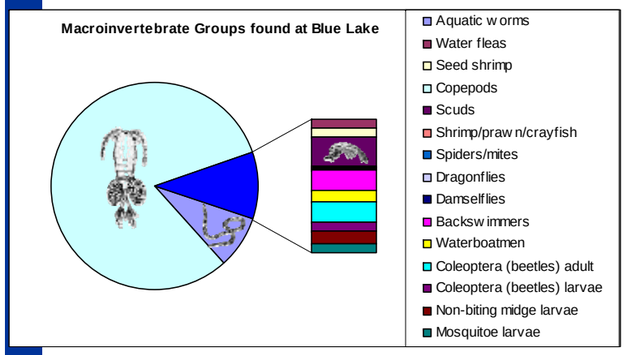
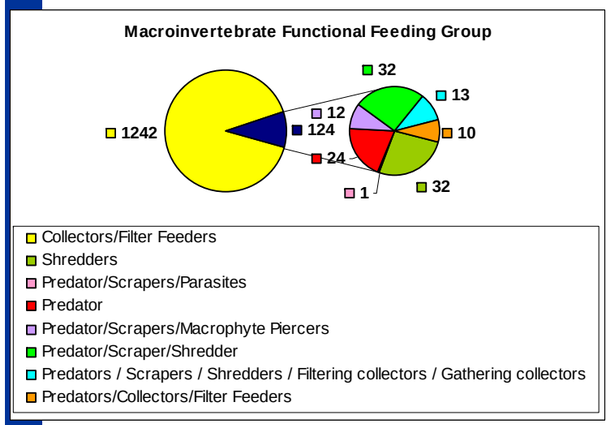
Blue Lake

South Coast Wetland Monitoring Project **June 2008**

Some macroinvertebrates fit into more than one of these groups, for example the Water Boatman is a Predator, a Scraper and a Macrophyte piercer.



A healthy wetland should have a representative of each functional feeding group. A loss or dominance in a particular group may indicate a change in ecology of the wetland. The composition of these groups at Blue Lake are displayed in the graph below.



Conclusion

Blue Lake is fed through surface runoff and sub surface flow with salinities ranging between marginal to brackish. The lake is a recharge lake and not connected to groundwater. It is an acidic lake with low pH due to a high proportion of sulphur-containing soils and the production of acid (H_2S0_4) from drying and wetting cycles. Due to the breakdown of organic material in the absence of oxygen there is a high amount of ammonium in the lake. Despite the low pH, which can lead to high heavy metal concentrations, heavy metal content was low, potentially due to the slow exchange between the sediments and water. The main consideration for Blue Lake is to maintain the integrity and protection of this wetland which situated in a near-pristine area which has high cultural and ecological significance. It is also important to protect the lake and surrounding area from the impact of fires to avoid exacerbation of acidification.

Some knowledge gaps were identified during the investigation, monitoring and data analysis for this wetland which should be addressed to improve understanding of the water quality and biodiversity and to detect changes over time. The monitoring period was relatively short and some effects of previous and current land use change and management may not yet be evident.

Macroinvertebrates would need to be identified to family or species level to allow more detailed analysis of ecological condition and relationship to other wetland characteristics. The hydrology of the wetland and its catchment is not fully understood or monitored, particularly the interaction between groundwater and surface water and the processes leading to the low pH and high ammonia concentrations. A future monitoring program should be developed to address these issues.

Acknowledgements

The Department of Water would like to sincerely thank and acknowledge the following people for their assistance and contribution toward the South Coast Wetland Monitoring Program and production of this report.

- Ruhi Ferdowsian (Department of Agriculture and Food, Albany) for providing knowledge of the hydrogeology associated with Blue Lake.
- Dr Brad Degans and Dr Kieryn Kilminster (Department of Water, Perth) as well as Dr Steve Appleyard (Department of Environment and Conservation, Perth) and Adam Lillicrap (Department of Agriculture and Food, Albany) for providing knowledge of the acidification of the lake.
- Ania Lorenz, Sherrie Randall, Kevin Hopkinson, and Albany Department of Water team who conducted the monitoring.
- Kevin Hopkinson, Naomi Arrowsmith, Andrew Maughan and others for their support and editing assistance.
- Sherrie Randall and Tracy Calvert for data analysis and report compilation.

For further information please contact Tracy Calvert at the Department of Water Albany (08) 9842 5760.

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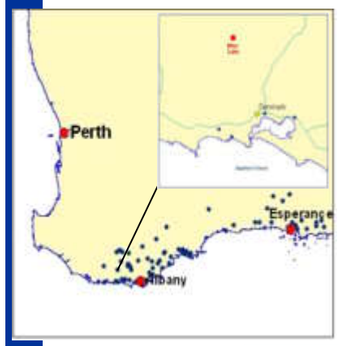
This report card summarises the Department of Water's current state of knowledge of the physical, chemical and biological characteristics of Blue Lake based on the knowledge gained from investigation and monitoring conducted by the Department of Water through the South Coast Wetland Monitoring Program.

Accompanying this document are appendices that provide more detailed information about the wetland monitoring program, terminology of wetland classification, parameters monitored, methodology and the ANZECC&ARMCANZ guidelines used in this report.

Funding for this program has been provided through South Coast Natural Resource Management Inc. - supported by the Australian Government and the Government of Western Australia.

About Blue Lake



Blue Lake is located approximately 25km north of Denmark in Western Australia, within the Wilson Inlet catchment and smaller Denmark River sub catchment. The wetland is at approximately 155m AHD (Australian Height Datum) and the area receives an annual average rainfall of 835mm.

	GPS Location Coordinates		
Wetland Suite	Easting	Northing	MGA Zone
Boronia Road Suite	525059	6152416	50

Blue Lake

Blue Lake has a catchment of approximately 3.15km^2 and is situated within the Mt Roe National Park which is part of the larger Walpole Wildernesss area vested with the Department of Environment and Conservation. The lake is important in terms of Noongar cultural values as the lake was a traditional camping and hunting area.

Vegetation consists of *Eucalyptus marginata* (Jarrah) in the upper storey and *Banksia attenuata*, *Banksia brownii*, *Taxandria pressiana* in the mid storey and *Baumea articulata* in the understorey. There are scorch marks on surrounding native vegetation from previous fires. *Taxandria pressiana* are regenerating around the upper fringes of the lake and some *Baumea articulata* are stressed around the edge of the lake.

Stressed Baumea articulata around edges of the lake

Zonation of Riparian vegetation around Blue Lake

Water quality monitoring commenced in November 2005 however the lake was dry at the end of summer 2007 due to reductions in rainfall.

Rainfall for example at the turn of the century was 950mm/year compared to 750mm/year in more recent times. Monitoring included physical, chemical and biological parameters as outlined in the appendices.

Department of Water
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Blue Lake

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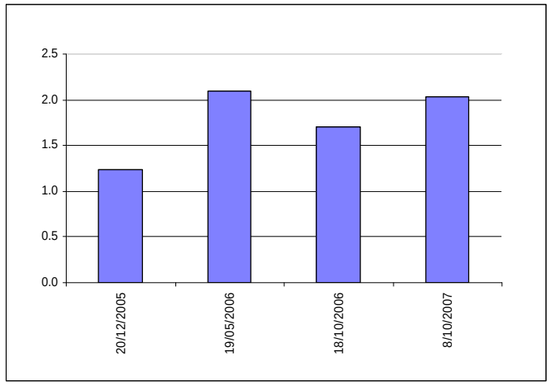
Wetland Classification

Wetland type	*Water Salinity*	*Consistency of Salinity*	*Size (Metres)*	*Shape*
Lake	Fresh	Stasohaline	Microscale 380 x 350	Round

Classification of Blue Lake has been evaluated on the basis of guidelines developed by V & C Semeniuk Research Group. For further explanation please refer to the appendices.

Salinity

Salinity over the sample period ranged between marginal (1.2mS/cm) and brackish (2.0mS/cm). Fluctuations in salinities relate to seasonal variation in rainfall, evaporation and hence water levels.



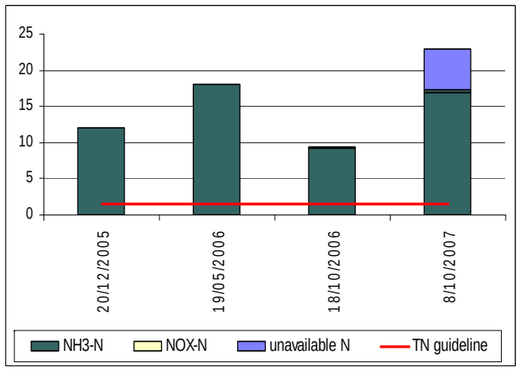
Salinity (mS/cm) over sample period

Blue lake is situated in a depression in a sheer zone within a granite fault containing a deep weathered profile of approximately 50-60m deep that includes fine clays, coal deposits and 2-3m of peaty organic rich soils at the surface. The wetland receives fresh water from surface runoff and sub surface flow from surrounding land particularly from the steeper slopes to the north. The lake is not connected to the groundwater table however recharges the groundwater which flows toward the water course to the south.

Nutrients

Total Nitrogen (TN) analysis was only obtained on one occasion where the TN concentration was 23mg/L which significantly exceeded the guidelines developed for ecosystem protection for southwest Australian wetlands for slightly disturbed systems of 1.5mg/L.

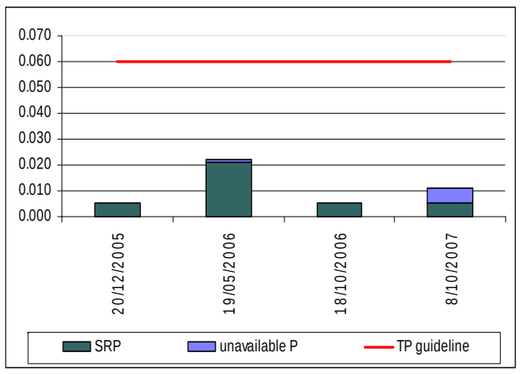
Dissolved inorganic nitrogen fractions of ammonia (NH_3-N) ranged between 9.3-17mg/L which significantly exceeded the recommended guideline value of 0.04mg/L on all sample occasions. Total oxidised nitrogen (NOx-N) ranged between 0.01-0.32mg/L which exceeded the recommended guideline value of 0.1mg/L on one of the four sample occasions.



Nitrogen fractions in mg/L over the sample period with TN guideline illustrated

High proportions of ammonium (NH3-N) relate to anaerobic (low or no oxygen) decomposition of organic matter in the coal-rich sediments which releases high amounts of ammonia into the water column.

Total Phosphorus (TP) concentration ranged between 0.005-0.02mg/L which did not exceed the water quality guidelines of 0.06mg/L on any sample occasion. Soluble Reactive Phosphorus (SRP) (form of phosphorus available for uptake by plants) ranged between 0.005-0.021mg/L which did not exceed the recommended water quality guideline value of 0.03mg/L on any sample occasion.



Phosphorus fractions in mg/L over the sample period with TP guideline illustrated

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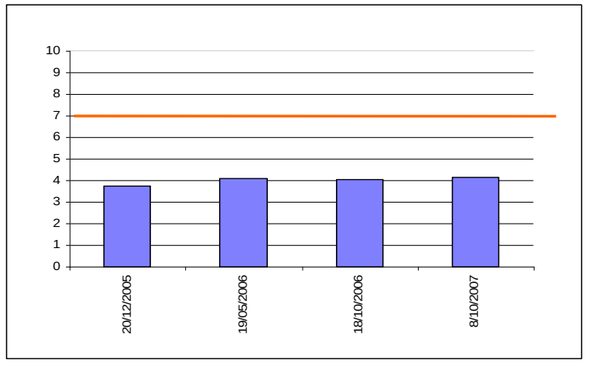
Nutrients are recycled naturally through the swamp due to uptake and assimilation of nutrients by plants and animals and through release of nutrients for example through microbial breakdown of organic material.

The low proportions of phosphorus may relate to the fact the lake is situated in a relatively pristine area where inputs may be low and possibly most of the TP may be bound to clay soils.

pH

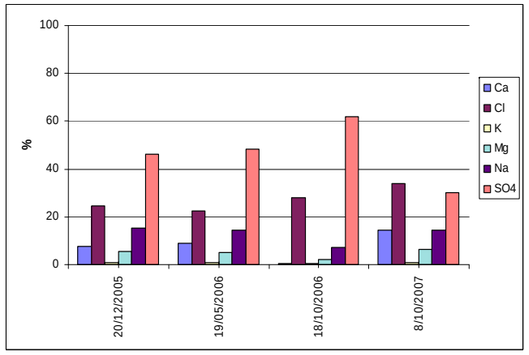
pH on all sample occasions was very low (acidic) ranging between 3.7-4.1. It is likely that acidification has occurred in the past in Blue Lake due to the fact the coal-rich sediments contains a lot of 'sulphur containing soils' (including organic rich soils) that are at risk of creating acid sulphate soils. After exposure of sediments to air (potentially through fire) and wetting again following rain, the sulphur or sulphate soils are oxygenated to form sulphuric acid (H_2SO4). Records show the area was last burnt in 2005 by prescribed burning and had been burnt through either wildfire or prescribed burns approximately every 10 years since the 1970's. With continuous wetting and drying of wetland soils and depending on the amount of stored sulphur, acidification of the wetland may continue for some years.

Coal organic rich sediments at Blue Lake



Low pH on all sample occasions (neutral pH =7)

Whilst the pH in Blue Lake is low, the total acidity in Blue Lake is also low which may be due to the clayey content in the sediments buffering or reducing the acidity. It has been suggested that the acidity that is released is being stored in the sediments rather that in the water column. There was also low heavy metal concentrations in the water which may relate to a slow exchange of acidity from the sediments to the water column.



Percentage of sulphate (SO_4) is high in comparison to other cations or anions (salts)

Macroinvertebrates

Fifteen groups of macroinvertebrates were found at Blue Lake during the monitoring period of which the most abundant included Ostracoda (seed shrimp), Copepoda (copepods), Notonectidae (backswimmers), and Cladocera (water fleas).

Other groups of less abundance were found including; Oligochaeta (aquatic worms), Hirudinea (leeches), Gastropoda (snails/limpets), Acarina (spiders/mites), Zygoptera (damselflies), Corixidae (waterboatmen), Coleoptera (beetles) adult, Coleoptera (beetles) larvae, Chironomidae (non-biting midge larvae), Ceratopogonidae (biting midge larvae), Culicidae (mosquitoe larvae), Other Diptera (fly larvae), Trichoptera (caddisflie larvae), and Other taxa.

The diversity of macroinvertebrates found over the sample period ranged between eight to fourteen groups with a median of ten groups, which rates as average based on the Ribbons of Blue Wetland Habitat Score.

Each group of Macroinvertebrate play a different role in the food chain, some feed on organic material (Shredders), others feed on fine organic particles (Collectors/filter feeders), others graze on algae (Scrapers), some feed on each other (Predators), others are parasitic (Parasites) and some are Macrophyte piercers that feed off living plants and algae fluids. These groups are called Functional Feeding Groups (FFG).