia Nut
PROTEACEAE	<i>Stenocarpus sinuatus</i>	Fire Wheel Tree
PROTEACEAE	<i>Triunia youngiana</i>	Honeysuckle Bush
RHAMNANCEAE	<i>Alphitonia excelsa</i>	Red Ash
RUBIACEAE	<i>Atractocarpus chartaceus</i>	Narrow-leaved Gardenia
RUBIACEAE	<i>Canthium coprosmidis</i>	Coast Canthium
RUTACEAE	<i>Flindersia australis</i>	Teak
RUTACEAE	<i>Flindersia schottiana</i>	Cudgerie
RUTACEAE	<i>Pentacerus australis</i>	Crows Ash
RUTACEAE	<i>Melicope micrococca</i>	Hairy-leaved Doughwood
RUTACEAE	<i>Pentacerus australis</i>	Crows Ash
RUTACEAE	<i>Sarcomelicope simplicifolia</i> subsp. <i>simplicifolia</i>	Bauerella
SAPINDACEAE	<i>Arytera distylis</i>	Twin-leaved Coogera
SAPINDACEAE	<i>Diploglottis australis</i>	Native Tamarind
SAPINDACEAE	<i>Ellatostachys nervosa</i>	Green Tamarind
SAPINDACEAE	<i>Guioa semiglauca</i>	Guioa
SAPINDACEAE	<i>Harpullia alata</i>	Wing-leaved Tulip
SAPINDACEAE	<i>Jagera pseudorhus</i> var. <i>pseudorhus</i>	Foambark Tree
SAPINDACEAE	<i>Mischocarpus pyriformis</i>	Yellow Pear-fruit
SAPINDACEAE	<i>Sarcopterix stipata</i>	Steelwood
SAPINDACEAE	<i>Toechime dasyrrhache</i>	Blunt-leaved Steelwood
SAPOTACEAE	<i>Pouteria australis</i>	Black Apple
SOLANACEAE	<i>Duboisia myoporoides</i>	Soft Corkwood
STERCULIACEAE	<i>Brachychiton acerifolius</i>	Flame Tree
STERCULIACEAE	<i>Commersonia batramia</i>	Brown Kurrajong
STERCULIACEAE	<i>Heritiera trifoliolata</i>	White Booyong
THYMELIACEAE	<i>Wikstroemia indica</i>	Wikstroemia
ULMACEAE	<i>Trema tomentosa</i>	Native Peach
URTICACEAE	<i>Dendrocide excelsa</i>	Giant Stinging Tree
URTICACEAE	<i>Dendrocide photinophylla</i>	Shining-leaved Stinging Tree
VERBEBACEAE	<i>Clerodendrum floribundum</i>	Smooth Clerodendrum
VERBENACEAE	<i>Gmelina leichhardii</i>	White Beech

Vines and Climbers

FAMILY	Botanical name	Common Name
APOCYNACEAE	<i>Parsonsia straminea</i>	Common Silkpod
ARACEAE	<i>Pothos longipes</i>	Pothos
ARECACEAE	<i>Calamus muelleri</i>	Lawyer Vine
ARISTOLOCHIACEAE	<i>Pararistolochia praevensa</i>	Aristolochia
BIGNONIACEAE	<i>Pandorea jasminoides</i>	Bower Vine
BIGNONIACEAE	<i>Pandorea pandorana</i>	Wonga Vine
CAESALPINIACEAE	<i>Caesalpinia scortechinii</i>	Large Prickle Vine
CAESALPINIACEAE	<i>Caesalpinia subtropica</i>	Corky Prickle Vine
CELASTRACEAE	<i>Hippocraetia barbata</i>	Knot Vine
CUCURBITACEAE	<i>Diplocyclos palmatus</i>	Native Bryony
DILLENACEAE	<i>Hibbertia scandens</i>	Twining Guinea Flower
DIOSCOREACEAE	<i>Dioscorea transversa</i>	Native Yam
FABACEAE	<i>Austrosteenisia glabristyla</i>	Giant Blood Vine
FABACEAE	<i>Derris involuta</i>	Native Derris
FABACEAE	<i>Millettia megasperma</i>	Native Wistaria
FLAGELLARIACEAE	<i>Flagellaria indica</i>	Whip Vine
LAZURIAGACEAE	<i>Geitonoplesium cymosum</i>	Scrambling Lily
MENISPERMACEAE	<i>Legnephora moorei</i>	Round-leaf Vine
MENISPERMACEAE	<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine
MENISPERMACEAE	<i>Tinospora tinosporoides</i>	Arrow-head Vine
MORACEAE	<i>Maclura cochinchinensis</i>	Cockspur Thorn
MORACEAE	<i>Trophis scandens</i>	Burny Vine
MYRSINACEAE	<i>Embelia australiana</i>	Embelia
PIPERACEAE	<i>Piper nova-hollandiae</i>	Giant Pepper Vine
RIPOGONACEAE	<i>Ripogonum album</i>	White Supplejack
RIPOGONACEAE	<i>Ripogonum discolor</i>	Prickly Supplejack
ROSACEAE	<i>Rubus moluccanus</i>	Molucca bramble
ROSACEAE	<i>Rubus rosifolius</i>	Rose-leaf Bramble
SMILACACEAE	<i>Smilax australis</i>	Austral Sarsaparilla
VITACEAE	<i>Cayratia clematidea</i>	Slender Grape
VITACEAE	<i>Cissus antarctica</i>	Water Vine
VITACEAE	<i>Cissus hypoglauca</i>	Five-leaf Water Vine
VITACEAE	<i>Tetrastigma nitens</i>	Three-leaf Water Vine

Ferns, Grasses and Groundcovers

FAMILY	Botanical name	Common Name
ACANTHACEAE	<i>Pseuderantherum variabile</i>	Pastel Flower
ADIANTACEAE	<i>Adiantum aethiopicum</i>	Common Maidenhair
ADIANTACEAE	<i>Adiantum hispidulum</i>	Rough Maidenhair
APIACEAE	<i>Centella asiatica</i>	A Pennywort
APIACEAE	<i>Hydrocotyle acutiloba</i>	A Pennywort
ARACEAE	<i>Alocasia brisbanensis</i>	Cunjevoi
ASPENIACEAE	<i>Asplenium australasicum</i>	Bird's Nest Fern
ASTERACEAE	<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>	Indian Weed
BLECHNACEAE	<i>Doodia aspera</i>	Rasp Fern
BLECHNACEAE	<i>Doodia caudata</i>	Small Rasp Fern
CARYOPHYLLACEAE	<i>Drymaria cordata</i>	Tropical Chickweed
COMMELINACEAE	<i>Commelina cyanea</i>	Commelina
COMMELINACEAE	<i>Pollia crispata</i>	Pollia
CONVOLVULACEAE	<i>Dichondra repens</i>	Kidney Weed
CYATHEACEAE	<i>Cyathea australis</i>	Rough Tree Fern
CYATHEACEAE	<i>Cyathea cooperi</i>	Straw Tree Fern

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CYATHEACEAE	<i>Cyathea leichhardtiana</i>	Prickly Tree Fern
CYPERACEAE	<i>Carex inversa</i>	Knob Sedge
CYPERACEAE	<i>Gahnia aspera</i>	Saw-sedge
DAVALLIACEAE	<i>Arthropteris tenella</i>	Climbing Fishbone Fern
DENNSTAEDTIACEAE	<i>Pteridium esculentum</i>	Bracken
DRYOPTERIDACEAE	<i>Lastreopsis marginans</i>	Bordered Shield Fern
DRYOPTERIDACEAE	<i>Lastreopsis munita</i>	Naked Shield Fern
GERANIACEAE	<i>Geranium solanderi</i>	Native Geranium
LAMIACEAE	<i>Plectranthus parviflorus</i>	Few-flowered Plectranthus
LOMANDRACEAE	<i>Lomandra spicata</i>	Rainforest Mat-rush
PHORMIACEAE	<i>Dianella caerulea</i>	Blue Flax Lily
POACEAE	<i>Opismenus aemulus</i>	Basket Grass
POACEAE	<i>Opismenus imbecillis</i>	Basket Grass
POLYPODIACEAE	<i>Platynerium bifurcatum</i> subsp. <i>bifurcatum</i>	Elkhorn
POLYPODIACEAE	<i>Platynerium superbum</i>	Staghorn
ZINGIBERACEAE	<i>Alpinia caerulea</i>	Native Ginger

Appendix 2: Weed Species at Duck Creek

Trees and Shrubs

FAMILY	Botanical name	Common Name
ASTERACEAE	* <i>Baccharis halimifolia</i>	Groundsel Bush
CAESALPINIACEAE	* <i>Senna septemtrionalis</i>	Smooth Senna
LAURACEAE	* <i>Cinnamomum camphora</i>	Camphor Laurel
OCHNACEAE	* <i>Ochna serrulata</i>	Ochna
OLEACEAE	* <i>Ligustrum lucidum</i>	Large-leaved Privet
OLEACEAE	* <i>Ligustrum sinense</i>	Small-leaved Privet
SOLANACEAE	* <i>Solanum mauritianum</i>	Tobacco Bush
VERBENACEAE	* <i>Lantana camara</i>	Lantana

Vines

ASPARAGACEAE	* <i>Protasparagus plumosus</i>	Climbing Asparagus
BASELLACEAE	* <i>Anredera cordifolia</i>	Maidera Vine
PASSIFLORACEAE	* <i>Passiflora edulis</i>	Edible Passionfruit
PASSIFLORACEAE	* <i>Passiflora subpeltata</i>	White Passionflower

Herbs, Ferns and Groundcovers

FAMILY	Botanical name	Common Name
ARACEAE	* <i>Xanthosoma violaceum</i>	Blue Taro
ASTERACEAE	* <i>Ageratina adenophora</i>	Crofton Weed
ASTERACEAE	* <i>Ageratina riparia</i>	Mistflower
ASTERACEAE	* <i>Ageratum houstonianum</i>	Blue Billygoat Weed
ASTERACEAE	* <i>Ambrosia artemisiifolia</i>	Annual Ragweed
ASTERACEAE	* <i>Bidens pilosa</i>	Cobbler's Pegs
ASTERACEAE	* <i>Crassocephalum crepidioides</i>	Thickhead
ASTERACEAE	* <i>Senecio madagascariensis</i>	Fireweed
CARYOPHYLLACEAE	* <i>Stellaria media</i>	Chickweed
COMMELINACEAE	* <i>Tradescantia fluminensis</i>	Wandering Creeper
MALVACEAE	* <i>Sida rhombifolia</i>	Paddy's Lucerne
OXALIDACEAE	* <i>Oxalis debilis var. corymbosa</i>	Oxalis
PHYTOLACCACEAE	* <i>Phytolacca octandra</i>	Inkweed
POACEAE	* <i>Chloris gayana</i>	Rhodes Grass
POACEAE	* <i>Paspalum wettsteinii</i>	Broad-leaved Paspalum
SOLANACEAE	* <i>Solanum capsicoides</i>	Devil's Apple
SOLANACEAE	* <i>Solanum nigrum</i>	Black-berry Nightshade
VERBENACEAE	* <i>Verbena bonariensis</i>	Purpletop

Appendix 3: Weed Profiles for Duck Creek

This appendix provides profiles of significant weed occurring at the Duck Creek study site.

TREES & SHRUBS

Asteraceae

Baccharis halimifolia

Groundsel Bush

Native of E. North America. Perennial shrub 1-6 metres high, grows in swampy areas near the sea, often behind mangroves (Harden, 1992, 200). It has the ability to form impenetrable thickets (Auld & Medd, 1992, 85). A declared W2 noxious weed for the Far North Coast of N.S.W. (W2 weeds must be continuously suppressed and destroyed).

Erythrina x sykesii

Coral Tree

Hybrid probably from New Zealand. A tree to 15 metres high which does not set fruit. It readily grows from old stumps and cuttings (Harden, 1991, 414). Its bulk displaces native vegetation. Often found on stream banks and spreads through floating fallen branches.

Lauraceae

Cinnamomum camphora

Camphor Laurel

Native of China and Japan. A large tree of spreading habit that can grow to approximately 25-30 metres. It has abundant seed production, effective dispersal mechanism, mainly by birds, and some seed dormancy. It is a hardy, long-living competitive tree which can also reproduce rapidly by suckering to form single species stands. Camphor Laurel prefers deep, well-drained red soil but will grow well on alluvial soil; it cannot, however, tolerate prolonged flooding (Firth, 1992, p.69). It is extensively naturalized in coastal areas on the North Coast of NSW (Harden, 1990, p.144). It is a declared W4(d) noxious weed (i.e. must not be sold, propagated or knowingly distributed and must be fully and continuously suppressed and destroyed).

Ochnaceae

Ochna serrulata

Mickey Mouse Bush

Shrub two to three metres high. Leaves oblong to narrow elliptic, margins toothed. Ovoid drupes, five to eight millimetres long, black and embedded on a swollen red receptacle. Often cultivated. Native of South Africa (Harden, 1990, p. 490).

Oleaceae

Ligustrum lucidum

Large-leaved Privet

Native of China and Japan. A shrub to small tree up to 10 metres high which is an invasive weed, especially of coastal rainforests (Harden, 1992, 473). It is adapted to low light levels, coppices readily when damaged and has a mass of fibrous roots near the surface of the ground, these roots efficiently utilize the available moisture and nutrients in the soil to the detriment of any nearby plant. Each mature plant can produce from 10,000 to 100,000.00 seeds, which have a 1-2 year viability and are effectively spread by birds (Buchanan, 1989, 67-68).

Ligustrum. sinense

Small-leaved Privet

native of China a shrub to about 3 metres high. An invasive weed, especially on the margins of rainforest (Harden, 1992, 471). It is adapted to low light levels, coppices and suckers readily and has a mass of fibrous roots near the surface of the ground. These roots efficiently utilize the available moisture and nutrients in the soil to the detriment of any nearby plant. It can form thickets within the forest. Each plant can produce approximately 600 seedlings per square metre and seeds are effectively dispersed by birds (Buchanan, 1989, 67).

Solanum mauritianum

Wild Tobacco

A shrub or small tree up to 4 metres high, widely naturalized in rainforest regrowth (Harden, 1992, 359). Its fruit are dispersed by birds. In areas of higher light levels it can form thick stands displacing native species by competing for water, space and nutrients.

Verbenaceae

Lantana camara

Lantana

Native of tropical South America. A scrambling shrub that often forms dense thickets (Harden, 1992, p.614) and can climb over 20 metres into trees. It grows best on well-drained, fertile soils including nutrient-enriched sands; roots also develop on branches that contact the ground, aiding its spread. It produces abundant seed, which is effectively dispersed by birds. According to Richard Lamb of Sydney University, when Lantana is present, particularly in sclerophyll communities, litter fall and nutrient turnover is altered, populations of native seeds are depleted, new seedlings are suppressed, soil structure is altered and micro-climate is changed, and some nutrients may be mobilized and lost to neighboring communities and others accumulated in unnatural amounts. These changed conditions seem to further favour Lantana and other weeds over native species (Buchanan, 1989, p.72) and in many forest areas can block secondary succession. It is a declared W3 noxious weed (i.e. must be prevented from spreading and its numbers reduced).

VINES & SCRAMBLERS

Asparagaceae

Protasparagus plumosus

Climbing Asparagus

Perennial vine with wiry stem. It is a serious bushland weed once established. Difficult to eradicate; occurs on rainforest margins and tolerates low light conditions; tolerates various soils. Flowers are greenish white; solitary or paired; which flower in spring and summer. Fruit/seeds are black berries which fruit in June, and are dispersed by birds, ants, water, and rubbish dumping. Seeds are germinated readily. Broken rhizomes regrow, and are found underground, roots are fibrous (The Big Scrub Rainforest Landcare Group, 2000)

Passifloraceae

Passiflora edulis

Edible Passionfruit

Native of America. A climber which is often naturalized on the edge of rainforest and moist gullies (Harden, 1990, 434). This plant bears heavy fruit whose seeds are readily dispersed by birds and animals. Its foliage cover inhibits photosynthesis of supporting plants, which can also be damaged by its weight.

Passiflora subpeltata

White Passionflower

Native of Brazil. A climber which is a widespread weed along the coast on margins of rainforest and moist gullies (Harden, 1990, 435). Its foliage cover inhibits photosynthesis of supporting plants, which can also be damaged by its weight. Its seed is dispersed by birds and animals.

HERBS, FERNS AND GRASSES

Asteraceae

Ageratina adenophora

Crofton Weed

Native of Mexico. Erect, perennial, branched herb up to 1-2 metres high, growing in disturbed moist sites on fertile soils (Harden, 1992, 151). Its seeds are dispersed mainly by wind, it can form a dense cover inhibiting and sometimes preventing natural native regeneration. A declared Category 3 noxious weed in the Far North Coast of N.S.W. (W3 - weed must be prevented from spreading and its numbers and distribution reduced).

Ageratina riparia

Mistflower

Native of Mexico. Erect, perennial, sometimes decumbent herb, 0.3-1 metres high. Grows in disturbed damp sites, often in or near rainforests (Harden, 1992, 151). Its seeds are dispersed mainly by wind, and vegetative fragments can carry downstream. It can form a dense cover, inhibiting and sometimes preventing natural native regeneration. A declared Category 3 noxious weed in the Far North Coast of N.S.W. (see *a. adenophora*).

Ageratum houstonianum

Blue Billy Goat Weed

Native of Mexico. Common weed of wasteland north of Sydney. Erect or decumbent branched herb, 0.3-1 metre high, coarsely hairy or nearly glabrous. Leaves ovate to triangular, two to seven centimetres long. Margins are regularly toothed and both surfaces have scattered hairs. Florets are blue-mauve (Harden, 1992, p.150).

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Commelinaceae

Tradescantia fluminensis (albiflora)

Wandering Jew

Native of S. America. A perennial succulent herb with fibrous roots and branching stems which readily take root at the nodes. It is naturalized on creek banks and in shaded places, especially rainforests (Harden, 1993, 257). Its resistance to herbicide and its growth habit make this plant difficult to eradicate. This dense groundcover suppresses the germination and growth of native species, thereby blocking secondary succession. It has been observed, however, that those species whose seed is large can penetrate and grow well e.g. Black Bean.

Poaceae

Paspalum wettsteinii

Broad-leaved Paspalum

Native of America. A naturalized, tufted perennial grass (Harden, 1993, 467).

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Source: adapted from Joseph, R. 1995. *Rainforest Remnants Restoration and Rehabilitation Project Incorporating Plant Pest Species Survey and Prior Works Documentation: Boatharbour Nature Reserve*. NSW National Parks and Wildlife Service, Alstonville.

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Appendix 4: Weed Treatment Methods

1. “Cut-scrape-paint”: this method applies to all woody shrubs, trees and some vines.
 - (a) Cut plant low to the ground at an angle.
 - (b) Apply Glyphosate immediately at the rate of 1 part Glyphosate: 1.5 parts water, with a paintbrush approximately 1.5 centimetres wide.
 - (c) Scrape sides lightly to reveal green tissue and apply the herbicide to the scraped area.
 - (d) Take care that the brush is not contaminated with soil.

Note: all seed that has high viability and longevity, e.g. *Senna* spp. and other members of the Fabaceae family, or plants with a high invasive potential, such as *Schefflera actinophylla*, must be removed from the parent and either composted on site or removed from the site.
2. “Gouge-paint”: this method applies to those plant species that have a fleshy root system, such as rhizomes or large bulbs. It is particularly appropriate for the treatment of *Protasparagus* spp. (*Asparagus*).
 - (a) Gouge out sections of the fleshy base with a knife (if using on *Asparagus*, first cut the stems at shoulder height and also at the base).
 - (b) Apply 1 part Glyphosate: 1.5 parts water immediately, with a paint brush approximately 1.5 centimetres wide.
3. “Stem Injection”: this method applies to all woody trees and shrubs with a diameter of about six to ten centimetres or greater.
 - (a) With a tomahawk, make a cut the width of the blade, at a slight angle, into the trunk. **Note:** it is important not to make cuts too deep.
 - (b) Apply herbicide immediately into the cut using a tree-injecting device (if using Glyphosate, apply at the rate of 1 part Glyphosate: 1.5 parts water).
 - (c) Repeat this procedure in a brickwork pattern around the circumference of the tree, as close to the ground as possible. Where the presence of a crotch angle makes this difficult, make a cut above it. **Note:** two rows of cuts will be sufficient for trees with trunks of six to ten centimetres; larger trunk diameters will need correspondingly more.
 - (d) Treat all visible lateral roots as per (a).
4. “Scrape-ditch-paint”: this method is applicable to many species of vines where it is desirable to treat the vines intact, particularly those with aerial tubers such as *Anredera corifolia* (Madeira Vine) or those which will propagate from segments, e.g. *Delairia odorata* (Cape Ivy).
 - (a) Scrape the stem tissue on one side of the stem only for at least 20-30 centimetres if possible. **Note:** on Madeira Vine, it is necessary to scrape heavily. Scrape as many sections of the stem as possible.
 - (b) Apply undiluted Glyphosate with a paintbrush.
 - (c) On stems that are thicker or horizontal, make a ditch into the stem with a knife and apply herbicide. Tubers and side roots should be treated the same way. **Note:** care must be taken not to sever the stem.
5. “Spraying”: this is carried out using a 15 litre backpack spray unit with a modified spray nozzle that gives a solid spray pattern. Glyphosate is the main herbicide used with the addition of a marker dye. For plants that show some resistance (e.g. Madeira Vine) or where growing conditions are not optimal, an acidifying agent, such as Protec® is added (in the past LI700® has been used. Protec® is an oil based alternative which is effective and more versatile in its applications), is added. Metsulfuron can also be used for resistant species and grasses. It should be used with a surfactant, such as Protec® (Previously Protec® has been used for this purpose).

Note: where both Glyphosate and Metsulfuron are recommended for a species, it may be possible to use a commercially available compound of these two herbicides. This approach is currently under trial and is not suitable for operators unskilled in precision spraying.

Note: dilution rates for Glyphosate and Metsulfuron are in accordance with the manufacturer’s recommendations and any variation requires a permit from the National Registration Authority.

Dilution Rates (Glyphosate: water):

- Plants with more or less succulent leaves, e.g. *Tradescantia fluminensis*, *Anredera cordifolia* (autumn to winter is the suggested time for spraying these plants), *Chlorophytum* spp. etc.
1 part Glyphosate: 50 parts water + Protec®
- *Lantana camara*
1 part Glyphosate: 100 parts water
- Other soft-leaved plants, annuals and grasses
1 part Glyphosate: 100 parts water

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- *Chrysanthemoides monilifera* subsp. *rotundata*
1 part Glyphosate: 150 – 400 parts water

Dilution Rates (Metsulfuron: water):

- 1.5g Metsulfuron: 10 litres water + Protec®:

6. “Overspray”: this method is applicable to large, dense infestations of such plants as *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Lantana camara* (Lantana), where it is desirable to leave the dead plants intact to prevent erosion and over-exposure of large areas, protect native seedlings from predators such as wallabies, and avoid trampling by humans.

- (a) Spray over the top of the infestation, using a weak solution of Glyphosate. Marker Dye (such as Herbi Dye) is used to indicate sprayed areas.

Note: any native plants that may be under the weed will be protected by the foliage cover of the weed.

- (b) Leave the sprayed plants intact so that native seedlings can establish under the shelter provided.

Note: Lantana – 1 part Glyphosate: 100 parts water

Bitou Bush – 1 part Glyphosate: 150 parts to 400 parts water

Alternatively: weeds can be cut and flattened with bush-hooks or loppers and the subsequent regrowth sprayed with Glyphosate.

Note: in many cases it is preferable to overspray wherever practicable as this will cause less erosion and trampling of suppressed native plants, such as ferns and seedlings. However, handwork will be necessary to “cut-scrape-paint” any unsprayed Bitou Bush or Lantana that surrounds native plants.

7. “Crowning”: this method is applicable to weeds which have their growing points below the surface of the ground (corms, bulbs, rhizomes, clumped or fibrous root systems, etc. e.g.

Protasparagus spp., *Chlorophytum comosum* and grasses).

- (a) Grasp the leaves or stems and hold them tightly so that the base of the plant is visible. Plants with sharp leaves or stems should be cut back first.
- (b) Insert the knife close to the base of the plant at a slight angle, with the tip well under the root system.
- (c) Cut through the roots close to the base. Depending on the size of the plant, two or more cuts may be needed to sever all the roots.
- (d) Remove the plant. Make sure that the base of the plant where the roots begin is completely removed.

Source: adapted from Joseph, R., 2001. *Course Notes from Certificate II in Bushland Regeneration*. TAFE, Wollongbar.

Appendix 5: Treatment Methods for Main Weeds at Duck Creek

Scientific Name	Common Name	Control Method
<i>Ageratina adenophora</i>	Crofton Weed	Spray <i>glyphosate</i> 1:100 + Dye; Hand pull and hang up
<i>Ageratina riparia</i>	Mistflower	Spray <i>glyphosate</i> 1:100 + Dye; Hand pull and hang up
<i>Ageratum houstonianum</i>	Blue Billygoat Weed	Spray <i>glyphosate</i> 1:100 + Dye; Hand pull and hang up
<i>Anredera cordifolia</i>	Madeira Vine	Spray ground infestation & tubers with <i>glyphosate</i> 1:50 + Protec® + dye. Do not cut stem. Scrape as much stem as possible in 1m lengths on alternate sides & paint with 100% <i>glyphosate</i> ; scrape/gouge & paint (100%). Bag tubers
<i>Baccharis halimifolia</i>	Groundsel Bush	Cut, scrape and paint 1:1.5, spray seedlings/regrowth <i>glyphosate</i> 1:50 Protec® + dye
<i>Canna indica</i>	Canna Lily	Spray <i>glyphosate</i> 1:100 + Protec®
<i>Cinnamomum camphora</i>	Camphor Laurel	Cut, scrape and paint 1:1.5. Stem inject large specimens 1:1.5. Spray seedlings <i>glyphosate</i> 1:50 + Protec® + dye.
<i>Erythrina x sykesii</i>	Coral Tree	Stem-inject 1:5 (1 pt. <i>glyphosate</i> : 5 pts water): Best results in Autumn. Do not leave cut pieces on ground. Spray regrowth 1:50 + Protec® + dye.
<i>Lantana camara</i>	Lantana	Lopper and cut, scrape and paint base 1:1.5. Overspray and spot spray <i>glyphosate</i> 1:100 + dye
<i>Ligustrum lucidum</i> <i>Ligustrum sinense</i>	Large-leaved Privet Small-leaved Privet	Stem inject 1:1.5 larger trees; Cut, scrape & paint 1:1.5 small plants. Spray seedlings <i>glyphosate</i> 1:50 + Protec®
<i>Ochna serrulata</i>	Mickey Mouse Bush	Scrape and paint (lightly) 2 sides with straight <i>glyphosate</i> . Spray seedlings <i>glyphosate</i> 1:50 + Protec®. Difficult to pull & will re-grow from broken root. Paint stem on large specimens with neat <i>glyphosate</i> to a height of 50cm.
<i>Passiflora edulis</i>	Edible Passionfruit	Hand pull or cut, scrape & paint 1:1.5. Bag fruits.
<i>Passiflora subpeltata</i>	White Passionflower	Hand pull or cut, scrape & paint 1:1.5. Bag fruits.
<i>Paspalum wettsteinii</i>	Broad-leaved Paspallum	Hand pull or spray <i>glyphosate</i> 1:100 + dye
<i>Protasparagus plumosus</i>	Climbing Asparagus Fern	Crowning, cut stems at head height, then at ground level, spray regrowth <i>glyphosate</i> 1:50 + Protec®
<i>Solanum mauritianum</i>	Tobacco Bush	Cut, scrape and paint , 1:1.5 stem inject larger species
<i>Tradescantia fluminensis</i>	Trad	Spray with <i>glyphosate</i> at 1:50 + Protec® +Dye: handweed and compost off site ensuring all segments are removed. For best results spray at 1:50 + Brushkill® (1.5g:10l) + Protec®.

Appendix 6: Daily Work Sheet

Name of Site:

Zone:

Date:

Hours worked:

Weather conditions (temperature, wind speed & direction, cloud cover, rain)

Personnel:

Work undertaken (main weed species, control methods, zone worked)

Work undertaken (main weed species, control methods, zone worked)

Zone	Activity	Method	Area	Comments

Additional observations: Flowering/fruitleting/germination/fauna sightings

Comments: Previous work/Follow up/reminder

Note the above Information will need to be summarised into the standard EnviTE Monthly Record of activities sheet and activity report.

Appendix 7: Chemical Operators Data Sheet

<u>Site</u>		<u>Operator</u>									
Date/Time	Specific Site Details	Target	Chemical Used	Batch Number / Date	Rate Used	Quantity Used (mls)	Additives	Equipment	Wind Speed, Direction	Other Weather Details	
			Glyphosate Roundup Bioactive® Weedmaster Duo ® Metsulfuron Methyl Brushkiller® Brushoff ®		1:100 1:50 1:1.5 1:50 + 1.5g/10l Neat		Li700 Protec Dye	Backpack Stem Injector Poison Pot	Strong NE Gusty SE Light SW Calm NW	Showers Overcast Clear Sky Calm	
			Glyphosate Roundup Bioactive® Weedmaster Duo ® Metsulfuron Methyl Brushkiller® Brushoff ®		1:100 1:50 1:1.5 1:50 + 1.5g/10l Neat		Li700 Protec Dye	Backpack Stem Injector Poison Pot	Strong NE Gusty SE Light SW Calm NW	Showers Overcast Clear Sky Calm	
			Glyphosate Roundup Bioactive® Weedmaster Duo ® Metsulfuron Methyl Brushkiller® Brushoff ®		1:100 1:50 1:1.5 1:50 + 1.5g/10l Neat		Li700 Protec Dye	Backpack Stem Injector Poison Pot	Strong NE Gusty SE Light SW Calm NW	Showers Overcast Clear Sky Calm	
			Glyphosate Roundup Bioactive® Weedmaster Duo ® Metsulfuron Methyl Brushkiller® Brushoff ®		1:100 1:50 1:1.5 1:50 + 1.5g/10l Neat		Li700 Protec Dye	Backpack Stem Injector Poison Pot	Strong NE Gusty SE Light SW Calm NW	Showers Overcast Clear Sky Calm	

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Scientific Name	Common Name	Cover Abundance (Braun-Blanquet)	DAFOR	Number of Individual Stems						Comments	
				< 20 cm	20 - 50 cm	50cm - 1m	1m - 2m	2m - 5m	> 5m		
Vines											
Other											

Note can record native species and exotics on separate sheets if this makes recording / sampling easier.

Appendix 10: Tools and Equipment Required

Non-consumables

- Plastic or steel boxes for equipment storage
- Leather pouches with belts to secure secateurs and knives
- Felco® secateurs (no.5)
- Victorinox® boning knives with non-slip handles
- Sandvik® loppers (no.16)
- Large bow saw
- Small pruning saws
- Poison pots, stands, and paintbrushes
- Goggles for mixing and applying herbicide
- Tomahawk
- Tree injection unit
- Sharpening stone
- Wheel barrow
- Chemical measuring container
- Rubber gloves for measuring and applying herbicide
- Gardening gloves
- 15 litre backpack spray unit with Rega® nozzle
- Black builders' plastic for composting
- Native plant and weed identification manuals
- Hand lens
- Camera
- First aid kit

Consumables

- Aerosol oil for tool maintenance (WD40® or Inox®)
- Diary/ journal
- Work record sheets (see Appendix 7)
- Flagging tape
- Photographic film
- Glyphosate (Newfarm Duo)
- Protec®
- Metsulfuron (Brushoff® or Brush Killer®)
- Spray marker dye (Kiwi Lite, pink, organic dye or Herbi Dye)
- Stakes or star pickets for photo points

