Water Salt Balance Model for the Lower Barwon Wetlands

Findings summary

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Image: Hospital Swamps, Corangamite CMA

Why review the Water Salt balance of the Lower Barwon wetlands

In 2019/20, an independent review of the Lower Barwon Wetlands was commissioned by the CCMA to assess the suitability of the four-year trial watering regime (Alluvium, 2020). In the review, a series of recommendations were made, which if implemented, would improve watering actions to optimise ecological benefits.
Two of the recommendations included in the review were identified as critical and urgent:

1. Complete a water-salt balance model for the wetlands complex, and
2. Update the 2012 environmental flows investigation in the light of the completed model and other advances in the understanding of environmental watering that have taken place over the intervening decade.

This project was conducted under the first of those recommendations, and focusses on salinity at Reedy Lake and Hospital Swamps.

The Lower Barwon Wetlands complex forms part of the internationally significant Port Phillip Bay (Western shoreline) and Bellarine Peninsula Ramsar Site and is highly valued for its ecological significance, supporting a diverse mosaic of freshwater, estuarine and marine vegetated habitats, important for breeding, feeding and refuge requirements of many species of native fish, waterbirds and significant (rare and endangered) flora and fauna.

The purpose of this project was to help understand the influences on wetland salinity.
It aims to:

- To develop a water salt balance model to be used by CCMA
- Use the model to test impacts of likely future scenarios
- Help understand the potential impact on ecological character

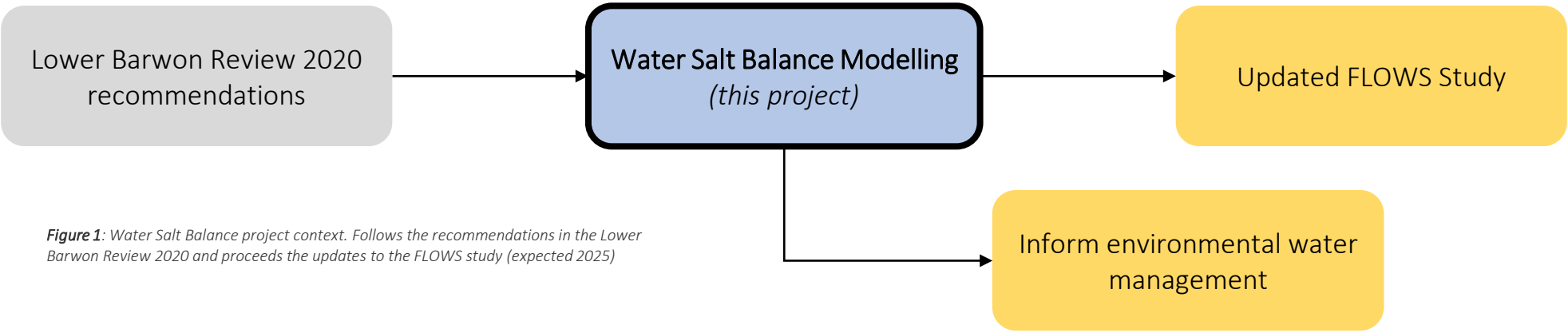

Figure 1: Water Salt Balance project context. Follows the recommendations in the Lower Barwon Review 2020 and proceeds the updates to the FLOWS study (expected 2025)

What influences wetland salinity

The influences on salinity in the wetlands are identified as part of the model development to ensure all aspects are represented. A conceptual model is developed to provide a high-level overview of the wetland interactions.
Important drivers of change were identified as urbanisation, climate change, and management actions. The principal salt load inputs to the system were identified as the Barwon River, Armstrong Creek, groundwater flux, and tidal inflows.

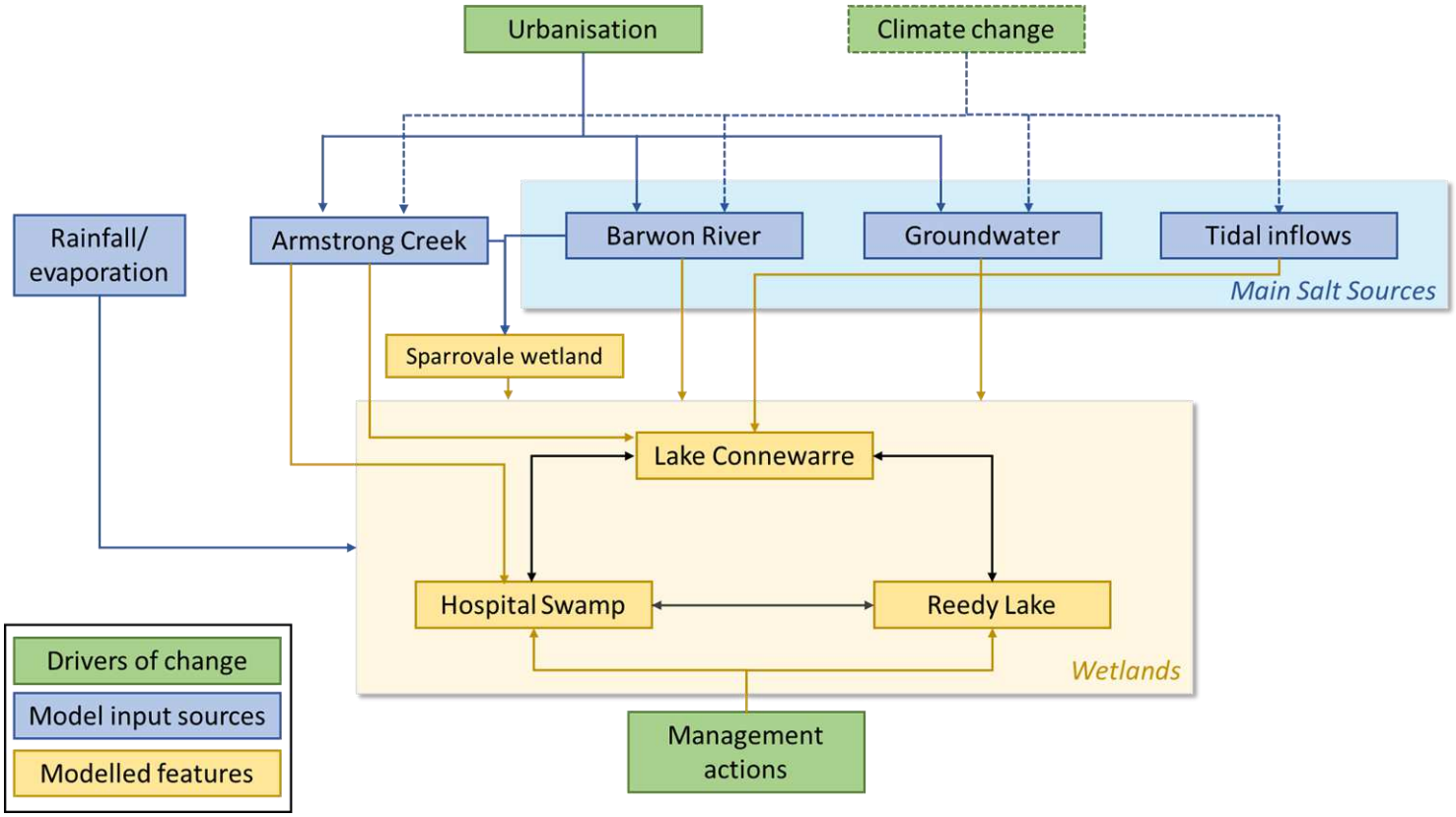

Figure 2: Conceptual model of the water-salt balance model. Includes drivers of change, sources and interactions

Catchment changes tested

A series of scenarios were developed to investigate how the salt-water balance responded to broad scale operational, catchment characteristic and climatic changes.
A series of parameters were identified that were used as individual changes and then in combination to build 22 model scenarios.

We note here that the scenarios that have been modelled are not intended to act as recommendations or be considered likely future management scenarios. The intention of the scenarios run as part of this project are to test the sensitivity of the wetland salinity to various changes. These tests are often through running more extreme scenarios to exaggerate the change to ensure a substantial impact can be assessed.

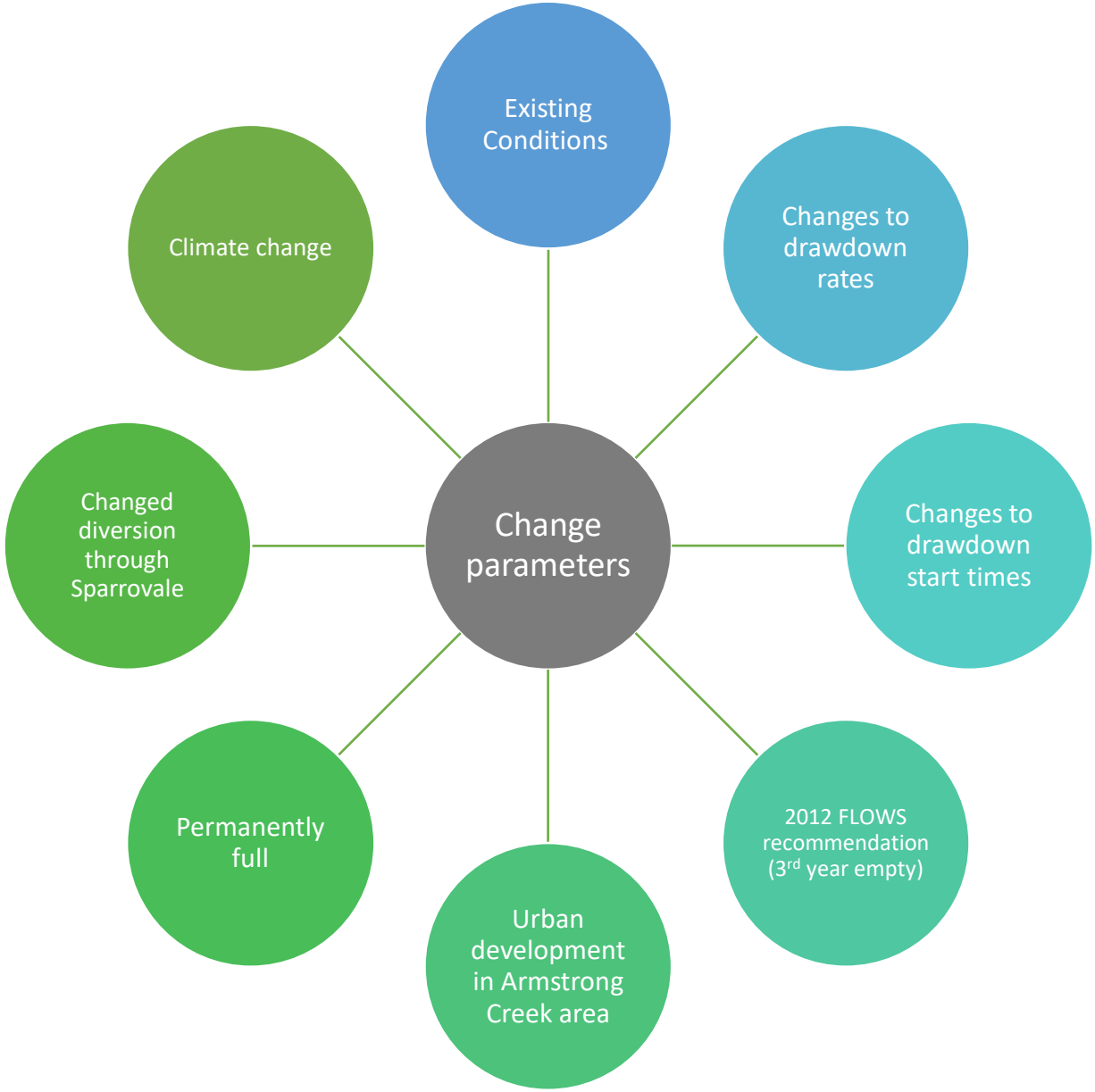

Figure 3: Change parameters used to amend the model to build 22 model scenarios

What the modelling found

The outcomes of the modelling found clear trends in wetland salinity and the outcomes of different scenarios.
Ultimately, the volumes of fresh water held in the wetlands drives the salinity. Higher volumes of fresh water dilute salt in the water and reduce influx of groundwater. Reduction in freshwater as a result of evaporation, outflow or reduced inflow from river or rainfall sources allow saltier groundwater to take over and increase salinity.

Influences

- Lower wetland volumes increasing groundwater inflow
- Higher wetland volumes decreases groundwater inflow
- Evaporation, reduced rainfall and river flow
- Increased rainfall, urban runoff and river flows
- Drier years and seasons
- Wetter years and seasons

Saline ⟷ Fresh

Scenarios

- Reduced rainfall climate change scenarios
- Urban Development
- Wetlands empty
- Wetlands full
- Earlier drawdown
- Later drawdown
- Quicker drawdown
- Slower drawdown

What the modelling found

Model results that focussed management activity on the summer and autumn periods (not cases that maintained full wetland levels or open gates) diverged during the summer to autumn period only. Winter rainfall and river flows return salinity to a consistent level, indicating no lasting salinity impacts.

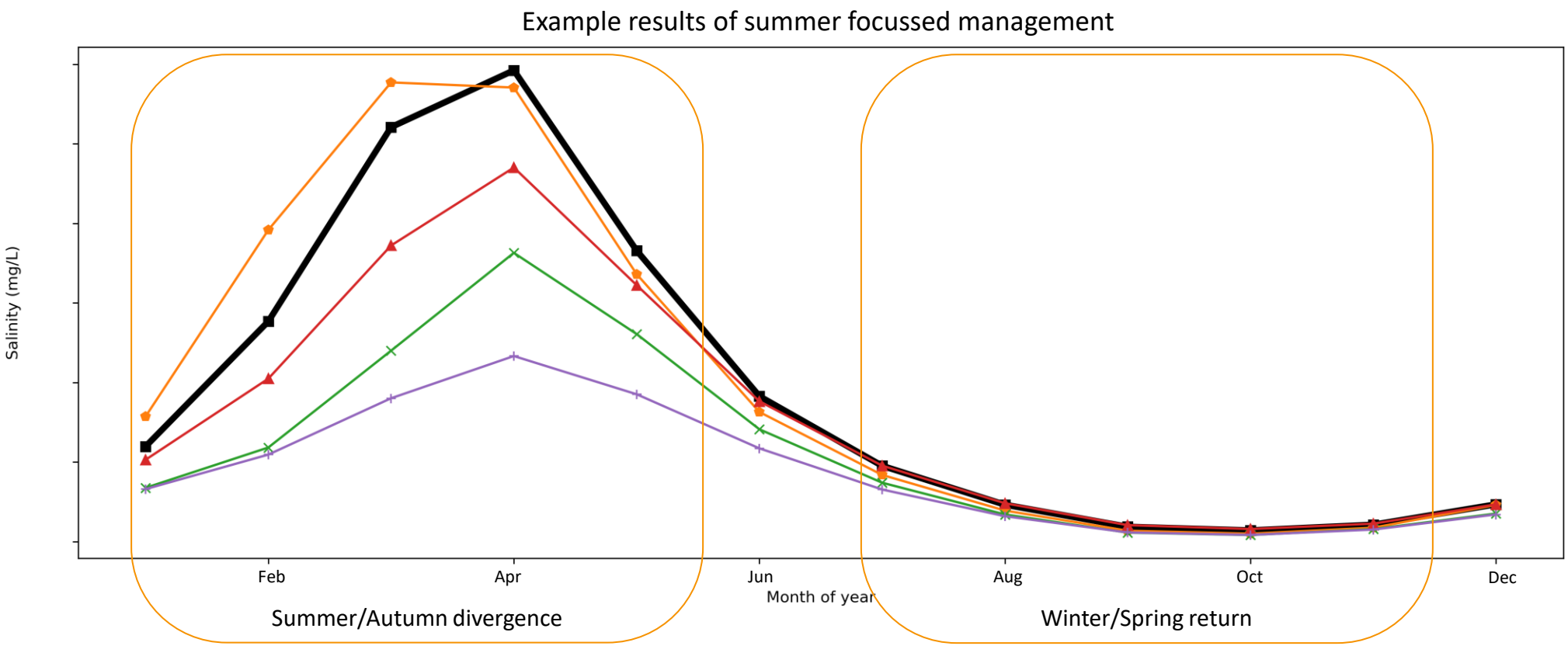

Figure 4: Example results from the water salt balance modelling. These results demonstrate the divergence seen during the Summer to Autumn period before returning to a consistent level in Winter and Spring

Results in an ecological context – Primary impacts

To understand the impact of changing the watering regime at Reedy Lake and Hospital Swamps, the Expert Review Panel examined the new data that had become available since 2012, along with older data (where available) to provide a longer-term perspective. This was done to provide context to the water salt balance results only, and not designed to be taken as an environmental assessment. Other drivers of ecosystem health need to be included and this is expected to be completed during the FLOWS study update.

There is potential for impacts on vegetation

Long periods of extreme high or low salinity may have adverse impacts on wetland vegetation. As high salinity occurs at lower water levels this may be confined to the lower sections of the wetlands. Impacts on vegetation are likely to reduce the growth and spread of vegetation rather than causing vegetation die offs. Scenarios that lower water levels for longer periods allowing groundwater inflow, or maintain high water levels permanently appear the most likely to be detrimental to local vegetation.

Fish species rely on salinity and vegetation

Fish species in the wetlands areas are highly dependant on salinity, vegetation and connectivity.

Salinity variation can play an important role in the life cycle of fish species. Many species require fresh and saline water and travel across the salinity profile is vital. Scenarios that limit the connectivity or restrict access to either fresh or saline water can impact local fish species. Additionally, fish will often swim up outflow streams if the conditions in the streams are favourable. If outflows from the wetlands are unseasonably fresh or saline, fish will choose alternative travel paths that lead away from the wetlands. While this does not impact the fish health, the movement elsewhere would reduce populations in the wetlands.

Fish also rely on vegetation health for food and habitat, so any scenario that reduces the coverage of vegetation is likely to have negative impacts on fish populations.

Image: Hospital Swamps, Corangamite CMA

Results in an ecological context – Secondary impacts

To understand the impact of changing the watering regime at Reedy Lake and Hospital Swamps, the Expert Review Panel examined new data that had become available since 2012, along with older data (where available) to provide a longer-term perspective. This was done to provide context to the water salt balance results only, and not designed to be taken as an environmental assessment. Other drivers on ecosystem health need to be included and this is expected to be completed during the FLOWS study update

Birds are not directly impacted by changes in salinity.
While waterbirds are less sensitive to changes in salinity, they are affected indirectly by changes in vegetation and food availability. Species that have been selected as water quality indicators include Brolga, Great Egret, Australasian bittern, Australian little bittern, and Orange-bellied parrot. The overall impact of the changes that impact the bird population are linked to vegetation condition. The changes that were made in the water salt balance do not appear to have a significant impact on the bird indicator species, though a more detailed investigation with a more wholistic assessment is recommended.

There is potential for impacts on Growling Grass Frogs
The GGF is found in large permanent to semi-permanent wetlands with moderate to low salinity. Minor increases in salinity may benefit GGF, but once salinity becomes more extreme, it will become a threat to survival and recruitment. As a result, the scenarios that are more likely to create higher saline conditions or any management decisions that result in lower water levels such that groundwater and tidal flows can impact salinity will impact GGF

There is potential for impacts on the geomorphology
The salinity variations are unlikely to directly impact geomorphology. Changes in salinity and mean water level have the potential to impact the type, extent and density of vegetation within Reedy Lake and Hospital swamp. Should changes in salinity or mean water level be large (either decreasing or increasing significantly compared to existing conditions), then vegetation die-back may result. Vegetation die-back reduces the resistance of the bed and shorelines which has the potential to trigger erosion.

Image: Hospital Swamps, Corangamite CMA

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The Water Salt Balance Model project was conducted from December 2021 to December 2022. Alluvium were engaged by Corangamite CMA to develop the hydrological model in the eWater Source model platform, consult with stakeholder to develop model scenarios, test those scenarios in the water-salt balance model and comments on the results from an ecological health perspective.

This document provides a summary of the project and its results. More detail can be found in the Water Salt Balance Model for the Lower Barwon Wetlands Summary Report

The **Project Steering Committee** were:

- Sharon Blum-Caon (CCMA)
- Denis Lovric (CCMA)
- Phil Mitchell (DELWP)
- Donna Smithyman (CoGG)

The **Expert Review Panel** comprised:

- Dr John Sherwood, estuarine specialist
- Prof. Paul Boon, Ecologist
- Dr Ben Gawne, Ecologist
- Dr Alex Sims, Geomorphologist
- Dr Jon Fawcett, groundwater specialist

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