

# Water Supplementation for Thomsons Lake Nature Reserve

## Review of the 2014 Supplementation Program

### 1. BACKGROUND AND PURPOSE

A water supplementation program was first trialled at Thomsons Lake in winter 2004 and, due to its observed success, has been continued every winter since. The program aims to ensure that Thomsons Lake contains enough water in late spring and early summer to support the resident and migratory waterbird population. In addition, ensuring the lake contains water for a longer period in early summer will allow the resident cygnet population to mature enough to enable them to fly over the vermin proof fence surrounding Thomsons Lake Nature Reserve, to find alternative water sources.

Given the apparent positive impact of the 2013 water supplementation program on the Thomsons Lake ecosystem, the 2013 Review recommended that the supplementation program be implemented again in winter 2014.

As outlined in the *Water Supplementation Operational Management Plan for Thomsons Lake Nature Reserve - July 2004* (cited as the *Operational Management Plan*), the purpose of the annual review is to determine:

- whether there have been any detrimental impacts on Thomsons Lake;
- the appropriateness of nutrient concentration guidelines;
- the extent of the supplementation period; and
- whether supplementation should continue to occur in the future.

### 2. OVERVIEW OF THE SUPPLEMENTATION PROGRAM IN 2014

#### Supplementation period

The supplementation period commenced on 15 July and ceased on 15 September in accordance with the *Operational Management Plan*.

The Bureau of Meteorology (2014) climate summary for Perth outlines that rainfall in 2014 was below average for most sites across the Perth metropolitan area. Rainfall was generally near average in most months, with only May seeing above average rainfall. Little rainfall was recorded over the summer whilst June totals were well below normal. The low June totals had the biggest impact on annual rainfall for most sites, leading to a below average year.

#### Monitoring

As in previous years, a number of parameters were monitored at Thomsons Lake over spring and summer 2014/2015 which assisted in determining the effectiveness of the water supplementation program (see Table 1).

**Table 1. Monitoring parameters, monitoring agencies and relevant monitoring projects undertaken at Thomsons Lake Nature Reserve.**

Monitoring Agency/Group	Parameter	Monitoring project
Water Corporation	Water quality (including TP & TN), flow and water levels at Bartram Road Buffer Lakes and Russell Road Buffer Lake. Water levels at Thomsons Lake.	Operation of the Southern Lakes Drainage Scheme.
Bennelongia Environmental Consultants on behalf of the Department of Water	Macroinvertebrate diversity, water quality and depth at Thomsons Lake.	Jandakot Wetland Monitoring: Annual Report 2014 (April 2015).

#### Water levels and comparison to previous years

Water Corporation data shows a maximum water level at Thomsons Lake of 12.44 mAHD. This was attained in September and the lake dried completely in early January 2015. Complete drying usually occurs during December or January so 2014/2015 is comparable with previous years, and noticeably better than 2010 when rainfall was well below average and the lake dried-up during early November.

**Table 2. Maximum water levels at Thomsons Lake and annual precipitation at Jandakot airport.**

Year	Water level (mAHD)	Annual Precipitation (mm)
2014	12.44 (lake bed = 11.50 mAHD*)	690.6
2013	12.51	889.0
2012	12.17	684.4
2011	12.28	915.6
2010	12.06	495.8
2009	12.68	687.6
2008	12.68	869.4
2007	12.42	816.8
2006	12.00	509.8
2005	12.91	945.8
2004	12.475	685.4
2003	12.468	714.0
2002	12.245	758.0
2001	12.240	715.6
2000	12.645	982.4

\*To note: previous reports incorrectly noted the lake bed as 11.75 mAHD

The 690.6 mm rainfall recorded for the year at the nearest official recording station (Jandakot Airport) was significantly below the long term average of 830 mm for the site (1972 to 2014) (Bureau of Meteorology 2015).

### Supplementation water sources

Prior to 2008, supplementation occurred entirely from the Bartram Road Buffer Lakes outfall, immediately to the east of Thomsons Lake. This water is piped into the South Jandakot Branch Drain and diverted into an open channel leading into Thomsons Lake by means of adjustable weir boards within an access chamber on the Branch Drain. In 2008, the Water Corporation completed works on what it calls the "Russell Road Buffer Lake" (also known as Lake Copulup), the outflow from which was channelled directly into the South Jandakot Branch Drain (along with overflow from the "Boronia Gardens" subdivision), upstream of the Bartram Road Buffer Lakes outfall junction. This means that supplementation waters now originate from two distinct sources, which currently cannot be separated.

It is to be noted that testing of the Russell Road Buffer Lake outflow in August 2008 indicated the water quality was substantially poorer than the Bartram Road Buffer Lakes outflow. Ongoing testing reveals there to be only a slight improvement in water quality since connection and it may be many years before the water quality approaches that flowing from the Bartram Road Buffer Lakes.

### Water quality and comparisons with previous years

Water quality monitoring undertaken by the Water Corporation indicated that during the 2014 water supplementation period (from 15 July to 15 September 2014), the Bartram Road Buffer Lakes outflow had Total Phosphorus levels ranging between a 0.09 mg/L minimum and a 0.16 mg/L maximum, with an average reading over the period (from 21 samples) of 0.12 mg/L (unfiltered). This value is below the [0.25 mg/L and 0.30 mg/L] target range specified in the *Operational Management Plan* and represents a decrease in the average level recorded for the years 2010, 2011, 2012 and 2013 during the supplementation regime (0.25, 0.22, 0.18 and 0.22 mg/L, respectively).

Sampling of the Russell Road Buffer Lake outflow revealed Total Phosphorous levels ranging between a 0.43 mg/L minimum and a 1.0 mg/L maximum, with an average reading over the period (from 17 samples) of 0.70 mg/L. This value represents a slight improvement on the 2013 average of 0.88 mg/L but still well outside the expected [0.25 mg/L and 0.30 mg/L] target range specified in the *Operational Management Plan* and substantially higher than the average Total Phosphorous in the Bartram Road Buffer Lakes outflow (0.12 mg/L).

The average Total Phosphorus reading for the Russell Road Buffer Lake outflow has been outside of the target range every year since 2008 when it was first directed into the South Jandakot Branch Drain, except for 2011 when an average of 0.30 mg/L was attained. A declining trend was noted between 2008 and 2012 but in 2013 and 2014 the average readings were substantially higher, the cause of this increase is not clear.

For Russell Road Buffer Lake outflow the average reading for Total Nitrogen is around 3 times higher than for Bartram Road Buffer Lakes outflow (4.54 mg/L and 1.57 mg/L, respectively), while the average reading for Ammonia (as N filtered) is around 20 times higher (0.87 mg/L and 0.04 mg/L, respectively). Unmonitored inflow from the adjacent Boronia Gardens development is an unknown quantity, however this is understood to be relatively minor, and should only occur during periods of heavy rainfall, when

considerable catchment flushing has already occurred.

Bennelongia Environmental Consultants also undertook some physico-chemical monitoring on behalf of the Department of Water in 2014. The Department of Water has a requirement to report to the Office of the Environmental Protection Authority on a number of parameters, as part of Ministerial Statement No. 688 which relates to groundwater abstraction from the Jandakot Mound.

The *Jandakot Wetland Monitoring: Annual Report 2014* (Bennelongia 2015) shows that from one water sample taken at Thomsons Lake in spring 2014, a Total Phosphorus level of 0.03 mg/L and a Total Nitrogen level of 2.9 mg/L were recorded. Overall the nutrient values appear to be similar to previous years, and were still reduced from 2010 where the low water level appears to have been the main factor influencing water quality. The report concluded that water chemistry data recorded at Thomsons Lake this year were within historic ranges and showed no concerning trends. Thomsons Lake is an alkaline lake and the pH stayed within the historical range, the lake did not return to the very low pH levels of 2012 when acidic conditions were recorded for the first time.

**Table 3. Water quality data at Thomsons Lake (in spring) over the period 1996 to 2014\***

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Depth (cm)	95.1	50.6	43.1	67.1	89.6	48.6	42.1	66.5	65.6	113.4	24.5	66.9	92.7	93.0	31.0	53.0	42.4
pH	9.1	9.35	9.78	7.88	9.87	7.49	7.49	8.03	9.85	7.96	9.94	7.49	7.9	9.19	8.68	8.55	6.3
Conductivity(µS/cm)	3200	6430	4321	2190	3120	3660	3660	1693	3200	2430	5570	3030	2343	2270	4553	2370	2760
ortho-P(µg/L)	112	2	4	15	7	11	11	10	22	4	8	8	7	4	12	6	3
organic-P(µg/L)	82	116	87	110	122	289	289	60	6	45	66	46	56	25	168	35	33
<b>TP(µg/L)</b>	194	118	91	125	129	300	300	70	28	49	74	54	63	29? (67)	180	41	36
NH <sub>4</sub> (µg/L)	22	12	6	33	29	36	36	43	16	13	27	11	17	20	77	13	40
NOX(µg/L)	10	11	9	14	18	14	14	15	9	5	10	3	4	2	4	5	11
organic-N(µg/L)	3650	3892	3152	3902	5065	6750	6750	3742	3275	2882	4863	2786	2889	1978	5219	2582	2949
<b>TN(µg/L)</b>	3682	3915	3167	3949	5112	6800	6800	3800	3300	2900	4900	2800	2900	2000	5300	2600	3000
Chl a (µg/L)	1.1	16.6	12.3	10.2	61	63	63	0.9	0.6	3	6.6	0.5	7.8	1.5	3	8	2.7
Phaeophytin (µg/L)	5.3	6.7	3	3.9	12.3	63	63	3.9	n/a	0.5	2.2	1	0.6	0.5	0.8	1.8	1.5
Turbidity (NTU)	2.1	4	6.5	26	16.5	27	n/a	2.7	1.55	0.97	3.14	2.49	4.55	1.43	3.71	2.18	1.59
Colour (g440/m)	20.95	6	7.83	23.49	15.1	22.7	n/a	19.8	7.3	21.6	6.67	10.9	21.6	9.3	12	18	12

\*Source: Strehlow *et al* 2013 (p29) for 1996 – 2012 data

	2013	2014
Mean sampling depth (cm)	43.3	38
pH	8.59	7.96
Conductivity(µS/cm)	2447	3547
ortho-P(µg/L)	<10	<10
organic-P(µg/L)	-	-
<b>TP(µg/L)</b>	70	30
NH <sub>4</sub> (µg/L)	<10	<20
NOX(µg/L)	<20	<10
organic-N(µg/L)	-	-
<b>TKN(µg/L)</b>	3300	2900
Chl a (µg/L)	9	2
Phaeophytin (µg/L)	-	-
Turbidity (NTU)	3	2.1
Colour (g440/m)	14.4	14.4

\*Source: Sampey *et al* 2014 (p25-28) for 2013 data and Bennelongia 2015 (p6 & p11) for 2014 data

### Macroinvertebrate diversity

In addition to the water quality data that has been discussed, Bennelongia Environmental Consultants monitored the diversity and richness of macroinvertebrates on behalf of the Department of Water in 2014. The sampling was undertaken at the same three sites as in previous years. Murdoch University monitored the diversity and richness of macroinvertebrate families at Thomsons Lake between 1996 and 2012; in 2013 the monitoring was undertaken by Edith Cowan University.

The *Jandakot Wetland Monitoring: Annual Report 2014* (Bennelongia 2015) indicates that the total number of macroinvertebrate families recorded at Thomsons Lake in spring 2014 was 34, which is the highest recorded value since 1996, see Figure 1 below. The recorded value is significantly higher than

the spring mean (1996-2014) for the species richness recorded in Thomsons Lake, which is 23. Water levels can impact on macroinvertebrate communities when they are extremely low but the 2014 levels were clearly adequate to support a rich community. There is often a strong positive relationship between depth and richness at depths up to about 0.3 m and it is mostly at deeper depths that the relationship between depth and richness is weak (Bennelongia 2015).

The *Wetland Monitoring Report 2014* (Sampey *et al* 2014) outlined that some taxa had been more frequently observed since the water supplementation program began however this trend was not reflected in the results of the 2014 sampling. The abundance of macroinvertebrates was high in the 2014 sampling with 691 specimens recorded at Thomsons Lake. Several families were recorded for the first time but excluded from further analyses of wetland condition because their identification may reflect improvements in sampling and processing protocols rather than variation in wetland condition. According to the abundance scoring system used by Sampey *et al* (2014), Thomsons Lake had 16 rare, eight scarce, 14 common and one abundant group in 2014 compared with seven rare, seven scarce, eight common and seven abundant groups in 2013. This represents a decline in abundant groups in 2014, when only Cyprididae was abundant (Bennelongia 2015).

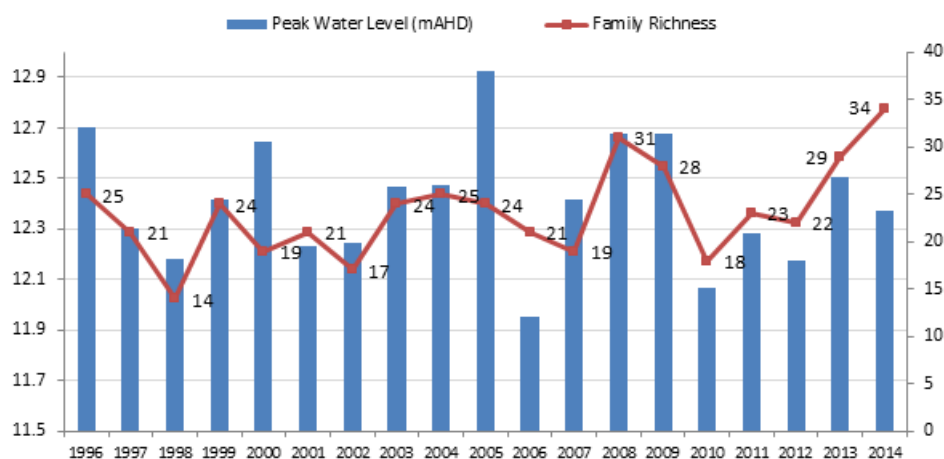
The 2012 monitoring report (Strehlow *et al* 2013) outlined that one requirement for the persistence of viable reproducing populations of macroinvertebrates is that the wetlands remain inundated (to a minimum depth of 50 cm) for a minimum period of 4 to 5 months. Since 2010 the mean hydroperiod (duration of water present at a wetland per year) at Thomsons Lake has been below 6 months, but still above the minimum period (Strehlow *et al* 2013). Water Corporation data show that the hydroperiod was greater than 6 months during 2014, for the first time since 2009.

The water depth recorded at the three monitoring sites ranged from 37-40 cm (mean 38 cm) in 2014, which is slightly lower than last year's mean water depth of 43.3 cm. The water depth at Thomsons Lake has been below average for the last five years (since monitoring began in 1996 the average water depth is 61.2 cm).

The 2012 monitoring report (Strehlow *et al* 2013) identified that the maximum water depth data since 1971 clearly demonstrated a decreasing trend. The *Jandakot Wetland Monitoring: Annual Report 2014* (Bennelongia 2015) report concluded that there has been little change in peak water levels in the period from 2008 to 2014 however the levels are still low compared to historic records and lower than the peak water level target of approximately 12.6 mAHD under the current management plan. As discussed in the previous section, the report also concluded that water chemistry data recorded at Thomsons Lake this year were within historic ranges and showed no concerning trends. The supplementation program at Thomsons Lake appears beneficial but ongoing monitoring is required to ensure that this maintenance remains at sufficient levels to maintain ecological benefits.

The *Jandakot Wetland Monitoring: Annual Report 2014* (Bennelongia 2015) identified that threats to the conservation values of Thomsons Lake include declining water levels since 1992 as a result of groundwater abstraction and reducing rainfall, the use of pesticides to control non-biting midges, increasing urbanisation of the catchments leading to higher nutrient levels and the loss of historical lake habitats (open water and mudflats) because of invasion by introduced bulrushes.

**Figure 1. Peak water level and spring invertebrate richness recorded at Thomsons Lake over the period 1996 – 2015 \*. The minimum number on the water level axis is the AHD (m) level at which the staff gauge dries.**



\*Source: Bennelongia Environmental Consultants 2015 (p20) (amended to showing peak water level for 2006)

## Waterbird observations

In previous years, preliminary waterbird counts have been supplied by Mike Bamford and Wes Bancroft (M.J. & A.R. Bamford Consulting Ecologists), who for a number of years have prepared an annual report on behalf of the Department of Water, entitled *Environmental Investigations for the Jandakot Groundwater Scheme Stage 2 - Wetland Waterbird Monitoring*. These regular waterbird surveys ended in 2008. For 2009/2010 waterbird counts were supplied by Western Wildlife, who was undertaking observations under contract to AECOM environmental consultants. There has been no available data on waterbird observations for Thomsons Lake since 2010.

As in previous years, cygnet patrols were carried out by the department during the latter part of the breeding season along the vermin-proof fence surrounding the lake. In December 2014 and January 2015, 26 cygnets were found along the vermin-proof fence surrounding Thomsons Lake Nature Reserve, which were then released through the fence into Kogolup Lake, immediately to the north. Whilst no cygnets were found stranded in 2010, 2009 and 2008, there were 76 stranded cygnets in late 2013, 30 in 2012, 96 in 2011, 188 in 2007 and 32 in 2006.

## Occurrence of botulism

There is no information available in 2014 on signs of botulism in waterbirds at Thomsons Lake.

## 3. CONCLUSIONS

### Water levels

Water Corporation data show the highest water level in 2014 was approximately 12.445 mAHD (recorded in late September), with the lake retaining water until early January 2015. This represents the fifth highest mid-spring depth reading during the last 10 years.

### Water quality

Recorded nutrient levels in the Bartram Road Buffer Lakes waters were within the limits specified in the *Operational Management Plan*; though for the Russell Road Buffer Lake outflow, nutrient levels were outside of the limits. It is unknown to what extent the supplementation waters contribute towards the total recharge of the lake, however the Total Phosphorous level recorded at Thomsons Lake itself in spring 2014 from a combined sample from three sites, was 0.030 mg/L, which is lower than the 2013 and 2012 records (0.070 mg/L and 0.036 mg/L) and the calculated average of 0.063 mg/L since supplementation commenced in 2004. It is also notable that the calculated average is still significantly lower than the consistently high levels recorded at Thomsons Lake during the late 1990s and early 2000s, prior to the commencement of the water supplementation program.

Overall the nutrient values were still reduced from 2010, where the low water level appears to have been the main factor influencing water quality, and appears similar to previous years. Despite the poor quality of the Russell Road Buffer Lake outflow into Thomsons Lake, the *Jandakot Wetland Monitoring: Annual Report 2014* (Bennelongia 2015) concluded that water chemistry data recorded at Thomsons Lake this year were within historic ranges and showed no concerning trends.

It is recommended that the department continue to pursue its enquiries with the Water Corporation with respect to the possibility of supplementing Thomsons Lake only from the Bartram Road Buffer Lakes outflow, at least until such time as the Russell Road Buffer Lake outflow shows some significant improvement. The potential loss of flow volume into Thomsons Lake would have to be weighed up against the benefit of improved water quality however. During the 63 day water supplementation period for 2014 the average daily flow volume from Bartram Road Buffer Lakes was 4,673 m<sup>3</sup> while the average daily volume from Russell Road Buffer Lake was 2,930 m<sup>3</sup>, so Russell Road Buffer Lake makes up a significant proportion of the flow into Thomsons Lake.

### Macroinvertebrate diversity

The total number of macroinvertebrate families recorded in Thomsons Lake during spring 2014 was 34, which is the highest recorded value since 1996. This may be a reflection of increased sampling or processing efficiency in 2014. Water levels can impact on macroinvertebrate communities when they are extremely low but the 2014 levels were clearly adequate to support a rich community.

The *Jandakot Wetland Monitoring: Annual Report 2014* (Bennelongia 2015) identified that threats to the conservation values of Thomsons Lake include declining water levels since 1992 as a result of groundwater abstraction and reducing rainfall; the use of pesticides to control non-biting midges; increasing urbanisation of the catchments leading to higher nutrient levels and the loss of historical lake habitats (open water and mudflats) because of invasion by introduced bulrushes. The supplementation program at Thomsons Lake appears beneficial but ongoing monitoring is required to ensure that this maintenance remains at sufficient levels to maintain ecological benefits.

## Waterbird observations

There was no available data on waterbird observations for Thomsons Lake in 2014. In December 2014 and January 2015, 26 cygnets were found along the vermin-proof fence, which were then released through the fence into Kogolup Lake. This confirms that the lake levels and inundation period were sufficient to allow a successful breeding season; however, many cygnets had not matured enough to fly over the surrounding fence before water levels became unacceptably low.

### **Analysis of assessment criteria for the 2014 program**

The following addresses the four assessment criteria listed in the *Operational Management Plan*.

1. The monitoring undertaken indicated that there were no appreciable detrimental impacts on Thomsons Lake that could be directly attributed to water supplementation, however monitoring and evaluation of water quality, macroinvertebrate numbers should continue to occur. In 2014 there was no available data on waterbird numbers. Ongoing monitoring of waterbird numbers is required.
2. All observations indicate that nutrient concentration guidelines listed for the Bartram Road Buffer Lakes outflow in the *Operational Management Plan* are still appropriate (maximum Total Phosphorous levels of 0.30 mg/L). However the Russell Road Buffer Lake has higher levels of nutrients and pollutants and needs to be improved or not included in supplementation waters for the long term.
3. The extent of the nominal supplementation period from 15 July to 15 September each year is still considered appropriate and should remain unchanged for 2015, subject to there being adequate rainfall prior to commencement, and sufficient winter rains during supplementation. Discharge volumes and water quality should continue to be monitored and reviewed in the future to determine whether changes are required to the supplementation period, and postponing the commencement of the program to allow for the first flush of nutrients should be implemented as required. Where high rainfall is experienced early in the season, consideration should be given towards commencing the supplementation program earlier and then continuing the supplementation until late September, given the trend of above average rainfall during September.
4. Given the data collected on water levels, water quality and macroinvertebrate diversity, it is recommended that supplementation continue in 2015. Nevertheless, the outflow from the Russell Road Buffer Lake is a continuing cause for concern and steps should be taken to either find some means of improving outfall water quality or requiring the Water Corporation to devise a mechanism whereby supplementation can occur from the Bartram Road Buffer Lakes only. In 2012 acidic conditions were recorded at Thomsons Lake. It is recommended that this be monitored and if any further acidic conditions occur then further investigations should be considered.

In implementing water supplementation at Thomsons Lake in the future, the Regional Parks Unit will continue to liaise with the department's Science and Conservation Division and other wetland experts as required.

## **4. REFERENCES**

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