

APPENDIX M

Coorong Salinity Management Strategy – Intervention Monitoring Framework

AIMS AND OBJECTIVES

This monitoring framework has been designed specifically to detect hydrometric, water quality and ecological responses to the proposed interventions, that is:

- Extraction of hypersaline water from the Coorong South Lagoon to the Southern Ocean, by pumping 250ML/day from an area between Woods Well and Policeman's Point.

Secondary project aims may include assessment of the effectiveness of a targeted excavation between the 2 lagoons in order to improve transmission efficiency and salt flux, along with an assessment of a managed water level regime in the event that a temporary sheet piled regulator is constructed. At this stage it is uncertain if a temporary regulator or another structure will ever be built to manage water levels.

This monitoring framework and operational response plan is a point in time document and will regularly be updated. A whole of site (Lower Lakes, Coorong and Murray Mouth) ecological monitoring plan is under development, to be implemented by September 2010. This whole of site approach will include any of the monitoring for the interventions planned under the Murray Futures Long Term plan, hence providing a single reference document for condition and intervention monitoring.

The objectives of this monitoring program are:

- measure Coorong South Lagoon water quality and hydrometry in response to the proposed interventions
- measure Coorong South Lagoon ecological parameters in response to proposed interventions

In the first phase of the intervention, we predict few ecological responses, given the current absence of ecological assets from the Coorong South Lagoon. However, pre- and post-intervention ecological monitoring are still required in the short-term, to establish an ecological baseline with which to compare future responses.

MEASUREMENT PARAMETERS

Hydrometric – the following hydrological measures will form the basis for hydrological monitoring within the Coorong:

- water depth
- water velocity
- flow direction

Flow Monitoring

Due to the lack of actual data on water movement between the North and South Lagoon confidence in the model predictions for improving the transmission efficiency is low. The cost of targeted excavation of any sills or limestone reefs within the narrow corridor between north and South lagoon is significant and in order to inform any investment decisions a flow monitoring program is planned. This will involve;

Permanent Flow Monitoring Techniques (Using ADP)

Permanent ADP monitoring can be performed using side looking or up looking sensor installations. These sensors have operational distance and beam spread characteristics that require them to be positioned strategically relative to flow and channel shape. Side looking sensors would be mounted on a pile and need to be on a vertical track that allows for operation at various depths. The pile would be sited in sufficient water depth and near a bank so that its field of view captures the majority of the flow. An up looking sensor would be mounted on a flat plate on the bed and near the middle of the channel. The field of view of an up looking ADP is not generally as representative as a side looking ADP.

The parameter measured is water velocity within a portion of the whole cross-section. The relationship between time series velocity measurements and discharge is formed by comparison to gaugings. For this reason it is important to select a valid position for time series installation.

The validity of the velocity vs discharge relationship will depend upon site suitability, instrument capabilities and the number and range of reference gaugings.

Reference gaugings would be conducted at various flow and stage conditions. Initial gaugings would be planned over a daily tidal cycle in order to cover a range of flow rates in either direction. There is a need to repeat this process for daily tide cycles of various magnitudes and this would occur across the seasons. Supplementary one-off gaugings could occur to help build the relationship.

The amount of further gauging work would be determined after comparison of results with time series data.

Installation Options

Option 1 – Side Looking ADP At Old Ferry Crossing (semi-permanent installation)

This would be established using hand driven 80mm piles. It would be difficult to drive piles into a firm bed due to deep silt. The silt would be relied on to provide stability and station design would be a tripod framework. A permanent station could be considered at a later date.

Advantages:

- This is the best cross-section due to a natural rocky reef and old ferry landings
- Sensor is available for loan from stock
- Deployment of a side looking sensor has been undertaken at Morgan using similar sensor mounting methods.

Disadvantages:

- Requires pile driving
- Telemetry option requires a radio link to A4260633
- Requires approvals from DEH and Ngarrindjeri Regional Authority for the structure

Option 2 – Side Looking ADP At Existing Beacon

Advantages:

- Existing beacon can be used to mount the instruments
- Sensor is available for loan from stock
- Can utilise existing logger and telemetry
- Does not require further approval from DEH and Ngarrindjeri Regional Authority.

Disadvantages:

- Beacon position is mid channel and the sensor would only be profiling about half of the channel.
- The cross-section has a wide shallow portion at the peninsula side and this would not be measurable due to spread characteristics of the beam. A significant percentage of the total flow was observed in this shallow portion during the site investigation.

Water Quality – the following water quality measures will form the basis for water quality monitoring, within the Coorong and in the Ocean :

- Salinity
- pH
- Turbidity
- DO
- Temperature
- Metals, Nutrients, Chlorophyll A concentrations

This complies with existing water quality and hydrological monitoring undertaken by Upper South East water Quality Monitoring (DWLBC), and covers the parameters required to relate interventions to ecological responses that are relevant for ecological responses. Historic data exist for EC from 1981, while pH, temperature, turbidity and water level data exist from 1997. These historic data can be used to complement baseline data collected specifically for this monitoring program.

Baseline water quality data is available from the following web links;

<http://data.rivermurray.sa.gov.au/Telemetry/Default.aspx?App=RMW>

<http://e-nrims.dwlbc.sa.gov.au/>

http://www.epa.sa.gov.au/environmental_info/water_quality/water_quality_monitoring_sites/coorong#raw

http://www.epa.sa.gov.au/environmental_info/water_quality/monitoring_programs_and_assessments/lower_lakes

Ecology – the following biota will be monitored;

- Aquatic Vegetation – Ruppia shoots and propagule distribution and abundance
- Macro invertebrates - both benthic and pelagic with particular focus on insect larvae (chironomids), brine shrimp and Goolwa cockles and other benthic marine organisms
- Fish - particularly smallmouth Hardyheads in the Coorong Lagoons
- Birds -aquatic, migratory and terrestrial
- Mammals – DEH propose to use existing monitoring programs for large order animals such as Southern Right Whales.
- Terrestrial Vegetation – Required to comply with Native Vegetation council approval and to demonstrate no adverse effects of matter of NES, mainly on Young husband Peninsula but also for any storage or site compounds on the eastern shores of the Coorong

With the exception of brine-shrimp, this list complies with existing ecological monitoring undertaken by the several services providers on behalf of various agencies (DWLBC, SA MDB NRM Board / TLM), and covers the ecologically significant organisms in the Coorong's South Lagoon. Historic data exist for these ecological assets continuously from 1998, with additional historic data collected in 1984-5 and 1990-3. Some historic data also exist for brine-shrimp, collected through the CLLAMMecology Research Cluster (from 2006-7). The intention of the whole of site monitoring framework, currently under development, is to identify if any further gaps exists and to increase sampling sites and frequencies, if determined value for money.

SAMPLING LOCATIONS AND FREQUENCY

Sampling locations will conform to the following principles:

- be compatible with existing (historical) hydrological, water quality and ecological monitoring for the Coorong South Lagoon,
- ensure relevant overlap between sampling sites and frequency for the different components (hydrology, water quality, ecology) being monitored,
- complies with any consent/permit or exemption for specific interventions

Water Quality / Hydrology – ten sites are currently monitored for water quality in the Coorong South Lagoon (DWLBC). Currently, these ten sites are monitored bi-monthly (when inundated), focussed primarily around the Salt Creek outflow and southern end of the South Lagoon (all South of Jack's Point). For the purposes of this intervention monitoring framework, these ten sites would be supplemented with extra sites in the northern part of the South Lagoon, and southern part of the North Lagoon. Frequency of monitoring would be maintained at bimonthly samples, supplemented by data collected by remote monitoring stations. Additional monitoring may also be required near the Murray mouth, although the current dredging operations collects this data which can be easily referenced.

Current Water Quality: 15 sites (10 existing + 5 new), data collected bi-monthly, supplemented with continuous remote monitoring stations

Ecology – the ecological components at up to eight sites in the South Lagoon are currently being monitored semi-annually (4 South Lagoon + 1 North Lagoon sites in winter, 8 South Lagoon + 8 North Lagoon sites in Summer). These historic sites are distributed evenly across the Coorong South Lagoon. The sampling frequency should be increased to quarterly, at the full complement of 8 South Lagoon sites, plus 4 North Lagoon sites, using the Summer core sampling method (described below). In addition, *R. tuberosa* cover (currently measured at 5 sites in winter only) should be expanded to be measured at all 12 sites, although this would only have to be done annually (i.e. in Winter, to coincide with current *Ruppia* cover monitoring). Waterbird spot counts and behavioural performance indicators (see below) will be monitored at all sites at the same time as other ecological monitoring. In addition, South Lagoon waterbird monitoring will be maintained at a six monthly frequency (through other monitoring programs). This monitoring regime is implemented under the Living Murray Program and the Murray Futures funds will further develop this program to inform the emerging adaptive management framework, decision support tools and proposed Research program. The future monitoring program will be determined by biotic life cycles and temporary variables with increased monitoring in the 1st year of the pumping project.

Current Ecology: 12 sites, data collected quarterly (*Ruppia*, infauna, fish, bird spot counts), six monthly count of all South Lagoon waterbirds, annual winter *R. tuberosa* cover monitoring

METHODS

Water Quality – Water quality measures are measured using a hand-held TPS 90FL-T multiprobe water quality instrument. These measures are also cross-checked by collecting 1L water samples at each site, which are returned to a laboratory, diluted and measured at AWQC (DWLBC). At each site each parameter is measured just below the surface, mid depth and just above the bottom.

Due to serious Health and Safety considerations of collecting water samples within the Ocean a separate proposal to determine the extent of the discharge plume in the Ocean is being prepared.

Ecology – At each site, three sets of 25 core samples (core size: 7.5 cm ø, 4 cm deep) of surface mud are collected. Each of these three sets are collected at a different position relative to the waterline: 1) water depth of 30cm, 2) at the waterline, and 3) dry mud mid-way between the waterline and the high-water mark (shoreline). All 75 mud samples are then sifted *in situ* through a series of Endecott sieves (250 µm and 500 µm grid size), and the abundance of *Ruppia tuberosa* propagules (seeds, turions) and shoots, chironomid larvae and pupae, and other aquatic invertebrates (e.g. polychaetes) are recorded. In addition, at each site, a single annual measure of *Ruppia tuberosa* cover will be undertaken. This involves taking 200 cores at each site

(stratified across 5 water depths), and counting the number of shoots in each core *in situ* (i.e. without sieving).

The abundance of Smallmouth Hardyhead *Atherinosoma microstoma* is measured at each site by dragging a 7m seine net a distance of 50m, at a depth of approximately 0.7m. Three seine net drags are performed at each site for replication.

The abundance of brine shrimp *Parartemia zietziana* is measured at each site by dragging a zooplankton trawl net for a distance of 50m, at a depth of between 1-2m. Three trawls are performed at each site for replication.

Waterbirds will be surveyed by conducting repeated-measure counts at each site for one hour per site. At each site, all waterbirds within a set area are counted and classified to species and behaviour. These counts are repeated every 5 minutes, for one hour (giving a sample size of 12 counts per site.sampling period). Additionally, the foraging performance of individual waterbirds (measured using foraging attempt rate, foraging success rate, distance travelled between foraging attempts) will be collected opportunistically during this hour period. The data from these spot counts will supplement existing waterbird censuses. For these censuses, the system is divided into 1 km sections, running approximately perpendicular to the direction of the South Lagoon. Within each 1-km section, counts of waterbirds on the eastern shoreline are conducted on foot and/or by car, identifying all waterbirds to species, and categorising the behaviours of all waterbirds (foraging, flying, resting).Censuses of the eastern shore of the South Lagoon are done annually in July (DWLBC), and of the entire Coorong annually in January (SA MDB NRM Board, TLM).

A monitoring methodology for inter-tidal infauna within the proposed impact zone for the discharge into the Ocean is under consideration by South Australia's SARDI Aquatic Sciences and Flinders University.

Monitoring Frequency / Timetable

Program	# sites	frequency	current # sites	current frequency	additional sites required	additional frequency required
Hydrology/H ₂ O quality	15	bimonthly	10 ¹	bimonthly	5	-
Ecology	12	quarterly	16 ²	annual	-	quarterly (3 additional samples p.a.)

1 – water quality currently done by DWLBC

2 – ecological monitoring currently done by DC Paton (University of Adelaide) for SAMDBNRM Board (TLM)