Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

Biodiversity and Conservation Science

Hydrology of a temperate coastal salt-marsh

Dr Gavan McGrath
Research Hydrologist
Biodiversity and Conservation Science, DBCA
gavan.mcgrath@dbca.wa.gov.au

Michael Hatch, University of Adelaide
Aaron Davis, CSIRO

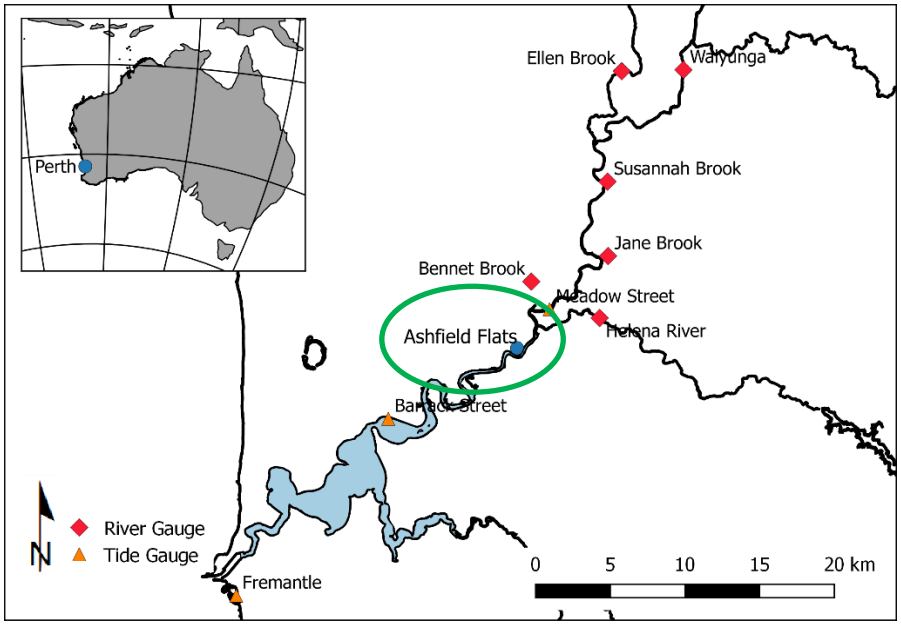
Acknowledgements

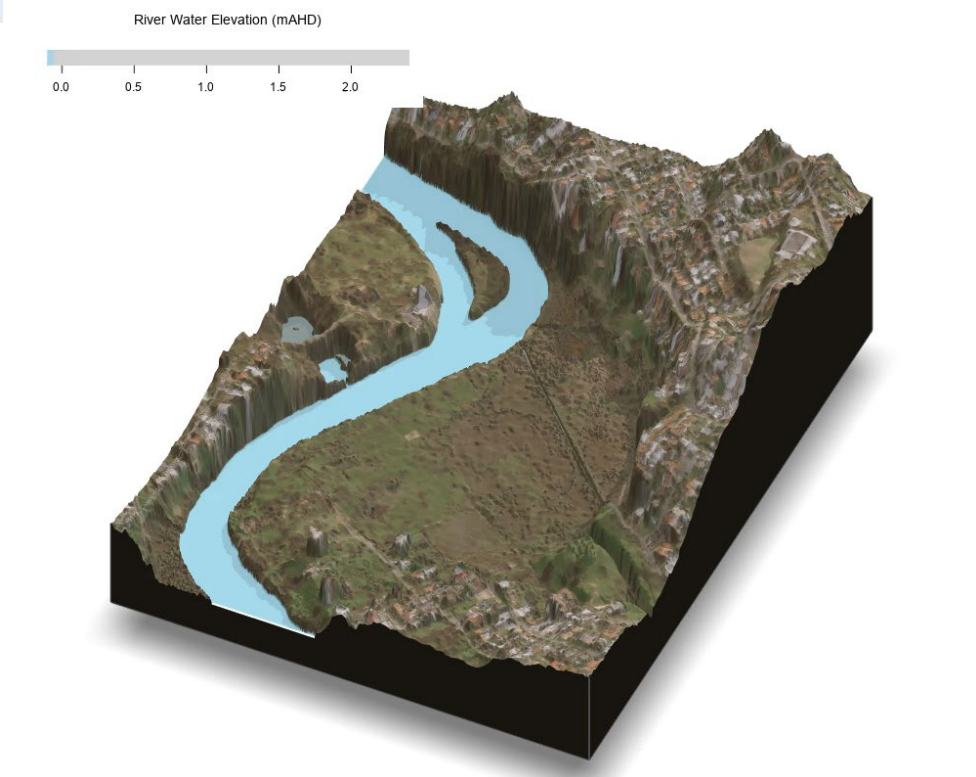
- Noongar Whadjuk
- Andrew Rate
- Matthias Leopold
- James Barrett
- Greg Street
- Andrew Duncan
- Dept of Planning Lands and Heritage
- DBCA
  - Rivers and Estuaries Branch
  - Ecosystem Science
- Town of Bassendean
- Department of Water
- Water Corporation

Department of **Biodiversity, Conservation and Attractions**

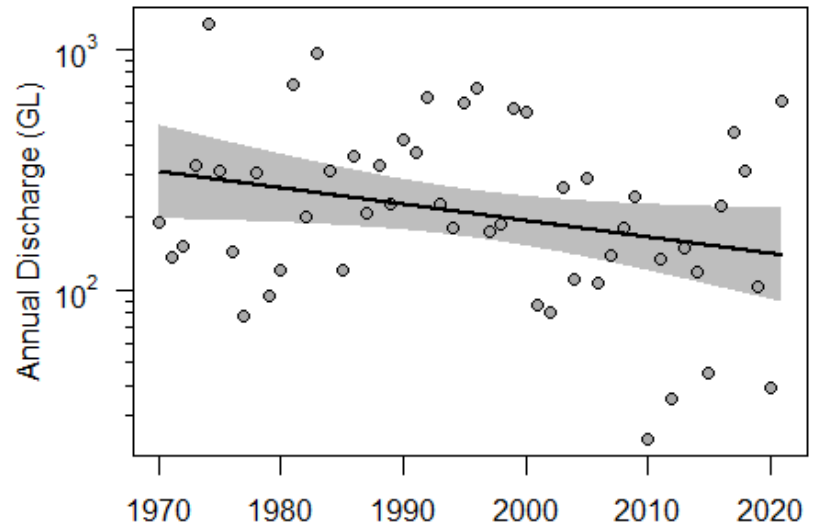
GOVERNMENT OF WESTERN AUSTRALIA

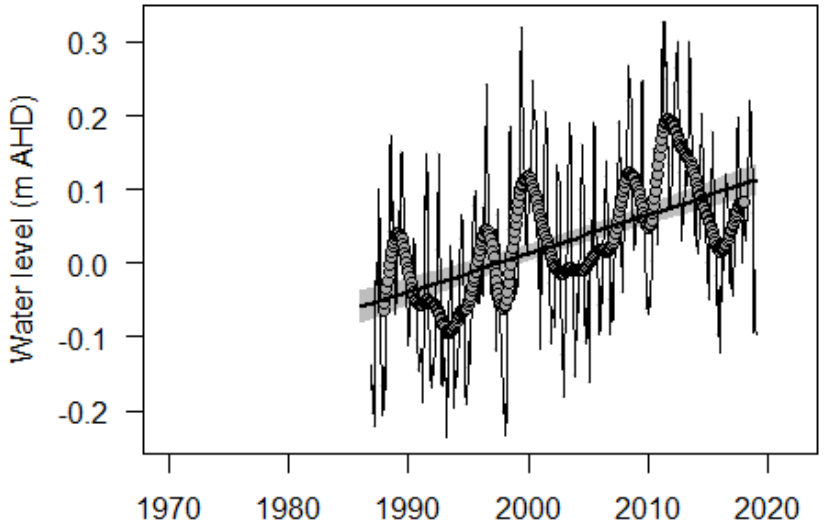
Ashfield Flats TEC

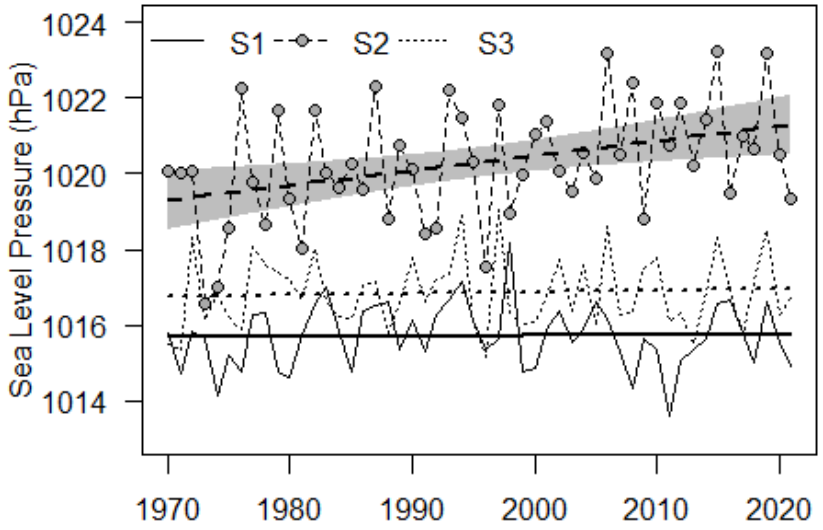




Changing Forcings







Aims

- Develop an understanding of the dominant hydrological processes sustaining the TEC
- Assess threats
  - industrially contaminated groundwater
  - urban drainage
  - climate change

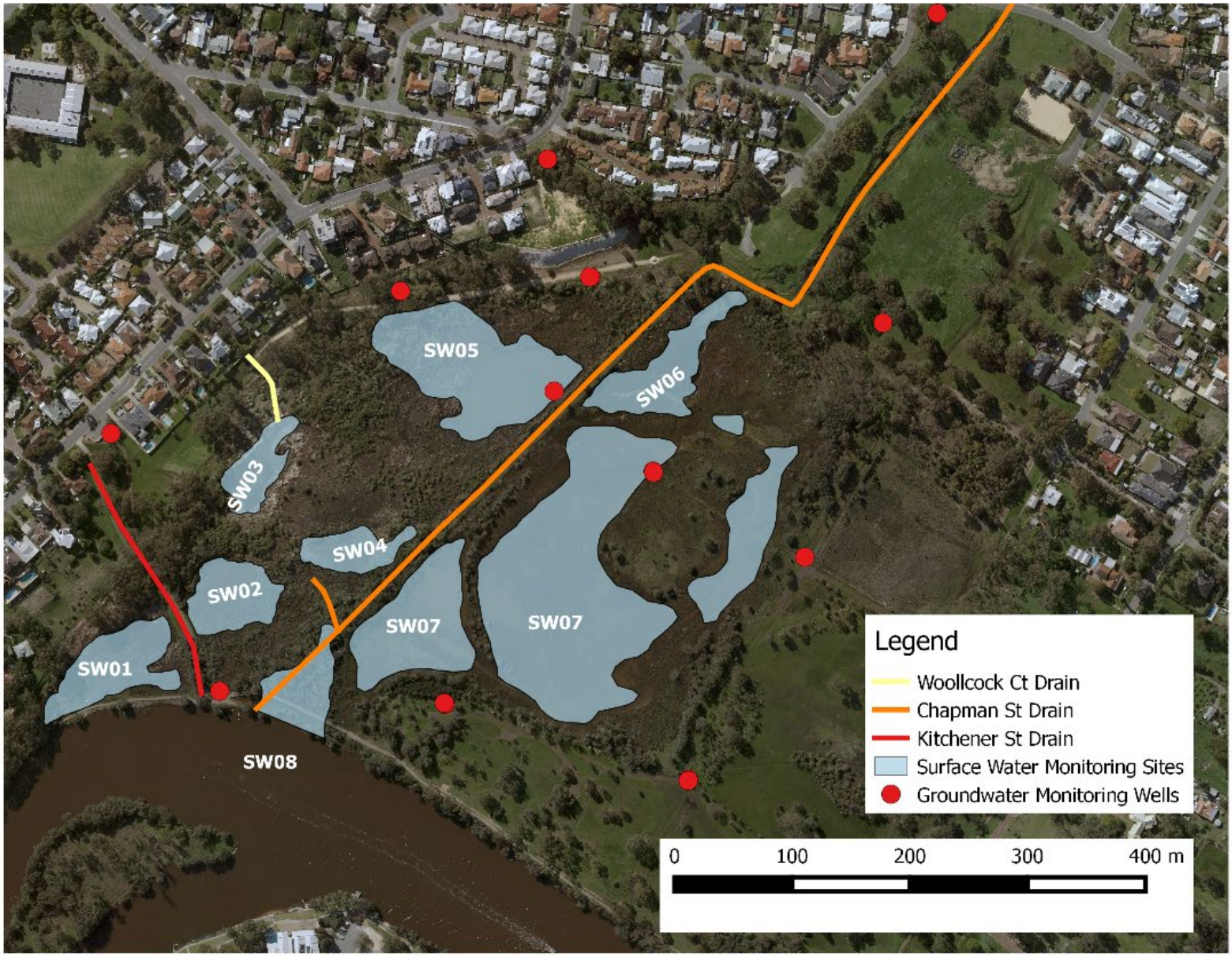
Objectives

- Conduct a monitoring program to measure components of the wetland water balance
- Quantify water quality, water sources and and pollutant loads
- Develop hydrological models to inform management

Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

Monitoring Program

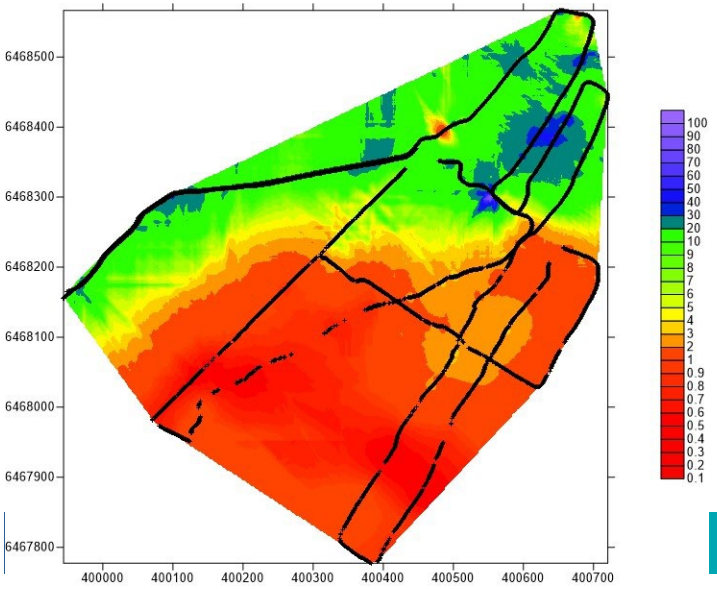


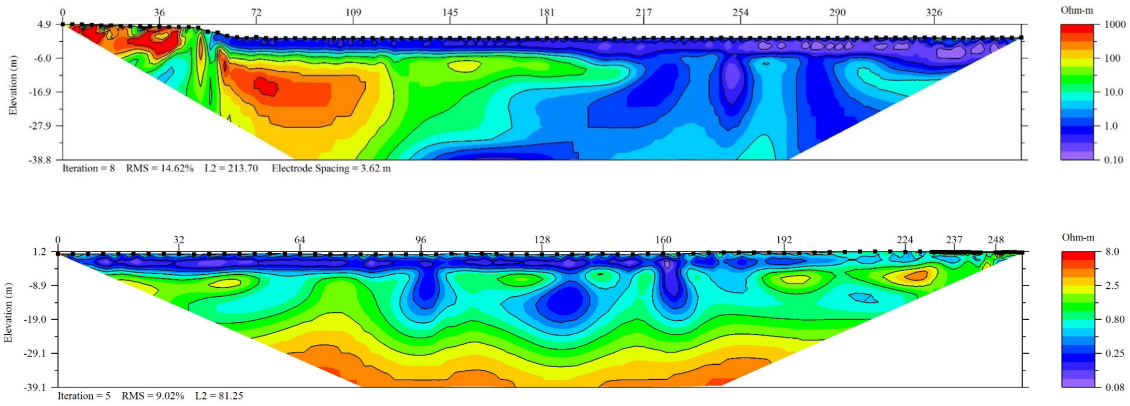
Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

Loupe and ERT Surveys

ERT Conducted in February 2019 and 2020
Loupe TEM conducted in June 2021

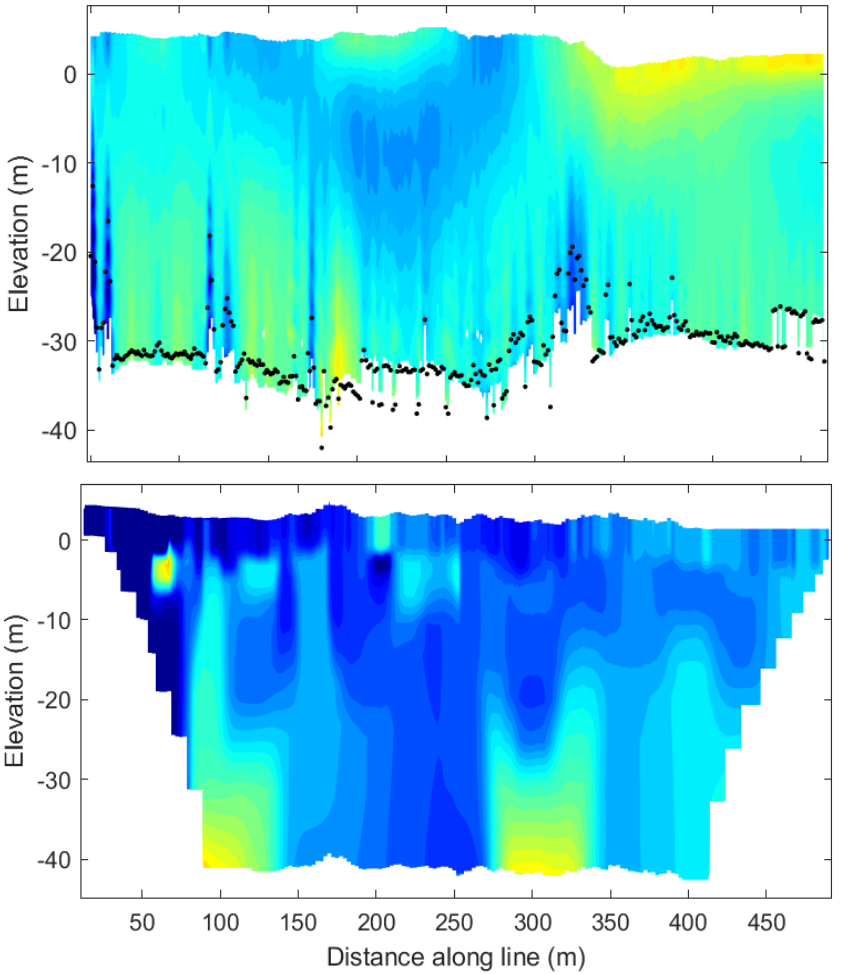


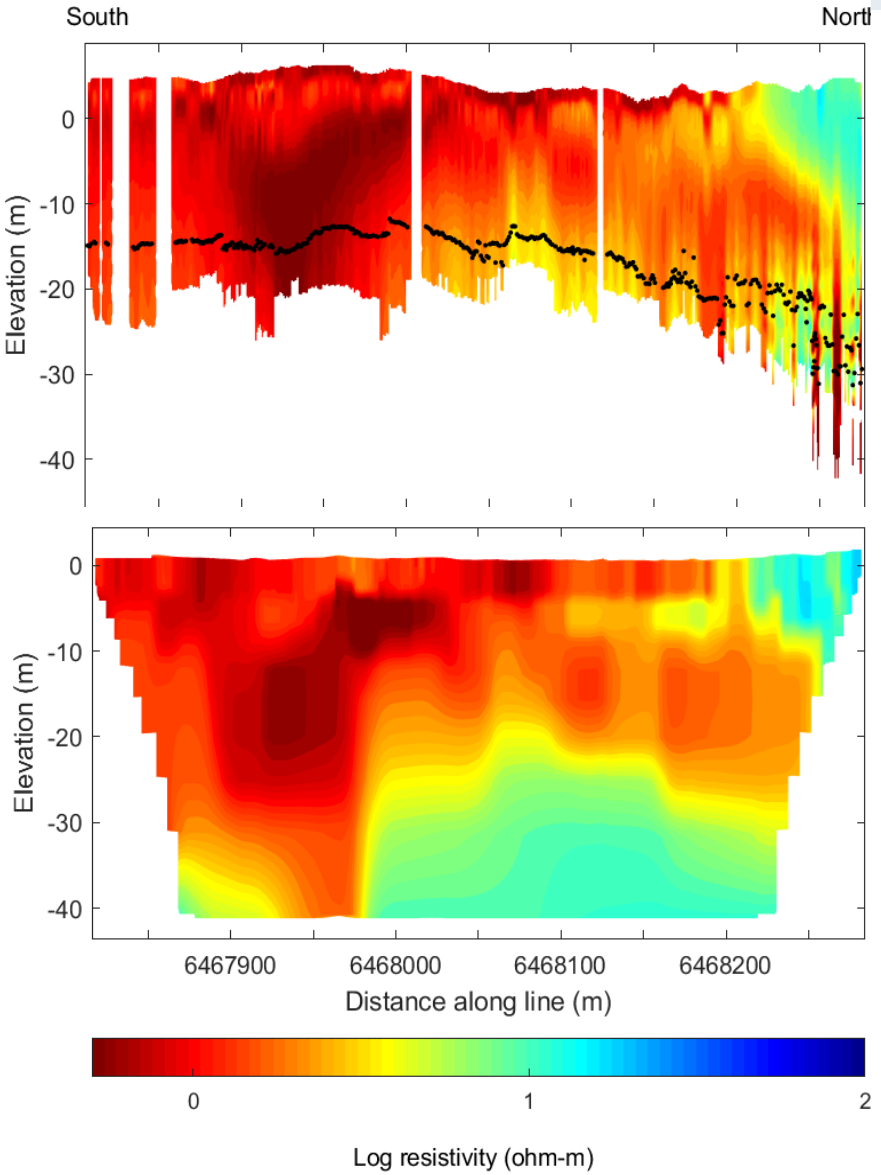


Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

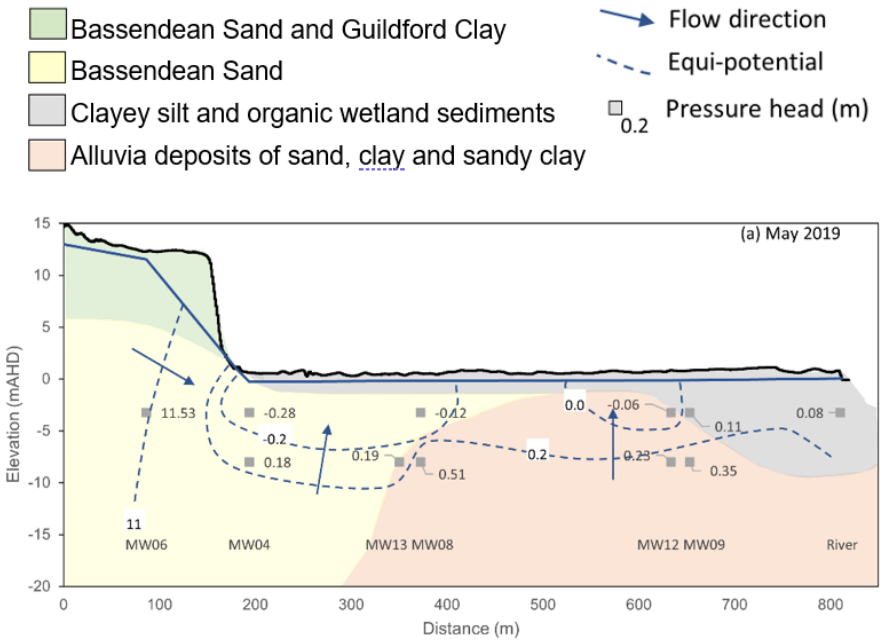
Loupe and ERT Surveys



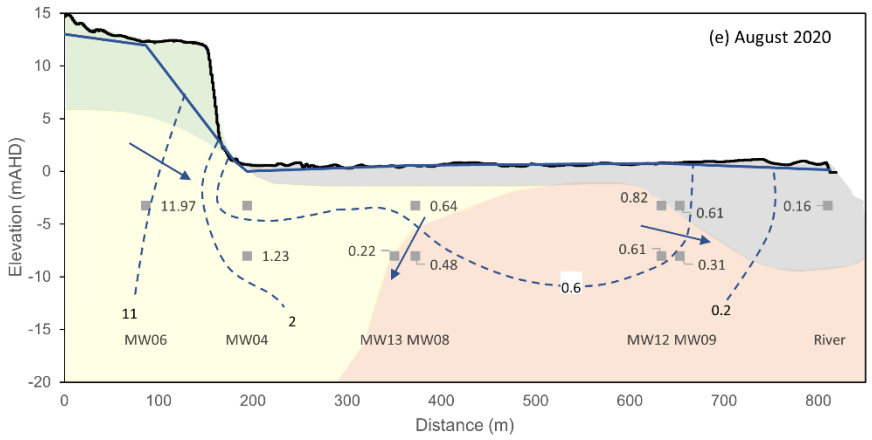


Groundwater

- Seasonally evaporating / recharging
- Semi-confined aquifer
- Aquifer properties characterized via barometric and tidal methods



May 2019



August 2020

Department of Biodiversity, Conservation and Attractions

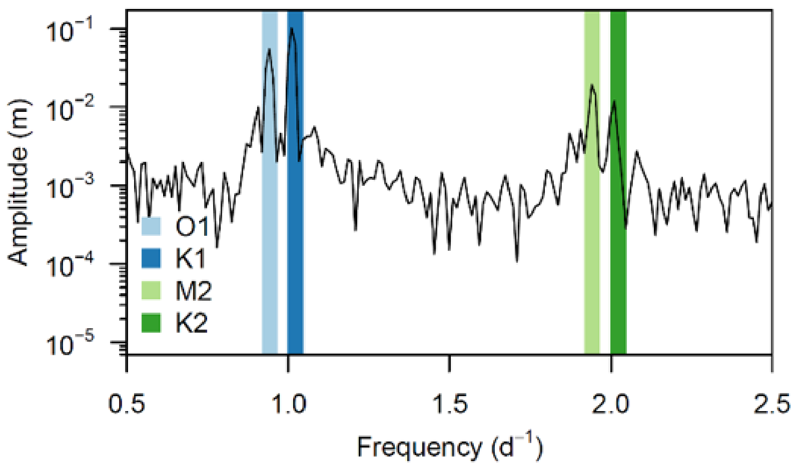
GOVERNMENT OF WESTERN AUSTRALIA

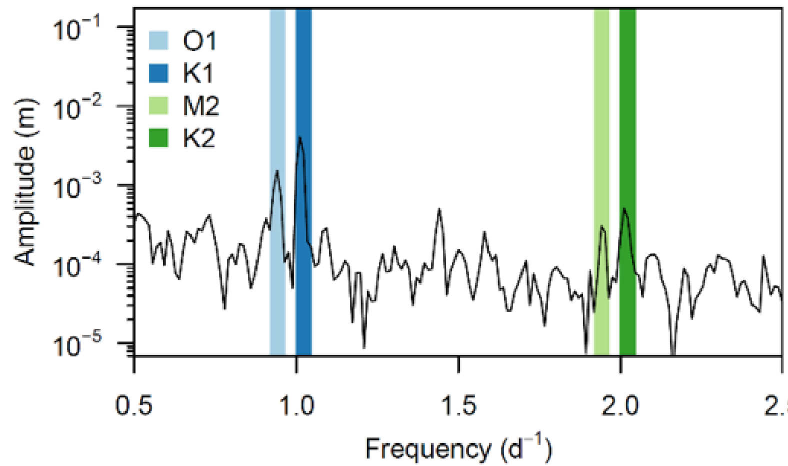
Estimation of Aquifer Properties

Amplitude spectrum

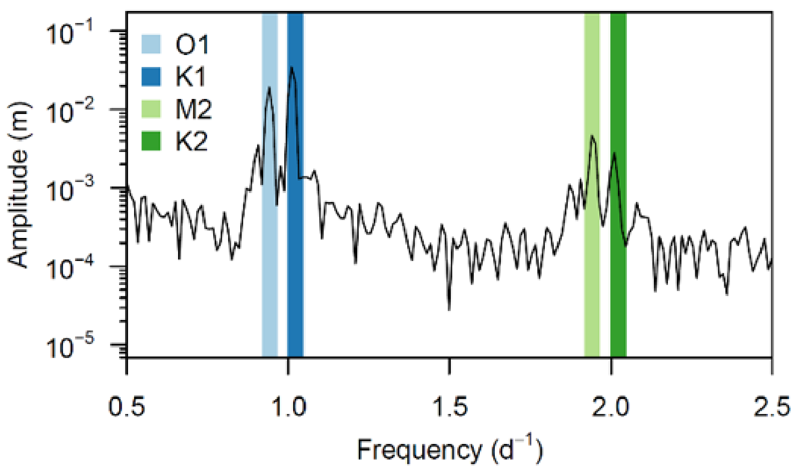
Deep Wells

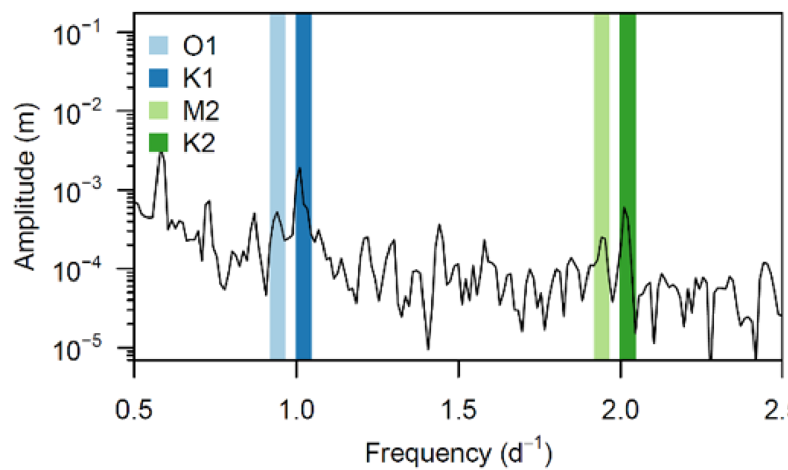
River





Deep Well Nearest River

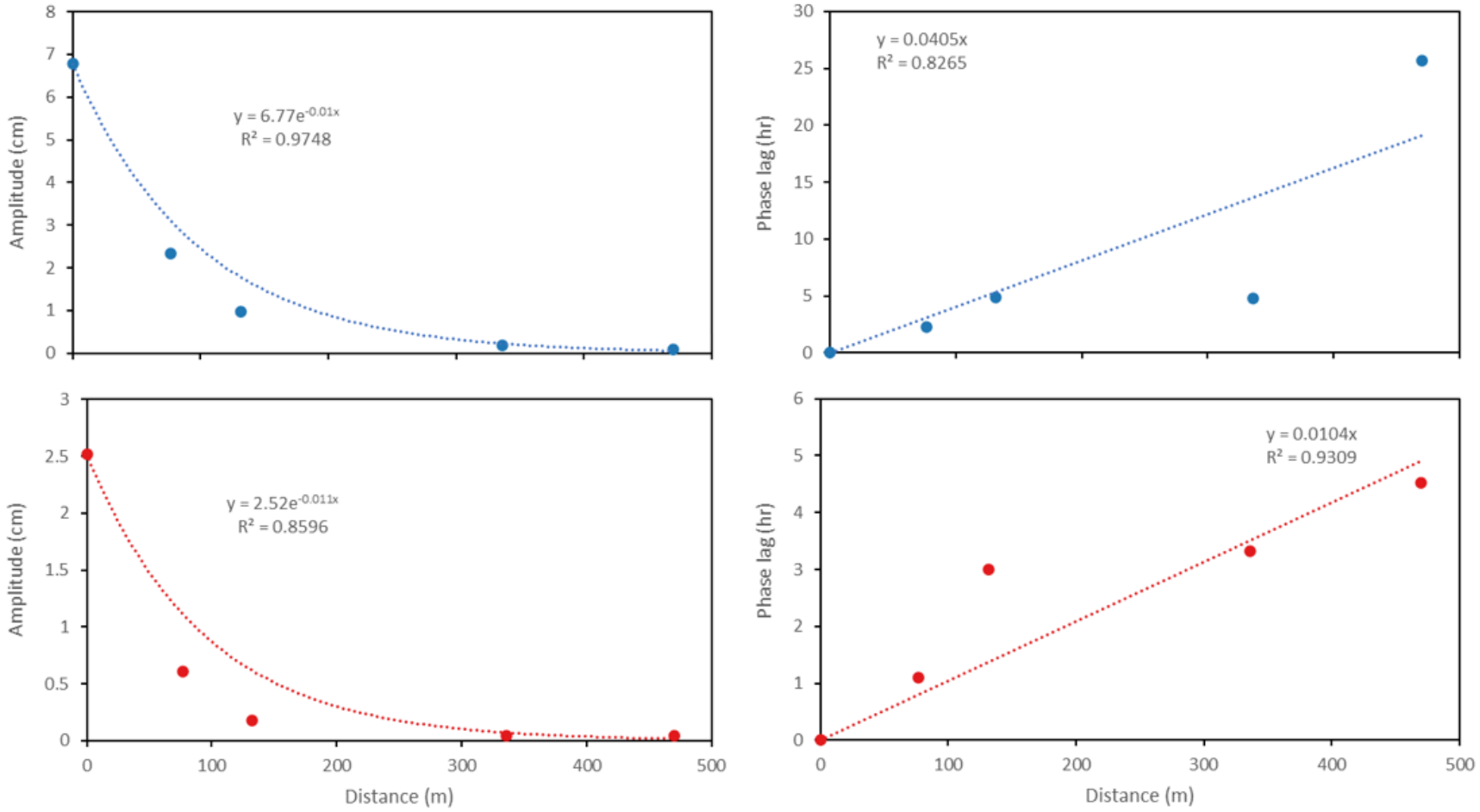




Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

Estimation of Aquifer Properties

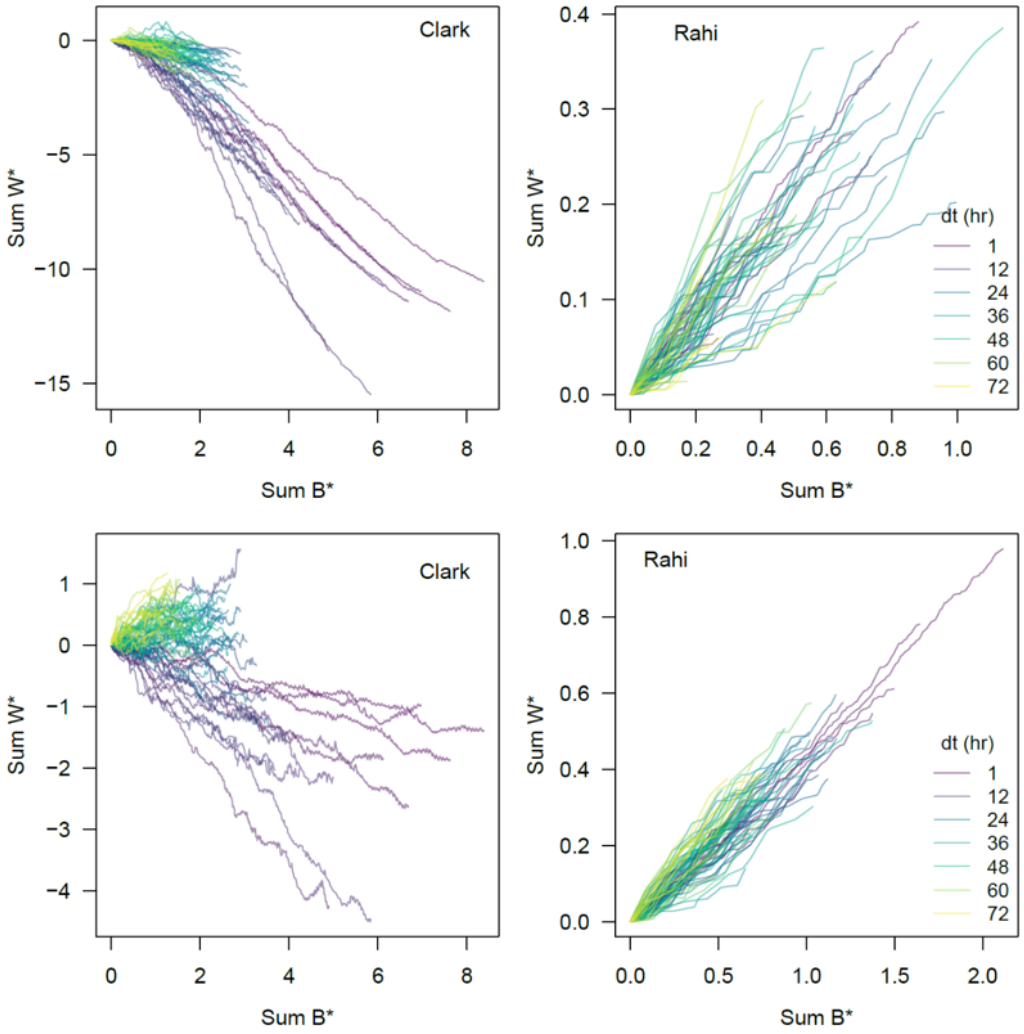


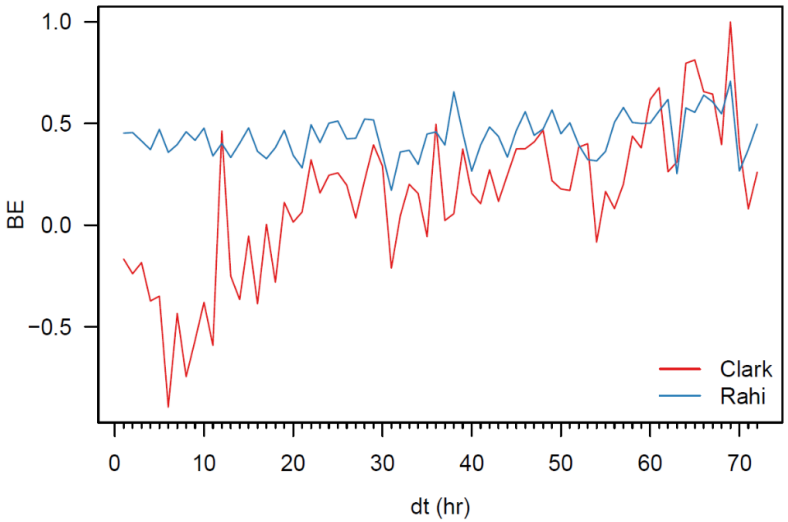
Following Jiao and Tang (1999)

Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

Estimation of Aquifer Properties



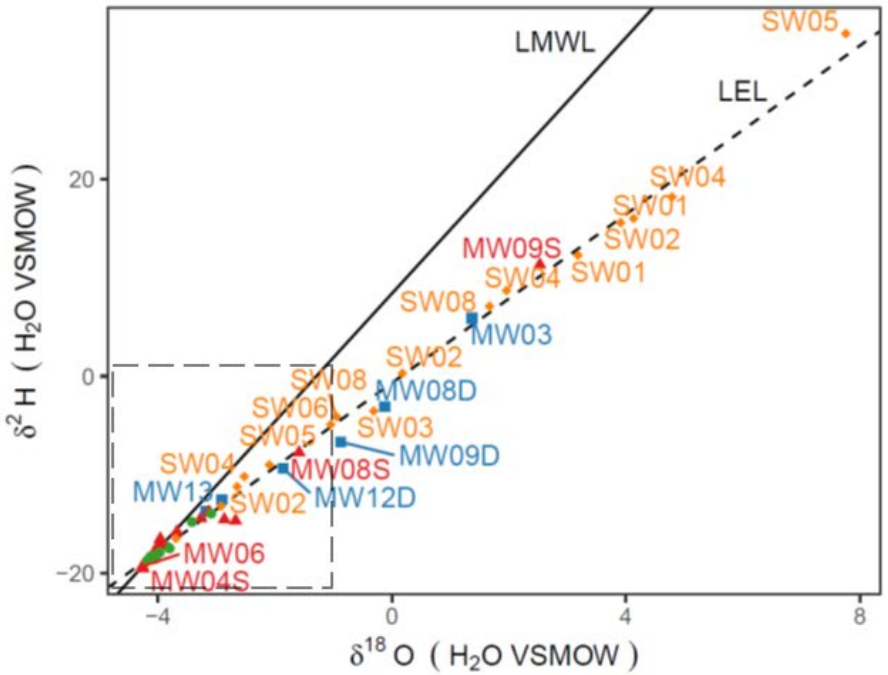


Department of Biodiversity, Conservation and Attractions

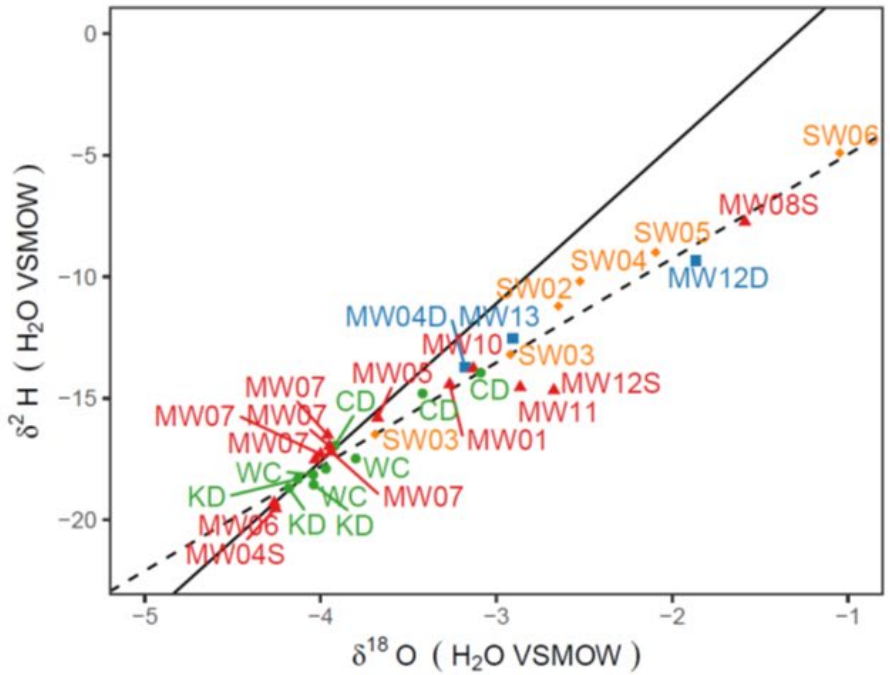
GOVERNMENT OF WESTERN AUSTRALIA

Evaporative Enrichment

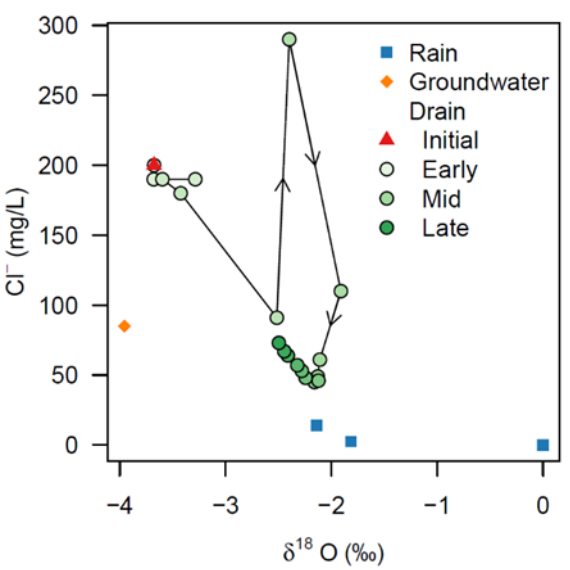
- Deep groundwater
- Drains
- Shallow groundwater
- Surface water

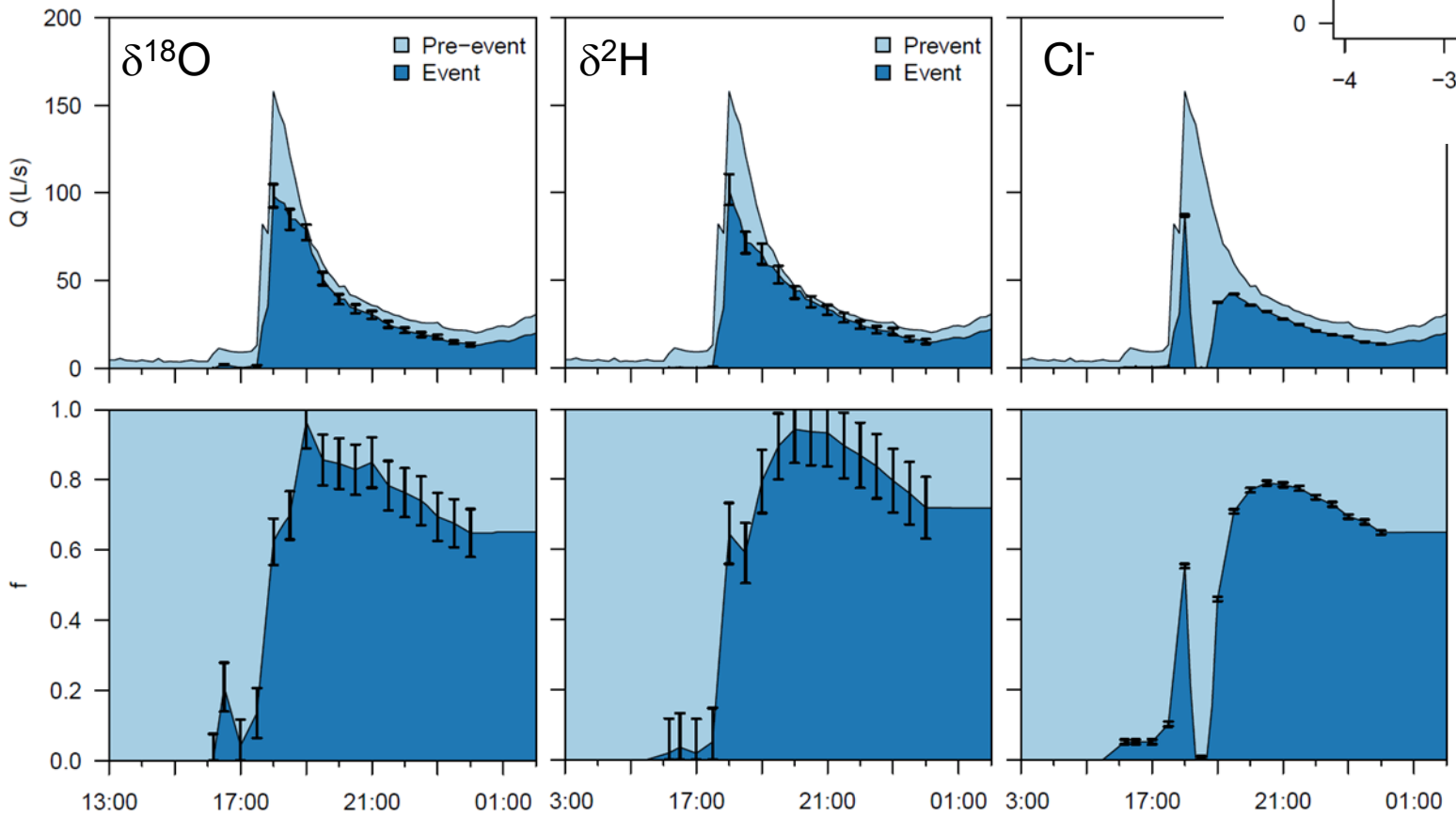


(d)



Stormwater sources unmixing





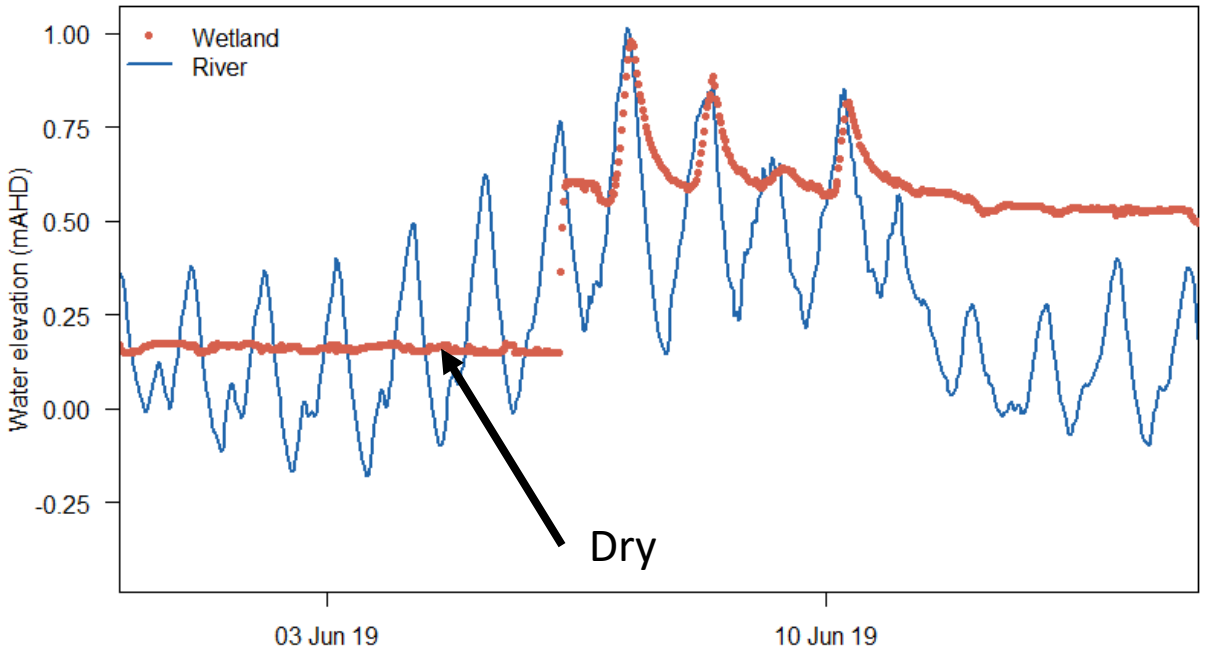
Pre-event water is slightly evaporated groundwater

Stormwater is comprised of ~45% groundwater

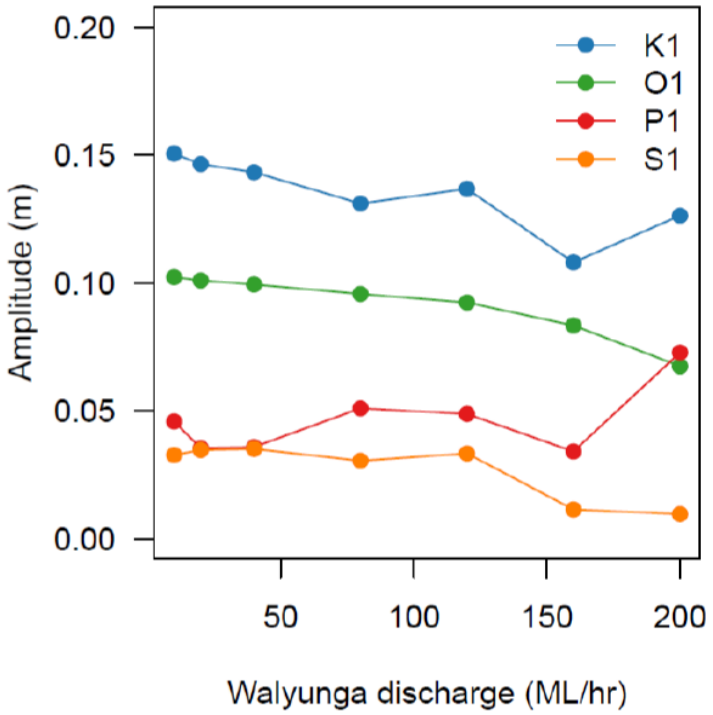
Surface Water

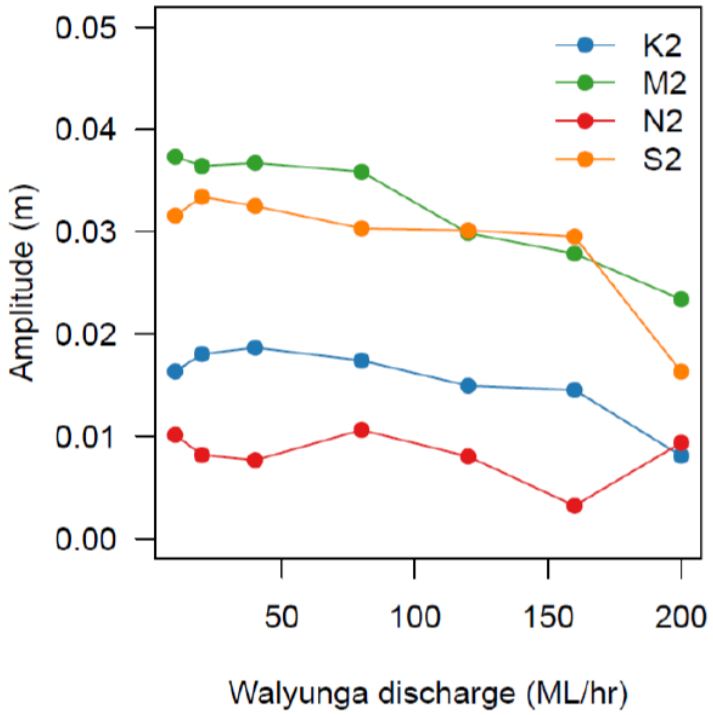
River the dominant surface water source

River exceeds flooding threshold ~208 hours per year at present



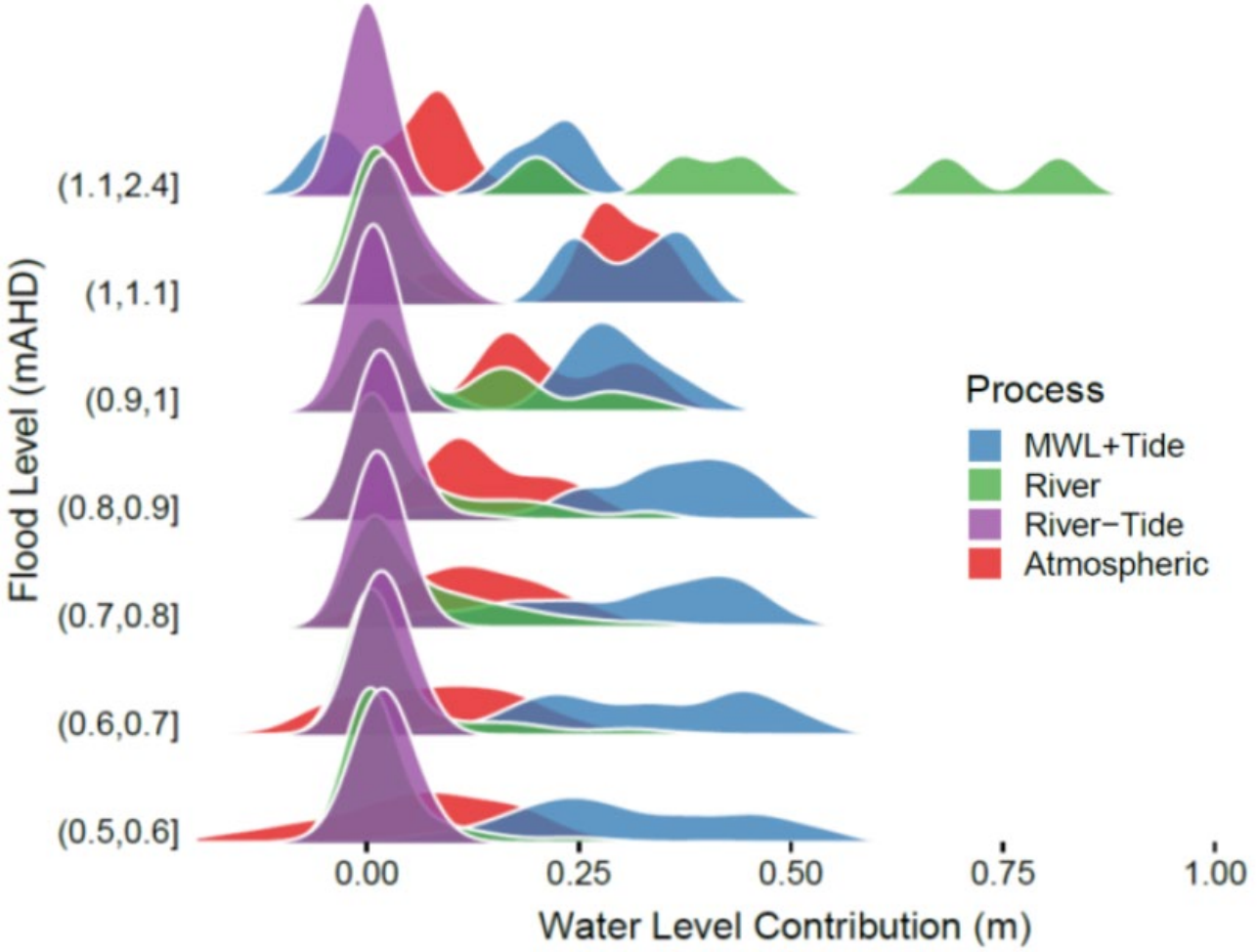
River Flows Dampen Estuary Tides





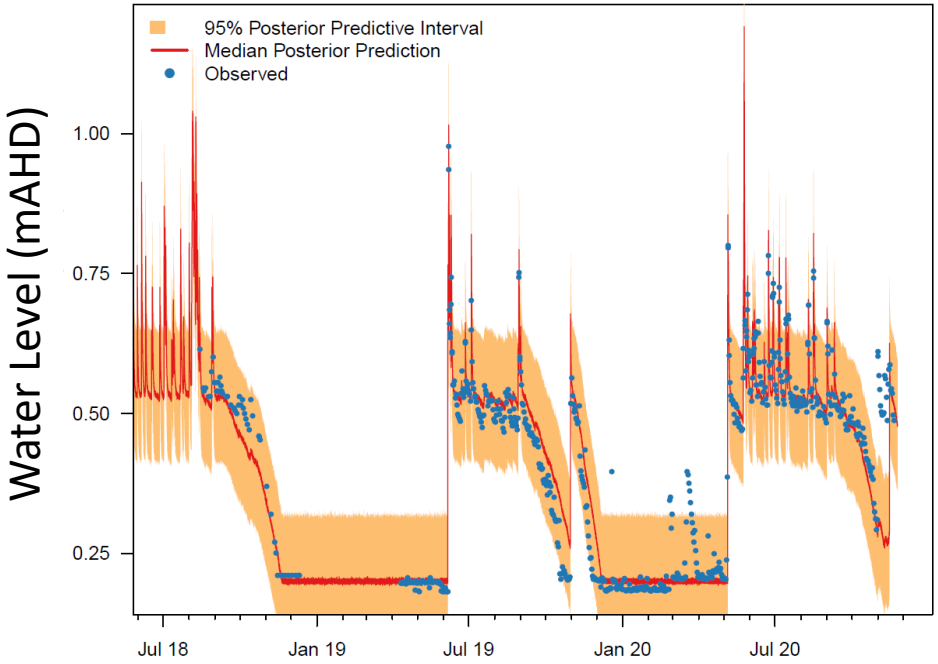
Declining winter river flows have been compensated for (somewhat) by rising tidal amplitudes

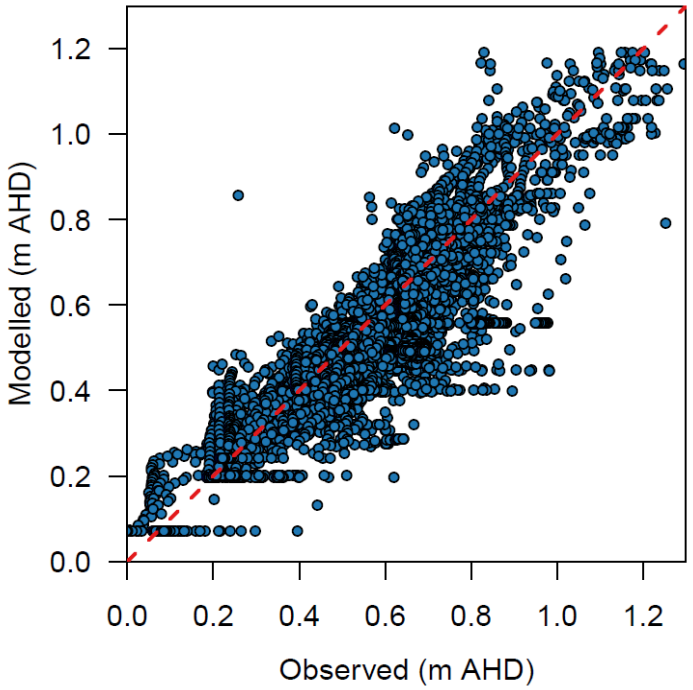
Contributions to Flooding at Ashfield



In the last 30 years increasing tidal amplitude and rising sea levels have been offset by declining winter runoff and increasing winter atmospheric pressure

Modelling Surface Water Levels

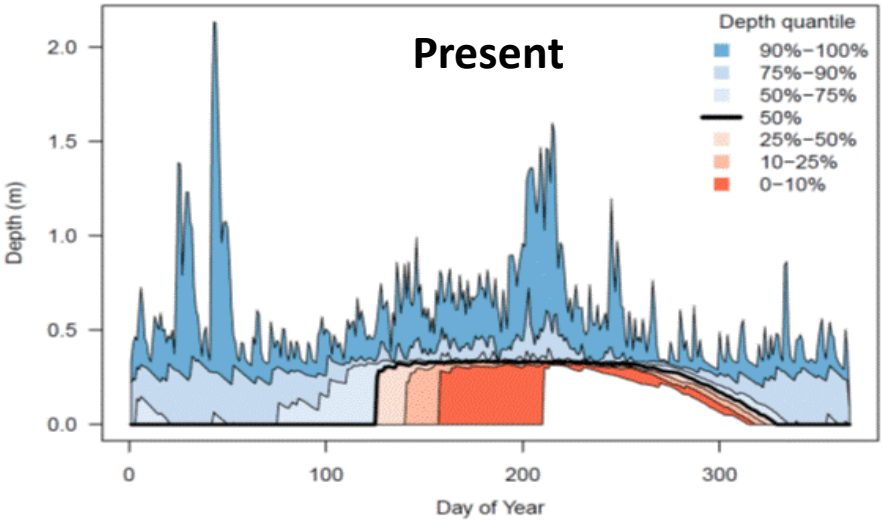


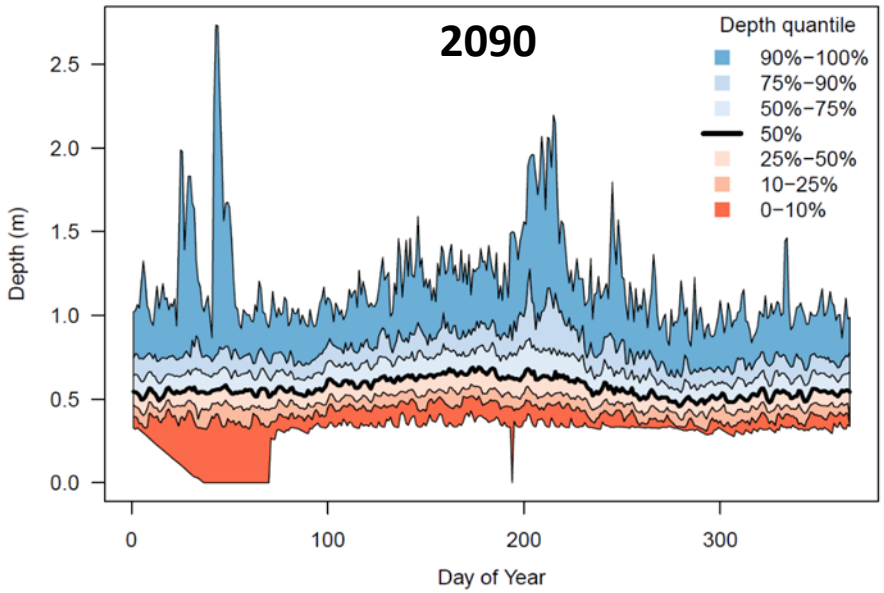


Climate Change Scenarios

Scenario	Year	Mean Water Depth (m)	Mean Hydroperiod (days/year)
Present	1990-2020	0.20	266
RCP4.5	2030	0.25	325
	2050	0.29	351
	2070	0.33	361
	2090	0.39	362
RCP8.5	2030	0.25	324
	2050	0.30	356
	2070	0.36	362
	2090	0.48	364

*Hydroperiod defined as having at least 10 cm of water in the north eastern pool

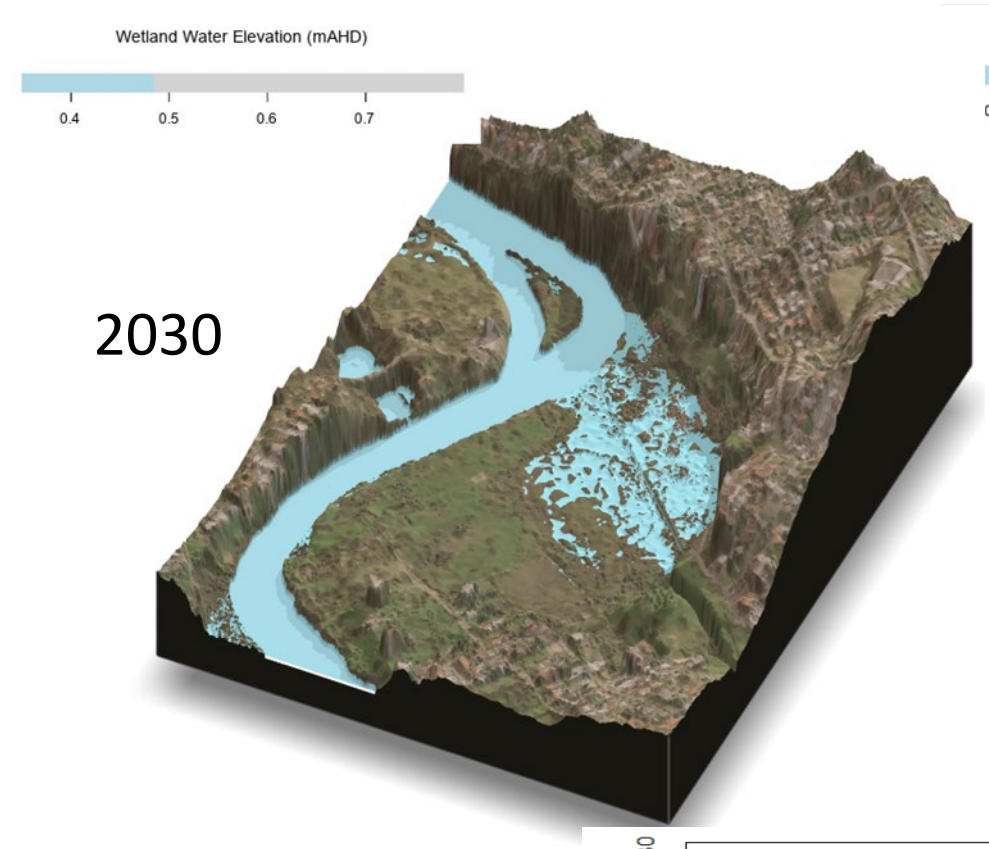




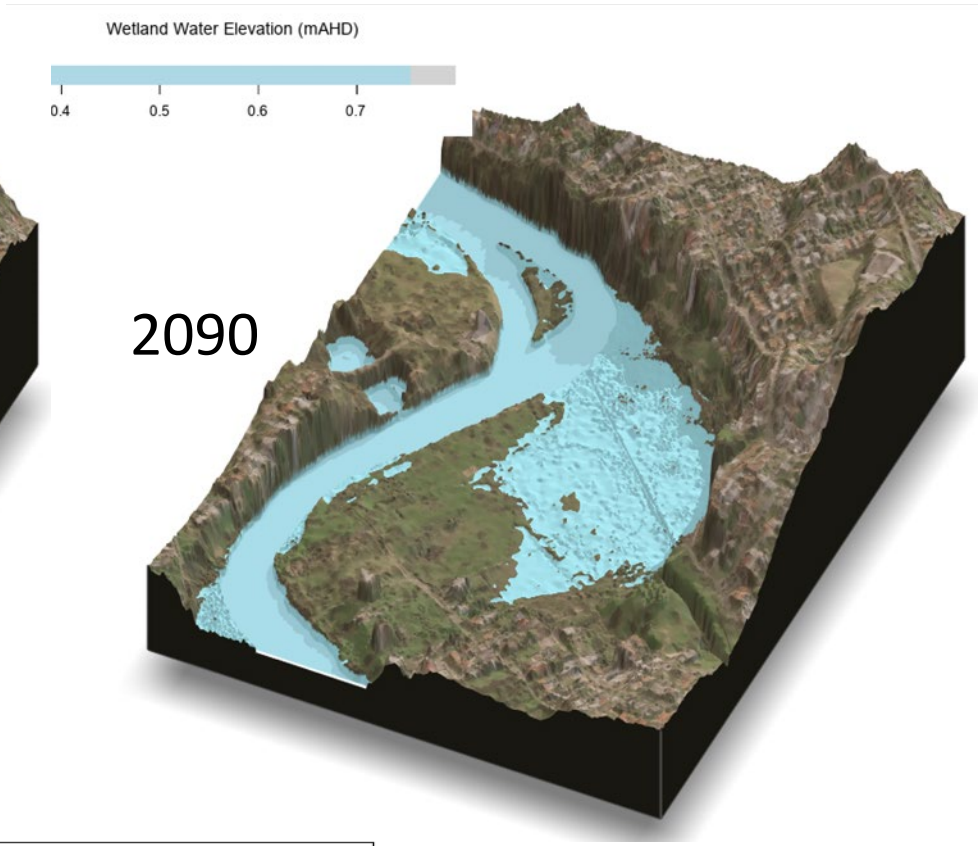
Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

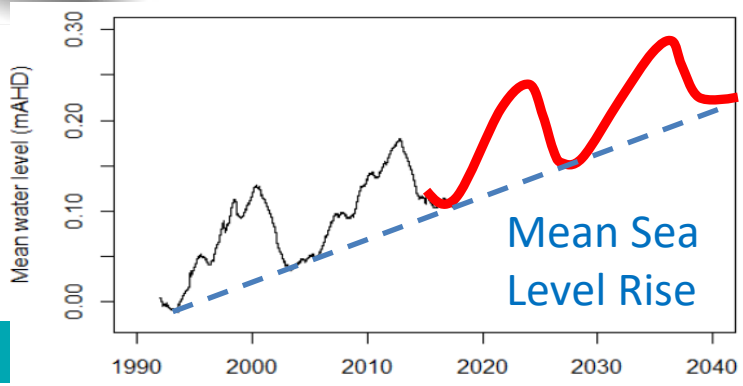
Future Mean Water Levels



2030



2090



8 and 16 year nodal tidal cycles

Summary

- Tide dominated wetland
- Weak surface water – groundwater interaction
- Dominant hydrological processes changing significantly

- Multiple methods essential
  - Geophysical
  - Modelling
  - Hydrodynamics
  - Hydrogeological
  - Geochemistry
  - Urban hydrology

https://library.dbca.wa.gov.au/#record/158172