



Annual monitoring of Matted Flax-lily:
Aurora, Epping (2016–17)

FINAL REPORT

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1 Background

Biosis Pty Ltd was commissioned by Lendlease Communities (Australia) Limited to undertake the year 9 (2016/17) annual monitoring of the Matted Flax-lily *Dianella amoena* population within reserves 2-3, 5-7, 9 and 11-13 at the Aurora residential development, Epping, Victoria (Figure 1).

1.1 Approval under the EPBC Act

The Aurora development area (ADP2, refer to Figure 2) received approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 16 March 2008, subject to several conditions (DEWHA 2008). Conditions relating to Matted Flax-lily include 1, 2c and 2e, and area outlined below.

1. The person taking the action must undertake all works in accordance with the Aurora Conservation Management Plan – January 2008 (Biosis Research 2008).
2. To protect the threatened species listed EPBC Act, in particular the Matted Flax-lily and Golden Sun Moth *Synemon plana*, the person taking the action must monitor and manage the reserves identified in Figures 1a and 1b in accordance with the Aurora Conservation Management Plan – January 2008. In particular the following actions must be taken:
 - c. Monitoring of the Matted Flax-lily is to be undertaken between 1 October and 1 March every 12 months commencing 2008 and continuing for a period of 10 years after establishment of reserves.
 - e. If monitoring indicates a decrease of the Matted Flax-lily, the cause of the decline must be investigated. Corrective actions must be developed and implemented. In this event the Department must be provided, within two months of the monitoring results being known, with a report stating the corrective action(s) implemented.

1.2 Annual monitoring

Biosis has monitored the Matted Flax-lily population at Aurora annually since 2008. Annual reports submitted to the relevant Departments are listed in Table 1.

Table 1 Annual monitoring reports

Year	Report
Year 1: 2008	Letters to DEWHA, 5 May and 26 June 2009
Year 2: 2009	Report to DEWHA, 19 July 2010
Year 3: 2010	Report to DSEWPaC, 4 May 2011
Year 4: 2011	Report to DSEWPaC, 8 June 2012
Year 5: 2012	Report to DSEWPaC, 4 April 2013
Year 6: 2013	Report to DoE, 11 April 2014
Year 7: 2014	Report to DoE, 12 March 2015
Year 8: 2015	Report to DoE, July 2016
Year 9: 2016	Current report – to be sent to Department of Environment and Energy upon finalisation

Figure 1 Location of the Aurora development, Epping North, Victoria

Figure 2 Conservation reserves and the distribution of Matted Flax-lily, year 9

Conservation reserves within Aurora and the distribution of Matted Flax-lily, year 9

1.3 Timing of surveys

A total of 30 Matted Flax-lily were included in the EPBC referral submission and these plants were recorded over a number of years prior to March 2008. Since then, Biosis has completed eight years of annual Matted Flax-lily population monitoring. Surveys undertaken are set out in Table 2.

Table 2 Annual monitoring surveys

Year	Surveys
Pre 2008	Original records – plants included in the EPBC approval in March 2008, from surveys between 2001–2008 (i.e. the 30 original records)
2008/9 Year 1	Monitoring in December 2008 and June 2009
2009/10 Year 2	Monitoring in November 2009 and January 2010 (when plants were staked) and May/June 2010
2010/12 Year 3	Monitoring in December 2010 and January 2011 (when new plants were located with a DGPS and staked)
2011/12 Year 4	Monitoring in January/February 2012
2012/13 Year 5	Monitoring in December 2012 and January 2013
2013/14 Year 6	Monitoring in December 2013
2014/15 Year 7	Monitoring in December 2014 and January/February 2015
2015/16 Year 8	Monitoring in December 2015
2016/17 Year 9	Monitoring in December 2016 and January 2017

In years 1 and 2 monitoring was undertaken in late spring/summer (as per the EPBC approval conditions), when the plants were due to flower and therefore generally easier to locate. However, due to poor conditions (drought and grazing) during 2008–2010 it was found that most of the plants had not flowered and were generally difficult to locate during the late spring/summer period. As a result, for both years 1 and 2, Biosis undertook follow-up surveys in autumn/winter, following substantial rains and subsequent growth of the plants. In both years, the plants were easier to locate at this time.

Surveys in years 3–9 have been undertaken in late spring/summer only. Plants were observed to be flowering and fruiting in each of these years and were mostly easily located. In addition, all of the plants have now been individually marked in the field with star pickets and labels, making them easier to locate.

1.4 Additional plants

Many additional plants have been located within reserve 9 since year 1, such that the reserve has been found to support an above-average population of the species. By December 2011, a total of 82 plants had been recorded within this reserve. At this point it was decided there was no further value in continuing to record or monitor additional plants so Biosis have ceased to record, mark or monitor any additional plants encountered during surveys. It is known that the number of plants in reserve 9 exceeds the 82 plants recorded to date.

An additional 26 Matted Flax-lily plants were recorded outside of reserves 6, 9 and 10 prior to 2014. These were salvaged in January 2014 in accordance with the translocation plan (Biosis 2013). Clones of these plants were translocated into reserve 7 in winter 2015. Extra clones of each plant are currently being maintained by Grey Box and Grassland Indigenous Nursery (GAGIN). Translocated Matted Flax-lily plants are now being monitored as part of the annual monitoring.

2 Methods

2.1 Marking of Matted Flax-lily

At commencement of the 10-year monitoring program, the locations of Matted Flax-lily were recorded using a hand-held GPS unit (+/- 7 m accuracy). This aided in relocation of plants, but still led to difficulties where plants were stressed and/or surrounding biomass was high.

Biosis have since recorded plants with a DGPS, which has greater accuracy than a standard GPS (+/- 4 m) enabling improved accuracy of mapped Matted Flax-lily locations.

All monitored Matted Flax-lily have also been marked with a star picket positioned adjacent to each plant with a numbered tag attached to each star picket. This has made relocation of plants much easier and also ensures contractors undertaking vegetation management works within conservation reserves are aware of the location of all Matted Flax-lily plants.

2.2 Monitoring data

During year 9 (2016/17) monitored plants were located using current mapping (Figure 2) and with the aid of star pickets next to each plant.

The following information was recorded for each plant:

- Plant health (good, moderate, poor)
- Number of inflorescences (< 5, $\geq 5 < 10$, ≥ 10)
- Approximate number of leaf tufts (< 5, $\geq 5 < 10$, ≥ 10)
- Approximate spread of the plant (width at the widest point in cm)
- Management/other notes (e.g. relating to presence of fruit, if weeding is required, evidence of herbivory).

2.3 Year 9 monitoring dates

Monitoring in Year 9 was undertaken on 21, 22 and 23 December 2016, and 12 January 2017.

3 Results

The total number of Matted Flax-lily recorded in each reserve is provided in Table 3 and plant health data is provided in Table 4 and 5. Figure 2 indicates the location of monitored Matted Flax-lily in year 9.

Data for the translocated Matted Flax-lily has been tabulated separately in this report to distinguish remnant population health from translocated population health (Table 5).

3.1 Annual numbers of Matted Flax-lily

Table 3 provides the located and monitored numbers of Matted Flax-lily by survey year. During the period 2008 – 2011 (years 1 – 3) the reserves were surveyed and numbers of Matted Flax-lily were recorded. Over this period the number of Matted Flax-lily present increased significantly. After this point no additional plants were recorded and monitoring focused on the health and survivorship of the known population. In year 1 data was collected on 25 Matted Flax-lily across the entire Aurora landholding whereas in year 9 data was collected on 163 Matted Flax-lily plants. It is possible some of the additional plants are due to recruitment within the population, but the increase is also likely to be a result of a higher level of survey effort over time enabling these plants to be found. Despite small annual fluctuations in recording of individual Matted Flax-lily plants, the Aurora population is considered to be stable and thus it appears that current management of the population is appropriate.

3.2 Plant health

A comprehensive level of data collection relating to Matted Flax-lily health, including numbers of inflorescences and leaf tufts, commenced in year 4 (2011/12). A comparison of data collected in years 4 to 9 for remnant Matted Flax-lily is provided in Table 4. Translocated Matted Flax-lily health data is provided in Table 5. Health data collected during year 9 includes Matted Flax-lily from reserves managed by Lendlease Communities (Australia) Limited.

The apparent decline in health observed between years 7 and 8 was reversed in year 9. In year 9, 86 per cent of plants were recorded with 'good' health compared to 47 per cent in year 8 – a return to the good health observed in years 6 and 7. Numbers of inflorescences present also increased in year 9 with 58 per cent of plants containing more than five inflorescences compared to 15 per cent in year 8. A high number (96 per cent) of translocated plants were recorded with inflorescences this season, however, 47 per cent of remnant plants had no inflorescence this season.

Translocated plant health in year 9 is generally lower than that of the natural populations with 67 per cent of plants in 'good' health. Most translocated plants were small, with 87 per cent containing less than five leaf tufts. Many did not produce inflorescences at the time of monitoring and none of the translocated plants produced more than five inflorescences during year 9.

Table 3 Number of Matted Flax-lily observed yearly by reserve

Reserve/location	Baseline pre-2008	Year 1 2008/09	Year 2 2009/10	Year 3 2010/11	Year 4 2011/12	Year 5 2012/13	Year 6 2013/14	Year 7 2014/15	Year 8 2015/16	Year 9 2016/17
2	2	-	1	2	2	2	2	2	2	2
3	-	-	-	3	3	3	3	3	3	3
5	1	2	2	3	3	3	3	3	3	3
6	2	2	4	8	8	8	7	7	6	7
7 (existing plants)	-	-	-	5	5	5	5	4	4	4
9	5	5	7	18	80	82	81	81	81	82
12	2	2	5	6	6	6	6	5	6	5
13	9	5	5	5	5	5	7	7	6	7
Subtotal in reserves	21	16	24	50	112	114	114	112	111	113
Public open space, outside conservation reserves	2	1	1	1	1	1	2	1	0	1
Plants outside reserves 6, 9 & 10 (now planted in reserve 7)	2	1	1	9	9	9	26	26	-	-
7 (translocated plants)	-	-	-	-	-	-	-	-	44	49
Total Matted Flax-lily	25	18	26	60	122	124	142	139	155	163

Table 4 Analysis of Matted Flax-lily remnant population health

	Year 4: 2011/12	Year 5: 2012/13	Year 6: 2013/14	Year 7: 2014/15	Year 8: 2015/16	Year 9: 2016/17
Health						
Poor	10%	9%	0%	1%	17%	0%
Moderate	76%	20%	1%	8%	31%	6%
Good	14%	71%	99%	91%	41%	86%
SNF	-	-	-	-	11%	8%
Number of inflorescences						
< 5	51%	66%	40%	83%	85%	34%
≥ 5 < 10	21%	14%	13%	8%	10%	17%
≥ 10	28%	20%	47%	9%	5%	41%
Number of leaf tufts						
< 5	5%	13%	5%	11%	37%	6%
≥ 5 < 10	21%	13%	8%	17%	18%	8%
≥ 10	74%	74%	87%	72%	44%	78%

Table 5 Analysis of Matted Flax-lily translocated population health

	Year 9: 2016/17
Health	
Poor	4%
Moderate	25%
Good	67%
SNF	4%
Number of inflorescences	
< 5	100%
≥ 5 < 10	0%
≥ 10	0%
Number of leaf tufts	
< 5	88%
≥ 5 < 10	12%
≥ 10	0%

3.3 Missing plants

A total of twelve Matted Flax-lily were not located during the survey. Eleven of the twelve plants are now presumed dead as they have not been seen for two consecutive years. This includes the ten remnant plants (23, 183, 191, 144, 37, 41, 42, 43, 200, 21) and one of the translocated plants (P10C2). Translocated plant P84C2 was not located this year and will be checked next year to determine if the plant has been lost.

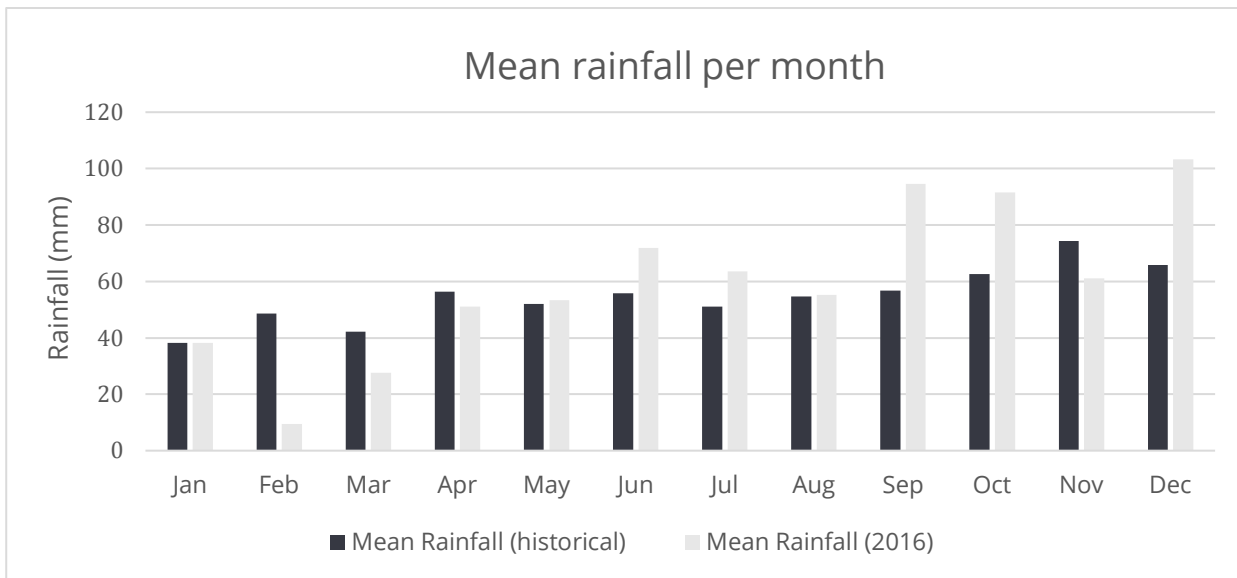
The loss of these plants is believed to be attributable to drought, natural population fluctuations, and/or grazing stress. Alternatively, mapping errors prior to commencement of the 10-year monitoring program may be responsible for the difficulties with relocating some of these plants. Overall, the loss of 11 plants from the large population now present at Aurora is minor and does not represent a concerning decline in the population. Details of each plant are provided in Table 6.

Table 6 Remnant and translocated Matted Flax-lily presumed dead

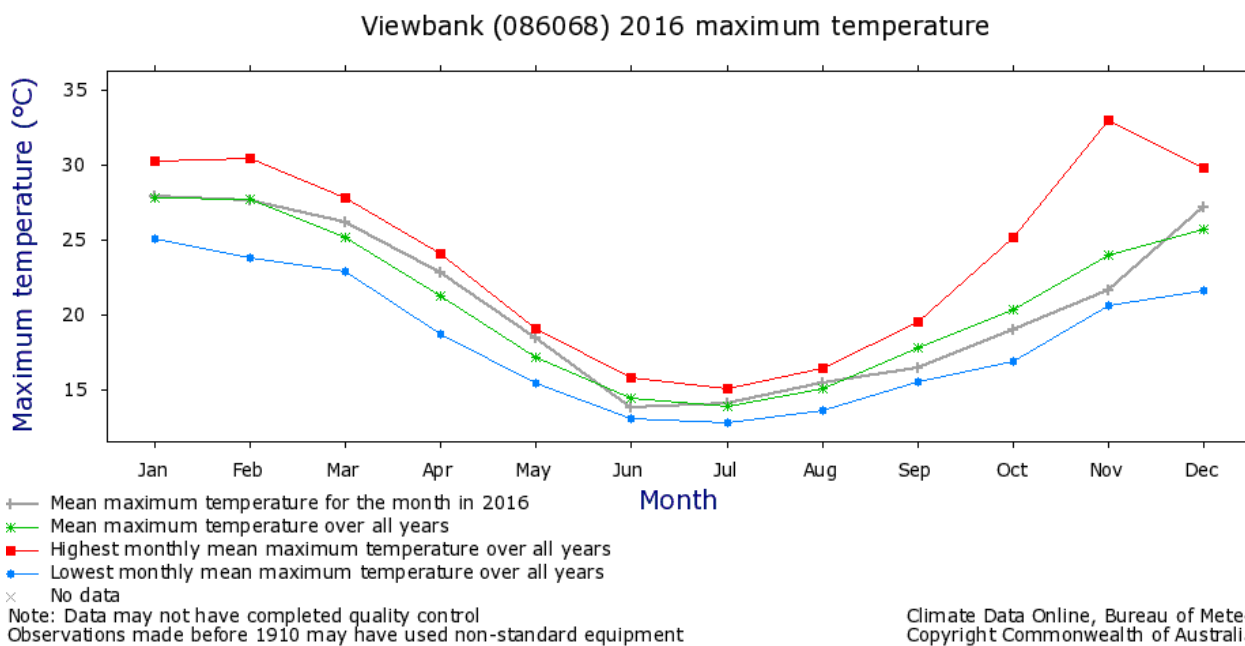
Matted Flax-lily ID	Location	Last recorded
021 MFL	Public open space (west of Shields Street)	Last recorded in year 4, in year 6 it was searched for but not found
022 MFL	Gas easement (north side of Harvest Home Road). Completely buried.	Last recorded in year 1
023 MFL	Reserve 2	Last recorded pre-2008 prior to commencement of monitoring
037 MFL	Reserve 13	Last recorded pre-2008 prior to commencement of monitoring
041 MFL	Reserve 13	Last recorded in year 1
042 MFL	Reserve 13	Last recorded pre-2008 prior to commencement of monitoring
043 MFL	Reserve 13	Last recorded in year 1
144 MFL	Reserve 12	Last recorded in year 6
183 MFL	Reserve 6	Last recorded in year 5
191 MFL	Reserve 9	Last recorded in year 5
200 MFL	Public open space (west of Shields Street)	Last recorded in year 6
P84C2	Reserve 7	Not recorded since translocation
P10C2	Reserve 7	Not recorded since year 8

3.4 Seasonal conditions of 2016

Weather data from Epping (the closest meteorological recording station to Aurora) shows on average 2016 was similar to the mean for temperature but with above average rainfall for most of the year. Most of the months with significantly higher rainfall were in the latter half of 2016, which is a critical time for Matted Flax-lily reproduction (Graph 1 and Graph 2). By contrast, in 2015, October had 8.8 mm of rain recorded, which is well below the average of 66.3 mm. It was also the warmest month on record and recorded the hottest October day on record. The combination of a moderate temperature and high rainfall during spring and summer 2016/17 is likely to have resulted in the good condition of Matted Flax-lily plants observed in year 9.



Graph 1 2016 rainfall vs mean rainfall records from Viewbank, Victoria



Graph 2 2016 maximum temperature records Viewbank, Victoria

4 Proposed actions in accordance with Condition 2(e)

At the end of year 9 the health of the natural populations of Matted Flax-lily is stable and generally good. Fluctuations in health are within the ranges of natural variability and do not represent a decline. Translocated plants are less healthy and should continue to be monitored closely. If significant further declines in health or survivorship are observed amongst this population further actions may need to be taken.

5 Conclusion

Since monitoring began (2008/09) the number of Matted Flax-lily plants has increased. In year 1 data was collected on 25 Matted Flax-lily within the EPBC approvals area whereas in year 8 data was collected on 155 Matted Flax-lily plants within the reserves managed by Lendlease Communities. There are additional Matted Flax-lily in reserves managed by Places Victoria.

In year 9 overall population health was good for the remnant Matted Flax-lily. The overall health observed in year 9 was higher than year 8 and more inflorescences were recorded. Better seasonal conditions during spring and summer of 2016, including increased rainfall, are likely to have contributed to the results observed. Overall health of the translocated Matted Flax-lily in reserve 7 was also good, although lower than that of the natural populations. These plants are still stunted and recovering from the 2015 season.

Two translocated Matted Flax-lily (P84C2, P10C2) were not located during year 9 monitoring after being located in year 8. Matted Flax-lily are known to undergo natural cycles of dieback and we anticipate that with improved climatic conditions in 2017 this plant may recover over winter. Eleven remnant plants have been categorised as 'presumed dead' since monitoring began. A much larger number of plants have been discovered and added to the annual monitoring program during this time. All plants categorised as presumed dead will continue to be searched for during each subsequent monitoring event.

At this stage it is considered that translocated Matted Flax-lily plants not detected in year 8 or 9 are unlikely to have survived translocation. These plants will be replaced with clones in winter 2017 when conditions are suitable. A watering program will be initiated to assist these plants during times where natural rainfall is low.

If weather forecasting for the second half of 2017 predicts a hot, dry summer outside of the normal climatic limits, year 10 monitoring will be conducted early in the season to capture Matted Flax-lily at peak flowering time. This will ensure that all Matted Flax-lily should be successfully located as they are easier to detect when flowering.

The population of Matted Flax-lily at Aurora is considered stable and it appears that current management of the population is appropriate. Changes in overall population health observed in year 9 are favourable.

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