Submission to the Parliament of Australia Senate Inquiry into water management in the Coorong and Lower Lakes

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Thursday 11th September, 2008.
Answers to questions taken on notice at the Public Hearing in Adelaide on 10th September will be forwarded as a separate document next week.

1. The Coorong and Lower Lakes are the traditional home of the Ngarrindjeri people. Prior to European settlement the River's "environment" and the indigenous people sustained by it had all the water. The natural mixing of fresh and estuarine waters between the Lakes, the Coorong and the sea was a critical ecological process that supported the vast array of habitats and endemic species.
2. The Lower Lakes were naturally fresh and permanent (ranging in height from c. +0.3 to +0.6 mAHD) with at least 2,000 ML per day of water discharging to sea which prevented significant sea water incursion. It is known from the diatom record (silicon based shells of animals that persist in sediments for thousands of years) that sea water incursions under natural conditions were brief and did not extend beyond Point Sturt nor beyond the mouth of Currency Creek on the western edge. There are 8 additional lines of evidence for this fresh history including remnant freshwater flora and fauna natural histories such as the occurrence of Yarra Pygmy Perch in the Lakes that have been in the system some 7,000 to 10,000 years since the Murray-Darling and Yarra River Basins were connected. These fish require fresh, flowing cool water and only live for 5 years and thus indicate that the system has been fresh and permanent since formation.
3. Under natural conditions, the River Murray would have dried in the semi-arid mid-sections but the lower River Murray (from approximately Tailem Bend to the sea) was permanent and fresh being supplied with water from seasonal draining of the Lower Lakes, groundwater and immense wetlands adjacent to the River. Freshwater also entered the Coorong from regional groundwater discharge and surface drainage of wetlands in the South-east of South Australia.
4. Damage to the Coorong and Lower Lakes ecosystem, such as inadequate flows and losses of keystone aquatic flora, was evident within 50 years of European settlement in NSW, Victoria and South Australia. At the time of the Federation Drought, NSW and Victoria had in place pumping rules that enabled each State to pump 50% of water passing each pumping station along their section of the River allowing for the incoming tributaries to refill the River ready for pumping at the next station.
5. The building of the barrages (1930s and 1940s) to separate the Lower Lakes from the sea was the first act of engineering of the River. Although the barrages, locks and weirs were primarily installed for river navigation purposes their construction enabled extensive development of water resources throughout the catchment. Their

installation also restored freshwater "riparian rights" to lake side communities whose water supplies had been depleted through taking of River water upstream.

6. The Mouth of the Murray was kept open by freshwater flows from c. 5,500 BC to 1981 when it closed for the first time. Water trading commenced in 1984 without any provision for a secure volume of water to keep the Murray Mouth open or to adequately remove silts and salts entering the River from storages, irrigation, over-grazing and land clearance.
7. The Coorong and Lower Lakes were nominated as Wetlands of International Importance under the Ramsar Convention in 1985. They contain 23 different wetland types ranging in salinity from fresher than rain water to hypersaline. Australia is Internationally bound by this nomination to maintain the Ecological Character (that is the sum of the ecological components, processes, services and benefits) as it was, or better than, in 1985.
8. The Ecological Character of the Coorong and Lower Lakes has significantly deteriorated since nomination. The first concise Description of Ecological Character, prepared by Dr Bill Phillips, myself and other experts in 2006, shows that of the 54 Ecological Character parameters assessed only 3 were considered to be in a healthy condition. The remaining 51 parameters were considered to be in urgent need of management intervention to improve their status or to ensure that they remained in the landscape. This document details recommendations to rehabilitate the Ecological Character to 1985 condition.
9. In early 2008, Phillips, myself and Jason Higham prepared a draft Ramsar Management Plan for the site which shows further deterioration of the Ecological Character since 2006 and details urgent management actions required to prevent complete loss of the nominated Ecological Character.
10. To date, no adequate management that will prevent the loss of the Ecological Character of the Coorong and Lower Lakes has occurred even though irreversible damage has occurred and will continue to occur. It is evident that the Coorong and Lakes are in such poor ecological condition because decision makers have successively failed to act in a timely manner on the recommendations of experts.
11. The Lower Lakes contain significant Acid Sulfate Soils (ASS) hotspots where the pH has dropped to lower than 4. This indicates that the fundamental pathways for energy movement (carbon and nutrients) through the food web of the Coorong and Lower Lakes has been severely altered by development and poor management of the catchment. Impacts of ASS exposure include mobilization of heavy metal salts formed by these soils into stock and domestic water supplies, blowing of toxic dust and soils onto rooves and pastures and alterations to the soil structure.
12. At some point the neutralizing capacity of the soils and groundwater of the Lakes will be exhausted if freshwater is not provided to the site after which there will be a rapid and unpreventable drop in pH (-1.2 mAHD modeled Lake levelfro acidification). If the lake water bodies do drop to a pH of 5 or less, there will be widespread losses of biota (e.g. fish kills including large iconic Murray Cod), the water will be effectively untreatable for town and domestic supplies and recovery will be extremely expensive if it were possible. It is of paramount importance that the Lakes do not acidify and become a contaminated site.

13. Best practice management for ASS sites is to keep them wet if wet, not to disturb them (i.e. do not build weirs, channels, embankments or other structures), to take care when discharging water from them, to neutralize them slowly preferably with fresh source water, to bioremediate where possible with plants and mulch and to not add extra sulfate, particularly to confined systems.
14. ASS science and management experience suggests that letting sea water into Lake Alexandrina will not fix the ASS problem but will exacerbate it because once in the Lakes, the sea water will not be able to be thoroughly discharged and hypersaline conditions conducive to the production of monosulfidic black oozes are likely to be created.
15. Ramsar listed and otherwise significant wetlands, tributaries and River reaches in all parts of the Murray-Darling Basin, not just the Lower Lakes and Coorong, are severely degraded and in need of additional flows to rehabilitate their Ecological Character. Not one of the six *Living Murray* Icon sites is receiving adequate water and thousands of wetlands and several major tributaries across the Basin are at risk from exposure and/or disturbance of Acid Sulfate Soils.
16. Significant and rapid declines in Ecological Character at the Coorong and Lower Lakes site as well as at many other sites across the Murray-Darling Basin mean that the Basin's ecosystem will no longer be able to provide Ecosystem Services such as provision of treatable town water, irrigation water, fishing, boating and camping that we depend on. There are clear ecological signals that the whole Murray-Darling Basin is being pushed beyond its ecological resilience which is counter-productive given the required adaptation needed by the Basin's ecosystems if they are to continue to provide Ecosystem Services under any of the various Climate Change scenarios.
17. There is an urgent need to provide Cultural water flows to the indigenous peoples of the Murray-Darling Basin to improve their cultural economy and their capacity to adapt to climate change. The Murray Lower Darling Rivers Indigenous Nations have signed a Memo of Understanding with the Murray Darling Basin Commission and have prepared a paper on cultural water needs that requires urgent attention.
18. The volume of water required to replenish the Lower Lakes and Coorong needs to be looked at in terms of water required to a) reach a series of target Lake level heights from current (-0.3 mAHD) to a new high water line of +0.6 mAHD and b) provide adequate flow through the Murray Mouth to achieve water quality targets for the Lower Lakes and Coorong (see Targets 1 to 6 below). The absolute volumes will vary depending on climatic factors both locally and across the Basin but it is likely that 350-400 GL per annum will be the minimum needed to prevent acidification and return Lake levels to sea level over the next few years. After that, volumes of 750-1,000 per annum would be needed to rehabilitate the Ecological Character of this site. This water will aid in the restoration of ecological functionality to many other sites in the Basin on its way down the River.

Target 1: Prevent acidification of Lakes by keeping Lakes above -0.8 mAHD at all times.
This may require 150-350 GL of water during spring/summer 2008/09 depending on lakes water balance although most recent modeling suggests the lesser amount may be needed this year. Employ bioremediation techniques (e.g. mulch and revegetate 30% of exposed lakeshore with mixture of terrestrial and aquatic species) to minimize mobilization of the heavy metal salts formed when ASS were exposed and prime the lake bed for safe refilling.

Target 2: Reconnect Lake Albert by removing bunding between the two Lakes by beginning of spring 2009.
A lake level of -0.3 mAHD will need to be reached to allow for removal of the bund. Care needs to be taken to control turbidity and pH levels in Lakes during refilling and removal. Continue to revegetate and mulch the exposed Lake shore to minimize heavy metal mobilisation and re-acidification (aim for 60% of exposed area). Investigate options for flushing water out of the barrages under different wind/tide/flow scenarios to determine whether Lake water can be flushed out.

Target 3: Return Lake levels to greater than sea level (>0 mAHD) by spring 2010. Continue to revegetate and mulch the exposed Lake shore to minimize heavy metal mobilisation and re-acidification (aim for 100% of exposed area). Care needs to be taken to control turbidity and pH levels in Lakes during refilling and removal.

Target 4: Return Lake levels to greater than +0.3 mAHD by spring 2011.
Care needs to be taken to control turbidity and pH levels in Lakes during refilling and removal. Modify barrages if necessary and begin flushing out Lake water as soon as possible.

Target 5: Return Lake levels to full capacity of +0.6 mAHD by spring 2012 with a discharge to sea of at least 350 GL per annum.
Modify the barrages, if necessary, to allow release of Lake water from below +0.6 mAHD when and where possible to achieve water quality targets for the Lower Lakes, Murray Mouth estuary and the North Lagoon of the Coorong. .

Target 6: Operate Lakes between +0.3 and +0.6 mAHD with occasional surcharging to +0.8 mAHD. Provide sufficient flows to keep the Murray mouth open at all times without dredging (750 to 1,000 GL per annum) to purge the Lakes of pollutants that accumulated during the low flow period to reach water quality targets in Ramsar Management Plan and to reinstate ecological functionality to the Murray Mouth and estuary.

19. Significant and timely volumes of water can be provided to the Lower Lakes from the Eastern Mount Lofty Ranges (EMLR) tributaries. Local inflows and rain on the Lakes has brought the Lakes up to -0.3 mAHD over winter 2008 and has been responsible for significant discharges in previous years when otherwise scant water

would have been released through the barrages (e.g. 250 GL through the barrage fishways in 2006). The EMLR tributary inflows need to be protected to ensure that some water is delivered to the Lower Lakes in a natural pattern every year and that disconnection of Lake Alexandrina from the EMLR tributaries and fringing wetlands is minimised. Further development of the EMLR water resources should be prevented by capping extractions and diversions at current rates at least until lake levels return to +0.6 mAHD. Mechanisms and opportunities for purchasing or otherwise delivering water from the EMLR tributaries to the Lakes should be explored as an emergency action to prevent acidification of the Lakes and further losses of species from the site.

20. One option for drought management being considered to prevent acidification of the Lower Lakes is that of opening the barrages and allowing sea water to flow into Lake Alexandrina. This option is not recommended for the following ecological reasons, including the most striking argument that letting in the sea is likely to produce more acid rather than quench it as intended. It should be noted that there will also be widespread social and economic impacts on people that rely on the ecosystem services of the lakes as a freshwater ecosystem; in particular, irrigators, graziers and the tourism sectors although quantification of these impacts is outside of my expertise.
    - Sea water may neutralise the acid generated from the exposure of ASS in the areas it reaches, depending on its buffering capacity, but it is unlikely to reach most parts of the Lakes currently affected by acidification because of the low energy transferred by the tidal signal at the barrages (approximately 0.2m) and the topography of the lake bed. That is, the sea water will not reach all the acid hot spots under its own energy.
    - Sea water introduces a fresh supply of sulfate ions ready to be converted to more sulfuric acid in the areas subjected to ASS exposure (that is, around the high water mark) and may be counter-productive and lead to more rapid and complete acidification of the Lakes water bodies. If the Lake soils generate more acid from fresh inputs of sulfate in sea water than the waters can neutralize, the Lake water bodies will acidify leading to losses of most forms of complex ecosystems, heavy metal contamination of potable water supplies and possible discolouration of the water to a yellow or orange colour.
    - Without significant River Murray inflows, tributary inflows or rainfall on the Lakes, it is unlikely that an effective flushing regime could be established on marine tidal signal alone. Therefore, the Lakes environment would receive sea water on high tides against low River flows, the salt would not drain out completely before sea water came in again which would lead to a progressive increase in salinity and risk of acidification. This would lead to major ecological losses in the Lakes environment and may result in an acidified Lakes system that does not support complex ecosystems.
    - With increasing salinity, algae and bacteria will dominate the system, hindering rehabilitation of the system back to what it was;

- Significant alteration of the composition and reduced health of the benthic ecosystem, which is unlikely to be able to adapt fast enough to the rapid increase in salinity to sea water concentrations will result;
- The groundwater under the lakes, which in most cases is fresher than the lake water, will recharge with sea water causing extensive salinisation of an unknown area of aquifers and overlying land. Connectivity between the lakes and the groundwater is highly variable depending on soil type;
- The sea water that enters the Lakes will evaporate so that parts of the Lakes exceed the salinity thresholds of most species and tend towards very simple algal-based ecosystems (akin to that seen in the *Dead Sea* areas of the Coorong now);
- Toxic heavy metal salts and acid will mobilize from exposed ASS causing deoxygenation of the water column and widespread fish and other aquatic fauna kills, with secondary impacts up the food chain;
- Production of hydrogen sulfide and other toxic gases may lead to stock death or human injury/fatality;
- Salt crusts will form around the lake margins from evaporation of sea water, preventing growth of plants at the high water mark, leaving it bare and susceptible to erosion;
- Exposed sediments will be recharged with sea water leading to long term salinisation even if flushing volumes of River Murray water were returned to the system, especially in sediments and soils with high clay content;
- Likely changes to surface chemistry properties of clay minerals in the lake bed, making them increasingly sodic. Initially, the salinity of seawater should flocculate clays in the lake, clarifying the water column and allowing for increased growth of algae (NB: most aquatic plants will not survive these higher salinities). Subsequent freshening may result in the dispersion of these clays affecting turbidity and the transmissivity of underlying clayey sediment;
- As consequence of all of the above, letting in the sea would result in:
    (a) loss of the Ecological Character for which the lakes part of the site was nominated as a Ramsar Wetland of International Importance;
    (b) transferred loss of ecological character for which the Coorong part of the site that is dependent on lake outflows was nominated as a Ramsar Wetland; and,
    (c) likely loss of threatened freshwater biota from the system, including several EPBC and State-listed species.

21. The South Lagoon of the Coorong is unlikely to be rehabilitated by River Murray flows nor by the volumes of water currently available from Salt Creek at the southern end of South Lagoon without further intervention. It is likely that some water in the South Lagoon will have to be pumped out to reduce the salinity that has built up there and that the lagoon will have to be refilled with less saline water some of which could be sourced from preventing losses of water from the wetlands of the South-East of South Australia to the sea and redirecting that water into the South Lagoon. This

option is currently under investigation by the State Government and should be put to the Ngarrindjeri and Boandik peoples for comment and advice.

22. Current Governance arrangements are failing the Basin's natural assets and in particular the Lower Lakes and Coorong that are subject to failures to implement sustainable water allocations and river management policies across the whole Basin given their location at the bottom of the system. There are over 140 plans covering the South Australian portion of the Murray-Darling Basin alone. Too much water is taken out of the Basin for its water dependent ecosystems to survive and this has been evident in the declining state of the environment particularly since the wet conditions of the 1990s that spawned extensive water resource development as well as a burst of health for the Basin's wetlands. It is imperative that water allocations are reduced to be within a sustainable cap that allows wetlands and farmers alike to withstand prolonged dry periods given that 30% or more of the years of rainfall record for the Basin show less than average rainfall and that climate change predictions suggest a further decline in run-off of c. 20%.

23. Current Governance structures are too clumsy and ill-co-ordinated to be effective at managing a system as complex as the Murray-Darling Basin. Tensions exist between community and Statutory Groups, Agencies within each State as well as between the States and the Commonwealth Agencies that prevent cohesive action. State borders as well as "policy borders" such as the constrained scope of the *Living Murray* program also impede cohesive and timely action and key activities are falling between the gaps. Little or no ownership of the Lower Lakes and Coorong crisis is shown by Queensland, NSW, Victoria and the Commonwealth and it is too often left to South Australia to fight for environmental provisions. The condition of the Lower Lakes and Coorong is the responsibility of all Basin States. Control by the new Murray Darling Basin Authority should start as soon as possible and delivery of water to Ramsar listed wetlands including the Lower Lakes and Coorong should be prioritized. Ramsar is an International obligation and as such should over-ride domestic policies in regard to maintenance or in this case rehabilitation of Ecological Character through the provision of adequate and secure water allocation for the Murray Mouth.

24. The loss of the Lower Lakes and Coorong will have widespread and strong ramifications in terms of impacting on Australia's Clean and Green image to overseas markets. In particular, this is likely to impact negatively on wine exports.

25. It is inevitable that some socio-economic adjustment to failure to supply water to irrigators will continue to occur. Under current management, irrigators such as those around Lake Albert fall victim to unsustainable water allocation policies in an ad hoc manner. It is imperative that the socio-economic adjustment that must occur as we learn to equitably and more sustainably share a decreasing bucket of water (predicted under any of the Climate Change scenarios), occurs with some overall Governmental guidance and assistance. Ecosystem services payments including payments for

returning cleared, farming land to native vegetation for carbon credits and biodiversity gains may be one way of keeping families on farms and rural communities going whilst rebuilding the Ecological Character of the Basin and improving ecological resilience to Climate Change.

26. The proposal to construct a temporary weir at Pomanda Island near Wellington in South Australia has triggered an EPBC Act assessment of environmental impacts. A preliminary assessment based upon best available information has been lodged with the SA Department for Environment and Heritage and is likely to benefit the Senate in their deliberations about options for the site.

27. Holistic management objectives for the Murray-Darling Basin, as follow, should be adopted and implemented to rehabilitate Ecological Character across the Basin, build resilience of the Basin's ecosystem and allow for adaptation to climate change and on-going provision of Ecosystem Services:
    i. Rehabilitate, and then maintain, the globally recognised ecological and biological assets of the Basin, including the full spectrum of wetland types which provide its unique suite of habitats and ecosystem services;
    ii. Secure increased environmental flows that are "Green to the Sea": providing flows to wetlands, tributaries, the River, Lower Lakes and Coorong before entering the sea, sufficient (1,000 GL per annum as a minimum requirement) to keep the mouth of the river open at all times without the need for dredging, and to see ecological functions re-established across the Basin;
    iii. Improve water quality across the site, most notably to reinstate recommended limits and variations in salinity, pH and turbidity;
    iv. Use the natural resources of the Basin wisely - in an ecologically sustainable manner;
    v. Introduce pro-active measures to address the urgent requirements for drought recovery, Acid Sulfate Soils mitigation and to anticipate the longer-term impacts of climate change on the Basin's ecosystem;