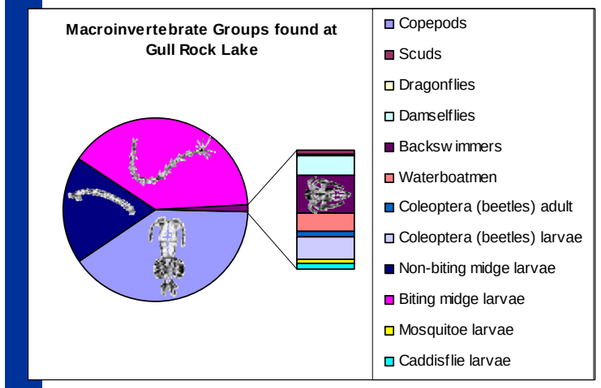
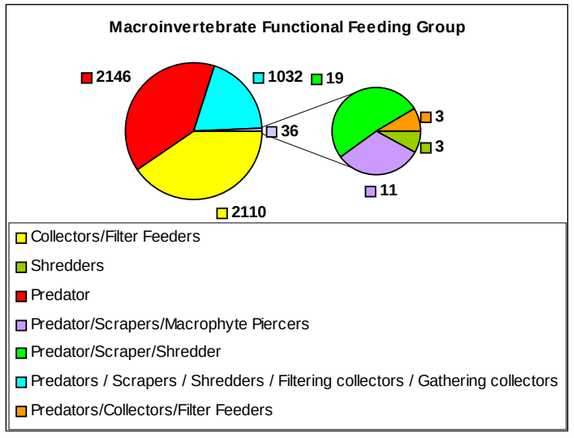
Gull Rock Lake

South Coast Wetland Monitoring Project **June 2008**

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). 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 Gull Rock Lake are displayed in the graph Macroinvertebrate Functional Feeding Groups.

Conclusion

Gull Rock Wetland is fed through surface runoff sub surface flow and most likely through groundwater. Wetland salinity ranged between saline and highly saline. It is an acidic lake with low pH due to the high amount of 'sulphur containing soils' and the production of acid (H_2S0_4). High nutrient concentrations may relate to the limited biological or geochemical processes that occur under low pH and concentration of nutrients and potentially nutrients may be released from the sediments under anaerobic conditions. Aluminium was high due to the mobilisation of heavy metals in low pH (<4) conditions. Further understanding of the acidification process and duration of acidification, including potential wetland-groundwater relationship and water level trend is needed. Assessment of threats to ecological function in the wetland that may arise from on-going acidification is also required. It is 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. 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 Department of Water's South Coast Wetland Monitoring Program and production of this report.

- Dr Ruhi Ferdowsian (Department of Agriculture and Food, Albany) for providing knowledge of the hydrogeology associated with Gull Rock Lake.
- Dr Brad Degans and Dr Kieryn Kilminster, Department of Water (Perth) and Dr Steve Appleyard, Department of Environment and Conservation (Perth) for providing information of the acidity in the wetland and assisting with editing.
- 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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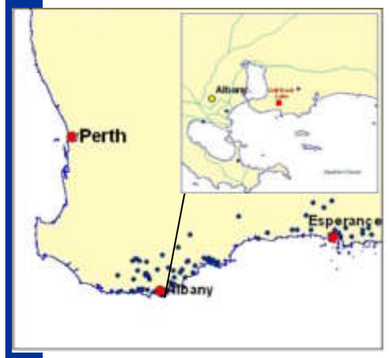
This report card summarises the Department of Water's current state of knowledge of the physical, chemical and biological characteristics of Gull Rock Lake based on the knowledge gained from investigation and monitoring conducted by the Department of Water through the South Coast Wetland Monitoring Program.

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 Gull Rock Lake



Gull Rock Lake is located on the coast approximately 12km east of Albany in Western Australia within an ill-defined coastal catchment. The wetland is at approximately 5m AHD (Australian Height Datum) and the area receives an annual average rainfall of 840mm.

Gull Rock Lake is located on Crown land within a catchment of approximately 16km^2. The wetland is situated in the Gull Rock National Park and is surrounded by uncleared native vegetation (Coastal banksia-heath community) extending to the coast.

	GPS Location Coordinates		
Wetland Suite	**Easting**	**Northing**	**MGA Zone**
Gull Rock Suite	591370	6126332	50

Gull Rock Lake

Below: Stressed and dead Baumea articulata with regenerating Taxandria juniperina

Above: Dense stands of Taxandria juniperina at Gull Rock Lake.

Wetland vegetation includes thick stands of *Taxandria juniperina* in the upper storey, regenerating *Taxandria juniperina* in the mid storey and *Baumea articulata* in the under storey. There are old tree roots in the lake and stressed *Baumea articulata* on the north-west side of the lake.

Gull Rock lake is situated in a largely uncleared catchment however; approximately 10% of the catchment has been cleared of native vegetation for livestock and cropping.

Water quality monitoring commenced in November 2005 which included physical, chemical and biological parameters as outlined in the appendices.

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

Department of Water
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Gull Rock Lake

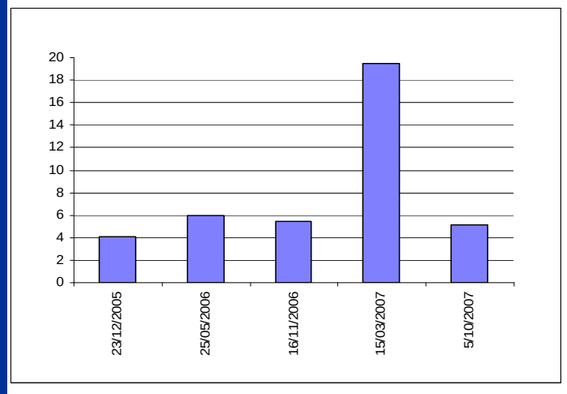
Wetland Classification

Wetland type	*Water Salinity*	*Consistency of Salinity*	*Size (Metres)*	*Shape*
Lake	Subhaline - Hyposaline	Poikilohaline	Mesoscale 960 x 430	Irregular

Salinity

Salinity over the sample period ranged between saline (4.13mS/cm) and highly saline (19.5mS/cm). Fluctuations in salinities relate to seasonal fluctuations in rainfall, evaporation, water levels and geochemical processes.

Gull Rock Lake lies in a depression at the base of sloping granite hills near the coast. The wetland was previously a coastal embayment or inlet which has now been cut off from the ocean through sand migration and dune formation. The wetland has since shrunk to its present size with the lake floor at 2m AHD. Although further investigations are required, groundwater interception is likely at this elevation and due to the very low gradient toward the ocean, groundwater movement is likely to be slow with little recycling of water. Groundwater salinities in this area are marginal (500-1000mg/L)



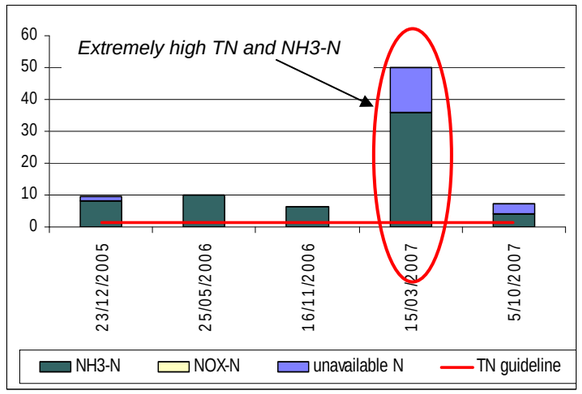
Salinity (mS/cm) over the sample period

which is lower than wetland salinities. The wetland receives fresh water from surface runoff and sub surface flow from the surrounding land.

Nutrients

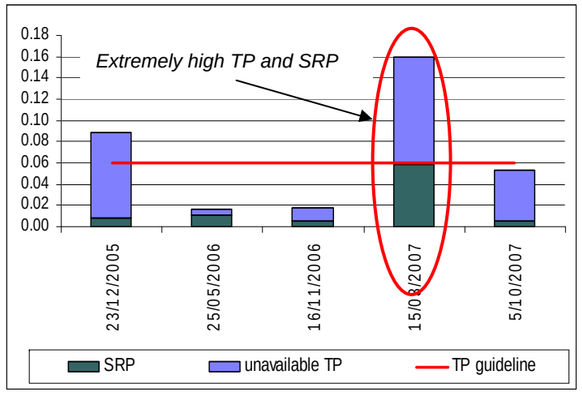
Total Nitrogen (TN) concentrations ranged between 7.3-50.0mg/L which exceeded the guidelines developed for ecosystem protection for southwest Australian wetlands for slightly disturbed systems of 1.5mg/L on all sample occasions.

Dissolved inorganic nitrogen fraction of ammonia (NH_3-N) ranged between 4.0-36.0mg/L which exceeded the recommended guideline value of 0.04mg/L on all sample occasions. Total oxidised nitrogen (NOx-N) ranged between 0.01-0.023mg/L which did not exceed the recommended guideline value of 0.1mg/L on any sample occasion.



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

Total Phosphorus (TP) concentration ranged between 0.016-0.08mg/L which exceeded the water quality guidelines of 0.06mg/L on two of the six sample occasions.



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

Soluble Reactive Phosphorus (SRP) (form of phosphorus available for uptake by plants) ranged between 0.005-0.059mg/L which exceeded the recommended water quality guideline value of 0.03mg/L on one of the five sample occasions. Nutrients are recycled internally in 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. However, the acidity of the waters (and probably underlying sediments) may limit many biological or geochemical processes to the extent

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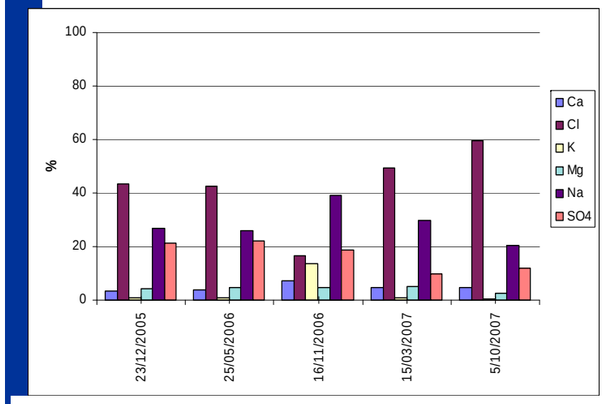
that cycling of nutrients is limited and dominated by evapo-concentration. Drying, resulting in evapo-concentration of the waters in the lake, may explain the increased concentrations of N and P in the waters (also corresponding with high salinity at the time of sampling).

High proportions of total nitrogen and ammonium (NH3-N) relate to anaerobic (low or no oxygen) decomposition of organic matter which releases high amounts of ammonia from the sediments into the water column. Lower proportions of phosphorus may relate to the fact the lake is situated in a relatively pristine area where inputs may be low or possibly most of the phosphorus may be bound to clay soils.

pH

pH on all sample occasions was low (acidic) ranging between 2.8-3.4. Coastal wetland soils



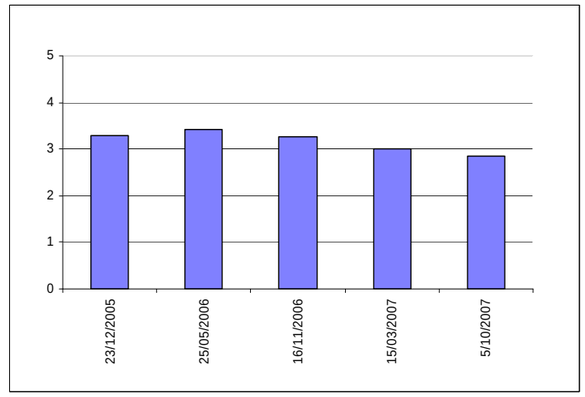
Of the total salts, percentage of each cation and anion (note higher proportions of sulphate along with sodium and chloride)

have high stores of marine-derived sulphur deposits accumulating during periods of sea level rise over the last 10000 years. The sulphur is usually bound to iron (iron sulphide) and exposure of these sulphidic or pyritic soils to oxygen generate acidification in the form of sulphuric acid (H_2SO4).

It is expected that Gull Rock Wetland may be a naturally acidic wetland as there has not been any anthropogenic disturbance, however it is unclear what is driving the acidification process or how long it has been acidic.

Signs of intense acidification are present along the northwest margin with iron and jarosite (a yellow mineral containing iron, potassium and sulphate) deposits. Although further investigations are required, the appearance of the healthy vegetation on the southern side may indicate acidification could be isolated or concentrated at the northwest margin of the lake. When water levels in the wetland recede a large area of the northern margins are exposed to air which may trigger the oxidation of sulfidic sediments and acidification. Acid may also have originated from drying subsoil layers (containing sulfidic sediments) in the low-lying fringing land around the wetland, particularly in the area where groundwater flows into the wetland (the northwestern side of the lake).

There were high amounts of Aluminium (20mg/L) in the lake waters which can be mobilised from sediments during the acidification process and at low pH (<4). Notably, there was little iron which is typical of acidity having originated from



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

characteristic of sulfuric sediments (ie sulfidic soils that have begun to oxidise and release acid). Occasionally empty turtle shells have been found at the edges of the lake which may relate to high heavy metal concentrations.

This was most likely because the iron was locked in minerals forming on the shoreline of the lake.

Macroinvertebrates

Twelve groups of macroinvertebrates were found at Gull Rock Lake during the monitoring period of which the most abundant included Copepoda (copepods), Chironomidae (non-biting midge larvae), and Ceratopogonidae (biting midge larvae).

Other groups of less abundance were found including; Amphipoda (scuds), Epiproctophora (dragonflies), Zygoptera (damselflies), Notonectidae (backswimmers), Corixidae (waterboatmen), Coleoptera (beetles) adult, Coleoptera (beetles) larvae, Culicidae (mosquitoe larvae), and Trichoptera (caddisflie larvae).

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