Pacific Highway Sapphire to Woolgoolga Upgrade
Threatened Flora Monitoring Year 6 (2017) Annual Report

FINAL Version (March 2018)

Prepared for NSW Roads and Maritime Services
Peter Richards

This report, **Pacific Highway Sapphire to Woolgoolga Upgrade Threatened Flora Monitoring Year 6 Annual Report**, was prepared for NSW Roads and Maritime Services in accordance with the NSW *Environmental Planning and Assessment Act* 1979, the NSW *Threatened Species Conservation Act* 1995 and the Commonwealth *Environmental Protection and Biodiversity Conservation Act* 1999.

The author of this report is Peter Richards, Consultant Ecologist, whose qualifications are B.Sc. (UNE).

Any opinion expressed in this report is the professional, objective opinion of the author.

March 2017

Title Page Images
Top: *Marsdenia longiloba* bearing a single fruit. *In situ* plant at Moonee Beach South site.
Bottom: *Quassia* sp. B bearing fruit. *In situ* plant at Sapphire North site.

Images taken by Peter Richards, March 2017.

TABLES

FIGURES

GLOSSARY

TERM	MEANING
ANPC	Australian Network for Plant Conservation
EP&A Act	*NSW Environmental Planning and Assessment Act* 1979
In situ	Latin term meaning 'in the original place'. In this report, refers to threatened plants that are being protected where they were found
LGA	Local Government Area
MCoA	Minister's Conditions of Approval
NSW EPA	NSW Environmental Protection Agency
NSW OEH	NSW Office of Environment and Heritage
RMS	NSW Roads and Maritime Services
S2W	Sapphire to Woolgoolga Pacific Highway Upgrade Project
S2W ERG	Sapphire to Woolgoolga Environmental Reference Group
TA	Translocation Area
TSC Act	*NSW Threatened Species Conservation Act* 1995

INTRODUCTION

Background

The Sapphire to Woolgoolga Pacific Highway Upgrade project (S2W) is a 25 km-long section of the Pacific Highway upgrade located entirely within the Coffs Harbour Local Government Area (LGA). Translocation of three threatened plant species directly impacted by the project was undertaken, with the aim of salvaging impacted individuals and establishing new, self-sustaining populations at alternative sites to compensate for the habitat and/or plants lost due to the highway development (Ecos Environmental 2010, 2011). The three translocated plant species are:

- *Lindsaea incisa*, a small ground fern, listed as Endangered under the NSW *Threatened Species Conservation Act 1995* (TSC Act);
- *Marsdenia longiloba* (Slender Marsdenia), a slender vine, listed as Endangered under the TSC Act; and
- *Niemeyera whitei* (Rusty Plum), a medium-sized rainforest tree, listed as Vulnerable under the TSC Act.

In addition to the translocated specimens, a number of individuals of the same three species were also recorded at various sites within the S2W project boundaries, along with individuals of the threatened plant *Quassia* sp. B. These plants were not directly impacted by the construction works and have been protected *in situ* within areas of native vegetation adjacent to the S2W alignment. Figure 1 shows the location of the three translocation areas and the sites supporting *in situ* threatened flora species. Figure 2 shows the same sites in relation to the route of the new S2W alignment.

In accordance with the Minister's Conditions of Approval (MCoA) for the S2W Flora Translocation Plan (Ecos Environmental 2010), an annual monitoring report is to be prepared, addressing the following matters:

- Background and description of the translocation project;
- A description of translocation methods;
- A description of monitoring methods;
- An analysis of monitoring data on a species by species basis;
- An assessment of causes of plant mortality;
- An accurate record of the plants transplanted and propagated;
- A description of the population enhancement program;
- Evaluate the short-term success of the translocation in accordance with ANPC Guidelines for the Translocation of Threatened Plants in Australia (Vallee *et al.* 2004).
- An evaluation of the methods and cost-effectiveness of the translocation project; and
- Work plan for monitoring, maintenance and management of the translocation site over the next twelve months.

In addition to the above, RMS has requested that the author also provide an assessment for the need to continue monitoring of all sites.

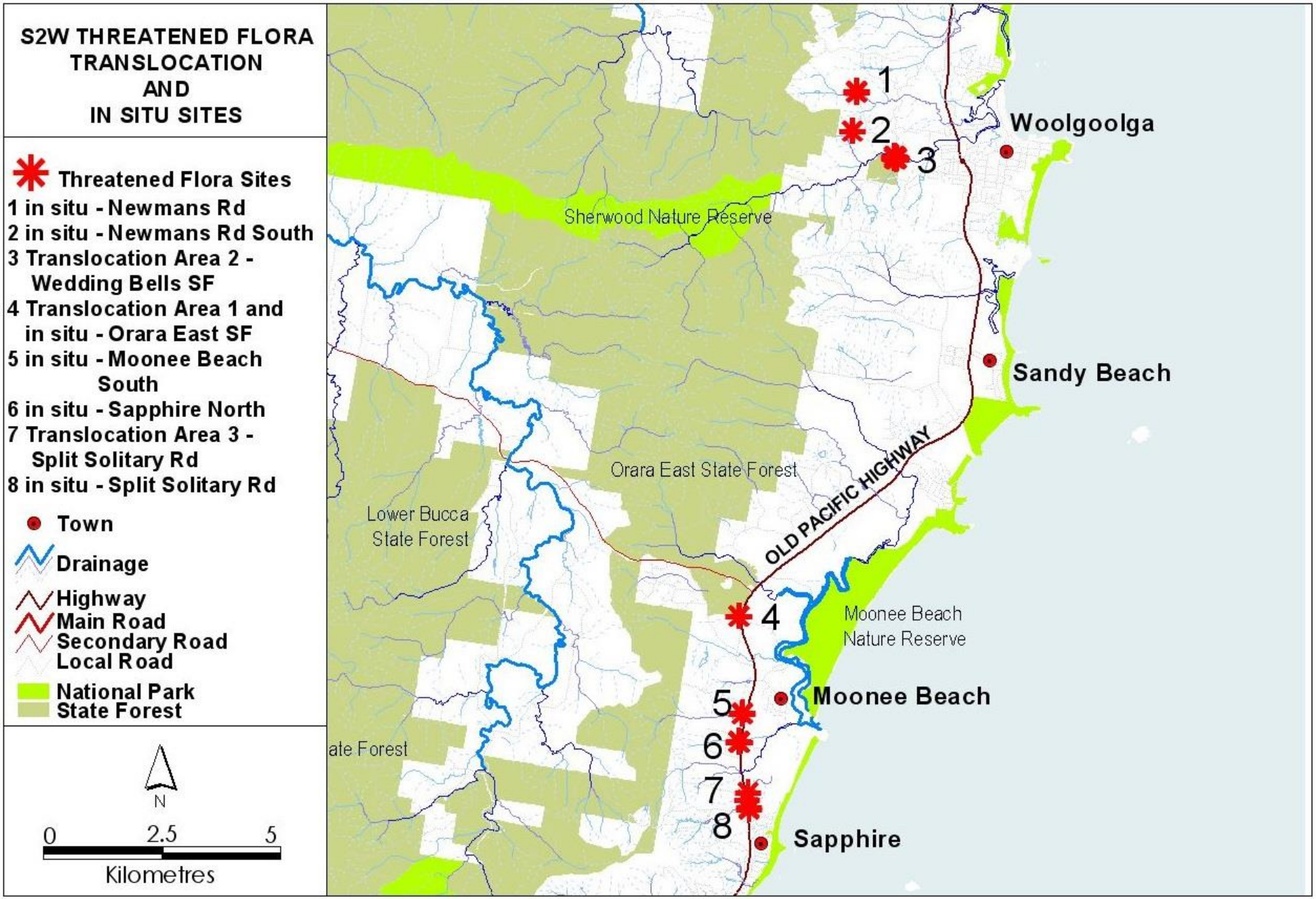

Figure 1: Location of S2W Threatened Flora Translocation Areas and in situ Threatened Flora sites.

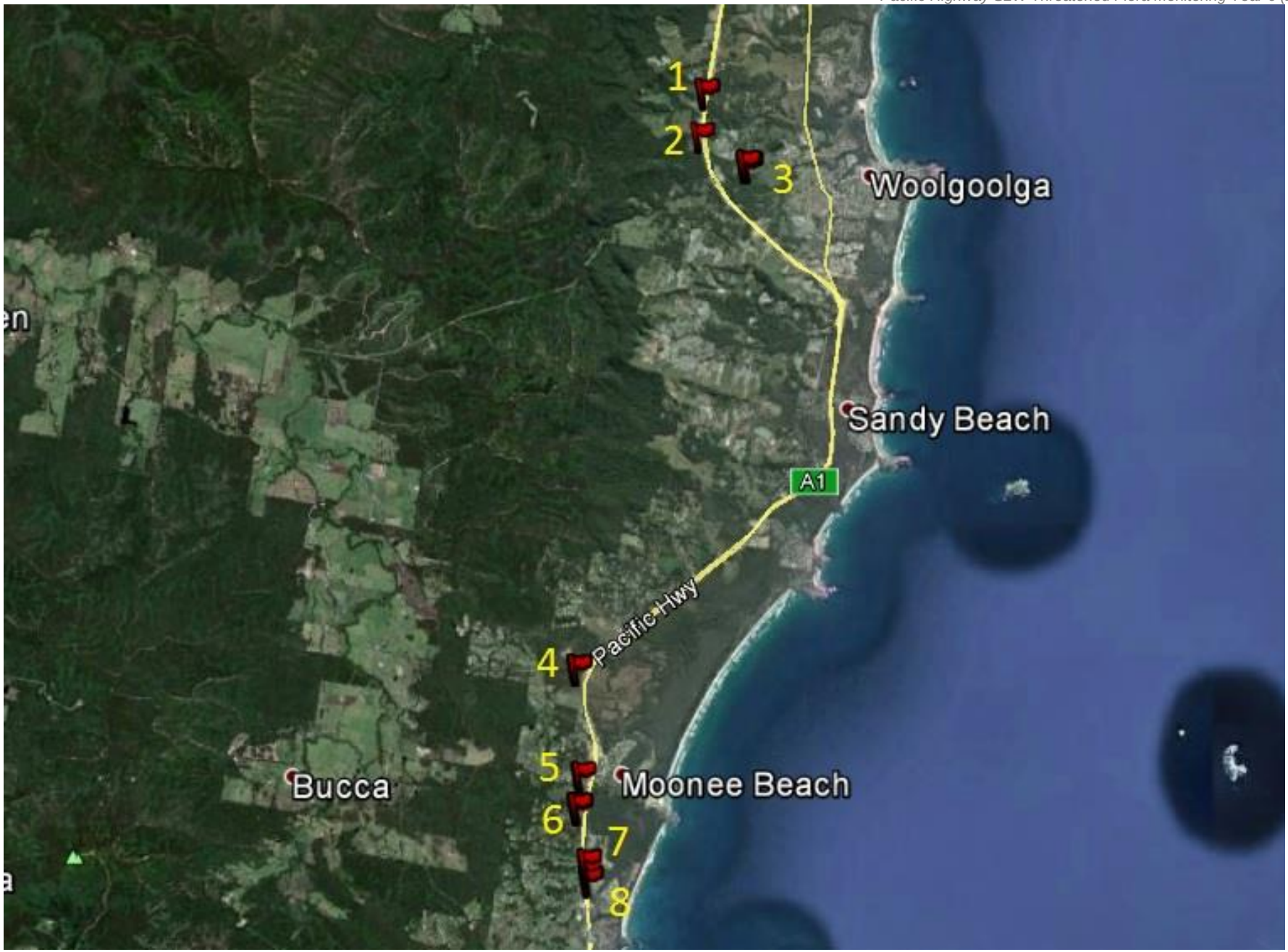

Figure 2: Location of S2W Threatened Flora Translocation Areas and in situ Threatened Flora sites in relation to the S2W upgrade route.

Implementation of the flora translocation program and monitoring of translocated and *in situ* flora is based on the S2W Threatened Flora Translocation Plan (Ecos Environmental 2010) and the approved S2W Ecological Monitoring Program (Benchmark Environmental Management 2009). The first annual monitoring report (Ecos Environmental 2011) covered the period up to June 2011; the second annual reports (Ecos Environmental 2012a & b) provide results up to October 2012 and the third annual report (Richards 2013) accounts for the period up to October 2013.

The results in the third annual report (Richards 2013) revealed that most translocated Slender Marsdenia plants in Translocation Area 2 (TA2) had died back, and many Slender Marsdenia plants protected *in situ* had also died back or were in poor condition. This prompted the approval regulator, the NSW Environment Protection Authority (EPA), to seek further information regarding the possible mortality of the translocated Marsdenia plants. It was suggested by the author that, rather than survey the sites in late spring at the peak of the seasonal dry period, a survey of all translocated and *in situ* plants be undertaken in early autumn 2014, after late spring and summer rains. This proposal was accepted by EPA, and an interim report (Richards 2014a) recorded a general improvement in the condition and number of plants of all target species, including an increase in the number of live translocated Slender Marsdenia recorded at TA2. All data collected in March 2014 were also presented in the fourth annual report (Richards 2014b) which was submitted in November 2014. The fifth annual report (Richards 2016) marked the commencement of the operational phase of S2W, with oversight of ongoing environmental monitoring and maintenance the responsibility of RMS.

This sixth annual monitoring report provides results and recommendations arising from the monitoring of translocated and *in situ* threatened flora undertaken in March 2017.

METHODS

Maintenance Tasks

Recommendations 1,3 and 4 in the fifth annual monitoring report (Richards 2016) identified four sites where weed control was required. These tasks and actions are listed below in Table 1.

Table 1: Maintenance and plant management tasks undertaken March 2017.

Task	Comments
Weed control / debris removal in TA3	Coffs Coast Bush Regeneration (CCBR) undertook weed control and debris removal. Priority species Mysore Thorn, Broad-leaf Paspalum, Blue Billygoat Weed, Winter Senna, Bat-wing Coral Tree, Lantana. Annual follow-up (two treatments per year) recommended to maintain site.
Weed control program at Split Solitary Road in-situ site by a team who are familiar with Slender Marsdenia or have been trained to recognise the species by an experienced botanist.	CCBR undertook selective weed control at the site after being familiarised with Slender Marsdenia by the author, who also flagged important areas within the site to guide weed control efforts. Target species Lantana, Winter Senna and some Camphor Laurel.
Targeted control of exotic grasses on eastern edge of *Lindsaea incisa in situ* site (TA1) and on eastern edge of Newmans Road South *in situ* site.	CCBR undertook targeted control of exotic grasses at both sites. Advised that both sites would benefit from twice-yearly treatment to better suppress competition from exotic grasses.

Translocation Methods

The translocation program was conceived, prepared and implemented by Ecos Environmental, and is described in detail in the S2W Threatened Flora Translocation Plan (Ecos Environmental 2010). The reader is referred to this plan for detailed descriptions of the objectives of the translocation project, the translocation recipient sites, and the methods employed to translocate each plant species.

Monitoring Methods

The methods employed to monitor the translocated plants and the plants protected *in situ* are described in Ecos Environmental (2010) and the approved S2W Ecological Monitoring Program (Benchmark Environmental Management 2009). A summary of those methods is provided here.

Plants targeted for translocation and all *in situ* plants to be protected within road reserves were each given a unique field identification code on labelled flagging tape. The labelled flagging was attached directly to each plant, or to a bamboo stake adjacent to the subject plant (in the case of *Lindsaea incisa* clumps) or to wallaby cages protecting individual plants (Rusty Plum enhancement plantings and Slender Marsdenia transplants). The locality of each plant was recorded using GPS, and maps prepared showing the location of plants in each Translocation Area or *in situ* site.

Translocated plants were assessed every three months for the first year, at six-monthly intervals for the following two years, then annually for the duration of the monitoring program. Plants protected *in situ* in road reserves were monitored at six-monthly intervals for the first two years, thence annually. Table 2 lists the information recorded during each monitoring survey.

Table 2: Data recorded for all translocated and in situ plants during the S2W flora monitoring program.
x = data recorded for this species; t = recorded only for translocated specimens. *See below for description of general condition classes.

Data recorded	*Marsdenia longiloba*	*Niemeyera whitei*	*Lindsaea incisa*	*Quassia* sp. *B*
Species name	x	x	x	x
Unique id code	x	x	x	x
Translocation type, date	t	t	t	
Place of origin	t	t	t	
Condition when planted	t	t	t	
Initial height	x	x	x	x
No. of stems, diameter	x	x		x
Bark condition		x		
Insect grazing	x	x	x	x
Mammal grazing	x	x	x	x
Evidence of recruitment	x	x	x	x
Date	x	x	x	x
Location	x	x	x	x
General condition*	x	x	x	x
Height	x	x	x	x
Leaf condition	x	x	x	x
No. Of leaves	x			
Flowers / fruits	x	x		x
Sporangia			x	
% Cover			x	
Length of new shoots		x		x
Distance outside quadrat			x	
Evidence of disease	x	x	x	x
Notes	x	x	x	x
Site data:				
Plant community height and cover	x	x	x	x
Weed abundance and composition	x	x	x	x
Unusual climatic events	x	x	x	x
Maintenance undertaken	x	x	x	x
Other ecological impacts	x	x	x	x

Condition Scores

The monitoring surveys recorded a general plant condition score on a scale of 0 to 5, where 0 is dead or died back and 5 is excellent. These condition scores may be defined for each species as follows:

Slender Marsdenia, Rusty Plum and *Quassia* sp. B condition classes:
0 = dead / died back; 1 = leafless and no sign of re-shooting; 2 = pruned foliage retained, or small amount of re-shooting after defoliating, or foliage sparse/discoloured; 3 = vigorous re-shooting; 4 = crown recovering, foliage healthy; 5 = crown recovered, growing actively, and/or flowering or seeding recorded.

***Lindsaea incisa* condition classes:**
0 = all dead; 1 = dieback >20%; 2 = >50% yellowing; 3 = slight to <50% yellowing; 4 = very slight yellowing; 5 = all fronds healthy and green.

A leaf condition score was recorded for Rusty Plum and *Quassia* sp. B (the number of leaves present on Slender Marsdenia plants was recorded, rather than leaf condition). This score was also on a scale of 0 to 5, where 0 is dead and 5 is excellent.

Slender Marsdenia – dead plants
The question of when a Slender Marsdenia plant should be considered dead is especially relevant to translocated individuals, as it is vital to determine outright success or failure of translocation efforts to inform future proposals that might include translocation as a mitigation measure. In on-site discussions with members of the S2W Environmental Reference Group (ERG) in February 2014, an arbitrary criterion was agreed whereby if no above-ground material is recorded on an individual Slender Marsdenia plant for four consecutive years then that plant is to be considered dead.

RESULTS

In situ Flora Monitoring

APPENDIX 1: Monitoring Results – all *in situ* flora March 201 provides full details of the results of the S2W Year 6 March 2017 monitoring of all *in situ* flora. Overall, the current survey revealed similar results to the previous year across all species and sites. A summary and assessment of the monitoring results for each species is provided below.

Slender Marsdenia

Table 3 below provides monitoring results for all *in situ* Slender Marsdenia sites.

Table 3: In situ Slender Marsdenia monitoring results, all sites March 2017

Condition Class	5	4	3	2	1	0*	Total no. of live plants recorded	Total no. of plants, live or died back
Number of Plants	14	193	31	5	0	59	243	302
Percentage	4.6	63.9	10.3	1.7	0.0	19.5	80.5	100.0

***** = this category only records died-back plants identifiable by the presence of numbered flagging.

Monitoring results for the current survey of *in situ* Slender Marsdenia were similar to the 2016 results, with a total of 302 plants (293 in 2016) now being monitored across all sites. 243 (80.5%) of these plants were recorded as alive and bearing aerial stems and leaves. Of the live plants observed this current survey, almost 80% were assessed as in good to excellent condition (condition classes 3 to 5). One plant at the Moonee South site bore a single fruit (Title Page Images). Fruiting is rarely recorded in Slender Marsdenia (PlantNet 2017; personal field observations). Two plants at the Split Solitary Road site were in bud.

Very dry conditions have characterised the past five winter-spring periods, with below-average rainfall recorded during that time each year since 2012 (refer to APPENDIX 4: Rainfall Statistics for full rainfall statistics). The winter-spring period for 2016 was very dry, but total rainfall for that period exceeded the average only because of two significant one-day rainfall events – 219mm on 5th June and 109mm on 4th August. This seasonal drought can induce Slender Marsdenia plants to die back to the subterranean rhizome and lie dormant, potentially for several years, according to monitoring data collected during this program. The summer of 2016-17 was the hottest and driest on record for north-eastern NSW (BOM 2017). Given the harsh conditions, it was surprising to record most Slender Marsdenia plants with above-ground growth and in generally good condition.

Rusty Plum

Ecos Environmental (2012b) and Richards (2013, 2014a) recorded four Rusty Plums protected *in situ* at the Moonee Beach South site (the only *in situ* Rusty Plum site). In November 2014 Richards (2014b), recorded an additional six Rusty Plums, some of which probably occur on private property outside the road reserve boundary. During the Year 5 survey (Richards 2016), a total of 34 Rusty Plum plants were recorded at this site. Of those plants, 13 were thought to be within the road reserve and the remaining 21 plants were most likely on adjacent private property. Those plants thought to occur on private property were not re-visited during the current survey.

The 2017 survey revealed 14 plants in the road reserve, 6 of which were seedlings (APPENDIX 1: Monitoring Results – all *in situ* flora March 2017). Most Rusty Plums were, in general, in reasonable health, with a mean condition score of 3.4 and median score of 3.5. No plants were recorded in flower or fruit during this survey. This is most likely due to the extremely dry winter-spring of 2015 and very hot and dry 2016-17 (see APPENDIX 4: Rainfall Statistics for rainfall statistics). The two Rusty Plums NW99 and NW100, which occur on the exposed eastern edge of the Moonee Beach South road

reserve, continue to display yellowed foliage because of exposure, and were, understandably, in worse condition this year than previous years. As noted last year, there is substantial regeneration of shrubs and trees in the road reserve to the east of these plants, and it is envisaged that protection of these Rusty Plums from exposure will improve over the next few years.

Quassia sp. B

As stated in the October 2012 monitoring report (Ecos Environmental 2012b) 15 *in situ* plants, totalling 41 stems, of *Quassia* sp. B were tagged at two sites (Sapphire North and Moonee South) for ongoing monitoring. Several of these plants consist of several stems as this species, like Slender Marsdenia, propagates vegetatively from its root system, which can make it difficult to discern individual plants. The Year 5 survey (Richards 2016) recorded a total of 24 *Quassia* sp. B plant sites, supporting 107 stems, up to 20 of which occur on private property adjacent to the Moonee South road reserve. Those plants recorded on private property in 2016 were not re-visited in 2017. The current survey revealed that almost all plants were in very good to excellent health. A total of 86 living stems were recorded at both sites within the road reserve, representing a survival rate of 95.6% of all monitored plants to date (Table 4) and a more than doubling of the number of stems originally recorded at the two sites. 15 plants across both sites were recorded as bearing fruit during the current survey (Title Page Images).

Table 4: March 2017 in situ Quassia sp. B monitoring results. Number refers to stems.

Condition Class	Not found	5	4	3	2	1	0 (dead)	Total living plants	Total all plants
Number	2	58	26	2	0	0	2	86	90
Percentage	2.2	64.4	28.9	2.2	0.0	0.0	2.2	95.6	100

Lindsaea incisa

The *in situ* protected site for *Lindsaea incisa* lies within Orara East State Forest adjacent to the S2W road reserve boundary. The *L. incisa* translocation sites are located to the immediate west of the *in situ* site (refer to the translocated plants section below for a description of the *L. incisa* translocation areas). In 2012/13, a hessian wall was erected along the eastern boundary of the *L. incisa in situ* population to reduce the level of exposure to which the ferns were subject. The October 2013 survey (Richards 2013) indicated that the hessian had a beneficial effect upon the *in situ* population. This recorded improvement was maintained in subsequent surveys (Richards 2014a, 2014b), and even after the hessian wall disappeared sometime during 2015 (Richards 2016). However, the current survey, not surprisingly, given the extreme weather conditions during 2016-17, recorded a reduction in average crown cover of the *in situ L. incisa* plots. Table 5 below provides comparative mean cover and condition scores since October 2013 (refer to APPENDIX 1: Monitoring Results – all *in situ* flora March 2017for full details). The decrease in mean canopy cover from March 2016 to March 2017 was statistically significant (t = 3.6527; P value equals 0.0107).

Table 5: In situ Lindsaea incisa monitoring results 2013 to 2017 – mean canopy cover and condition.

Date	Mean % canopy cover	Mean condition score
Oct-13	29%	3.1
Mar-14	46%	4.7
Nov-14	45%	5
Mar-16	56%	5
Mar-17	36%	3.9

Translocated Flora Monitoring

Slender Marsdenia

Full results of the current survey of translocated Slender Marsdenia are provided below in Table 6. The Year 5 survey (Richards 2016) recorded only one translocated Slender Marsdenia plant, ML6, bearing aerial stems. The current survey recorded two translocated plants, ML4 and ML6, with living aerial stems (Figure 3). ML4 has not been recorded since October 2012, a period of four and a half years. When it was last recorded, ML4 had died back, but the stem base remained alive (Table 6).

Figure 3: Slender Marsdenia transplant ML4 at Translocation Area 2, Wedding Bells State Forest, March 2017.

As stated previously, it is difficult to tell when a plant of Slender Marsdenia might have died or has simply died back to its subterranean rhizome, hence the decision to consider as dead any plant that has not shown above-ground growth for four consecutive years. The translocated individuals listed in Table 6 below were last recorded as all bearing aerial stems and leaves in May 2011. Since then, three plants, ML3, ML7 and ML8, have not been recorded as bearing living above-ground parts, and are therefore considered to be dead. In the Year 5 report (Richards 2016), two other plants, ML4 and ML5, were recorded as having died back and considered dead. The reappearance of ML4 provides important information about the longevity of the rhizome system in Slender Marsdenia, and should prompt a reconsideration of the point at which a plant is considered to have died.

To date, the Slender Marsdenia translocation effort has resulted in two plants (ML4 and ML6, 25% of the total) bearing aerial growth since translocation, and two of eight plants (ML1 and ML2) last recorded with aerial growth in Oct-Nov 2014, and therefore possibly still alive since translocation - a potential success rate of 50%.

Table 6: Slender Marsdenia translocation monitoring results 2011 – 2017. Plants shaded in grey were last recorded with aerial growth over four years ago.

Transplant No.	Height, no. of leaves pre-transplant March 2011	Height, no. of leaves May 2011	Height, no. of leaves Oct 2012	Height, no. of leaves Oct 2013	Height, no. of leaves Mar 2014	Height, no. of leaves Oct-Nov 2014	Height, no. of leaves Feb – Mar 2016	Height, no. of leaves in Mar 2017
ML1	100cm, 16 leaves	25cm, 5 leaves	28cm, 2 leaves	died back	110cm, 12 leaves	140cm, 12 leaves	died back	Died back
ML2	40cm, 6 leaves	80cm, 3 leaves	died back	died back	5cm, 3 leaves	30cm, 4 leaves	died back	died back
ML3	50cm, 8 leaves	120cm, 7 leaves	died back	died back	died back	died back	died back	Dead
ML4	10cm, 6 leaves	130cm, 2 leaves	died back, base green	died back	died back	died back	died back	0.8m, 23 lvs
ML5	150cm, 25 leaves	130cm, 8 leaves	stem died back, 4cm at base still green	died back	died back	died back	died back	Dead
ML6	rhizome	10cm, 4 leaves	180cm, 16 leaves active growing tip	230cm, 9 leaves	200cm, 2 leaves	240cm, 16 leaves	240cm, 18 leaves	2m, 19lvs
ML7	rhizome	130cm, 11 leaves	died back	died back	died back	died back	died back	Dead
ML8	rhizome	8cm, 3 leaves	died back	died back	died back	died back	died back	Dead

Rusty Plum Transplants

A total of nineteen (19) Rusty Plum trees, saplings and natural seedlings were transplanted to Translocation Area 2 (TA2) in Wedding Bells State Forest (15 plants) and TA3 at Split Solitary Road (four plants). By October 2013 the survival rate of transplanted Rusty Plums was 68% (Richards 2013). The Year 5 survey (Richards 2016) revealed that overall survival of translocated Rusty Plums had increased to 74% as at March 2016. The current survey showed a decrease in living Rusty Plums to 12 plants, a survival rate of 63%. Details of the current survey, and comparison with all previous surveys, are provided in Table 7 below. It is possible that some of the Rusty Plum seedlings that were not re-located in TA2 during this survey may be alive, but hidden under tree fall debris. The two plants surviving in TA3 are being encroached upon by native plants such as the vine *Morinda jasminoides* and the rainforest tree *Endiandra discolor*, and weeds, including *Senna pendula* (Winter Senna). Weed control and selective pruning of encroaching vegetation would assist these transplants.

Table 7: Rusty Plum individuals transplanted to TA2 and TA3 showing height and diameter at breast height (dbh) before transplanting, and height and condition from May 2011 to March 2017.

Site	Id No.	Height & dbh before transplanting	Height May 2011	Cond May 2011	Height Oct 2012	Cond Oct 2012	Height Oct 2013	Cond Oct 2013	Height Mar 2014	Cond Mar 2014	Height Nov 2014	Cond Nov 2014	Height Feb 2016	Cond Feb 2016	Height Mar 2017	Cond Mar 2017
TA2	NW58	2 stems joined at base, 8m, 10cm dbh	2 stems, 1.1m	3	1.8m	3	2.1m	3	2.2m	4	2.4m	5	2.9m	5	3.1m	5
	NW59	7m, 10cm dbh	3.2m	3	3.7m	3	4m	3	4.1m	4	4.5m	5	5m	5	6m	5
	NW60	6m, 6cm dbh	2m	3	2.4m	3	2.8m	4	3.0m	5	3.5m	5	4m	5	4m	4
	NW61	9m, 12cm dbh	4.8m	3	5.1m	3	5.5m	3	5.7m	5 in flower	6m	5	6.5m	5	6.5m	5
	NW62	3m, 3cm dbh	0.8m	3	0.8m	3	0.7m	3	0.8m	4	1m	5	1.1m	5	1.3m	3
	NW63	8.5m, 10cm dbh	2.2m	3	2.9m	3	3.2m	2	1.2m	3	1.8m	4	2.1m	4	2.5m	5
	NW64	3 stems, 6m, 6cm dbh	0.6m	3	0.9m	3	Dead	0	-	0	-	Dead	-	-	-	-
	NW64_1	part of NW64	0.5m	3	0.7m	3	Dead	0	-	0	-	Dead	-	-	-	-
	NW69	2 stems joined at base, 8m, 10cm dbh	2 stems, 2m, 0.9m	3	2.5m, 1.1m	3	2.2m	3	3.0m	4	2.4m	5	2.7m	5	3m	5
	NW58_1 (T1)	seedling	40cm	3	62cm	3	50cm	3	50cm	4	60cm	5	70cm	5	Not found	-
	NW58_2 (T2)	seedling	10cm	3	10cm	3	25cm	3	30cm	4	30cm	4	Not found	-	Not found	-
	NW58_3 (T3)	seedling	28cm	3	35cm	3	30cm	2	30cm	3	40cm	3	40cm	3	40cm	4
	NW58_4 (T4)	seedling	42cm	3	60cm	3	45cm	3	55cm	4	55cm	4	55cm	4	60cm	4
	NW58_5 (T5)	seedling	50cm	3	62cm	3	28cm	3	35cm	4	45cm	5	1m	2	Not found	-
	NW69_6 addendum	3m, 6cm dbh	1.6cm	3	1.8m	3	Not found	0	-	0	-	-	3.3m	5	3.6m	5
TA3	NW128	6m (transplanted Sept 2011)		2	1.7m	3	1.7m	0	-	0		Dead	-	-	-	-
	NW129	7m (transplanted Sept 2011)		2	1.8m	3	1.8m	0	-	0		Dead	-	-	-	-
	NW130	5m (transplanted Sept 2011)		2	1.8m	3	1.8m	3	1.5m	2	1.5m	2	1.6m	3	1.1m	3
	NW126	1.8m	0.2m	0		0	0	0	1m	3	1m	3	1.1m	3	1.2m	3

Rusty Plum Enhancement Plantings

Direct-seeding

Of the 68 Rusty Plum seeds directly sown into TA2 in November 2010, 35 (51%) were re-located in the current survey. Mean seedling height had increased substantially. Table 8 below provides comparative monitoring results for the duration of the program to date. Growth and general condition of seedlings was very good to excellent. For individual seedling height and condition details refer to APPENDIX 2a: Results – Direct-seeded Rusty Plum.

Table 8: Monitoring Results 2012-2017. Rusty Plum Seeds (68 seeds originally direct-seeded into TA2 in November 2010).

Year	2012	2013	Mar 2014	Nov 2014	Feb 2016	Mar 2017
Seed status	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	**No. (%)**
Seed germinated	51 (75)	29 (42.6)	43 (63.2)	44 (65)	36 (53)	35 (51)
Seed gone	17 (25)	39 (57.4)	25 (36.8)	24 (35)	32 (47)	33 (49)
Mean seedling height (cm)	31.2	35.0	34.6	37.5	49.9	63.9

Pot-germinated seeds

The 20 Rusty Plum seedlings that were germinated from seed then planted out into TA2 in March 2011 have fared similarly to the direct-seeding trial, with 13 (65%) of pot-germinated seedlings re-located during the current survey. Again, mean seedling height had increased substantially (Table 9). Refer to APPENDIX 2b: Results – Transplanted Rusty Plum Seedlings for individual seedling height and condition details. As mentioned above, at least some of the lost seedlings are most likely alive but concealed by ground debris. Similarly, natural regeneration at TA2 has obscured some areas.

Table 9: Monitoring Results 2012-2017. Rusty Plum Seedlings (20 seedlings originally planted at TA2 in March 2011).

Year	2012	2013	Mar 2014	Nov 2014	Feb 2016	Feb 2017
Seed status	**No. (%)**	**No. (%)**	**No. (%)**	**No. (%)**	**No. (%)**	**No. (%)**
Seedling alive	17 (85)	14 (70)	14 (70)	14 (70)	13 (65)	13 (65)
Seedling gone	3 (15)	6 (30)	6 (30)	6 (30)	7 (35)	7 (35)
Mean seedling height (cm)	30.6	35.1	40.4	45	66	87.7

During the Year 5 survey of TA2 (Richards 2016) the original wire wallaby guards, which had started restricting the growth of many Rusty Plum enhancement plantings, were removed and replaced with 1m to 1.2m high by 40cm wide plastic mesh guards supported by hardwood stakes. This action has resulted in a marked improvement in the growth and general condition of almost all plants. Damage to plants due to browsing by macropods has been virtually eliminated.

The enhancement planting program for Rusty Plum, utilising both direct-seeding and planting of pot-germinated seedlings, has been successful to date, with at least 48 plants established and growing within TA2, in addition to the original translocated plants. Overall, the plants are in good to excellent condition.

Lindsaea incisa

A description of the layout of the *L. incisa in situ* and translocation areas is provided below (Figure 4).

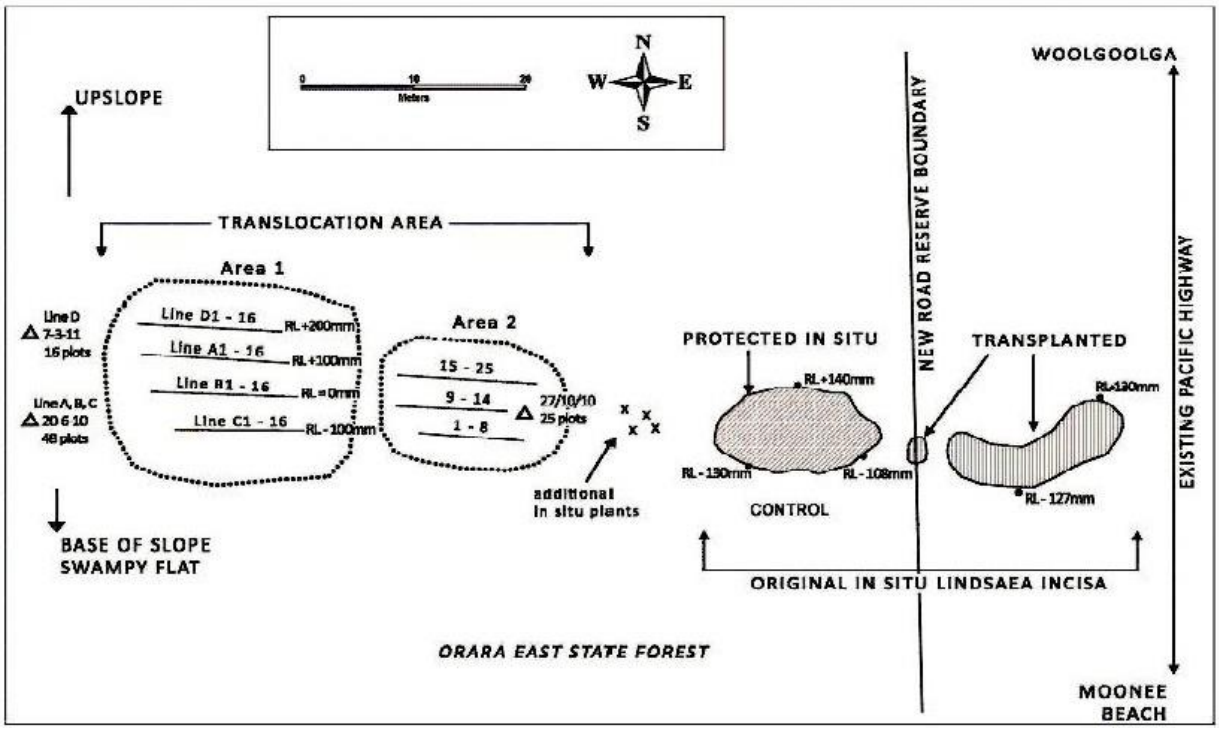

Figure 4: Diagram of Lindsaea incisa in situ and translocation sites in Orara East State Forest (from Ecos Environmental 2012a).

Area 1

Area 1 comprises three lines of 16 quadrats and one line (Line D) of 10 quadrats, each 0.5m square and containing *L. incisa* transplants (). Each line follows a contour relative to a surveyed elevation point, with Line D the highest, then Lines A, B and C each 100mm lower respectively.

Results from the current survey revealed a decrease in mean crown cover of *L. incisa* on all lines (Figure 5). In comparison to crown cover scores in February 2016, there was an extremely statistically significant decrease in cover on Line A, a very significant decrease on Line D, and non-significant decreases in mean cover on Lines B and C (Figure 5, Table 10). APPENDIX 3a: Monitoring results - *Lindsaea incisa* translocation quadrats, March 2017. provides individual quadrat details for the current March 2017 survey and APPENDIX 3b: Tests of significance - *Lindsaea incisa* mean crown cover Feb 2016 - Mar 2017. provides full results of the paired t-tests of significance.

The general condition of *L. incisa* plants in terms of foliage condition was generally lower than the previous survey across the site, although fronds bearing sporangia were still recorded in all quadrats that supported plants of *L. incisa*. The general reduction in crown cover of the translocated plants is like that recorded for the *in situ* plants of *L. incisa*, and is most likely a response to the extremely dry and hot weather pattern that has characterised 2016 and 2017 to date.

Notwithstanding the decline in crown cover, Lines A and D still supported plants in all quadrats as well as growth of plants beyond quadrat boundaries. The almost contiguous growth of *L. incisa* in quadrats 1 to 11 on Line A, recorded in Year 5 (Richards 2016), was much less obvious during the current survey. Line C still has only two quadrats containing plants as of March 2017. Line B had plants present in 10 of 16 quadrats in 2016, but now supports plants in 9 quadrats. Overall survival of *L. incisa*, based upon the proportion of all quadrats still supporting *L. incisa* in Area 1, stands at 64% (the figure given in the Year 5 report (Richards 2016) should have been 66%, not 76%).

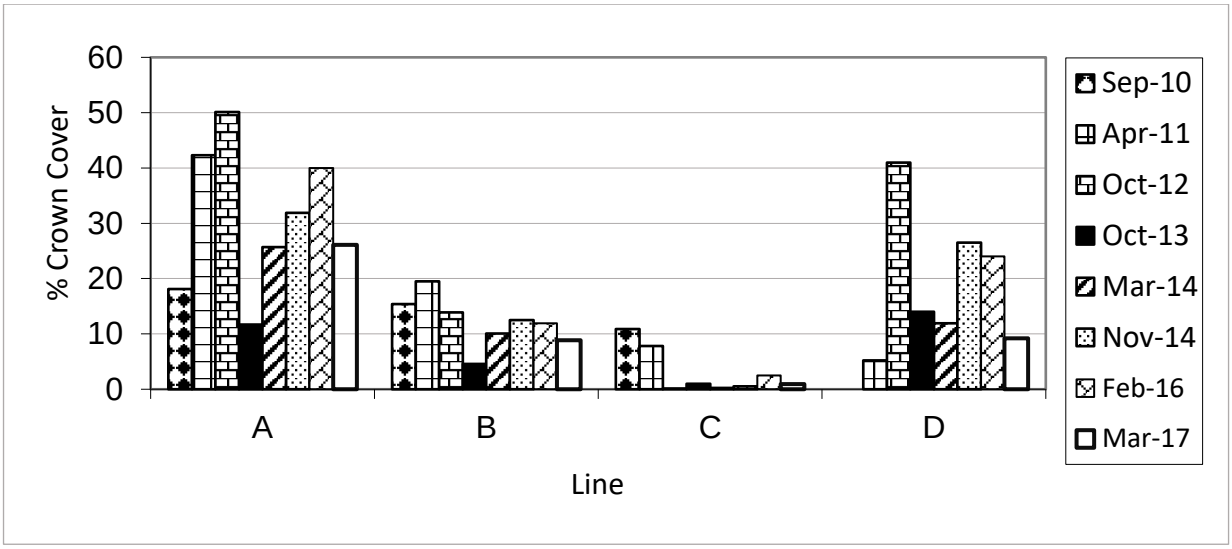

Figure 5: Mean percent crown cover of translocated Lindsaea incisa on lines A, B, C and D (Area 1) between September 2010 and March 2017.

Table 10: Mean percent crown cover of Lindsaea incisa (± standard error) on transect lines A, B, C and D (Area 1) September 2010 to March 2016. The results of paired t-tests comparing mean canopy cover data for February 2016 with data from March 2017 are provided. ESS = Extremely Statistically Significant; NSS = Not statistically significant; VSS = Very Statistically Significant.

Area 1 Line	Sep-10	Apr-11	Oct-12	Oct-13	Mar-14	Nov-14	Feb-16	Mar-17	T-value	P-value
Line A (n=16)	18.1 (±2.8)	42.3 (±6.2)	50.1 (±7.9)	11.69 (±2.5)	25.7 (±3.6)	31.9 (±4)	40.0 (±3.2)	26.1 (±4.)	4.6643	0.0003 (ESS)
Line B (n=16)	15.4 (±3.2)	19.5 (±4.9)	13.9 (±4.8)	4.56 (±1.6)	10.1 (±3.1)	12.5 (±3.4)	11.9 (±3.3)	8.9 (±2.9)	1.5159	0.1503 (NSS)
Line C (n=16)	10.9 (±0.9)	7.8 (±2.7)	0.1 (±0.1)	1.0 (±0.9)	0.25 (±0.2)	0.5 (±0.3)	2.5 (±1.7)	0.9 (±0.7)	0.9242	0.37 (NSS)
Line D (n=10)	NA	5.2 (±1.1)	41.0 (±5.7)	14 (±2.6)	11.9 (±5)	26.5 (±4.3)	24 (±2.3)	9.2 (±2.9)	4.5708	0.0013 (VSS)

Area 2

Area 2 is an additional set of three lines, with Line 1 the highest elevation and Lines 2 and 3 each 100mm lower respectively (Figure 4). Area 2 was established to transplant fragments of *L. incisa* that had been grown on in pots after the initial translocation into Area 1 had occurred (Ecos Environmental 2012a).

Of the 27 quadrats placed over three lines in Area 2, eight (30%) were recorded as supporting *L. incisa* in March 2017. Of those eight quadrats, five were on Line 1 and three were on Line 2. These findings are similar to those reported previously (Ecos Environmental (2012a); Richards (2013, 2014a & b, 2016)). Non-significant decreases in crown cover were recorded in Lines 1 and 2. Table 11 below provides a summary of crown cover of *L. incisa* over time in Area 2. All plants recorded in March 2017 were in good to very good condition, with at least some plants in each quadrat bearing sporangia. Full quadrat details and tests of significance for Area 2 are provided in APPENDIX 3a: Monitoring results - *Lindsaea incisa* translocation quadrats, March 2017. and APPENDIX 3b: Tests of significance - *Lindsaea incisa* mean crown cover Feb 2016 - Mar 2017. respectively.

Table 11: Mean percent crown cover of Lindsaea incisa (± standard error) on transect lines 1, 2 and 3 (Area 2) October 2010 to March 2017. The results of paired t-tests comparing data for February 2016 with data for March 2017 are provided. NSS = not statistically significant.

Area 2 Line	Oct-10	Apr-11	Oct-12	Oct-13	Mar-14	Nov-14	Feb-16	Mar-17	T-value	P-value
Line 1 (n=9)	13.3 (±2.5)	42.4 (±9.1)	20.1 (±7.7)	7.0 (±2.7)	15.6 (±6.4)	22.2 (±5.7)	33.3 (±8.7)	17 (±5.4)	0.2545	0.8117 (NSS)
Line 2 (n=12)	8.6 (±1.8)	19.0 (±7.4)	1.4 (±1.2)	1.33 (±0.9)	2.9 (±1.8)	7.5 (±4.1)	10.83 (±5.7)	10.0 (±5.4)	1.000	0.3388 (NSS)
Line 3 (n=6)	11.2 (±2.1)	17.3 (±2.1)	0	0	0	0	0	0	n/a	n/a

As stated in the Year 5 report (Richards 2016), the crown cover of translocated *L. incisa* quadrats is, in places, approaching the levels and natural variation of cover displayed by the *in situ* population. Despite the reduction in *L. incisa* crown cover recorded in the current survey, which is most likely due to the dry, hot conditions which have prevailed over the past year, it is considered that the surviving translocated plants are displaying natural levels of variation in cover and general condition.

SITE CONDITIONS

Plant community canopy height and cover

Newmans Rd: Mature Tallowwood – Ironbark – Pink Bloodwood moist open forest with good forest structure and mesic mid-stratum; height 20-30m, crown cover 60% apart from edge on roadside which remains more open and supports a ferny/grassy understorey. Some canopy gaps are regenerating naturally.

Newmans Rd South: Mature Grey Gum – Tallowwood - Ironbark moist open forest with good forest structure; height 25-28m, crown cover 60%, except near edge where canopy is more open.

Wedding Bells State Forest (TA2 for Rusty Plum and Slender Marsdenia): Regenerating Flooded Gum very tall wet sclerophyll forest 25-35m, crown cover 60% where canopy exists, with an open to dense mid-stratum of rainforest species under the canopy and open to very dense weedy understorey where substantial crown gaps exist. Good canopy cover and structure where canopy is intact, regeneration slow but advancing where canopy is absent. Native species such as Sandpaper Fig and White Cedar and are starting to colonise the open areas.

Orara East SF (*Lindsaea incisa* TA1 and *in situ* site): Mature Needlebark – Red Mahogany – Sieber's Paperbark heathy open woodland/forest with good forest structure; height 15-20m, crown cover 40%.

Moonee Beach South: Mature Tallowwood - Grey Gum - Brush Box - Flooded Gum wet open forest with good forest structure and mesic mid-stratum; height 25-35m, crown cover 60%.

Sapphire North (*Quassia* sp. B *in situ* site): Mature Grey Gum – Ironbark – Turpentine moist open forest with good forest structure and mesic small tree and shrub layer; height 25-30m, crown cover 60%.

Split Solitary Road (Slender Marsdenia *in situ* site and TA3 for Rusty Plum): Mature Tallowwood – Grey Gum – Grey Ironbark moist open forest with good forest structure and a moderate to dense mesic small tree and shrub layer; height 20-30m, crown cover 60%.

Weed abundance and composition

Newmans Road: Light to moderate *Lantana camara* (Lantana) and *Senna pendula* (Winter Senna).

Newmans Road South: Light to moderate Lantana.

Wedding Bells State Forest / TA2: Heavy infestations of *Ageratum houstonianum* (Blue Billygoat Weed) and *Paspalum mandiocanum* (Broad-leaf Paspalum); moderate level *Caesalpinia decapetala* (Mysore Thorn), Lantana and *Bidens pilosa* (Cobblers Pegs); significant numbers of young *Erythrina vespertilio* (Bat-Wing Coral Tree) and *Melicope elleryana* (Pink Doughwood). *Solanum mauritianum* (Wild Tobacco) is currently providing beneficial shade in the open regenerating areas. It is dying off and being replaced in some places by natives such as *Ficus coronata* (Creek Sandpaper Fig) and *Melia azedarach* (White Cedar). The many seedlings of Bat-Wing Coral Tree and Mysore Thorn originate from large naturalised specimens in the vegetated areas adjacent to TA2. These plants require eradication to prevent constant re-infestation of TA2 by these species.

Orara East State Forest / TA1: Weed free, apart from exotic grasses in the adjacent road reserve.

Moonee Beach South: Moderate Lantana, Winter Senna and *Ochna serrulata* (Mickey Mouse Plant).

Sapphire North: Light Lantana.

Split Solitary Road / TA3 – Moderate to heavy Lantana and Winter Senna, although these species often support plants of Slender Marsdenia. Small trees and seedlings of *Cinnamomum camphora* (Camphor Laurel) are also present at low frequency.

Climatic events

The local climate since 2010 has been characterised by four years of above average summer rainfall (2010-2013) but below average rainfall over winter and spring each year from 2012 to 2015. The summer of 2015-2016 was one of the hottest and driest on record, and the summer of 2016-17 was the hottest and driest on record for north-eastern NSW (BOM 2017). It is likely that sites on the western side of the highway experienced frosts in winter 2012, 2013 and 2014. Refer to APPENDIX 4: Rainfall Statisticsfor monthly rainfall statistics covering the duration of the translocation and monitoring program to date.

Site Maintenance

Newmans Road

Mar 2016: Some flagging and marker stakes replaced.

Newmans Road South

Mar 2016: Some flagging and marker stakes replaced. The eastern edge of this site was assessed by the author and Brent Hely of Coffs Coast Bush Regeneration (CCBR). Noted that natural regeneration is very good, but targeted spraying of exotic grasses would enhance regeneration.

Mar 2017: Targeted spraying of exotic grasses by CCBR to reduce competition and further enhance natural regeneration at this site.

Wedding Bells State Forest / TA2

Late 2013 – early 2014: CCBR undertook weeding and removal of dead Coral Tree wood.

March 2014: hand-weeding around a number of Rusty Plum seedlings, further opening of wallaby cages to allow seedling growth.

Oct-Nov 2014: weeding and removal of native vines from numbers of Rusty Plums; opening of remaining wallaby cages to enable unimpeded growth of seedlings.

Feb-Mar 2016: CCBR undertook weed control, removal of fallen tree debris from Rusty Plum transplant, and along with the author replaced the wire wallaby cages on most Rusty Plum enhancement plantings with larger mesh guards.

Mar 2017: CCBR undertook weed control, targeting Mysore Thorn, Broad-leaf Paspalum, Blue Billygoat Weed, Lantana, Bat-wing Coral Tree, etc.

Orara East State Forest / TA1

2014: Mesh boundary fencing replaced with flagged ropes to allow macropods to more easily traverse the site.

Feb-Mar 2016: Replacement of bamboo marker stakes and numbered flagging at all *Lindsaea incisa* transplant quadrats; replacement of marker stakes and numbered flagging at all *in situ Lindsaea incisa* quadrats.

Feb 2016: Eastern side of the *in situ Lindsaea incisa* site was assessed by the author and Brent Hely (CCBR) for targeted weed control. Confirmed that hessian shade screen is no longer required as regeneration is excellent.

Mar 2017: Targeted removal of exotic grasses by CCBR to reduce competition and further enhance natural regeneration at this site.

Moonee Beach South

Mar 2016: Flagging and marker stakes replaced.

Sapphire North

Mar 2016: Some flagging and marker stakes replaced.

Split Solitary Rd / TA3

Mar 2016: Re-location and re-flagging and numbering of Slender Marsdenia plants.

Mar 2017: Selective weed control targeting Lantana, Winter Senna and Camphor Laurel.

Other ecological impacts

No other ecological impacts such as outbreaks of disease, insect infestations or excessive dust deposition on foliage were observed.

DISCUSSION

Evaluation of Translocation Program

In accordance with the Minister's Conditions of Approval, an evaluation of the short-term success of the S2W flora translocation program against criteria outlined in *ANPC Guidelines for the Translocation of Threatened Plants in Australia* (Vallee *et al.* 2004) is required. A summary evaluation against those criteria is provided in Table 12 below.

Table 12: Evaluation of short-term success of S2W translocation program, using criteria in Vallee et al. (2004).

Short-term criterion (Vallee *et al.* 2004)	Slender Marsdenia	*Lindsaea Incisa*	Rusty Plum
>70% of transplants are surviving, with representatives from the range of genetic individuals planted	No (max. 50%)	No (64%)	No (63%)
New populations have similar characteristics to natural populations	No	Yes	No
Survival of transplants to reproductive stage (producing flowers and fruit)	No	Yes	Yes
Reproduction of transplants is at levels consistent with naturally occurring plants, including seed viability	No	Yes	No
Translocation success?	No	Yes	Yes

Slender Marsdenia

By all criteria, the translocation of Slender Marsdenia has failed in the short-term. It should be noted, however, that this assessment is based upon the decision to deem as dead those plants that have not produced aerial stems for four consecutive years. Table 6 shows that the longest period that a

transplanted Slender Marsdenia has died back before resprouting is four and a half years. It is possible that some rhizomes now classed as dead could resprout in the future but, to evaluate the success or otherwise of a translocation effort, there must be a point at which a plant can be assessed as dead. In the case of Slender Marsdenia, the currently agreed period of four years without above-ground growth seemed a reasonable, albeit arbitrary, length of time. Considering the reappearance of ML4, this period should now be amended to five years. In any case, ongoing monitoring of TA2 will still involve a search for all the original Slender Marsdenia transplants, as is currently the case.

Lindsaea incisa

The translocation of *Lindsaea incisa* has been successful, with slightly less than 70% (64%) of transplants in Area 1 surviving and relatively healthy, with many spreading well beyond the original quadrats. In addition, the experimental nature of the transplants has provided valuable information regarding specific habitat requirements of *L. incisa*, with most surviving transplants occurring along the highest elevation transects in Area 1. Whilst it is a simple matter to examine the fronds of this species for the presence of sporangia and spores, it is not possible to determine whether any propagation has resulted from spores (i.e., sexual reproduction) in the transplanted colonies, rather than vegetative propagation. Whatever its method of spreading, the translocated *L. incisa* in Area 1 is, in places, approaching the canopy cover measured at the *in situ* quadrats, and cover may be expected to remain more or less the same from now on, in response to natural processes operating at the site, such as seasonal variation in hydrology, fluctuations in prevailing weather conditions and competition from other (native) ground cover species.

Rusty Plum

The translocation of Rusty Plum should be considered a success at this stage, albeit with less than 70% survival of transplants (63%). Although survival of the Rusty Plum seeds and germinated seedlings is also below 70% (51% and 65% respectively), the addition of such a significant number of young plants to the recipient site is considered to greatly benefit the Rusty Plum translocation effort overall. Being long-lived trees, it is difficult to assess short-term criteria such as population structure and reproductive levels when it may take decades for some translocated Rusty Plum plants to become reproductive. As suggested by Vallee *et al.* (2004), it is recommended that for long-lived taxa the short-term criteria be limited to survival of plants, with other criteria being assessed in the long term.

Evaluation of Methods and Cost-effectiveness of the Translocation Program

An evaluation of the efficacy and cost-effectiveness of the different translocation methods employed during the S2W project was provided in the Year 5 report (Richards 2016). As nothing has occurred to change this evaluation, a summary is provided below.

Slender Marsdenia

The poor results for Slender Marsdenia suggest that there is no point in attempting future translocations with this species.

Lindsaea incisa

L. incisa appears to be a suitable subject for translocation in the future if suitable habitat is available and if other mitigation measures are not available.

Rusty Plum

Consideration should be given to employing the enhancement planting method for Rusty Plum, which involves direct-seeding and planting pot-grown seedlings into the recipient site, in preference to translocation of large Rusty Plum trees in the future.

FURTHER MONITORING OF THE TRANSLOCATION SITES AND IN-SITU SITES

An evaluation of the need for ongoing monitoring of the S2W flora translocation and *in situ* sites is presented below (Table 13).

Table 13: Evaluation of the need for further monitoring of S2W threatened flora sites.

Site	Method	Future Monitoring	Comments
Newmans Road	In situ	No further monitoring	Weeds at low levels, site relatively secure
Newmans Road South	In situ	No further monitoring	Weeds at low levels on site. Continue exotic grass control in adjacent road reserve to enhance native regeneration
TA2 Wedding Bells SF	Translocation	Further monitoring required	Weeds continue to seriously threaten this site; Slender Marsdenia requires ongoing monitoring
TA1 Orara East SF	Translocation	No further monitoring	Lindsaea incisa transplants approaching natural cover and condition; weed-free site
Orara East SF	In situ	No further monitoring	Continue exotic grass control in adjacent road reserve
Moonee South	In situ	No further monitoring	All in situ species appear healthy and secure
Sapphire North	In situ	No further monitoring	Quassia plants healthy and secure; weeds at low levels
TA3 Split Solitary Road	Translocation	Further monitoring required	Weeds and native climbers encumbering Rusty Plums; weed control required
Split Solitary Road	In situ	No further monitoring	Slender Marsdenia plants healthy, secure. Continue weed control at this site

RECOMMENDATIONS / WORK PLAN

Weed Control – Wedding Bells SF / TA2

1. Continuation of a twice-yearly weed control program, targeting infestations of Broad-leaf Paspalum, Mysore Thorn (a Class 3 Noxious Weed), Bat-Wing Coral Tree, Blue Billygoat Weed and Lantana (a Class 4 Noxious Weed). The next program should be undertaken in early December 2017.
2. Discuss with Forestry Corporation NSW the possibility of implementing a weed eradication program in areas of Wedding Bells State Forest adjoining TA2. Target weeds are Mysore Thorn and Bat-Wing Coral Tree. Other target species include Lantana and Winter Senna.

Weed Control – Split Solitary Road / TA3

3. Continue an annual weed control program at Split Solitary Road *in situ* site. To be undertaken by a bush regeneration team that is familiar with Slender Marsdenia or has been trained to recognise the species by an experienced botanist. Target species are Lantana, Winter Senna and Camphor Laurel.
4. Undertake weed control and selective pruning in TA3, as the two Rusty Plum transplants are being encroached upon by Winter Senna and native vines (Morinda) and trees.

Protective plantings – Orara East SF / TA1 and Newmans Road South

5. Continue targeted control of exotic grasses in road reserves adjacent to Orara East State Forest (TA1 and *L. incisa in situ* site) and Newmans Road South *in situ* site to reduce competition and promote regeneration of native shrubs and trees at both sites. Target species are Rhodes Grass, Setaria and Giant Paspalum. After consultation with CCBR during the March 2017 control program, control effort should be increased to one person for two hours at each site twice yearly.

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APPENDIX 1: Monitoring Results – all *in situ* flora March 2017

Species	Id No.	Location	General Condition	Height	Leaf No., Condition	Flower / fruit	Length of new shoots	Evidence of disease	Note	No. plants per site
Marsdenia longiloba	ML0126	Moonee Beach Sth	0						At base of Croton verrauxii just W of QB0104. Plus 3 other plants nearby	0
Marsdenia longiloba	ML0127	Moonee Beach Sth	5	2.1m	4	Fruit (1)			Robust plant on Synoum glandulosum at N edge of forest	1
Marsdenia longiloba	ML0128	Moonee Beach Sth	0						On Cissus hypoglauca and Lantana camara	1
Marsdenia longiloba	ML0129	Moonee Beach Sth	4	1.2m	7 lvs, 4				On ground debris near NW adults and seedlings (NW WPT063) plus one other plant	2
Marsdenia longiloba	ML0130	Moonee Beach Sth	2	0.2m	1 leaf, 2				On Cryptocarya rigida next to NW0140 - dying back	1
Marsdenia longiloba	ML0131	Moonee Beach Sth	4	1 - 1.2m	10-12 lvs, 4				On Pararchidendron pruinosum and Aphanopetalum resinosum. Plus 2 plants. Near NW0141	3
Marsdenia longiloba	ML102	Moonee Beach Sth	0						Died back	0
Marsdenia longiloba	ML104	Moonee Beach Sth	4	1m	8lvs, 4				Beside small Quassia. Plus 3 plants adjacent	4
Marsdenia longiloba	ML105a	Moonee Beach Sth	0						Died back.	0
Marsdenia longiloba	ML111	Moonee Beach Sth	0						At base of Cordyline stricta - died back	0
Marsdenia longiloba	ML112	Moonee Beach Sth	0						Died back. Plus 3 plants to N.	3
Marsdenia longiloba	ML119	Moonee Beach Sth	0						Died back. On Choricarpia leptopetala	0
Marsdenia longiloba	ML120	Moonee Beach Sth	0							0
Marsdenia longiloba	ML120a	Moonee Beach Sth	0						1m from ML120 flagging	0
Marsdenia longiloba	ML121	Moonee Beach Sth	4	1.1m	16lvs, 4				Plus 3 seedlings.	4
Marsdenia longiloba	ML122	Moonee Beach Sth	3	0.6m	7lvs, 3				On fallen Notelaea longifolia between two Brush Box	1
Marsdenia longiloba	ML123	Moonee Beach Sth	3	0.6m	5lvs, 3				On Croton verrauxii 1m from old flagging. Plus one seedling 1m downhill + another 1m downhill	3
Marsdenia longiloba	ML124	Moonee Beach Sth	4	0.2m	4lvs, 4				About 30cm N of base of flagged Cordyline stricta	1
Marsdenia longiloba	ML_WPT003	Moonee Beach Sth	0						Died back (first recorded Mar 2014)	0
Marsdenia longiloba	ML_WPT004	Moonee Beach Sth	4	1.8m	4				On Lantana camara. Very healthy. Adjacent to QB101	1
Marsdenia longiloba	ML_WPT005	Moonee Beach Sth	4	0.7m	15lvs, 4				On barbed wire	1
Marsdenia longiloba	ML_WPT007	Moonee Beach Sth	0						Three plants - all died Back	0
Marsdenia longiloba	ML_WPT060	Moonee Beach Sth	0						Died back	0
Marsdenia longiloba	ML_WPT060a	Moonee Beach Sth	3	0.6m	6lvs, 3				On old fence	1
Marsdenia longiloba	ML_WPT060b	Moonee Beach Sth	0						Between above plant (WPT060) and old fence. Died back Mar2016	0
Marsdenia longiloba	ML_WPT060c	Moonee Beach Sth	0						Between above plant (WPT060) and old fence. Died back Mar2016	0
Marsdenia longiloba	ML_WPT060d	Moonee Beach Sth	0						Between above plant (WPT060) and old fence. Died back Mar2016	0
Marsdenia longiloba	ML_extra2017	Moonee Beach Sth							Seven additional plants recorded during Mar 2017 survey	7
Marsdenia longiloba	ML0169	Newmans Rd	4	0.4m					Scrambling in Blady Grass near SW stake of MLplot	1
Marsdenia longiloba	ML0170	Newmans Rd	4	0.3m					3 stems in Calochlaena dubia near NW corner of MLplot	3
Marsdenia longiloba	ML0171	Newmans Rd	4	0.4m					3 stems in Calochlaena dubia near NW corner of MLplot	3
Marsdenia longiloba	ML0172	Newmans Rd	4	0.7m	9lvs				Very healthy in 2017. In Calochlaena	1
Marsdenia longiloba	ML0173	Newmans Rd	4	0.6m	13lvs				1 stem scrambling over Calochlaena dubia c. 2m SW of large Corymbia intermedia	1
Marsdenia longiloba	ML0174	Newmans Rd	4	0.7m	12lvs				2 stems on ferns at base of large Corymbia intermedia. Under Elaeocarpus obovatus	2
Marsdenia longiloba	ML0175	Newmans Rd	4	1.1m	17lvs				On Calochlaena dubia beneath Psychotria loniceroides c. 3m SW of large Corymbia intermedia. Very healthy 2017	1
Marsdenia longiloba	ML0176	Newmans Rd	3	0.05m					2 seedlings at base of large Eucalyptus acmenoides	2
Marsdenia longiloba	ML0177	Newmans Rd	0						On Calochlaena dubia 3m NE of slender Corymbia variegata	1
Marsdenia longiloba	ML137	Newmans Rd	4	2m	30+lvs				Very healthy 2017. On Jagera pseudorhus with Morinda jasminoides and Passiflora herbertiana.	1
Marsdenia longiloba	ML138	Newmans Rd	4	0.7m	12lvs				On marker stake. Plus 1 seedling present	2
Marsdenia longiloba	ML138a	Newmans Rd	0						At base of small Acacia maidenii amongst Calochlaena dubia	1
Marsdenia longiloba	ML138b	Newmans Rd	4	0.4m					New stem climbing from base of Olea paniculata. Plus 2 seedlings beneath. Large Tallowwood beside creek has fallen.	3
Marsdenia longiloba	ML141	Newmans Rd	0							0
Marsdenia longiloba	ML141a	Newmans Rd	0							0
Marsdenia longiloba	ML141b	Newmans Rd	0						Only Echinostephia aculeata present	0

Species	Id No.	Location	General Condition	Height	Leaf No., Condition	Flower / fruit	Length of new shoots	Evidence of disease	Note	No. plants per site
Marsdenia longiloba	ML142	Newmans Rd	0						On creek bank at W end of site	0
Marsdenia longiloba	ML150	Newmans Rd	0						Near base of slender Spotted Gum. WPT074	0
Marsdenia longiloba	ML151	Newmans Rd	0						2 stems on dense Calochlaena dubia	0
Marsdenia longiloba	ML157	Newmans Rd	0						Died back, on Cheese tree. 1 seedling present at base of tree.	0
Marsdenia longiloba	ML158	Newmans Rd	3	0.5m	5lvs				On sick Pittosporum revolutum	1
Marsdenia longiloba	ML165b	Newmans Rd	0							0
Marsdenia longiloba	ML166b	Newmans Rd	0							0
Marsdenia longiloba	ML166c	Newmans Rd	0							0
Marsdenia longiloba	ML166i	Newmans Rd	0						Sick 'seedling' beneath dead shrub	0
Marsdenia longiloba	ML167	Newmans Rd	0						On Calochlaena / Lantana	0
Marsdenia longiloba	ML168	Newmans Rd	0						2 stems amongst Calochlaena	0
Marsdenia longiloba	MLplot	Newmans Rd	4	0.05 - 0.5m					11 plants' in plot bounded by orange-flagged bamboo stakes in vicinity of ML165 - ML166 W of Forest Oak. Adult plants in plot are individually flagged and numbered	11
Marsdenia longiloba	MLWPT097	Newmans Rd	0						Trochocarpa laurina has fallen into creek along with large Tallowwood.	0
Marsdenia longiloba	MLextra2017	Newmans Rd	4						7 extra Marsdenia recorded during 2017 survey	7
Marsdenia longiloba	ML077	Newmans Rd Sth	3	0.1m	3				Weakly climbing over fallen log 2m E of fence where 75b/c flagging is located	1
Marsdenia longiloba	ML078	Newmans Rd Sth	4	0.2m	8lvs, 4				At base of 30cm dbh Turpentine - 2 stems 1 plant	1
Marsdenia longiloba	ML079	Newmans Rd Sth	2	0.25m	2				On Lepidosperma laterale 2m N of ML078	1
Marsdenia longiloba	ML080	Newmans Rd Sth	4	1.2m	11lvs, 4				On Lantana camara 10m SW of ML76	1
Marsdenia longiloba	ML080a	Newmans Rd Sth	0						On Lantana camara 1m W of ML080	0
Marsdenia longiloba	ML080b	Newmans Rd Sth	4	2m	16lvs, 4				On Lantana camara and Trochocarpa laurina 4m S of ML080	1
Marsdenia longiloba	ML71	Newmans Rd Sth	0							0
Marsdenia longiloba	ML72	Newmans Rd Sth	0							0
Marsdenia longiloba	ML72a	Newmans Rd Sth	3	0.1m	5lvs, 3				In litter 1m S of Wilkiea heugeliana with flagging	1
Marsdenia longiloba	ML73	Newmans Rd Sth	0							0
Marsdenia longiloba	ML73a	Newmans Rd Sth	2	0.05m	3lvs, 2				Fairly poor condition. Under fence line	1
Marsdenia longiloba	ML74	Newmans Rd Sth	4	0.4m	8lvs, 4				One plant 1m W of Trochocarpa laurina on Themeda	1
Marsdenia longiloba	ML74a	Newmans Rd Sth	2	0.1m	2lvs, 2				At base of small Eucalyptus propinqua - poor condition	1
Marsdenia longiloba	ML74b	Newmans Rd Sth	3	0.05m	2lvs, 3				Died back 2016. On ground 3m S of large Eucalyptus propinqua - 'seedling'	1
Marsdenia longiloba	ML75	Newmans Rd Sth	0							0
Marsdenia longiloba	ML75a	Newmans Rd Sth	0							0
Marsdenia longiloba	ML75b	Newmans Rd Sth	0							0
Marsdenia longiloba	ML76	Newmans Rd Sth	0						Healthy plant on Pittosporum multiflorum. Died back 2017	0
Marsdenia longiloba	ML76a	Newmans Rd Sth	0						On Pittosporum multiflorum. Died back 2017	0
Marsdenia longiloba	MLextra17	Newmans Rd Sth	4	1.4m	15lvs, 4				on fenceline 2m N of ML73	1
Marsdenia longiloba	ML001	Split Solitary Rd	5	0.7m	24lvs, 5				On broken Turpentine branch nr highway edge. Northernmost plants. Plus 3 seedlings	4
Marsdenia longiloba	ML002	Split Solitary Rd	0			Old inflor.			On small Turpentine adjacent to ML001. Died back 2017	0
Marsdenia longiloba	ML003	Split Solitary Rd	5	0.4m	10lvs, 5				In litter b/w Tallowwood and Grey Gum. Flagging on Notelaea longifolia 1m to W	1
Marsdenia longiloba	ML004	Split Solitary Rd	4	0.4m	3lvs, 3				In MLseedlings plot. On Senna pendula	1
Marsdenia longiloba	ML005	Split Solitary Rd	3	0.3m	5lvs, 3				In MLseedlings plot. On Smilax australis, base of Turpentine	1
Marsdenia longiloba	ML006	Split Solitary Rd	0						In MLseedlings plot. On Notelaea longifolia. Died back 2017	0
Marsdenia longiloba	ML007	Split Solitary Rd	5	1.1m	12lvs, 5				In MLseedlings plot. On Senna pendula, near large Bloodwood	1
Marsdenia longiloba	ML008	Split Solitary Rd	3	0.8m	5lvs, 4				In MLseedlings plot. On Pittosporum undulatum and Smilax australis	1
Marsdenia longiloba	ML009	Split Solitary Rd	3	0.6m	8lvs, 3				In MLseedlings plot. On Blackbutt branch on ground adjacent to stag	1
Marsdenia longiloba	ML010	Split Solitary Rd	0						In MLseedlings plot. On Blackbutt branch on ground adjacent to stag. Died back 2017	0
Marsdenia longiloba	ML011	Split Solitary Rd	4	0.8m	15lvs, 4				In MLseedlings plot. On dead Lantana camara and Turpentine sapling	1
Marsdenia longiloba	ML012	Split Solitary Rd	4	0.5m	12lvs, 4				On Blady Grass / Blechnum cartilagineum. Plus 3 seedlings. S of seedlings plot	4
Marsdenia longiloba	ML013	Split Solitary Rd	5	1m	14lvs, 5				On Senna pendula W od seedlings plot near star picket. Plus 8 seedlings	9
Marsdenia longiloba	ML014	Split Solitary Rd	5	2m	50lvs, 5				On Glochidion ferdinandi adjacent to Blackbutt 3m S of ML013. 2 stems counted as one plant	1

Species	Id No.	Location	General Condition	Height	Leaf No., Condition	Flower / fruit	Length of new shoots	Evidence of disease	Note	No. plants per site
Marsdenia longiloba	ML015	Split Solitary Rd	0						On Guioa semiglauca next to ML014. Died back 2017	1
Marsdenia longiloba	ML016	Split Solitary Rd	5	2.4m	30lvs, 5				On Notelaea longifolia on W edge of seedling plot. Plus 6 seedlings beneath	7
Marsdenia longiloba	ML017	Split Solitary Rd	5	1.8m	36lvs, 5	In bud			On Guioa semiglauca 2m SE of Blackbutt. Plus 4 seedlings beneath	4
Marsdenia longiloba	ML018	Split Solitary Rd	4	2m	10lvs, 4				On Guioa semiglauca adjacent to SW corner of seedling plot. Plus 2 seedlings	3
Marsdenia longiloba	ML019	Split Solitary Rd	0						On Blady Grass 1m NNE of large stump. Flagging on Guioa 1m E. Died back 2017	0
Marsdenia longiloba	ML020	Split Solitary Rd	3	1m	3lvs, 3				On dead Senna pendula, second stem on Blady Grass. Plus 1 seedling in grass	2
Marsdenia longiloba	ML021	Split Solitary Rd	3	0.7m	8lvs, 3				On branch of small Turpentine	1
Marsdenia longiloba	ML022	Split Solitary Rd	5	1.5m	46lvs, 5				On Maclura cochinchinensis SE of seedling plot	1
Marsdenia longiloba	ML023	Split Solitary Rd	5	1.9m	39lvs, 5				On Lantana camara / Smilax australis	1
Marsdenia longiloba	ML024	Split Solitary Rd	5	1.6m	37lvs, 5				On Lantana camara / Smilax australis	1
Marsdenia longiloba	ML025	Split Solitary Rd	0						On sick Rhodamnia rubescens - unhealthy vine. Died back 2017	0
Marsdenia longiloba	ML026	Split Solitary Rd	5	1.1m	22lvs, 5				On small Cryptocarya triplinervis adjacent to little Turpentine. Plus 4 seedlings between ML025 and ML026	5
Marsdenia longiloba	ML027	Split Solitary Rd	4	0.7m	9lvs, 4				On dead Senna pendula. Plus 2 seedlings	3
Marsdenia longiloba	ML028	Split Solitary Rd	4	0.6m	10lvs, 4				In Blady Grass 1m S of flagging. Plus 2 seedlings	3
Marsdenia longiloba	ML029	Split Solitary Rd	3	0.6m	5lvs, 3				On branches in litter amongst fallen Tallowwood limbs	1
Marsdenia longiloba	ML030	Split Solitary Rd	0						Scrambling on ground at base of large Tallowwood. Died back 2017	0
Marsdenia longiloba	ML031	Split Solitary Rd	2	1.1m	4lvs, 3				On Senna pendula at base of Elaeocarpus obovatus. Dying back	1
Marsdenia longiloba	ML032	Split Solitary Rd	4	0.7m	14lvs, 4				On root sucker of Elaeocarpus obovatus	1
Marsdenia longiloba	ML033	Split Solitary Rd	4	Up to 15cm	2 - 6lvs, 4				15 seedlings between large Eucalyptus propinqua to N and 2m X 2m pit to S. A lot of M. rostrata here as well	15
Marsdenia longiloba	ML034	Split Solitary Rd	0						On Guioa semiglauca. Lots of Smilax australis and Marsdenia rostrata. Died back 2017	0
Marsdenia longiloba	ML035	Split Solitary Rd	4	2.1m	10lvs, 4				Climbing on Smilax australis into Turpentine	1
Marsdenia longiloba	ML036	Split Solitary Rd	0						Dying back - stem still green. On dead sapling. Died back 2017	0
Marsdenia longiloba	ML037	Split Solitary Rd	3	0.3m	3lvs, 3				Below Cryptocarya triplinervis	1
Marsdenia longiloba	ML038	Split Solitary Rd	3	0.5m	4lvs, 3				On fallen limb at base of Tallowwood	1
Marsdenia longiloba	ML039	Split Solitary Rd	4	1.2m	29lvs, 4				On dead Senna pendula adjacent to Ironbark sapling	1
Marsdenia longiloba	ML040	Split Solitary Rd	0						On Senna pendula near tall Ironbark. Died back 2017	0
Marsdenia longiloba	ML041	Split Solitary Rd	3	0.8m	5lvs, 3				On Blechnum cartilagineum at base of Ironbark	1
Marsdenia longiloba	ML042	Split Solitary Rd	0						Scrambling on tree fall debris adjacent to ML13. Died back 2017	0
Marsdenia longiloba	ML043	Split Solitary Rd	0						On Senna pendula. Died back 2017	0
Marsdenia longiloba	ML044	Split Solitary Rd	4	1.5m	18lvs, 4				On Cyclophyllum longipetalum beside Ironbark. Plus 2 seedlings	3
Marsdenia longiloba	ML045	Split Solitary Rd	3	0.5m	4lvs, 3				Scrambling over ground debris downslope of Ironbark	1
Marsdenia longiloba	ML046	Split Solitary Rd	4	0.5m	11lvs, 4				On litter and small Cryptocarya triplinervis	1
Marsdenia longiloba	ML047	Split Solitary Rd	5	2.4m	38lvs, 5				On Pittosporum undulatum near W edge of reserve	1
Marsdenia longiloba	ML048	Split Solitary Rd	0						On Cyclophyllum longipetalum and Notelaea longifolia. Note: hairy stems, could be Tylophora paniculata (not T. woollsii). Died back 2017	0
Marsdenia longiloba	ML049	Split Solitary Rd	4	0.6m	12lvs, 4				On Blady Grass at foot of small slope	1
Marsdenia longiloba	ML050	Split Solitary Rd	4	1m	9lvs, 4				Sprawling over litter on slope	1
Marsdenia longiloba	ML051	Split Solitary Rd	0						On Jagera pseudorhus. Died back 2017	0
Marsdenia longiloba	ML052	Split Solitary Rd	3	0.4m	8lvs, 3				On litter adjacent to Blackbutt near large stump near W edge	1
Marsdenia longiloba	ML053	Split Solitary Rd	4	3m	19lvs, 3				In wet gully to SE of other plants - on Smilax australis	1
Marsdenia longiloba	ML054	Split Solitary Rd	0						On Notelaea longifolia with ML053. Died back 2017	0
Marsdenia longiloba	ML055	Split Solitary Rd	0						Very healthy plant on Trochocarpa laurina. Died back 2017	0
Marsdenia longiloba	ML1	Split Solitary Rd	4	0.2m	6lvs, 4				On ground log	1
Marsdenia longiloba	ML13	Split Solitary Rd	3	0.5m	2lvs, 3				On leaf litter. One other plant near old flagging	2
Marsdenia longiloba	ML16	Split Solitary Rd	4	1.1m	30lvs, 4				on Cryptocarya rigida downslope of ground layer ML16s recorded Nov 2014. 4 seedlings adjacent. WPT012 2017.	5
Marsdenia longiloba	ML16a-c	Split Solitary Rd	4	0.2-0.5m	6-20lvs, 4				Three plants on litter plus 2 seedlings	5

Species	Id No.	Location	General Condition	Height	Leaf No., Condition	Flower / fruit	Length of new shoots	Evidence of disease	Note	No. plants per site
Marsdenia longiloba	ML19	Split Solitary Rd	5	5m	44lvs, 5	In bud			On Jagera pseudorhus	1
Marsdenia longiloba	ML5d	Split Solitary Rd	4	0.5m	8lvs, 4				on Dianella caerulea	1
Marsdenia longiloba	ML5e	Split Solitary Rd	0						Died back	0
Marsdenia longiloba	ML8b	Split Solitary Rd	0						Died back	0
Marsdenia longiloba	MLseedlings	Split Solitary Rd	4	<40cm	2-6lvs, 4				Same site as WPT067 from Nov 2014. 41 'seedlings' in area bounded by pink-flagged bamboo stakes on NE, NW, SE and SW corners. Plot c. 6m X 20m (long axis N-S). All adult plants within this plot have been individually flagged and numbered.	41
Marsdenia longiloba	MLWPT089	Split Solitary Rd	3	0.3m	2lvs, 3				Beneath Cryptocarya rigida on stick. Flagged Oct '13. One other plant 30cm 12lvs on Lomandra longifolia to S. Plus 4 plants 2m west. WPT011 2017.	6
Marsdenia longiloba	MLWPT091	Split Solitary Rd	0						Dying back; stem green 2016. Died back 2017.	0
Marsdenia longiloba	MLextra2017	Split Solitary Rd	4	0.05-0.6m	Feb-22				15 adult plants and 15 seedlings recorded during 2017 survey	30
Niemeyera whitei	NW0133	Moonee Beach Sth	4	0.5m			60mm		4m N of creek line	1
Niemeyera whitei	NW0137	Moonee Beach Sth	4	1.7m	4		75mm		Sapling on E side of N-S creek line	1
Niemeyera whitei	NW0138	Moonee Beach Sth	3	0.3m	3				Seedling near NW0137	1
Niemeyera whitei	NW0139	Moonee Beach Sth	3	0.3m	3				Seedling near NW0137	1
Niemeyera whitei	NW0140	Moonee Beach Sth	4	7m	4				20cm dbh beside 40cm Tallowwood at QB0108	1
Niemeyera whitei	NW0141	Moonee Beach Sth	4	0.3m	4				Seedling amongst Lastreopsis sp.	1
Niemeyera whitei	NW100	Moonee Beach Sth	2	2.3m	2		40mm		Leaves yellowed due to exposure. Worse condition than last survey. Regeneration to the E is substantial, and should improve over next few years.	1
Niemeyera whitei	NW105	Moonee Beach Sth	4	2.5m	3		100mm		Foliage in better health than last year	1
Niemeyera whitei	NW109	Moonee Beach Sth	3	1.2m	3		50mm		Leaves unhealthy, but better than last year	1
Niemeyera whitei	NW109a	Moonee Beach Sth	0						Seedling 1.5m downhill from NW109 - under tree fall 2017	0
Niemeyera whitei	NW124	Moonee Beach Sth	4	0.8m	4		75mm		Tree fall flattened old leader 2016, both leaders OK 2017	1
Niemeyera whitei	NW99	Moonee Beach Sth	2	4m	2		20mm		Leaves yellowed due to exposure. Worse condition than last survey, badly affected by summer 2017 heatwaves. Regeneration to the E should improve over next few years.	1
Niemeyera whitei	NW_WPT063	Moonee Beach Sth	3	7m	3	Old fruit on ground			Double-stemmed small tree on creek bank beside large Brush Box. Looking stressed - drought.	1
Niemeyera whitei	NW_WPT064	Moonee Beach Sth	3	0.2m	3				1 seedling in fair health. Other seedling recorded last survey gone	1
Niemeyera whitei	NW_WPT068	Moonee Beach Sth	4	0.3m	4				Young plant at S of site near creek re-located 2017	1
Quassia sp. B	QB0104	Moonee Beach Sth	4	0.3m	5		40mm		50m due W of Highway culvert	1
Quassia sp. B	QB0105	Moonee Beach Sth	5	0.4m	5	11 fruits	80mm		On W bank of N-S creek line with Choricarpia leptopetala. Also one sucker on creek edge	2
Quassia sp. B	QB0106	Moonee Beach Sth	4	0.3 - 1.5m	4		80mm		3 stems on E side of N-S creek line. 0.3m, 1m and 1.5m tall.	3
Quassia sp. B	QB0108	Moonee Beach Sth	5	0.2 - 0.7m	5	Fruits on 5 plants	80mm		15 stems on W reserve boundary (ridge between two N-S creek lines). Spread over 3m X 3m area. In excellent health 2017	15
Quassia sp. B	QB101	Moonee Beach Sth	4	1.2m	5	old buds	70mm		Very healthy	1
Quassia sp. B	QB101a	Moonee Beach Sth	4	0.7m	5	old buds	70mm		Very healthy	1
Quassia sp. B	QB102	Moonee Beach Sth	4	0.8m	4		30mm		OK	1
Quassia sp. B	QB103	Moonee Beach Sth	4	1m	4	old buds	70mm		Plus 1 stem adjacent	2
Quassia sp. B	QB112a	Moonee Beach Sth	0						Dead	0
Quassia sp. B	QB125a	Moonee Beach Sth	5	0.3 - 0.7m	4	Fruits	100mm		3 plants. Leaves chewed. 4 fruit on big plant	3
Quassia sp. B	QBWPT062	Moonee Beach Sth	5	0.4m	4	Fruits	30mm		6 fruits	1
Quassia sp. B	QB_extra2017	Moonee Beach Sth							4 additional Quassia sp. B recorded during 2017 survey	4
Quassia sp. B	QB41	Sapphire Nth	0							0
Quassia sp. B	QB41a	Sapphire Nth	4	0.7m	4		100mm		Plant healthy but damaged by tree fall.	1
Quassia sp. B	QB42	Sapphire Nth	5	0.1 - 0.6m	5	n/a	20-50mm		Healthy. 12 stems	12
Quassia sp. B	QB42a	Sapphire Nth	5	0.4 - 0.5m	5	both with fruit	30-50mm		Healthy - beside concrete fence post on E edge. Each plant with 1 fruit	2

Species	Id No.	Location	General Condition	Height	Leaf No., Condition	Flower / fruit	Length of new shoots	Evidence of disease	Note	No. plants per site
Quassia sp. B	QB42b	Sapphire Nth	0							0
Quassia sp. B	QB43	Sapphire Nth	4	0.2 - 0.4m	4		10-30mm		Healthy. 4 plants	4
Quassia sp. B	QB43a	Sapphire Nth	4	0.1 - 0.45m	4	7 fruits	10-40mm		3 stems (one new 'seedling'). 7 fruits on tallest plant	3
Quassia sp. B	QB44	Sapphire Nth	5	0.15 - 0.6m	5	fruits	20-50mm		Healthy. Fruits on 3 plants, 20 fruits in total (images)	8
Quassia sp. B	QB44a	Sapphire Nth	4	0.4m	4		30mm		Healthy. 1 stem in Gahnia on creek edge at E bndry	1
Quassia sp. B	QB45	Sapphire Nth	5	0.05 - 0.8m	5		10-80mm		Good health. 10 stems plus 2 'seedlings'	12
Quassia sp. B	QB46	Sapphire Nth	5	0.1 - 0.3m	4	Fruit	20mm		1 new 'seedling' 1m uphill from flagged plant. 6 fruit on larger plant	2
Quassia sp. B	QB47	Sapphire Nth	5	0.5m	5		100mm		Healthy	1
Quassia sp. B	QB48	Sapphire Nth	4	0.15 - 0.45m	4		80mm		Healthy	2
Quassia sp. B	QB49	Sapphire Nth	4	0.2 - 0.35m	4		20-40mm		4 stems plus 2 'seedlings' (root suckers?)	6
Quassia sp. B	QB50	Sapphire Nth	0							0
Quassia sp. B	QBWPT002	Sapphire Nth	3	0.15 - 0.6m	3				2 stems under tree fall but not damaged. Leaves yellowed	2

Lindsaea incisa			Condition	Height (cm)	Reproduction	Crown cover (%)	Notes
Lindsaea incisa	LI01	Orara East SF	4	30	Spores	30	6 stakes in NE corner of site. Previously recorded as WPT082
Lindsaea incisa	LI02	Orara East SF	4	50	Spores	40	4 stakes in central E section of site c. 3m WSW of large Needlebark (E. planchoniana).
Lindsaea incisa	LI03	Orara East SF	4	40	Spores	30	7 stakes in central W section of site, immediately S of Angophora costata.
Lindsaea incisa	LI04	Orara East SF	4	40	Spores	40	2 stakes in centre of site, c. 3.5 m SE of Angophora costata. Previously recorded as WPT085
Lindsaea incisa	LI05	Orara East SF	4	30	Spores	50	3 stakes due E of Angophora costata in N central part of site. Plants sparser than other sites. Drier here.
Lindsaea incisa	LI27	Orara East SF	3	20	Spores	20	Very healthy patch (1m X 1m)
Lindsaea incisa	LI28	Orara East SF	4	40	Spores	40	Very healthy patch (1m X 1m)

APPENDIX 2a: Results – Direct-seeded Rusty Plum

Results of direct-seeding 68 Rusty Plum seeds into Translocation Area 2, showing seedling height (cm) or the fate of un-germinated seeds from April 2011 (five months after sowing) to March 2017.

Field tag	Seedling height Apr 2011	Seedling height Oct 2012	Seedling height Oct 2013	Seedling height Mar 2014	Seedling height Nov 2014	Seedling height Feb 2016	Seedling height Mar 2017	Notes Mar 2017
D1	16cm	20	20	20	25			
D2	18cm	33		25	25			
D3	seed rotted							
D4	seed intact							
D5	grazed, reshot 6cm	44	45	60	70	160	200	Very healthy. 40cm new growth
D6	10cm	36	45	50	45	50		
D7	grazed, reshot 3cm	21						
D8	grazed, reshot 11cm	33		25	30	35	40	ok
D9	12cm	28		30	33	65	80	Good cond.
D10	10cm	41	50	45	50	50	60	Very good cond
D11	seed intact							
D12	seed rotted							
D13	22cm	30	36	40	40	45	55	no cage - OK
D14	14cm	35						
D15	seed rotted							
D16	15cm	17				30	35	OK
D17	grazed, reshot 9cm	18	25	25	30	40	50	OK
D18	grazed, reshot 10cm	28	28	30	30	30	35	Poor cond
D19	grazed, reshot 11cm	22	40	40	42	45	60	OK
D20	grazed, reshot 14cm	26	20	25	30	30	50	Good cond.
D21	16cm	15	15	20	20		25	Fair
D22	12cm	38	37	40	40	45	50	OK
D23	8cm	25	27	27	25	30	30	Almost dead
D24	15cm	24	30	30	30	40		
D25	seed rotted							
D26	seed gone							
D27	seed rotted							
D28	14cm	58		70	110			
D29	6cm	28		25	35	40	40	OK now
D30	seed gone							
D31	7cm	42	28	28	30	40	70	v good
D32	grazed, reshot 9cm	39	32	40	30	33	40	OK

Field tag	Seedling height Apr 2011	Seedling height Oct 2012	Seedling height Oct 2013	Seedling height Mar 2014	Seedling height Nov 2014	Seedling height Feb 2016	Seedling height Mar 2017	Notes Mar 2017
D33	15cm	42		25	35	30	30	Poor cond
D34	grazed, reshot 10cm	43		45	45	60	120	v good
D35	20cm	31	24	25	25			
D36	grazed, reshot 12cm	65	70	70	75	100	140	excellent
D37	grazed, reshot 15cm	41		40	40	45	55	v good
D38	14cm	37	34	30	36	45	50	excellent
D39	13cm	22						
D40	14cm	43	65	40	40	90	150	excellent
D41	grazed, reshot 17cm	46	55	60	65	80	120	excellent
D42	grazed, reshot 4cm	14		10	15			
D43	grazed, reshot 4cm	8			10	15	15	poor cond
D44	13cm	22	26	30	32	40	80	excellent
D45	grazed, reshot 1cm	14						
D46	22cm	35	35	40	42	45	45	poor cond
D47	grazed, reshot 1cm							
D48	13cm	18		15	20			
D49	10cm							
D50	18cm	24						
D51	grazed, reshot 7cm	33	33	33	35	60	100	v healthy, not browsed
D52	32cm	41	43	40	42			
D53	19cm	42	46	40	42			
D54	gone							
D55	seed intact							
D56	15cm	25		30	30	40	45	OK
D57	12cm			20	25	25	30	OK
D58	seed rotted							
D59	seed intact							
D60	10cm	16	15	15	20	15	15	Poor cond
D61	seed gone							
D62	seed rotted							
D63	seed intact		20	25	25	25	25	Looking better
D64	18cm	36	39	40	45	80	80	excellent
D65	17cm	45		50	55	90	90	excellent
D66	10cm	29	31	35	40	50	60	excellent
D67	11cm	23		35	40	55	65	excellent
D68	seed rotted							

APPENDIX 2b: Results – Transplanted Rusty Plum Seedlings

Seedlings of Rusty Plum introduced to Translocation Area 2 showing height (cm) from April 2011 to March 2017.

Field tag	Seedling height Apr 2011	Seedling height Oct 2012	Seedling height Oct 2013	Seedling height Mar 2014	Seedling height Nov 2014	Seedling height Feb 2016	Seedling height Mar 2017	Notes Mar 2017
P1	10	42	45	40	40	45	60	
P2	28	39	40	40	45	110	70	damaged by tree fall (repaired)
P3	16	32	50	45	40	0		
P4	14					0		
P5	15	43				0		
P6	14	36	35	35	40	65	65	
P7	8	10	15	17	20	25	30	
P8	14	47	45	50	55	70	75	not caged, OK
P9	13	33	36	36	36	45	80	good growth
P10	20	34	45	70	70	100	140	excellent
P11	8	32						
P12	15	35	35	35	35	45	60	in wire cage
P13	10							
P14	17	46	62	90	100	150	180	much healthier
P15	15	21	30	35	35	80	130	v healthy
P16	13	37		30	40	110	140	excellent
P17	8	15	27	27	35	55	90	v healthy
P18	10	10	12	15	17	20	20	not healthy
P19	21		15					
P20	6	8						

APPENDIX 3a: Monitoring results - *Lindsaea incisa* translocation quadrats, March 2017.

Condition Scores

Foliage Condition	Score
All healthy, green	5
Very slight yellowing	4
Slight to <50% yellowing	3
>50% yellowing	2
Dieback >20%	1
All dead	0

Area 1 March 2017

Plant No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Line A %CC	5	15	20	30	20	20	30	5	40	3	20	60	30	40	30	50
Line B %CC	0	10	10	0	2	5	30	5	0	0	20	0	30	30	0	0
Line C %CC	0	0	10	0	0	0	0	0	0	0	0	0	5	0	0	0
Line D %CC	5	5	15	1	3	5	3	5	20	30						
Line A condition	3	3	3	4	4	4	4	3	4	3	3	4	4	4	4	4
Line B condition		3	3		3	3	3	3			4		4	4		
Line C condition			4										4			
Line D condition	3	4	4	3	4	3	3	3	4	4						
Line A distance	20	40	30	30	50	60	40	0	100	50	20	80	80	70	70	80
Line B distance		0	0		50	20	0	20			0		10	40		
Line C distance			0										0			
Line D distance	10	50	30	0	30	20	0	10	40	100						

Area 2 March 2017

Plant No.	1	2	3	4	5	5a	6	7	8	9	10	11	12	12a	13	14	15	16	17	18	19	20	21	22	23	24	25
%CC			10	5			30	10	30								50	30		40							
condition			4	4			4	4	4								5	4		4							
distance			20	30			30	20	40								40	0		10							

APPENDIX 3b: Tests of significance - *Lindsaea incisa* mean crown cover Feb 2016 - Mar 2017.

Note: SD = Standard Deviation; SEM = Standard Error of the Mean; N = Number of samples (Online analysis using Graphpad t-test calculator at http://graphpad.com/quickcalcs/ttest1/)

Area 1 – Line A

P value and statistical significance:

The two-tailed P value equals 0.0003

By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 13.88

95% confidence interval of this difference: From 7.53 to 20.22

Intermediate values used in calculations:

t = 4.6643

df = 15

standard error of difference = 2.975

Group	Group One	Group Two
Mean	40.00	26.13
SD	12.65	16.05
SEM	3.16	4.01
N	16	16

Area 1 Line B

P value and statistical significance:

The two-tailed P value equals 0.1503

By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 3.00

95% confidence interval of this difference: From -1.22 to 7.22

Intermediate values used in calculations:

t = 1.5159

df = 15

standard error of difference = 1.979

Group	Group One	Group Two
Mean	11.88	8.88
SD	13.15	11.81
SEM	3.29	2.95
N	16	16

Area 1 Line C

P value and statistical significance:

The two-tailed P value equals 0.3700

By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 1.56

95% confidence interval of this difference: From -2.04 to 5.17

Intermediate values used in calculations:

t = 0.9242

df = 15

standard error of difference = 1.691

Group	Group One	Group Two
Mean	2.50	0.94
SD	6.83	2.72
SEM	1.71	0.68
N	16	16

Area 1 Line D

P value and statistical significance:

The two-tailed P value equals 0.0013

By conventional criteria, this difference is considered to be very statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 14.80

95% confidence interval of this difference: From 7.48 to 22.12

Intermediate values used in calculations:

t = 4.5708

df = 9

standard error of difference = 3.238

Group	Group One	Group Two
Mean	24.00	9.20
SD	7.38	9.41
SEM	2.33	2.98
N	10	10

Area 2 Line 1

P value and statistical significance:

The two-tailed P value equals 0.8117

By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 3.00

95% confidence interval of this difference: From -29.73 to 35.73

Intermediate values used in calculations:

t = 0.2545

df = 4

standard error of difference = 11.790

Group	Group One	Group Two
Mean	33.33	17.00
SD	25.98	12.04
SEM	8.66	5.39
N	9	5

Area 2 Line 2

P value and statistical significance:

The two-tailed P value equals 0.3388

By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 0.83

95% confidence interval of this difference: From -1.00 to 2.67

Intermediate values used in calculations:

t = 1.0000

df = 11

standard error of difference = 0.833

Group	Group One	Group Two
Mean	10.83	10.00
SD	19.75	18.59
SEM	5.70	5.37
N	12	12

APPENDIX 4: Rainfall Statistics

Actual and mean rainfall recorded at Coffs Harbour during the S2W threatened flora project (note that the January 2015 total is from the Woolgoolga weather station, as the Coffs Harbour station was not operational). Mean rainfall from Coffs Harbour meteorological station records 1943-2015 (*Australian Government Bureau of Meteorology. Online at* http://www.bom.gov.au/nsw/coffs_harbour).

	Mean Rainfall (mm)	2010	2011	2012	2013	2014	2015	2016	2017
January	187.5	17.2	263.6	357.8	480.8	43	210.4	82	157.2
February	224.8	253.2	125.8	311.6	379.3	64.2	494.5	31.5	112
March	234.6	182.8	168.4	142	126.3	211.7	244.6	72.7	311.8
April	178.4	73.2	469	264.2	168	146	176.1	116.3	
May	160.8	68.4	91.8	55.2	306.2	56	280.6	3.5	
June	120.8	129.6	419.2	272.4	90	40.7	52	340.5	
July	72.5	159.4	54.2	54.3	97.6	5	29	22.7	
August	79.5	20.6	163.2	11.7	2.8	275	25.5	176.9	
September	59.9	55.6	29.2	33.2	16.4	28	81.5	34.9	
October	96.3	424.8	180.6	24.8	54	11.6	35.9	26.1	
November	144.7	215.2	158	232	290.4	119.6	153.3	106.4	
December	144.9	391.4	170.8	79.6	32.6	245.2	184.9	63.6	
Totals	1704.7	1991.4	**2293.8**	**1838.8**	**2044.4**	**1246.0**	**1968.3**	**1077.1**	