



Annual monitoring of Matted Flax-lily: Aurora, Epping (year 10: 2018-19)

FINAL REPORT

Prepared for Lendlease Communities (Australia) Limited

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1. Background

Biosis Pty Ltd was commissioned by Lendlease Communities (Australia) Limited to undertake the year 10 (2018-19) 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

Aurora is a residential development area in Epping North, Victoria (Figure 1). It is approximately 20 kilometres north of the Melbourne CBD, and 1.5 kilometres north of existing urban development in the township of Epping. Aurora is bounded by Craigieburn Road East to the north, O'Herns Road to the south and the Craigieburn Bypass to the west. The east boundary follows existing property titles. Development Victoria (formerly known as VicUrban and then Places Victoria) were the major landholder of Aurora. In 2014 Lendlease Communities (Australia) Limited (Lendlease) acquired the balance of development land at Aurora although three of the Conservation Reserves remain as Development Victoria land (Reserve 10, 11 & 14).

The action was referred to the Australian Government Department of the Environment and Energy (DoEE, now Department of Agriculture, Water and Environment; DAWE) on 3 July 2007 seeking approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC 2007/3524; (DEWHA 2008)). On 3 August 2007, DoEE declared that the proposed action is deemed a 'controlled action' and that it will be assessed by preliminary documentation. The project was approved with conditions on the 16 March 2008 (DEWHA 2008). Variations to the approval were given on the 15 April 2011, 3 October 2016 and the 29 November 2017.

Conditions relating to Matted Flax-lily include 1, 2c and 2e, as outlined below.

1. The person taking the action must undertake all works in accordance with the Aurora Conservation Management Plan – January 2008 (Biosis 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 0: 2008–2009	Letters to DEWHA, 5 May and 26 June 2009
Year 1: 2009–2010	Report to DEWHA, 19 July 2010
Year 2: 2010–2011	Report to DSEWPaC, 4 May 2011
Year 3: 2011–2012	Report to DSEWPaC, 8 June 2012
Year 4: 2012–2013	Report to DSEWPaC, 4 April 2013
Year 5: 2013–2014	Report to DoE, 11 April 2014
Year 6: 2014–2015	Report to DoE, 1 March 2015
Year 7: 2015–2016	Report to DoE, 25 August 2016
Year 8: 2016–2017	Report to DoE, 25 August 2017
Year 9: 2017–2018	Report to DoE, 02 August 2018
Year 10: 2018–2019	Current report – to be submitted to DAWE upon finalisation

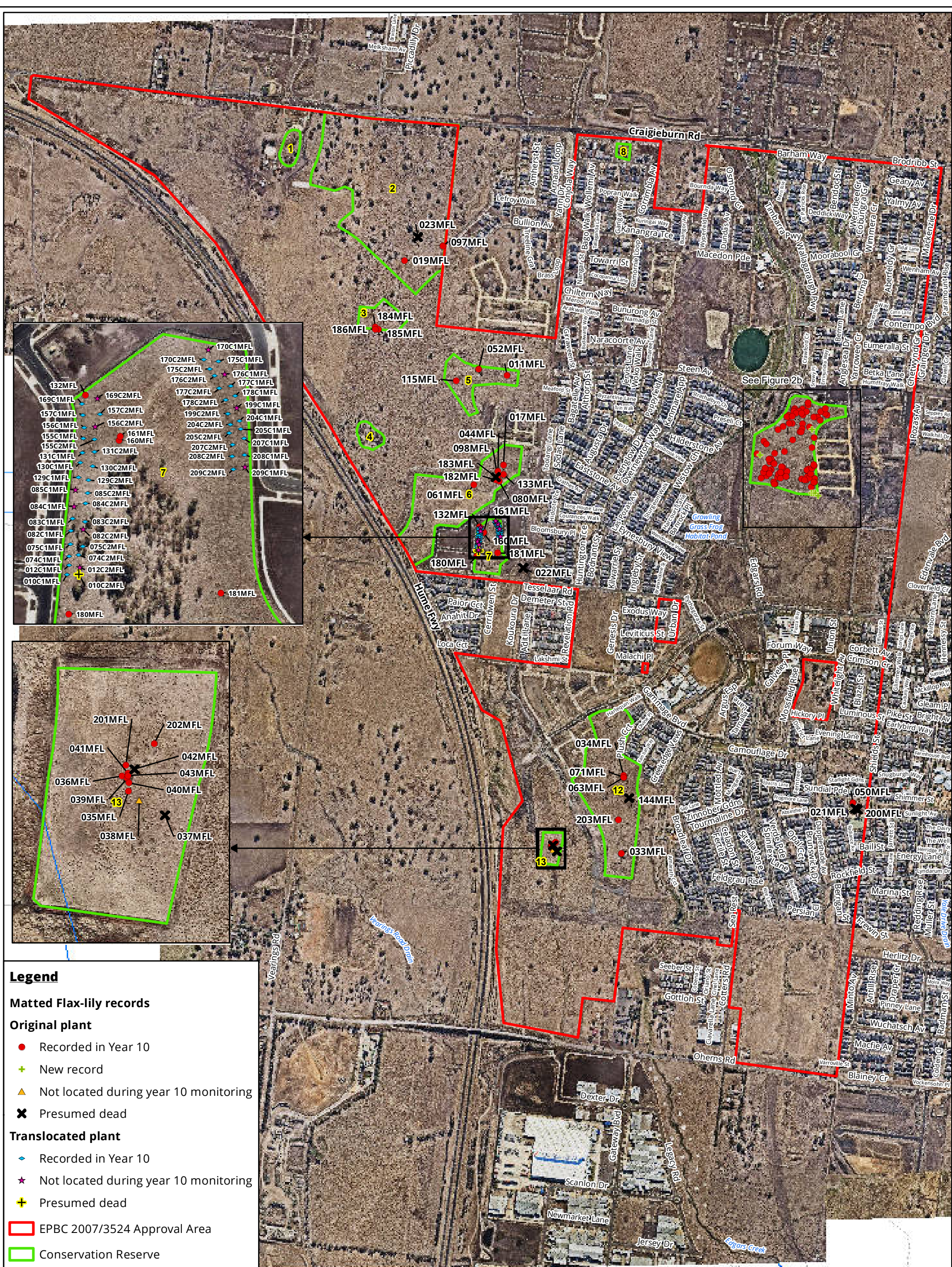


Figure 2a The distribution of Matted Flax-lily (MFL) within conservation reserves managed by Lendlease

1.3 Timing of surveys

A total of 30 Matted Flax-lily were included in the EPBC Act referral and these plants were recorded over a number of years prior to March 2008. Since then, Biosis has completed ten 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)
2008–09 Year 0	Monitoring in December 2008 and June 2009
2009–10 Year 1	Monitoring in November 2009 and January 2010 (when plants were staked) and May–June 2010
2010–12 Year 2	Monitoring in December 2010 and January 2011 (when new plants were located with a DGPS and staked)
2011–12 Year 3	Monitoring in January–February 2012
2012–13 Year 4	Monitoring in December 2012 and January 2013
2013–14 Year 5	Monitoring in December 2013
2014–15 Year 6	Monitoring in December 2014 and January–February 2015
2015–16 Year 7	Monitoring in December 2015
2016–17 Year 8	Monitoring in December 2016 and January 2017
2017–18 Year 9	Monitoring in January 2018
2018–19 Year 10	Monitoring in December 2018

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 3–10 have been undertaken in late spring–summer only. Plants were observed to be flowering and fruiting in each of these years and most were 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 stage, 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. There are approximately 88 MFL within this reserve, including two new records found in year 9 and 10, as well as the three plants captured within the southern boundary adjustment.

An additional 26 Matted Flax-lily plants were recorded outside 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. 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 10 (2018–19) 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 , ≥ 5 <10 , ≥ 10)
- Approximate number of leaf tufts (<5 , ≥ 5 <10 , ≥ 10)
- Approximate spread of the plant (width at the widest point in cm)
- Management – other notes (e.g. presence of fruit, if weeding is required, evidence of herbivory).

2.3 Year 10 monitoring dates

Monitoring in Year 10 was undertaken on 11, 12 and 21 December 2018.

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 **Note:** in years 3-7, plants with 0 inflorescences were recorded as <5 inflorescences.

Table 5. Figure 2 shows the location of monitored Matted Flax-lily in year 10.

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

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 0–3) the reserves were surveyed and numbers of Matted Flax-lily were recorded. Over this period, the number of Matted Flax-lilies recorded increased substantially. Very few additional remnant plants have been recorded in the reserves since 2011, therefore monitoring has focused on the health and survivorship of the known population. We suspect that this increase in the number of plants detected is a result of increased survey effort over time, however, it is possible that some of the additional plants observed were new recruits within the population.

Over the monitoring period to date, numbers of Matted Flax-lily recorded have increased substantially from 25 plants in year one across the entire Aurora landholding, to 159 Matted Flax-lily plants in year 10. This includes plants that have been translocated to reserve 7 as well as those found outside reserves 6, 9 and 10. 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

Comprehensive data collection on Matted Flax-lily health, including numbers of inflorescences and leaf tufts, commenced in year 3 (2011–12). A comparison of data collected in years 3 to 10 for remnant Matted Flax-lily is provided in Table 4. Translocated Matted Flax-lily health data is provided in Note: in years 3-7, plants with 0 inflorescences were recorded as <5 inflorescences.

Table 5. Health data collected during year 10 includes Matted Flax-lily from reserves managed by Lendlease Communities (Australia) Limited.

Among remnant populations, there was a sharp decline in plant health in year seven, where the proportion of plants recorded as having 'good' health dropped from 91 to 41 percent. However, the health of the population rapidly recovered the following season. The proportion of plants in 'good' health was higher this season compared with the last, with 98 percent of plants in good health in year 10. No plants were observed as showing 'poor' health in years 8 to 10.

There were fewer inflorescences present in year 10 compared with the previous years, with 55 per cent of remnant plants having less than five inflorescences in year 10.

Translocated plant health in year 10 was generally lower than that of the natural populations with 36 per cent of translocated plants in 'good' health compared to 98 percent of remnant plants in good health. However, 87 percent of translocated were in moderate or good condition in year 10. Translocated plants have expanded in size (i.e. number of leaf tufts has increased) from 2018 to 2019 (year 9 to 10), with 62 per cent having more than five leaf tufts in year 10. Majority of translocated plants did not have inflorescences

at the time of monitoring in year 10, i.e. only 4 percent of the translocated plants produced more than five inflorescences during year 10.

Overall plant health among translocated plants has declined in year 10 from year 9. Percentage of plants in good health decreased from 58 to 36 percent, and plants with moderate and poor health have both doubled in year 10. Despite this reduction in plant health, the number of plants with >10 inflorescences increased from 0 to 4 percent. The number of plants with >5 leaf tufts also increased in year 10 from 8 to 33 percent.

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

Reserve-location	Baseline pre-2008	Year 0 2008-09	Year 1 2009-10	Year 2 2010-11	Year 3 2011-12	Year 4 2012-13	Year 5 2013-14	Year 6 2014-15	Year 7 2015-16	Year 8 2016-17	Year 9 2017-18	Year 10 2018-19
2	2	-	1	2	2	2	2	2	2	2	2	2
3	-	-	-	3	3	3	3	3	3	3	3	3
5	1	2	2	3	3	3	3	3	3	3	3	3
6	2	2	4	8	8	8	7	7	6	7	7	7
7 (existing plants)	-	-	-	5	5	5	5	4	4	4	5	5
9	5	5	7	18	80	82	81	81	81	82	82	80
12	2	2	5	6	6	6	6	5	6	5	5	4
13	9	5	5	5	5	5	7	7	6	7	7	9
Subtotal in reserves	21	16	24	50	112	114	114	112	111	113	114	113
Public open space, outside conservation reserves	2	1	1	1	1	1	2	1	0	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	45	45
Total Matted Flax-lily	25	18	26	60	122	124	142	139	155	163	160	159

Table 4 Analysis of Matted Flax-lily remnant population health

	Year 3: 2011/12	Year 4: 2012/13	Year 5: 2013/14	Year 6: 2014-/15	Year 7: 2015/16	Year 8: 2016/17	Year 9: 17/2018	Year 10: 2018/19
Health								
Poor	10%	9%	0%	1%	17%	0%	0%	0%
Moderate	76%	20%	1%	8%	31%	6%	10%	2%
Good	14%	71%	99%	91%	41%	86%	82%	98%
Stake Not Found	-	-	-	-	11%	8%	-	-
Number of inflorescences								
0	NA	NA	NA	NA	NA	59%	0%	31%
<5	51%	66%	40%	83%	85%	26%	50%	9%
≥5 <10	21%	14%	13%	8%	10%	10%	14%	31%
≥10	28%	20%	47%	9%	5%	5%	28%	30%
Number of leaf tufts								
<5	5%	13%	5%	11%	37%	6%	5%	4%
≥5 <10	21%	13%	8%	17%	18%	8%	7%	7%
≥10	74%	74%	87%	72%	44%	78%	80%	89%

Note: in years 3-7, plants with 0 inflorescences were recorded as <5 inflorescences.

Table 5 Analysis of Matted Flax-lily translocated population health

	Year 8: 2016/17	Year 9 2017/18	Year 10: 2018/19
Health			
Poor	4%	6%	13%
Moderate	25%	23%	51%
Good	67%	58%	36%
Stake Not Found	4%	13% presumed lost	
Number of inflorescences			
0	0%	0%	80%
<5	100%	100%	16%
≥5 <10	0%	0%	0%
≥10	0%	0%	4%
Number of leaf tufts			
<5	88%	92%	38%
≥5 <10	12%	8%	33%
≥10	0%	0%	29%

Note: in years 8-9, plants with 0 inflorescences were recorded as <5 inflorescences.

3.3 Missing and dead plants

A total of 23 Matted Flax-lily plants were dead or could not be located during the survey. This includes eleven remnant plants (162, 72, 23, 183, 144, 37, 38, 42, 188, 200, and 21) and twelve translocated plants (P10C2, P12C2, P82C2, P84C1, P85C1, P156C2, 169C2, 157C2, P170C1, P176C1, P199C1, P20C1). Nine of the remnant and translocated plants were not found this year and are presumed lost (Table 6).

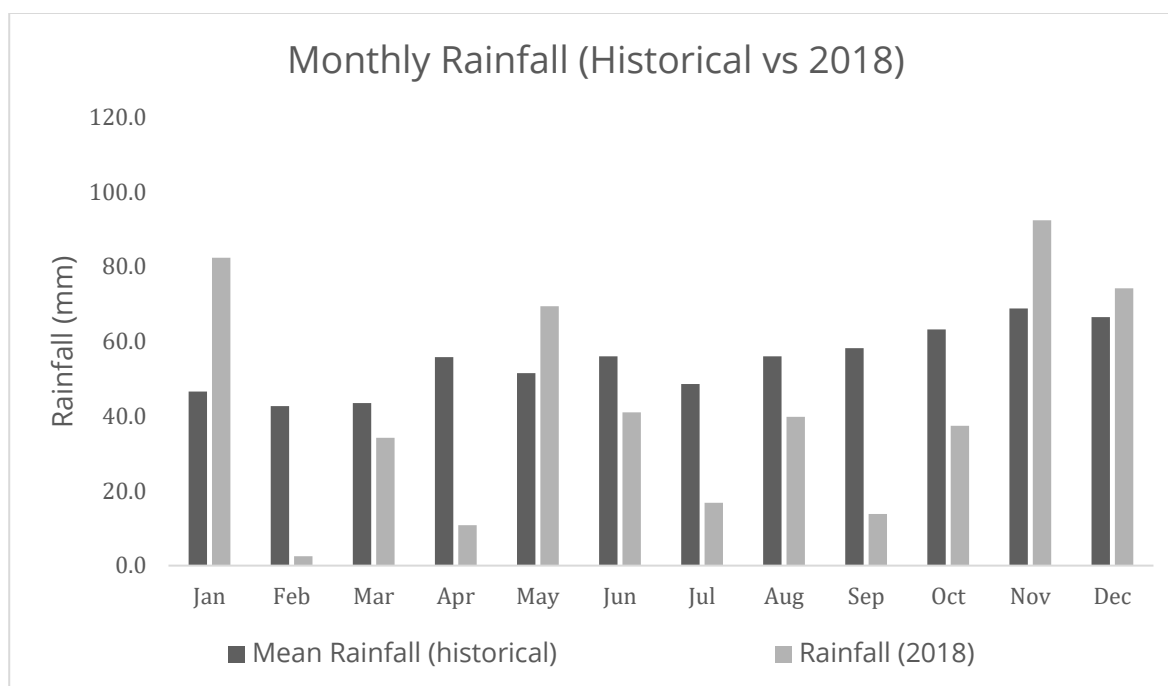
The loss of these plants is believed to be attributed to environmental pressures such as drought and grazing stress, and/or natural population fluctuations. Alternatively, mapping errors prior to commencement of the 10-year monitoring program may account for the difficulties with relocating some of these plants. Overall, the loss of 23 plants from the large population now present at Aurora is minor and does not represent a concerning decline in the population. Details of each of the nine plants presumed lost are provided in Table 6.

Table 6 Remnant and translocated Matted Flax-lily presumed lost

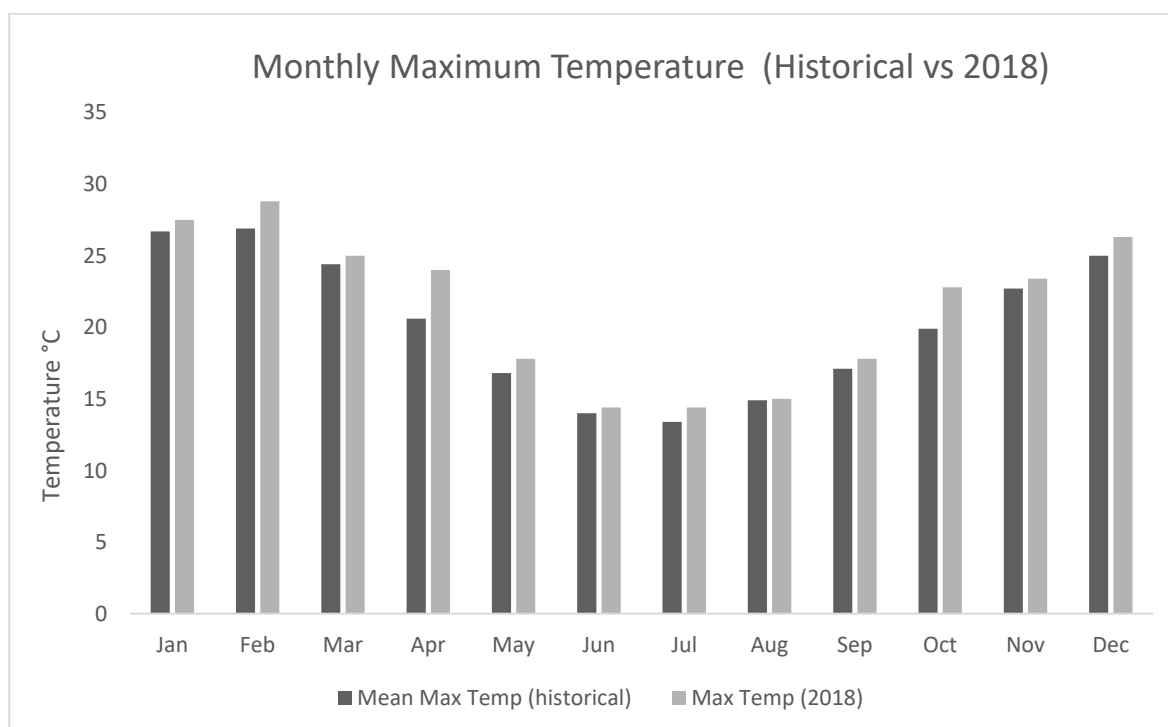
Matted Flax-lily ID	Location	Last recorded
021 MFL	Public open space (west of Shields Street)	Last recorded in year 4, in year 6 it was searched for but not found
022 MFL	Gas easement (north side of Harvest Home Road). Completely buried.	Last recorded in year 1
023 MFL	Reserve 2	Last recorded pre-2008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

3.4 Seasonal conditions of 2018 (year 10)

Weather data from Bundoora (the closest weather station to Aurora) presented in Graph 1 shows that overall, the mean monthly rainfall in 2018 was lower than the historical mean monthly rainfall (BOM 2020) – except for January, May, November and December (Graph 1). Spring and summer rainfall in particular, is known to influence the reproductive output of Matted Flax-lily. The below average rainfall experienced in early spring (September-October) may be a contributing factor to the limited flowering of plants recorded in year 10.



Graph 1 2018 monthly rainfall, Bundoora, Victoria.



Graph 2 2018 mean daily maximum temperature, Bundoora, Victoria.

4 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 10 data was collected on 159 Matted Flax-lily plants within the reserves managed by Lendlease Communities. There are additional Matted Flax-lily plants in reserves managed by Development Victoria.

In year 10, overall population health was good for the remnant Matted Flax-lilies. The overall health observed in year 10 was higher than in year 8/9, with 98 percent of remnant plants in good health, however fewer inflorescences were recorded in year 10 than other years. This may be the result of the lower than average rainfall experienced in spring in 2018 (year 10).

Twenty-three Matted Flax-lily plants were dead or could not be located during the year 10 survey. This includes eleven remnant plants and twelve translocated plants. Matted Flax-lily undergoes natural cycles of dieback and we anticipate that under more suitable climatic conditions, Matted Flax-Lily populations may recover. Nine of the remnant and translocated plants searched for and not found for three consecutive years are presumed lost.

The overall health of translocated plants observed in year 10 was lower than in year 9. However, 87 percent of translocated plants were in moderate or good health and plants are expanding in size (indicated by larger number of leaf tufts). The overall trend for Matted Flax-lily health appears to be remaining stable within the reserves for both remnant and translocated plants. We consider the population of Matted Flax-lily at Aurora in its current state to be stable and it appears that current management, which includes hand weeding of the population, is appropriate.

5 EPBC Act approval conditions – end of 10 year monitoring

Over the 10-year monitoring period, the health of the Matted Flax-lily population within the Aurora Development Area has improved. While there have been reported fluctuations in plant health, the overall variation in population health has remained within the natural ranges for this species.

Throughout the 10-year monitoring period, all works were completed in accordance with the conditions relating to Matted Flax-lily include 1, 2c and 2e, as outlined below.

1. The person taking the action must undertake all works in accordance with the Aurora Conservation Management Plan – January 2008 (Biosis 2008).

The Aurora Conservation Management plan states that

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.
 - f. 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.

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