Water Supplementation for Thomsons Lake Nature Reserve

Review of the 2012 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 the Thomsons Lake Nature Reserve, to find alternative water sources.

Given the apparent positive impact of the 2011 water supplementation program on the Thomsons Lake ecosystem, the 2011 Review recommended that the supplementation program be implemented again in winter 2012.

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 2012

Supplementation period

The supplementation period was scheduled to run from 15 July 2012 to 15 September 2012 in accordance with the *Operational Management Plan*. Supplementation commenced on 11 July 2012.

Rainfall across the Perth metropolitan area in 2012 was below average to near average. The Perth region experienced a dry autumn and a very dry winter, followed by above average rainfall during spring. Given that the lake level had not reached its allowable maximum of 12.8 metres (specified in the *Operational Management Plan*) and the fact that good rainfall was still being received, a decision was made to extend the supplementation period. The Department of Parks and Wildlife (DPaW), as the former Department of Environment and Conservation (DEC), requested the Water Corporation cease supplementation on 27 September 2012.

On 1 July 2013, DEC was separated into two new departments being DPaW and the Department of Environmental Regulation (DER). DPaW was created to ensure a dedicated focus on the conservation, protection and promotion of Western Australia's unique terrestrial and marine parks and reserves and will administer the *Conservation and Land Management Act 1984* and the *Wildlife Conservation Act 1950.* DER *w*ill focus on environmental regulation, approvals and appeals processes and administer the *Environmental Protection Act 1986*.

Monitoring

As in previous years, a number of parameters were monitored at Thomsons Lake over spring and summer 2012/2013 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.
Murdoch University (Karin Strehlow, Jenny Davis and Lien Sim) on behalf of the Department of Water	Macroinvertebrate diversity, water quality and water levels at Thomsons Lake.	Biomonitoring of Selected Jandakot Wetlands (Macroinvertebrates) for Jandakot Groundwater Scheme Stage 2 – Final Report (1996-2012)

Water levels and comparison to previous years

The Department of Water/Murdoch University report *Biomonitoring of Selected Jandakot Wetlands (Macroinvertebrates) for Jandakot Groundwater Scheme Stage 2 – Final Report (1996 – 2012)* (*BSJW Report 2013*) noted a depth reading of 42.4cm in Spring 2012, which equates to a water level of approximately 12.174m AHD (see Table 2). Separate Water Corporation data shows the maximum depth of 12.177m AHD to have been attained in early October, before drying up completely during mid December 2012. This drying compares favourably with previous years, when complete drying occurred in December to January, 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)
2012	12.17 (lake bed = 11.75m AHD)	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

The 684.4 mm rainfall recorded for the year at the nearest official recording station (Jandakot Airport) was significantly below the long term average of 827.4 mm.

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 2012 water supplementation period (from 11 July to 27 September 2012), the Bartram Road Buffer Lakes outflow had Total Phosphorus levels ranging between a 0.11 mg/L minimum and a 0.42 mg/L maximum, with an average reading over the period (from 34 samples) of approximately 0.18 mg/L. 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 during the 2011 and 2010 supplementation regime (0.22 mg/L and 0.25 mg/L, respectively).

Sampling of the Russell Road Buffer Lake outflow revealed Total Phosphorous levels ranging between a 0.23 mg/L minimum and a 0.72 mg/L maximum, with an average reading over the period (from 32 samples) of 0.35 mg/L. This value represents an improvement on the 2009 and 2010 values (0.46 mg/L and 0.38 mg/L respectively), but is higher than the 2011 value (0.30 mg/L) and outside the expected [0.25 mg/L and 0.30 mg/L] target range specified in the *Operational Management Plan*. The average reading for Total Phosphorous in the Russell Road Buffer Lake outflow is still higher than the Bartram Road Buffer Lakes outflow, while average reading for Total Nitrogen is around 1.6 times higher (2.93 mg/L and 1.76 mg/L, respectively) and for Ammonia (as N filtered) around 2.3 times higher (0.188 mg/L and 0.082 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.

The *BSJW Report 2013* shows that from one water sample taken at Thomsons Lake in spring 2012, a Total Phosphorus level of 0.036 mg/L and a Total Nitrogen level of 3.0 mg/L were recorded. Overall the nutrient values were reduced from 2010, where the low water level appears to have been the main factor influencing water quality, and appears similar to 2011 values.

Table 3. Water quality data at Thomsons Lake (in spring) over the period 1996 to 2012.*

	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
TP(µg/L)	194	118	91	125	129	300	300	70	28	49	74	54	63	29? (67)	180	41	36
NH4(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
TN(µg/L)	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, Davis & Sim 2013 (p29).

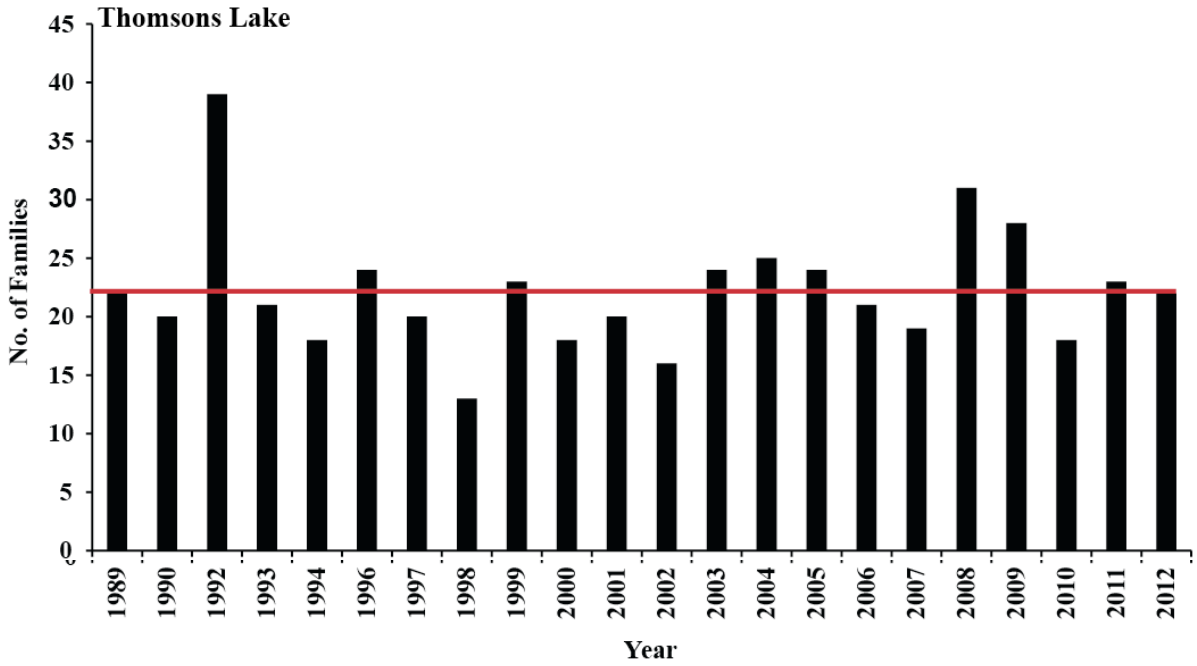
Macroinvertebrate diversity

Murdoch University have monitored the diversity and number of macroinvertebrates at Thomsons Lake since 1996. The *BSJW Report 2013* indicates that the total number of macroinvertebrate families recorded at Thomsons Lake in spring 2012 was 22, which is the second highest recorded value of the four annually sampled Jandakot wetlands (Thomsons Lake, Lake Kogolup North, Lake Yangebup and the Spectacles Wetland). This number is slightly lower than the 23 recorded in 2011, but is considerably higher than the 17 recorded in 2010 (see figure 1 below). It is also approximately equal to the average number of macroinvertebrate families recorded in Thomsons Lake since 1989, which is 22.2. These figures confirm that the higher number of macroinvertebrate families tend to occur with the higher water depths, due to a fundamental requirement for sufficient water and the fact that submerged plants support the richest assemblages of invertebrates.

The *BSJW Report 2013* outlines that one requirement for the persistence of viable reproducing populations of macroinvertebrates is that the wetlands remain inundated (minimum 50cm depth) for a minimum period of 4 to 5 months. The maximum water depth data since 1971 clearly demonstrated a decreasing trend in water depth. The water depth at Thomsons Lake has been below average for the last three years (since monitoring in 1996 the average water depth is 63.8cm). The declining trend of water levels is attributed to the combined effect of reduced rainfall and increased groundwater abstraction. Also 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. The water depth and hydroperiod at Thomsons Lake have continued to decrease despite water supplementation. If current trends continue and/or the water supplementation ceases, the ecological character of the lake would be compromised.

The report concluded that, despite the dry conditions experienced over the years, macroinvertebrate numbers in Thomsons Lake (and other wetlands in the Jandakot locality) appear to have returned to levels similar to those recorded in previous years, suggesting that the lake's ecosystem is resilient to present levels of eutrophication and some level of drying over extended periods of time. However, as rainfall decreases and if groundwater abstraction increases, the system may cross a threshold which may lead to a loss of ecosystem function.

Figure 1. Total and mean number of macroinvertebrate families recorded at Thomsons Lake over the period 1989 – 2012 *.



***Source**: Strehlow, Davis & Sim 2013

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 were undertaking observations under contract to AECOM environmental consultants. There was no available data on waterbird observations for Thomsons Lake in 2011 and 2012.

As in previous years, cygnet patrols were carried out by DEC during the latter part of the breeding season along the vermin-proof fence surrounding the lake. In December 2012, 30 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 96 in 2011/12, 188 found in 2007 and 32 in 2006.

Occurrence of botulism

There is no information available in 2012 on signs of botulism in waterbird populations at Thomsons Lake.

3. CONCLUSIONS

Water levels

The *BSJW Report 2013* and Water Corporation data show the highest water level in 2012 was approximately 12.17m AHD (equating to a depth of 42cm, recorded in late September), with the lake retaining water until mid December 2012. This represents the fourth lowest mid-spring depth reading since 2000 with the below average rainfall experienced in 2012.

Water quality

Recorded nutrient levels in the Bartram Road Buffer Lakes waters were within the limits specified in the *Operational Management Plan*; however the Russell Road Buffer Lake waters were not within 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 in Spring 2012 (0.036 mg/L) is lower than the 0.041 mg/L recorded in 2011, and considerably lower than the 0.18 mg/L recorded in 2010 and the calculated average of 0.066 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.

The *BSJW Report 2013* notes that overall, the recorded water quality in Thomsons Lake was good and a lack of major changes in the variables recorded in spring every year since 1996 suggest that the lake

is not undergoing salinisation or eutrophication. Low water levels appear to have been the main factor influencing the poor water quality observed in 2010. This year was the first time since monitoring commenced that acidic conditions have been recorded at Thomsons Lake. The reasons for the acidic conditions are not clear and it is recommended that this be further investigated.

It is recommended that DPaW 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.

Macroinvertebrate diversity

The total number of macroinvertebrate families recorded in Thomsons Lake during spring 2012 was 22, which is approximately equal to the long term average of 22.2. The *BSJW Report 2013* notes the composition of the invertebrate communities at the lake has remained essentially similar over time, when sufficient water is present, and that the lake's ecosystem appears to be resilient to present levels of eutrophication and some level of drying. However, as rainfall decreases and if groundwater abstraction increases, the system may cross a threshold which may lead to a loss of ecosystem function. Therefore it is recommended that any activities that may result in the further lowering of the groundwater table be reduced or discontinued.

Waterbird observations

There was no available data on waterbird observations for Thomsons Lake in 2012. In December 2012, 30 cygnets were found along the vermin-proof fence, which were then released through the fence into Kogolup Lake. This confirms that the higher lake levels and later drying contributed towards 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 2012 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 2012 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 and Russell Road Buffer Lake outflow in the *Operational Management Plan* are still appropriate (maximum Total Phosphorous levels of 0.30 mg/L). The Russell Road Buffer Lake has higher levels of nutrients, but the nutrient levels have improved slightly over time.

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 2013, 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 if 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 2013. 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. This year acidic conditions have been recorded at Thomsons Lake. It is recommended that this be further investigated or alternatively an assessment could be carried out to determine whether any Acid Sulphate Soils are present at this site.

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

4. REFERENCES

Department of Water/Murdoch University (Strehlow, K, Davis, J & Sim, L) 2013. *Biomonitoring of Selected Jandakot Wetlands (Macroinvertebrates) for Jandakot Groundwater Scheme Stage 2. Final Report (1996-2012)*.

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