VICTRACK ENVIRONMENTAL & PLANNING SERVICES

Translocation Plan for the Matted Flax-Lily; Year 4 Annual Report

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Acknowledgments

This report was produced with input from Garry French from Parks Victoria, who provided information on Parks Victoria management actions completed.

Limitations Statement

The sole purpose of this report and the associated services performed by Kellogg Brown & Root Pty Ltd (KBR) is to report on the condition of the translocated matted flax-lily in accordance with the scope of services set out in the contract between KBR and VicTrack ('the Client'). That scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

KBR derived the data in this report primarily from visual inspections, examination of records in the public domain and interviews with individuals with information about the site. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, KBR has relied upon and presumed accurate certain information (or absence thereof) relative to the sites provided by government officials and authorities, the Client and others identified herein. Except as otherwise stated in the report, KBR has not attempted to verify the accuracy or completeness of any such information.

No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings, observations and conclusions are based solely upon site conditions in existence at the time of the investigation.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between KBR and the Client. KBR accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

Revision History

Revision	Date	Comment	Signatures		
			Originated by	Checked by	Approved by
0	15/12/14	Final	A. Rigg	R. Pell	R. Pell

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1 Introduction

1.1 BACKGROUND

The South Morang Rail Extension Project (SMREP) was a controlled action based on the impacts to two Matters of National Environmental Significance (MNES), matted flax-lily (*Dianella amoena*) and Grassy Eucalypt Woodland of the Victorian Volcanic Plain (GEWVVP). The project was granted approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), subject to conditions, including the implementation of the *Translocation Plan for the Matted Flax-lily*.

Included in the conditions, Condition 5 requires the reporting of the projects' compliance with approval conditions.

1.2 PURPOSE

The translocation plan developed for the matted flax-lily requires that an annual report be prepared every year for 10 years on the status of the plan and the condition of the translocated plants after translocation. This document reports on the health of the translocated plants and the delayed translocation plants, planted during Year 2 of the translocation management program.

This report also includes reporting against each approval condition required for the project under EPBC 2010/5313. The report also proposes changes to site management if required, which may result in an update to the Translocation Plan. In light of the outcomes of previous annual monitoring and in agreement with relevant stakeholders, the Translocation Plan has recently been updated.

The current version, Revision 3, has recently been approved by relevant stakeholders and provided to the Department of the Environment by Public Transport Victoria (PTV) for approval. Reference to the Translocation Plan within this report relates to the current Revision 3 (May 2014).

1.3 SALVAGE AND TRANSLOCATION

The salvage of the matted flax-lily from the SMREP corridor took place from 30 September to 6 October 2010. A total of 98 distinct patches were removed from the corridor. From the 98 patches, 422 sections were removed, which resulted in:

- 183 sections directly planted into the receptor sites, excluding Receptor Site 3
- 135 sections taken to the nursery for subsequent plantings
- 104 sections taken to the nursery for insurance.

Following delayed translocation of matted flax-lily in August 2011, the total sections planted into each receptor site were:

- 52 sections planted into site 1

- 183 sections planted into site 2
- 108 sections planted into site 3 (all delayed translocation plants)
- 33 sections planted into site 4.

The remaining plants are held and managed at a Parks Victoria nursery for use as Insurance Plants. In accordance with the approved Translocation Plan, Parks Victoria may use excess nursery material gained from divisions of the Insurance Plants in plantings and revegetation, so long as enough insurance material is kept in the nursery to cover any deaths for the first 5 years of the translocation plan.

2 Plant health monitoring

2.1 METHOD

Annual matted flax-lily monitoring occurred over four days, on 8, 9, 22 and 23 October 2014. All direct and delayed translocation matted flax-lily were monitored. The monitoring of direct translocated plants corresponds with the Year 4 monitoring period, the monitoring of delayed translocated plants corresponds with the Year 3 monitoring.

2.1.1 Data collection

The following information was collected for each monitoring run using a hand-held GPS with a data-capture form. The data was captured at the location of the translocated plant into the receptor site. The following information was recorded:

- Plant ID Number; the number of the plant salvaged from the corridor
- Section Number; multiples of sections from plants salvaged and translocated
- Mat Width; taken at ground level of the greatest point between two tillers (cm)
- Maximum Height; height of tallest tiller, from ground to tip of leaf (cm)
- Number of Tillers; total number of tillers within section
- Presence of Inflorescence; any evidence of an inflorescence
- Stage of Flowering; early, flowering, late (if required)
- Stage of Fruiting; early, mid, late (if required)
- General Health; an assessment based on fields described below.

The assessment of the general health of the plant at the time of translocation was recorded based on categories ranging from Dead to Very Healthy. Each section translocated into a receptor site was assigned one of the following categories at the time of planting:

- Dead; plant generally with dead or dying leaves and no new growth
- Poor health; most leaves in poor condition, evidence of heavy herbivory or large areas of ‘browning’ of the leaves; > 30% of leaf area affected
- Moderate health; leaves either containing some level of ‘browning’ or some herbivory; 10 to 30% of leaf area affected

- Good health; leaves generally healthy, containing minimal evidence of herbivory or ‘browning’; < 10% of leaf area affected
- Very healthy; plant very healthy with no signs of herbivory or ‘browning’.

2.1.2 Data analysis

Data on the health of the plant was collected as five discrete categories ranging from Dead to Very Healthy. These descriptive ratings were then assigned an arbitrary health index to allow statistical analysis of change in health over time (Dead 0, Poor 25, Moderate 50, High 75, and Very High 100).

Plant health was analysed along with the other three continuous growth variables; width, height, and number of tillers. T–tests (Excel 2010) were then used to determine whether change in health or any of the growth variables was statistically significant. T–tests are a simple measure of similarity, used to compare the mean of two sets of data to determine if they are significantly different. Where results produced P values of <0.05, this was considered to be significant, and results with P values <0.01 were considered to be highly significant.

Statistical analyses of monitoring data enabled a more robust interpretation of plant growth data. Resulting mean growth variables for each parameter were illustrated using bar graphs to better visualize change in growth over time.

3 Results

3.1 PLANT HEALTH

A total of 378 direct and delayed translocated matted flax-lily sections were monitored. This includes 183 direct translocated sections and 195 delayed translocation sections. Of these, 8 sections were not located during the monitoring, with no above ground material present. These plants were assigned a rating of 'Dead' for the general health assessment. Seven of these plants considered dead were located in Receptor Site 2, with the remaining dead plant unable to be located in Receptor Site 1.

The current survival rate for translocated matted flax-lily is 97.9 per cent.

3.1.1 Direct Translocation

Overall, plant health indicators measured generally held steady from the previous monitoring (October 2013). The general health of plants and number of tillers both recorded increases from 2013, with plant health noted as significant ($P<0.05$). Both the width and height of plants reduced on average since 2013, with average height a strongly significant decrease ($P<0.01$). The results of all monitoring events since translocation are included in Table 3.1 and represented in Figure 3.1.

Currently, the overall health index is average at 69, which indicates that the plants are considered just below good health overall.

The decrease in average plant health of all direct translocation plants is only the second time in 4 years that a change, either decrease or increase in overall health has not recorded a strongly significant change and the first change in 18 months. The average width of plants and the number of tillers recorded only small changes since 2013, with decreases in averages of 1 cm and 2 cm respectively. Over the past 3 monitoring events, these two indicators have each recorded changes in averages of only 3 cm.

Table 3.1 Overall average health indicator results for direct translocation

Time since translocation	Health index	Width (cm)	Height (cm)	Number of tillers
Baseline	82	32	18	14
1 month	65**	33	26*	17**
3 months	74**	33	27	16
6 months	94**	40**	31**	27**
12 months	94	42**	32**	28
18 months	68**	47**	37**	22**
2 years	61**	52**	35	25
3 years	74**	50	33*	22*
4 years	69*	49	26**	24

*Significance of mean health variables using T-test where *P<0.05 and P<0.01***

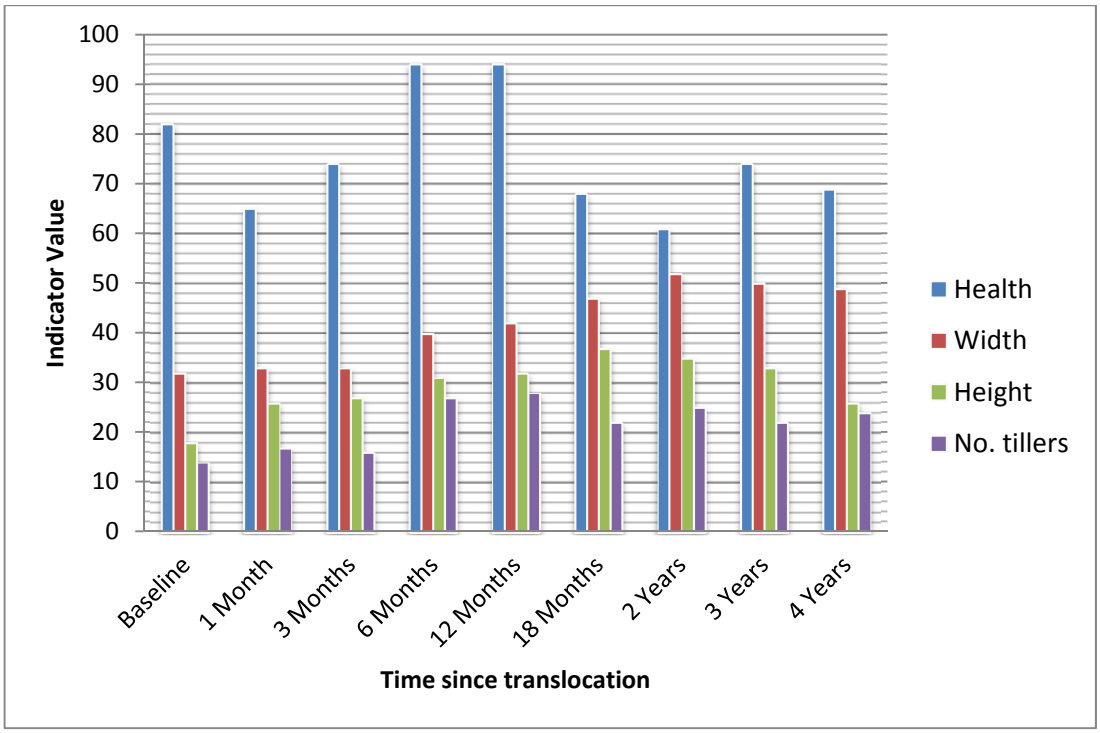

Figure 3.1
Health indicator values over time for direct translocation

Changes recorded in individual sites, for the period from 3 years to 4 years, generally reflect the overall results. The results for individual sites, Receptor Sites 1, 2 and 4 (no direct translocation occurred in Site 3), are included in Appendix A.

Receptor sites 2 and 4 both recorded a strongly significant decrease in the average height of plants, with Receptor Site 4 reducing by an average of 16 cm (P<0.01) and Receptor Site 2 recording an average decrease in height of 8 cm (P<0.01). No significant changes were recorded at Site 1, although the average height of plants increased on average by 2 cm.

Only one other change of significance was recorded between the current monitoring and 2013, with the average health of plants decreasing significantly at Receptor Site 1 (P<0.01). The average health decreased by an index of 16, from 94 at 2013 (considered very healthy), to an average health of 78 at 2014 (considered good health). However, the average health at Receptor Site 1 was consistent with the average health noted at 18 months and 2 years.

3.1.2 Delayed translocation

Overall, plant health indicators (plant health, width and height) for delayed translocation sections decreased in value compared to the previous monitoring event at 2 Years following translocation, in October 2013. Average number of tillers remained steady, maintaining an average count of 20 tillers per plant. Overall the average health of delayed translocated plants is considered slightly above moderate.

The results of all monitoring events since translocation are included in Table 3.2 and represented in Figure 3.2.

Table 3.2 Overall average health indicator results for delayed translocation

Time since translocation	Health index	Width (cm)	Height (cm)	Number of tillers
Baseline	80	42	43	35
1 month	43**	37**	38**	25**
3 months	72**	42**	33**	35**
12 months	88**	47**	22**	33
18 months	22**	20**	20*	5**
2 years	62**	47**	34**	20**
3 years	57*	44	24**	20

** Significance of mean health variables using T-test where *P<0.05 and P<0.01***

At 18 months since translocation, the average health for all delayed sections was on average below poor (poor health index is 25). At 2 years, the health of these plants had increased condition significantly (P<0.01) to between moderate and good health, with an average index of 62. Delayed translocation plants have displayed a high degree of variability between each monitoring period. This is highlighted by the health index and section width, which have both increased or decreased significantly (P<0.01) after each monitoring event. The overall monitoring results are represented in Figure 3.2.

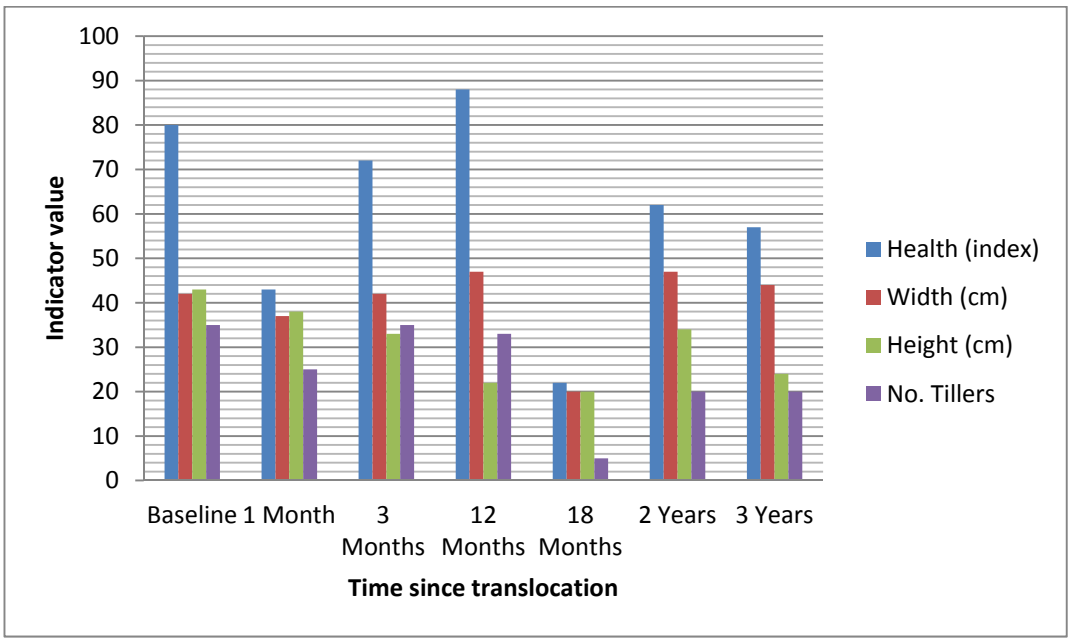

Figure 3.2
Health indicator values over time for delayed translocation

The results observed at each of the individual sites reflect those observed in the overall results. The results for each individual receptor site are included in Appendix B.

3.2 MONITORING DISCUSSION

Overall, the translocation effort has maintained a high level of success. The current survival rate of 97.9 per cent is the lowest rate achieved thus far, though is well above the required success target of 80 per cent (SMREP 2010). In general, this indicates that the species is well suited to translocation and that management of receptor sites has been adequate to maintain the presence of the species.

Critically, the most significant management action is considered to be the management of biomass. A key component in the management of grasslands and grassy ecosystems, biomass management allows for the regeneration and continual recruitment of grasses, herbs and forbs that maintain the diversity and processes of a grassy ecosystem. Several examples have been provided in previous reporting of the link between matted flax-lily presence and health and the level of biomass.

Biomass is likely to be an important management component due to the species ecology and methods to handle desiccation and water stress. As the species is known to be deciduous when water-stressed (Carter 2010), the regeneration of matted flax-lily following any dropping of leaves over hot and dry periods, is likely to be influenced by the amount of competition present following the onset of rains, generally around April in the Melbourne area.

Receptor Site 2 is considered to have the most significant management issues relating to biomass (see Figure 3.3). It is noted that of the eight plants considered dead during the 2014 monitoring event, seven of these plants were located in Receptor Site 2. Additionally, 21 plants were found to contain two tillers or less. Of these, 15 were

located within Receptor Site 2. The site has high levels of both biomass and weeds that threaten the persistence of matted flax-lily.

The biomass issues at Receptor Site 2 have been noted previously in annual reporting (SMREP 2012, KBR 2014). Despite not significantly affecting the current survival rate of the translocated plants, the survival rate of plants at Receptor Site 2 is likely to decrease over time without management.

Figure 3.3
High biomass of *phalaris aquatica* present in Receptor Site 2. The flag in the centre of the photo denotes a translocated matted flax-lily location

Parks Victoria are proposing to conduct a controlled burn within Receptor Site 2 during the upcoming 2014/15 fire season, followed by an increased weed control effort to reduce and then maintain lower levels of exotic biomass. Additional weed control works will be funded by PTV.

It is recommended that management measures be reviewed by Parks Victoria and PTV to control biomass levels at Receptor Site 2 over the long term. This will benefit the persistence of all plants at the site and encourage matted flax-lily plants to regenerate and recruit.

One approach may be to promote grazing of kangaroos in the fenced area. It was noted that rabbits had breached the gates at Receptor Site 2, with light grazing of several matted flax-lily near the gate. Seven plants were observed to have been affected by grazing, but were considered to have reasonable health, generally moderate and good, plus most still maintained high numbers of tillers.

Rabbit grazing is not considered appropriate, due to the animals often grazing and digging and eating rhizomes, however targeted kangaroo grazing, particularly during late summer and autumn could be facilitated by altering the gate structure. The application of this method should be agreed with Parks Victoria and DEPI.

Management techniques completed at Receptor Site 3 include spraying targeted grasses and herbs for the proposed re-seeding program. Herbicide spraying has affected the translocated matted flax-lilies at Receptor Site 3, with several tillers of many translocated plants either brown or yellow in appearance. The surrounding grasses had mostly cured from herbicide treatment. However, the majority of translocated plants included numerous regenerating tillers amongst the sprayed vegetation (Figure 3.4). It is likely that the thick rhizomes allow the species to handle a low rate herbicide compared to grasses and then regenerate following the removal of competition. Applying herbicide over matted flax-lily is only recommended amongst thick biomass and only very occasionally or a maximum of once annually.

Figure 3.4
Regenerating matted flax-lily tillers amongst herbicide treated grass in Receptor Site 3.

The translocated matted flax-lily plants are considered well established in each of the four receptor sites. The future success and health of the plants is likely to be linked to the level and effectiveness of management applied to each site. In general, the health and survival of matted flax-lily will continue or improve if ongoing management provides open spaces around plants and controls high threat weeds.

If high biomass levels are maintained or increase around matted flax-lily, it is likely that the success of the translocation will reduce over time.

4 Receptor site management

The following section briefly discusses management actions that have occurred over the previous year at each of the four receptor sites and comments on the current condition of each site, relevant to threats to matted flax-lily.

4.1 RECEPTOR SITE 1

Following the implementation of a controlled burn conducted during 2013, Parks Victoria has targeted annual grasses that have germinated following the burn. Otherwise, the site is considered to be in very good condition, with minimal potential threats from weeds and pest animals. Planned maintenance weed control will continue to occur within the site.

4.2 RECEPTOR SITE 2

Overall, the level of biomass appears to have reduced in Receptor Site 2 from previous years, however is still a significant management issue. The observed reduction in biomass is likely through effective management of the dominant exotic grasses (targeting large patches of Yorkshire fog (*Holcus lanatus*), phalaris (*Phalaris aquatica*), paspalum (*Paspalum dilatatum*) and sweet vernal-grass (*Anthoxathum odoratum*).

The general approach to management has been to target large infestations of weeds, spot-spraying of all broad-leaf and woody weeds, while attempting to avoid the matted flax-lily. Occasional unintentional exposure of matted flax-lily to herbicide residue is likely to result in the poor health and lower survival rate of matted flax-lily observed at this site.

Overall this site is considered to be in moderate to poor condition, with high biomass and grassy weeds threatening translocated plants. It was also noted that several woody weeds are regenerating, mainly hawthorn (*Crateagus monogyna*) at the southern end of the site. Additional management is required at this site to reduce the high biomass and grassy weed cover, including a planned burn during the 2014/15 fire season.

4.3 RECEPTOR SITE 3

Due to the low success rate and the extensive cover of high threat weeds, particularly Chilean needle-grass (*Nassella neesiana*), an additional weed control and re-seeding program has been proposed and included in the latest revision of the Translocation Plan. This program is currently underway.

This program aims to create a suitable environment that is favourable to native grass seed germination and establishment by removing the existing weed biomass and exhausting the weed seed bank. This is achieved through multiple spraying events

over an 18 month period, interspersed with cultivation of the soil to stimulate germination of weed seed for treatment and prepare the soil for seeding with native grasses.

At the time of the annual monitoring, the majority of the site was bare, except for the two plots containing translocated matted flax-lily and small patches of native grasses and forbs and discrete areas not yet cultivated. Very few high threat weeds, including Chilean needle-grass, were present and with very low cover (less than 1 per cent).

High levels of grass biomass were present in the northern plot containing translocated matted flax-lily, with moderate levels in the southern plot. Both plots had recently been treated with herbicide and the exotic grasses and herbs were curing, creating space for regenerating translocated matted flax-lily.

With intensive site management currently occurring, threats to matted flax-lily are considered to be controlled.

4.4 RECEPTOR SITE 4

Weed control was undertaken in autumn, winter and spring. Biomass control was implemented to reduce the level of biomass around translocated matted flax-lily, as previously there was often a high level of couch (*Cynodon dactylon*) and panic veldt-grass (*Ehrharta erecta*) around translocated plants. At the time of the annual monitoring, weed and biomass levels were low within the receptor site.

As part of the management strategy, the perimeter fence was repaired after several minor vandalism instances, to ensure it was rabbit-proof and functional. During annual monitoring, no evidence of rabbits was found, or of kangaroos, which have not been observed at the site since the last fence repair.

Receptor site 4 is considered to be in good condition with potential threats from weed species and faunal pests mitigated by current management.

4.5 ADAPTIVE MANAGEMENT

The adaptive management program currently operating within Receptor Site 3 (as described in Section 4.3) is currently controlling threats to matted flax-lily, with weeds observed to be at very low levels.

Adaptive management has also been proposed at Receptor Site 2, which includes a planned controlled burn during the current fire season (2014/15) and intensive follow-up weed control. As previous controlled burns completed at sites 1 and 3 have resulted in increases in translocated matted flax-lily health indicators, a controlled burn at Receptor Site 2 is likely to be highly beneficial for the site and the translocated plants.

Follow-up management will target the likely high levels of exotic pasture grass regeneration from the seed bank, with additional resources provided by PTV to target and control exotic grasses.

The success of these adaptive management measures will be reassessed in the next annual monitoring. Currently, the threats at Receptor Sites 1 and 4 are considered to be controlled and no other adaptive management measures are recommended.

5 Compliance with EPBC Act conditions

The following table (Table 5.1) describes how SMREP and PTV have demonstrated compliance with each of the EPBC approval conditions for the project (referral number EPBC 2010/5313).

Table 5.1 Summary of compliance with approval conditions

Conditions of approval	Compliance with approval conditions
1. For the protection of the endangered matted flax-lily (*Dianella amoena*) and the critically endangered Grassy Eucalypt Woodland of the Victorian Volcanic Plan (GEWVVP) within the rail reserve, adjacent E6 road easement, McDonald Road reserve and South Morang Protection Zone (see Attachment 1) the Matters of National Environmental Significance, Document No. SMREP–APP–PW–ENV–010, Revision 0, South Morang Rail Extension Project (September 2010), must be implemented.	Implementation of this plan occurred during the construction phase of the project. Construction is now complete and there are no remaining actions that are required to be implemented.
2. For the protection of the endangered D. amoena the *Translocation Plan for Matted Flax-lily*, Document No. SMREP–REP–PW–ENV–002, Revision 1, South Morang Rail Extension Project (September 2010), must commence prior to the commencement of construction and be implemented for a period of at least 10 years.	The salvage effort to translocate affected matted flax-lily began on 30 September 2010 and was completed on 6 October 2010. Construction commenced on the 13 October 2010, following the salvage of matted flax-lily. A revised plan (Revision 3) was recently reviewed and agreed by stakeholders and has been submitted to DoE for approval. The revision incorporates adaptive management to satisfy approval conditions.
3. Within 7 days of construction commencing the person taking the action must advise the Department in writing of the actual date of commencement.	An email was sent by Shelley Heron (SMREP Environment & Approvals Manager) to Narelle Sutherland (DoE Assessment Officer) to confirm the commencement of construction on 15 October 2010.

Table 5.2 Continued.

Conditions of approval	Compliance with approval conditions
4. If ownership and/or management of the protected land is to be transferred to another party, the person taking the actions must provide the Department with evidence that the other party has agreed to assume all the management responsibilities in accordance with the Translocation Plan and MNES Plan, and the conditions of this approval prior to any transfer occurring.	PTV has assumed the overall responsibility of the project approvals, with assistance from VicTrack, who have agreed to complete monitoring and reporting actions of all sites and management actions for Site 4. PTV and VicTrack have been assigned responsibility of actions within the current Translocation Plan, issued to DoE on 22 September 2014.
5. Within three months of every 12 month anniversary of the commencement of salvage of material for the translocation of D. amoena, the person taking the actions must submit to the Department a report addressing compliance with the conditions of this approval. Annual reports must be provided until the Minister is satisfied that the proponent has complied with all conditions of the approval.	This report demonstrates compliance with this condition.
6. If the person taking the action wishes to carry out any activity otherwise than in accordance with the MNES Plan or Translocation Plan referred to in condition 1 and 2 the person taking the action must submit for the Minister's approval a revised version of the MNES Plan or Translocation Plan. The varied activity shall not commence until the Minister has approved the varied MNES Plan or Translocation Plan in writing. If the Minister approves such a revised plan that plan must be implemented in place of the MNES Plan or Translocation Plan originally approved.	Revision 3 (May 2014) of the Translocation Plan has been approved by the relevant stakeholders, VicTrack, PTV, Parks Victoria and DEPI. The revision includes changes to management responsibility and critical adaptive management measures to control threats at Receptor Sites 2 and 3. This revision was submitted to DoE on 22 September 2014.
7. If the Minister believes that it is necessary or desirable for the better protection of listed threatened species and communities (under sections 18 and 18A of the EPBC Act) to do so, the Minister may request that the person taking the action make specified revisions to the MNES Plan or Translocation Plan approved pursuant to condition 1 and 2 and submit the revised MNES Plan or Translocation Plan, for the Minister's approval. The person taking the action must comply with any such request. The revised approved MNES Plan or Translocation Plan must be implemented. Unless the Minister has approved the revised MNES Plan or Translocation Plan then the person taking the action must continue to implement the MNES Plan or Translocation Plan originally approved, referred to in condition 1 and 2.	No such request has been made.

Table 5.1 Continued

Conditions of approval	Compliance with approval conditions
8. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the above conditions of approval, including measures taken to implement the MNES Plan or Translocation Plan required by tis approval, and make them available upon request to the Department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the Departments website. The results of audits may also be publicised through the general media.	Records on the health of the matted flax-lily have been compiled and reported on in this report.

6 Conclusions

The current survival rate of 97.9 per cent is well above the plan success target of 80 per cent however, the figure is the lowest since translocation and continues a trend of additional two or three plants considered dead each year. Notably, the majority of dead plants are present within Receptor Site 2, where grass biomass and competition for available space for matted flax-lily is the greatest of all four receptor sites. Additional plants will be lost in future without immediate management.

Planned management of Receptor Site 2, through a controlled burn and additional weed control, has the potential to increase the health of matted flax-lily at the site. An increase in space may also allow for regeneration of some plants previously considered dead, due to the species growing from rhizomes and their ability to persist in the soil. This will be assessed in the next annual monitoring following the controlled burn.

Overall, the health of translocated matted flax-lily sections appears to be reflected by the extent of management conducted around each plant. In general, plant health has increased when surrounding biomass has been controlled and reduced. This observation was noted during monitoring following burns conducted by Parks Victoria at Receptor Sites 3 (SMREP 2012) and 1 (KBR 2014). In the current monitoring period, following herbicide spraying at Receptor Site 3 there has been observed regeneration of matted flax-lily following the removal of weed biomass as the dying vegetation cures.

Matted flax-lily is durable and can persist in degraded sites, including those with high weed cover. Despite this persistence, the species is considered particularly vulnerable to a high biomass of perennial grasses during dry and hot periods, when the plant responds to water-stress by becoming deciduous and losing all above ground material. Matted flax-lily will typically reappear following autumn rains, but may stay dormant in the soil if no space is available to germinate into or if there is high competition for resources, such as soil moisture. If biomass and completion is not removed physically, the matted flax-lily may not regenerate. It is not known how long the species can remain dormant in the soil.

Ongoing biomass management is essential at all sites to maintain the health and viability of matted flax-lily. It may also be prudent to target biomass control activities during late summer and early autumn to provide space for species to regenerate into prior to autumn rains.

7 References

BoM 2014, Seasonal Climate Summary for Melbourne Metropolitan Area and Environs. http://www.bom.gov.au/climate/current/season/vic/archive/201302.melbourne.shtml#recordsTmaxAvgRecenthigh. Website accessed 31 October 2014.

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KBR 2014, South Morang Rail Extension Project, Year 3 Annual Monitoring Report. Prepared by Kellogg Brown & Root Pty Ltd for Public Transport Victoria, Melbourne.

SMREP 2010, Translocation Plan for the Matted Flax-lily. South Morang Rail Extension Project, South Morang.

SMREP 2012, South Morang Rail Extension Project, Year 2 Annual Monitoring Report. South Morang Rail Extension Project, South Morang.

Appendix A

MONITORING RESULTS PER SITE–DIRECT TRANSLOCATION

Table A1 Direct translocation results—Site 1

Time since translocation	Health index	Width (cm)	Height (cm)	Number of tillers
Baseline	81	31	19	14
1 month	68**	30	30**	18**
3 months	79**	33	27	14*
6 months	97**	38**	29	22**
12 months	96	44*	36**	25
18 months	72**	43	32	18
2 years	75	52*	33	22
3 years	94**	55	27*	26
4 years	78**	56	29	25

*Significance of mean health variables using T-test where *P<0.05 and P<0.01***

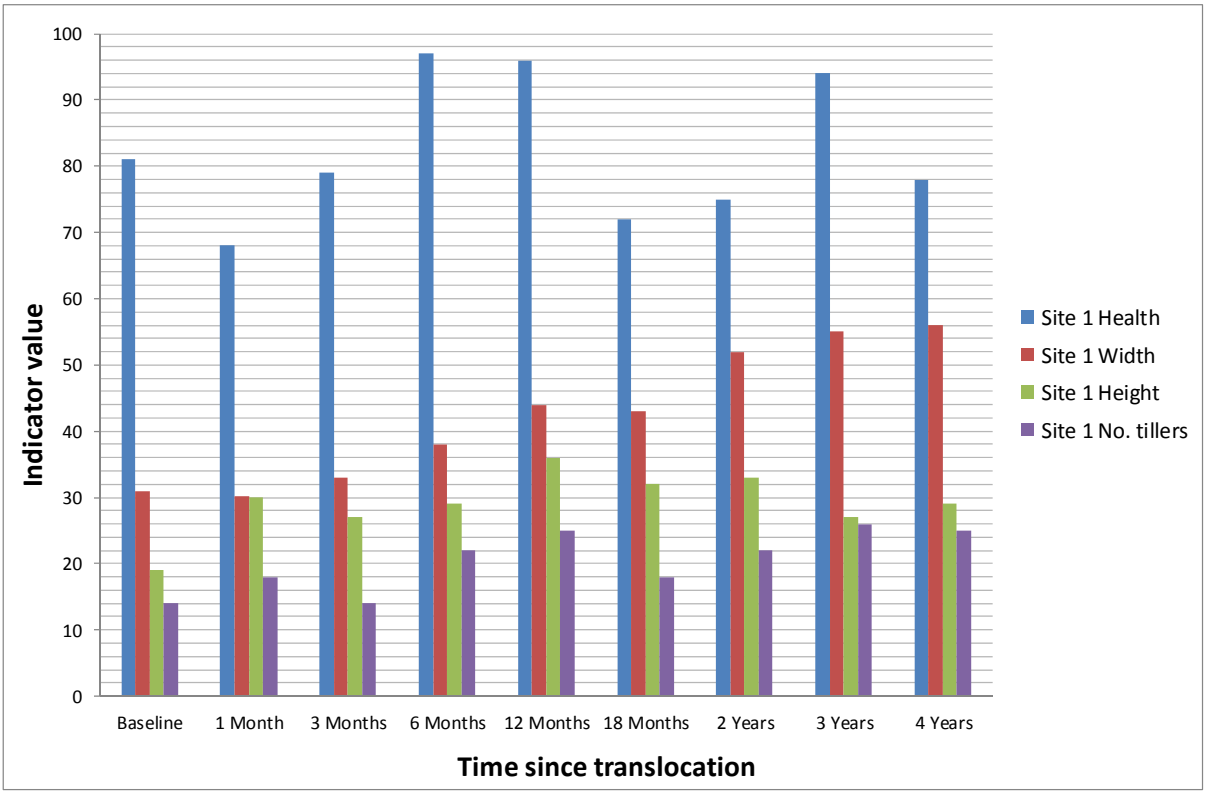

Figure A1
Direct translocation results—Site 1

Table A2 Direct translocation results—Site 2

Time since translocation	Health index	Width (cm)	Height (cm)	Number of tillers
Baseline	82	33	18	15
1 month	63**	35	26**	18**
3 months	72**	32	27	16
6 months	93**	40**	31**	29**
12 months	93	40	31	29
18 months	67**	48**	39**	22**
2 years	53**	50	34**	23
3 years	67**	47	34	20*
4 years	65	46	26**	22

*Significance of mean health variables using T-test where *P<0.05 and P<0.01***

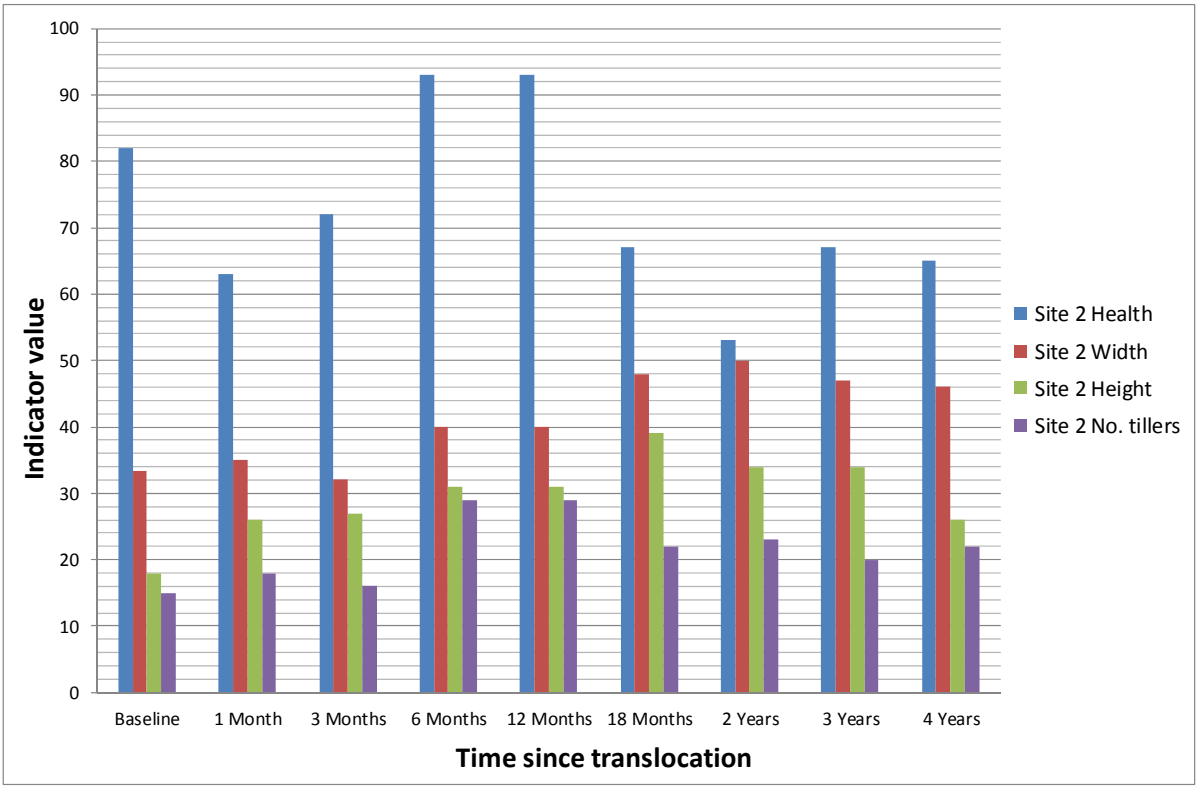

Figure A2
Direct translocation results—Site 2

Table A3 Direct translocation results—Site 4

Time since translocation	Health index	Width (cm)	Height (cm)	Number of tillers
Baseline	78	26	18	12
1 month	80	29	27**	10
3 months	84	36*	33	21**
6 months	96**	46**	35	27**
12 months	96	46	35	27
18 months	81**	49	36	28
2 years	91*	63**	42*	39**
3 years	88	59	40	27**
4 years	81	60	24**	33

*Significance of mean health variables using T-test where *P<0.05 and P<0.01***

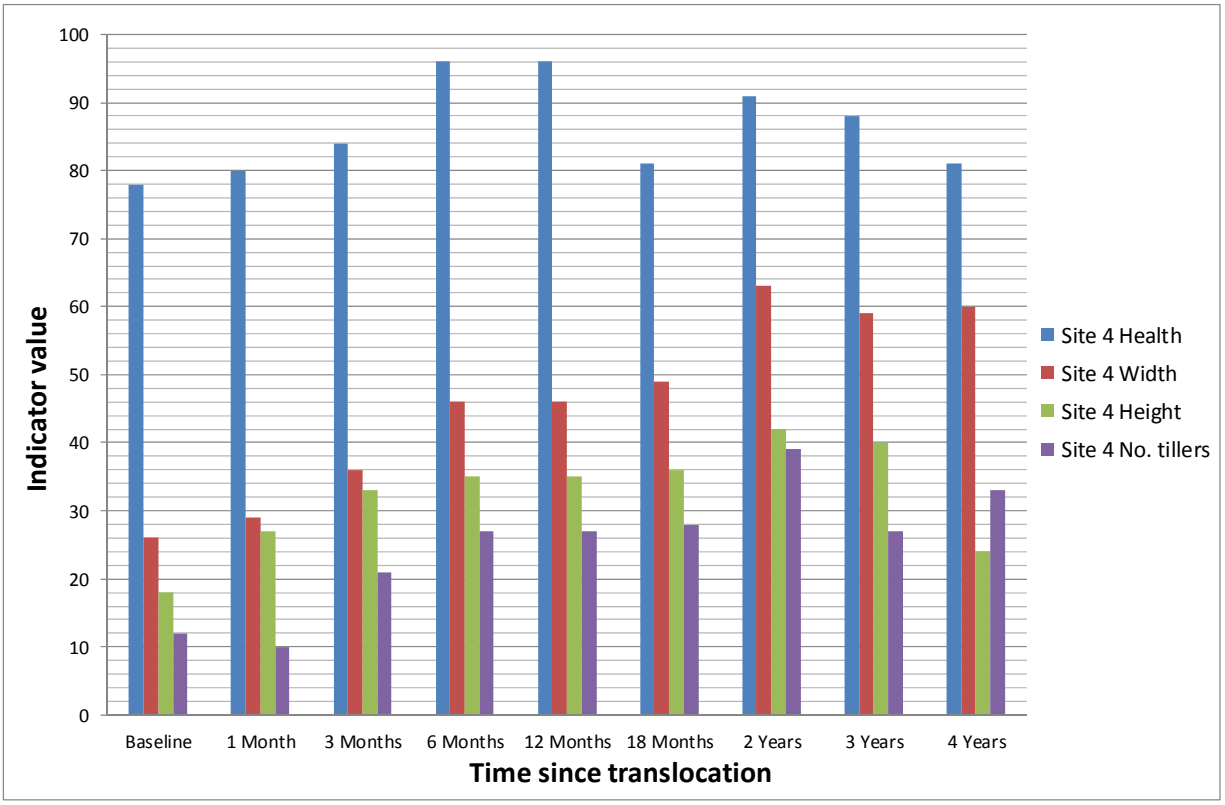

Figure A3
Direct translocation results—Site 4

Appendix B

MONITORING RESULTS PER SITE–DELAYED TRANSLOCATION

Table B1 Delayed translocation results—Site 1

Time since translocation	Health index	Width (cm)	Height (cm)	Number of tillers
Baseline	75	46	51	29
1 month	49**	43	44	24
3 months	75**	43	34**	29
12 months	88	47	25**	28
18 months	24**	23**	22	3**
2 years	100**	57**	29*	34**
3 years	76**	61	29	32

*Significance of mean health variables using T-test where *P<0.05 and P<0.01***

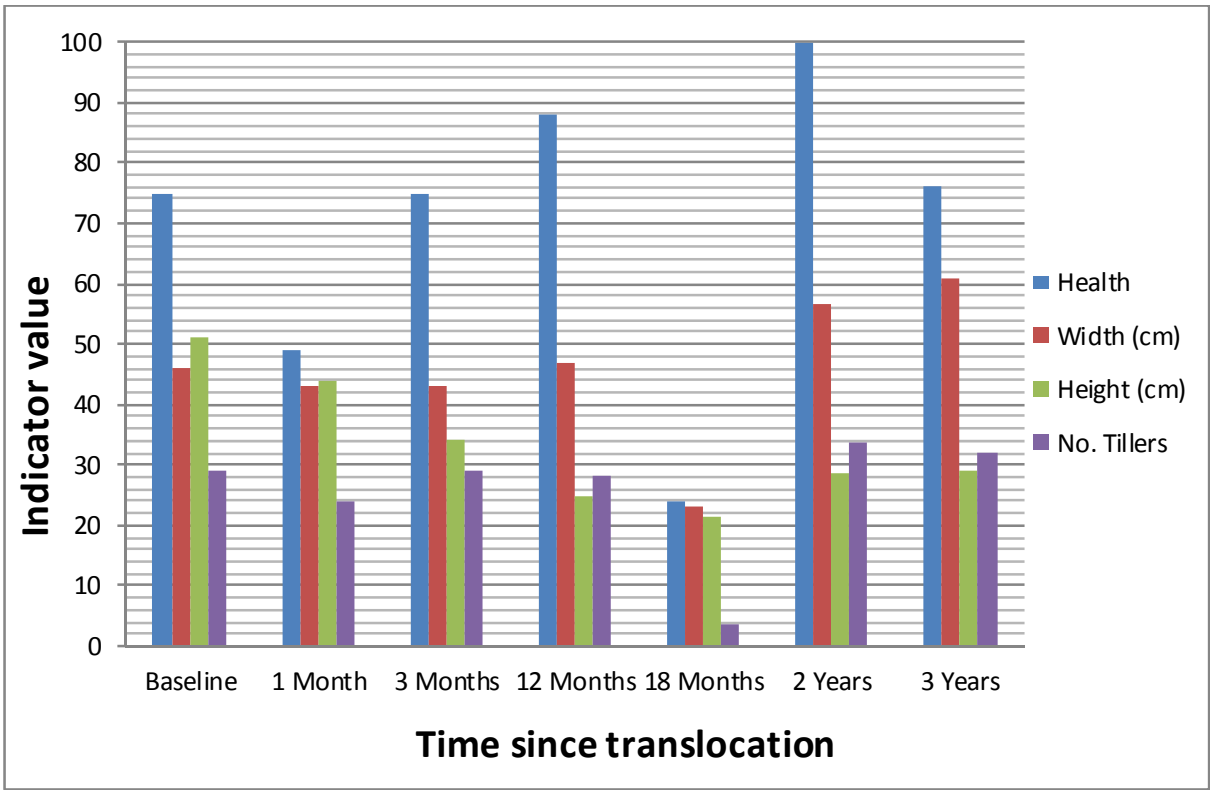

Figure B1
Delayed translocation results—Site 1

Table B2 Delayed translocation results—Site 2

Time since translocation	Health index	Width (cm)	Height (cm)	Number of tillers
Baseline	79	43	37	31
1 month	31**	34**	36	19**
3 months	70**	40**	31**	30**
12 months	73	40	30	20**
18 months	16**	10**	12**	2**
2 years	55**	34**	25**	11**
3 years	50	33	19**	13

*Significance of mean health variables using T-test where *P<0.05 and P<0.01***

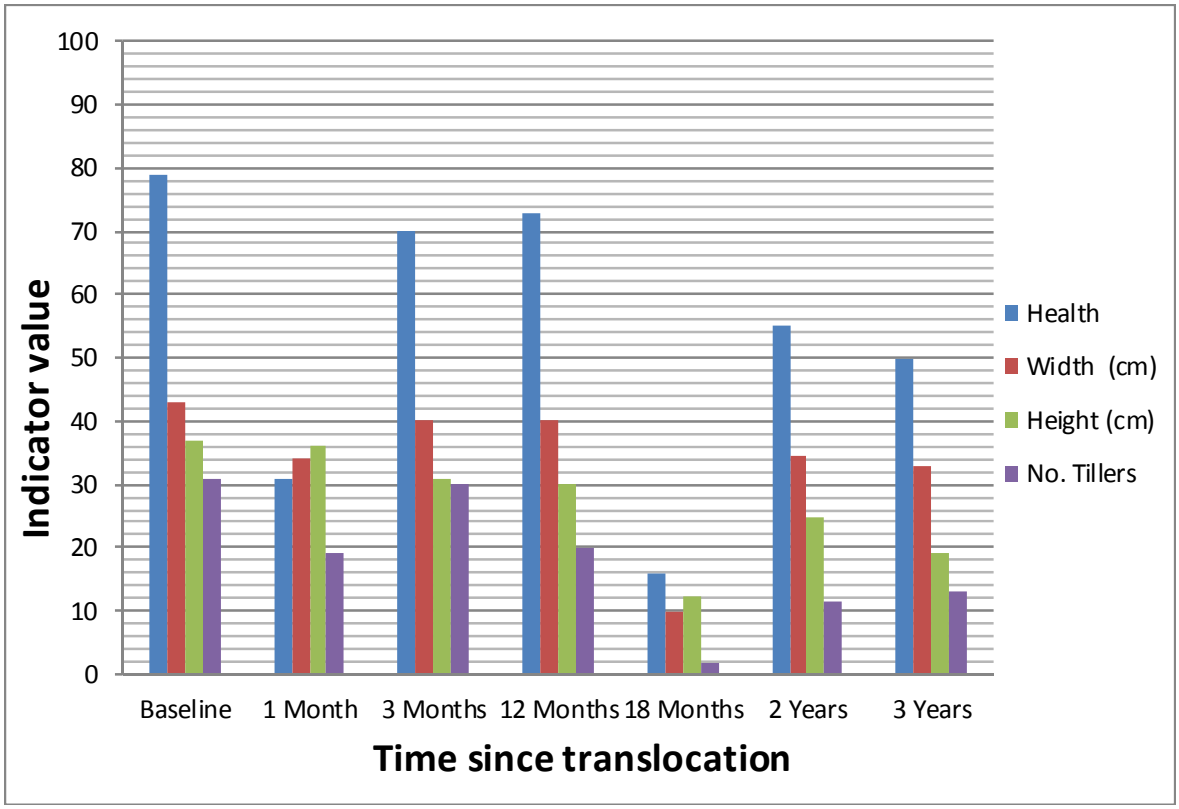

Figure B2
Delayed translocation results—Site 2

Table B3 Delayed translocation results—Site 3

Time since translocation	Health index	Width (cm)	Height (cm)	Number of tillers
Baseline	81	42	44	37
1 month	43**	37**	37**	26**
3 months	71**	43**	33**	38**
12 months	95**	49**	17**	40**
18 months	24**	24**	23**	7**
2 years	57**	49**	38**	19**
3 years	53*	44**	24**	20

*Significance of mean health variables using T-test where *P<0.05 and P<0.01***

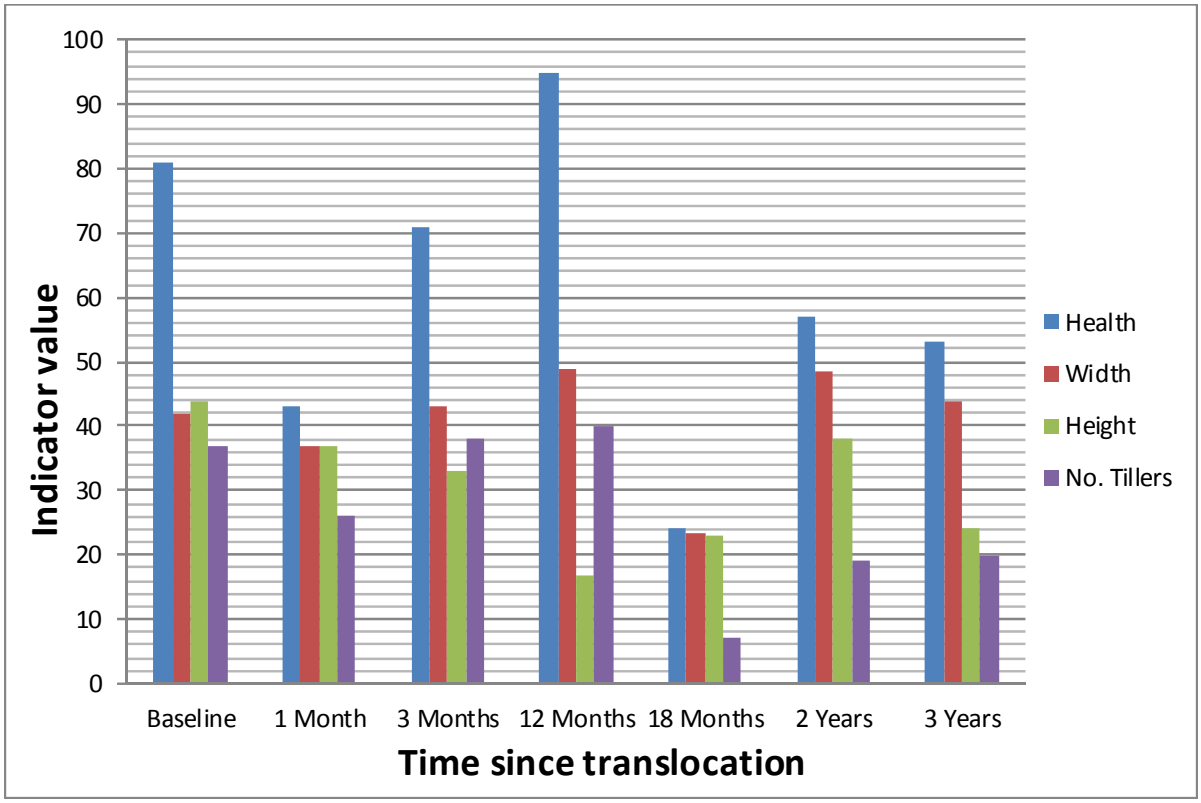

Figure B3
Delayed translocation results—Site 3

Table B4 Delayed translocation results—Site 4

Time since translocation	Health index	Width (cm)	Height (cm)	Number of tillers
Baseline	79	40	45	41
1 month	81	36	42	42
3 months	81	36	41	45
12 months	96**	55**	36	36
18 months	25**	32**	25**	6**
2 years	83**	66**	48**	35**
3 years	94	69	36	40

*Significance of mean health variables using T-test where *P<0.05 and P<0.01***

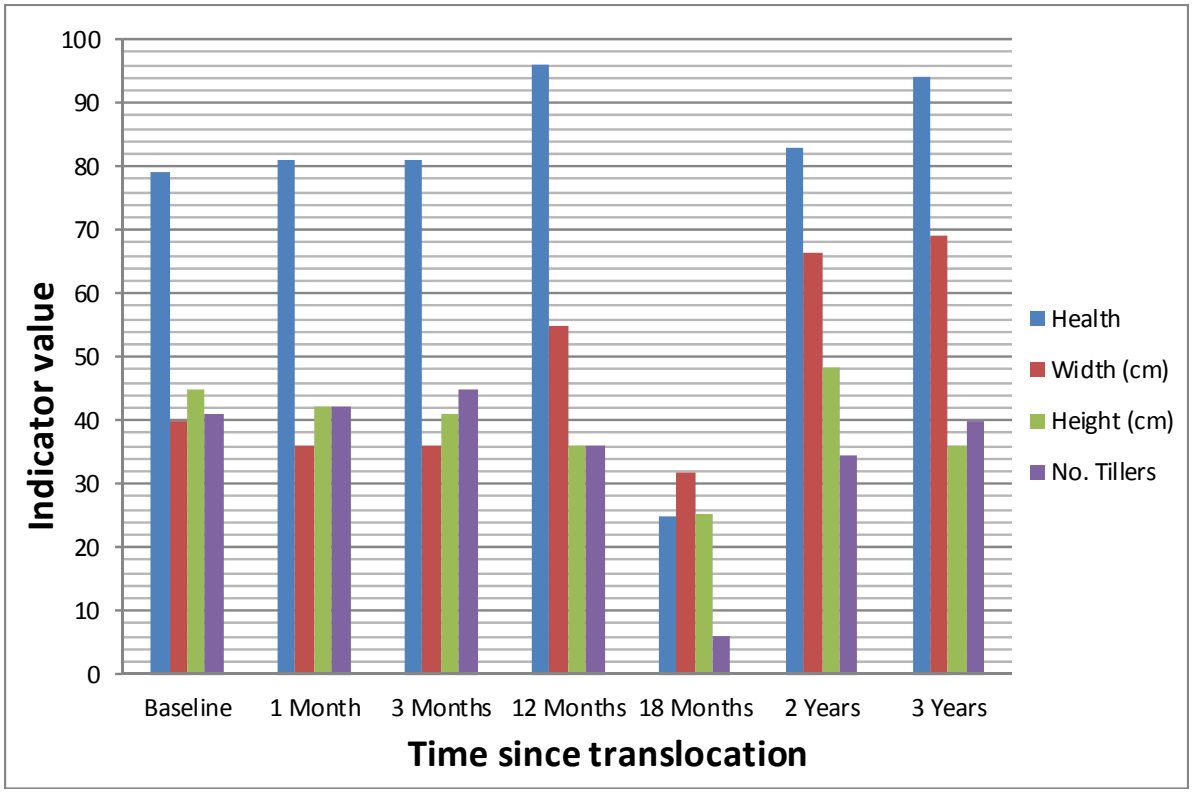

Figure B4
Delayed translocation results—Site 4