Attachment 2:
Background Briefing paper for CLLMM High Level Steering Committee – Meeting 26, 11 May 2012, Canberra.

1 HLSC update

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In addition, the update was to include:

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- the ecological impacts from the introduction of seawater; and

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Investigations into the ecological consequences of seawater introduction have been progressed since the HLSC last met in September 2010. This work is summarised below and will be presented to the HLSC to note at the upcoming workshop.

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2 Acid Sulfate Soil Management within Lakes Alexandrina, Albert and Coorong Ramsar Site.

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2.1.2 The Real Time Management Strategy

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Since the September 2010 HLSC meeting, the ecological consequences of seawater investigations were undertaken. This is discussed further below in section 3.

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In addition to the determination of trigger levels, the ASS research program results highlighted that enhanced acidity fluxes would likely occur around the lake margins if seawater were added to already oxidised ASS, due to initial increased rates of contaminant mobilisation compared to using freshwater.

The research details can be found at: http://www.environment.sa.gov.au/Conservation/Rivers_Wetlands/Coorong_Lower_Lakes_Murray_Mouth/The_environment/Acid_sulfate_soils/Acid_Sulfate_Soils_Research_Program_reports.

Hydrodynamic modelling predicts that the use of seawater or freshwater is preferable to a lake drawdown scenario which results in lake wide acidification. This study assumed a continuation of the then current drought conditions. However, a significant issue with seawater input is the hypersaline conditions forecast for Lake Alexandrina within two to three years if it is used to maintain water levels to -1.5 m AHD. Even greater hypersalinity (>200 g/L) is predicted for Lake Albert, together with high levels of total nitrogen and phosphorus (TN and TP) creating a eutrophication risk. Further considerations then are required regarding Lake Communities, Adelaide and Country Town's water security. Hence, stabilising the Lower Lakes with freshwater is considered to provide the best outcomes for water quality and the ecological character.

The modelling outputs based on drought conditions show salinity to be greater than 3 g/L across 100% of Lake Alexandrina at the starting date, of the modelling assessment, in year 1(October 2009). When seawater is first introduced in October 2010 to maintain water levels above -1.5m AHD, salinity rises very rapidly to > 30 g/L in the southern channel connecting the main lake body with the Coorong at the Tauwitchere Barrages. The highest salinities between October 2012 and April 2013 will be in the main lake body with fresher areas in the north under River Murray influence and south of Point Sturt where incoming seawater will provide a 'freshening' effect (35 to 40 g/L; see Figure 4). By April 2015 the whole lake will be 75 to 97 g/L (approximately 2.7 times seawater concentrations and 33 times the starting concentration in Lake Alexandrina). The River Murray will have little freshening effect under drought conditions and salinities in the confluence will remain between 65 and 70 g/L (approximately 1.8 times seawater and 75 times River Murray water salinities).

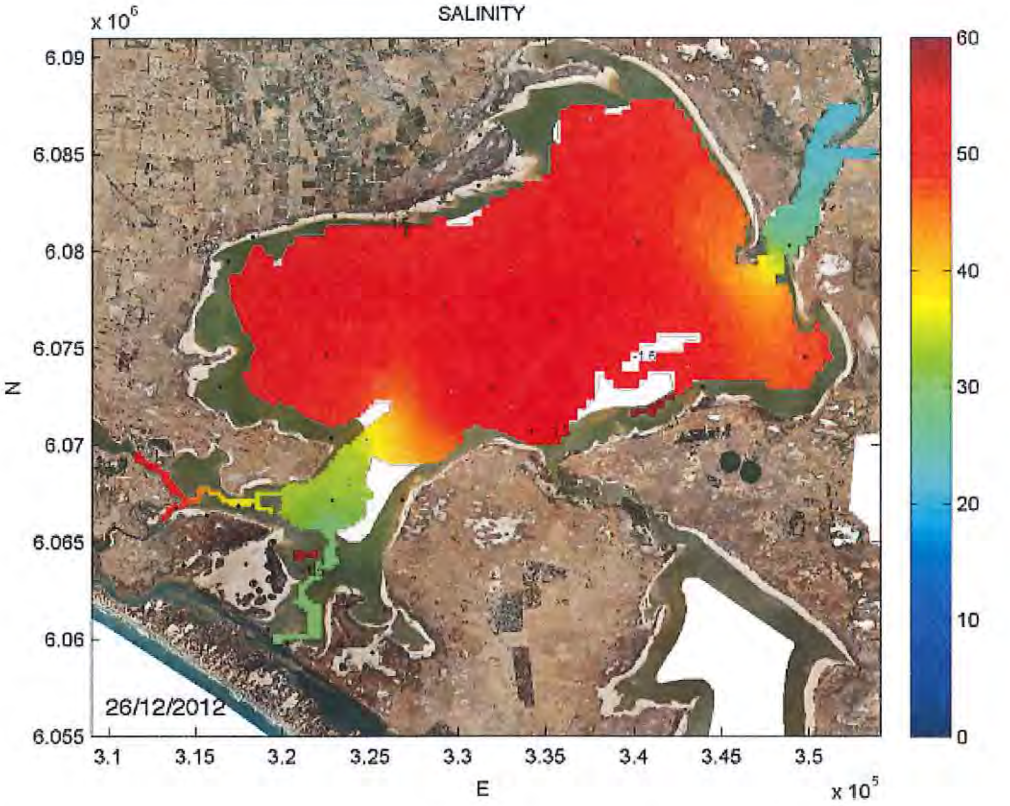

Figure: 4. Lake Alexandrina Salinity with Seawater at December 2012 showing the freshening effect of River Murray water in the north and seawater in the south. Note that salinities increase beyond this in subsequent years. Scale is in g/L. (30G/L is approximately seawater)

3 Ecological Consequences Assessment of Seawater Introduction

The hydrodynamic modelling outputs from the study above were used to assess the likely ecological consequences (both positive and negative) associated with each regional water management option. These options are do nothing, maintain with seawater and maintain with freshwater. The results of this assessment have not previously been provided to the HLSC. The Ecological Consequences Assessment (ECA) process began with facilitated expert workshops to document current knowledge of the Lakes and Coorong ecosystem and to identify a suite of ecological receptors (e.g. species, assemblages, functional groups) suitable for assessing both positive and negative consequences to the flora and fauna of the Coorong, Murray Mouth and Lakes Alexandrina and Albert. Sixteen local scientists familiar with the biota of the Coorong and Lakes Alexandrina and Albert were collectively trained in a common set of consequence assessment methods. Using these methods, each scientist determined the likely habitats, baseline conditions, thresholds and other considerations regarding tolerance and recovery strategies for their respective receptors. Each of the evaluations was based on three primary stressors: salinity, water level and pH.

The experts identified a total of 55 receptors across six biotic groups that could collectively be used to assess the consequences to the flora and fauna of the site. The experts independently completed the full suite of assessment templates using preliminary hydrological modelling outputs and attended a series of six two-day workshops in June 2010 covering six biotic groups: plankton, vegetation, lacustrine macroinvertebrates, estuarine macroinvertebrates, fish, frogs and birds. A combined workshop was then held to prepare guidelines for integration of individual receptor consequence scores and to review conceptual State and Transition models prepared in response to the information used in the workshops.

The outputs of these workshops were used to score consequences for each of the 55 receptors within these six biotic groups associated with three primary stressors: salinity, water level and pH, using outputs from the hydrological modelling. The consequence scores were then used to determine the most likely ecological outcomes (in terms of consequences to the different resident receptors and invasion of new taxa) under the six scenarios.

The start date for the ECA was October 2009. At that time, water levels in the lakes were very low (approximately -0.8 m AHD compared to full supply level of +0.75 m AHD) and it was not known whether future River Murray inflows would be sufficient to prevent further drawdown. Flow regulators were in place at Clayton and across the Narrung Narrows in October 2009. The Clayton regulator ponded water in Goolwa Channel to act as a freshwater refuge should the main lake bodies become more saline, acidic or both due to sustained low River Murray inflows.

The Draft report "Ecological consequences of managing water levels to prevent acidification in Lakes Alexandrina and Albert" (Muller, K 2012) concludes that salinity will be a key driver of ecological change in all scenarios, regardless of whether acidification occurs or not. The introduction of seawater to Lake Alexandrina will lead to extreme increases in salinity and transition to highly simplified, hypersaline ecosystems. A healthy, estuarine/marine community will not establish.

In Lake Alexandrina under both the pumping and cease-pumping seawater scenarios, salinity will be the major driver of a series of ecological changes through brackish-estuarine, then marine and finally hypersaline salinity conditions. This will result in mixed and depauperate assemblages of biota in Lake Alexandrina over space and time rather than promote establishment of a healthy, resilient estuarine-marine ecosystem.

Importantly, despite the occurrence of salinities within the estuarine range across the majority of the lake between spring 2010 and spring 2012, the very poor condition of the former estuary below the barrages at the beginning of the action period will severely limit establishment of estuarine taxa in Lake Alexandrina. However, even if estuarine-marine organisms could colonise Lake Alexandrina during that period they will be lost to on-going salinisation. The only receptors likely to be abundant in Lake Alexandrina at the end of the action period are hypersaline plankton and Insect larvae, with generalist shorebirds likely to remain to prey on the Insect larvae. Very small populations of estuarine macroinvertebrates may persist if indeed they can establish and Small-mouthed hardyhead may also persist although they will experience almost complete loss of habitat and food. Overall, the receptors typical of the Lake Alexandrina ecosystem will perish under the seawater scenario regardless of whether pumping to Lake Albert ceases or not and a healthy replacement ecosystem will not form.

If pumping to Lake Albert continues, water levels will be maintained and acidification will not occur. However, salinities will rapidly increase and cause the progressive loss of all resident Lake Albert receptors by the end of the action period except for Small-mouthed hardyhead, Insect larvae and some predatory birds. It is highly unlikely that other more salt-tolerant taxa will establish a new, complex ecosystem.

If pumping ceases, complete ecological collapse will occur from the catastrophic cascade of increasing salinity, acidification and then drying of the lake.

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