Hydrological Study at Ashfield Flats: A Temperate Coastal Saltmarsh Threatened Ecological Community

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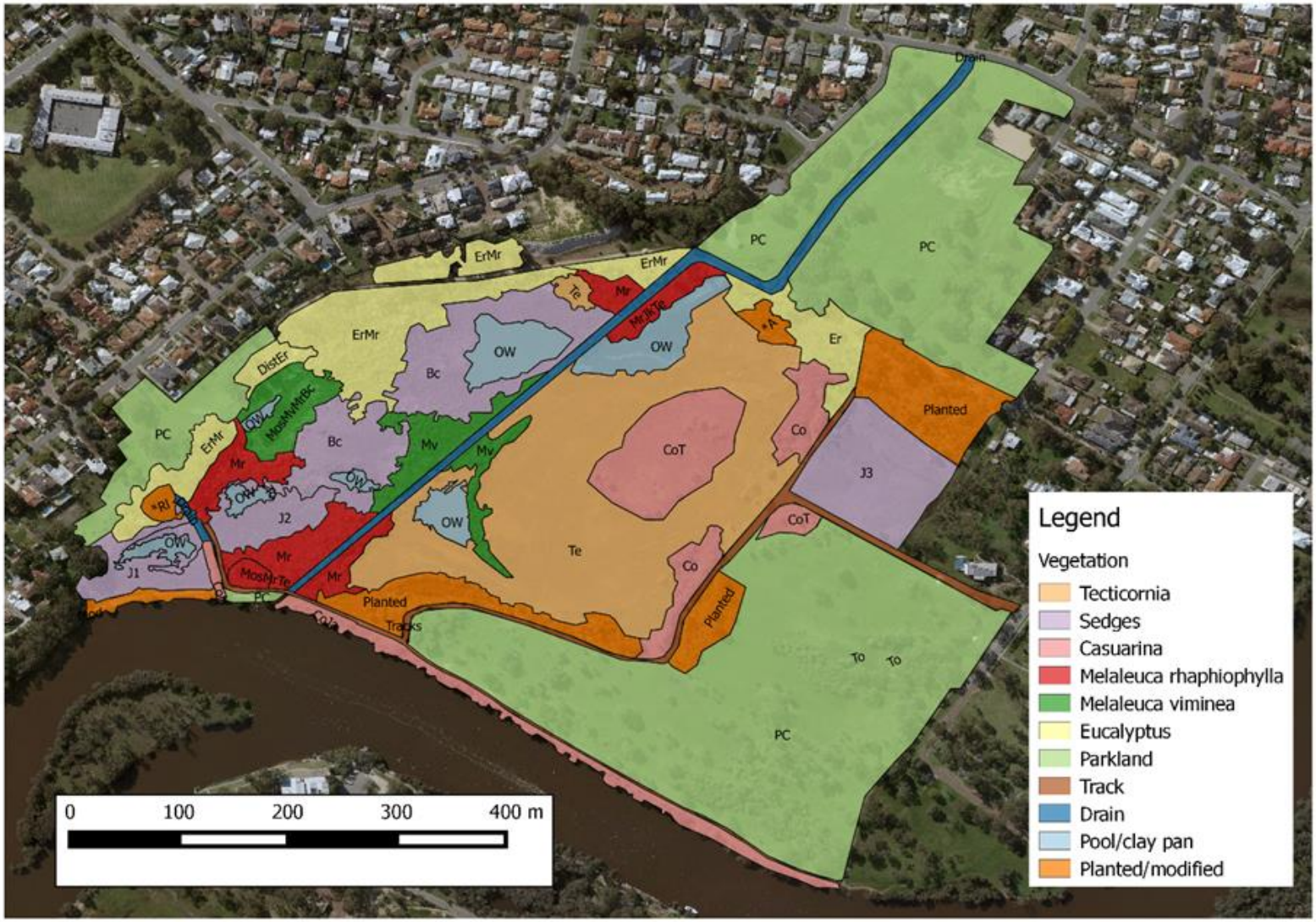
- DBCA
  - Rivers and Estuaries Branch
  - Ecosystem Science
- Town of Bassendean
- Department of Water

Ashfield Flats Reserve

- Bush Forever Site
- Threatened Ecological Community
- Largest remaining river flat in the Swan estuary
- Pressure from urbanization, weeds, known groundwater contamination, climate change

Ecological Communities

- Samphire vegetation within the Subtropical and Temperate Coastal Saltmarsh threatened ecological community
- Open Woodland of Melaleuca rhaphiophylla
- Sedgeland of Juncus kraussii
- 47 native and 65 introduced taxa


Drain
PC
ErMr
Te
Mr
MrTeTe
OW
Bc
DistEr
MosMrMrBc
Mv
CoT
Co
Er
Planted
J3
J2
J1
MosMrTe
Planted
Tracks
To
0
100
200
300
400 m
Legend
Vegetation
Tecticornia
Sedges
Casuarina
Melaleuca rhaphiophylla
Melaleuca viminea
Eucalyptus
Parkland
Track
Drain
Pool/clay pan
Planted/modified

Aims

- Develop an understanding of the dominant hydrological processes sustaining the TEC
- Assess the potential of contamination to the wetland and the Swan River Estuary from urban drainage and known groundwater pollution

Objectives

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

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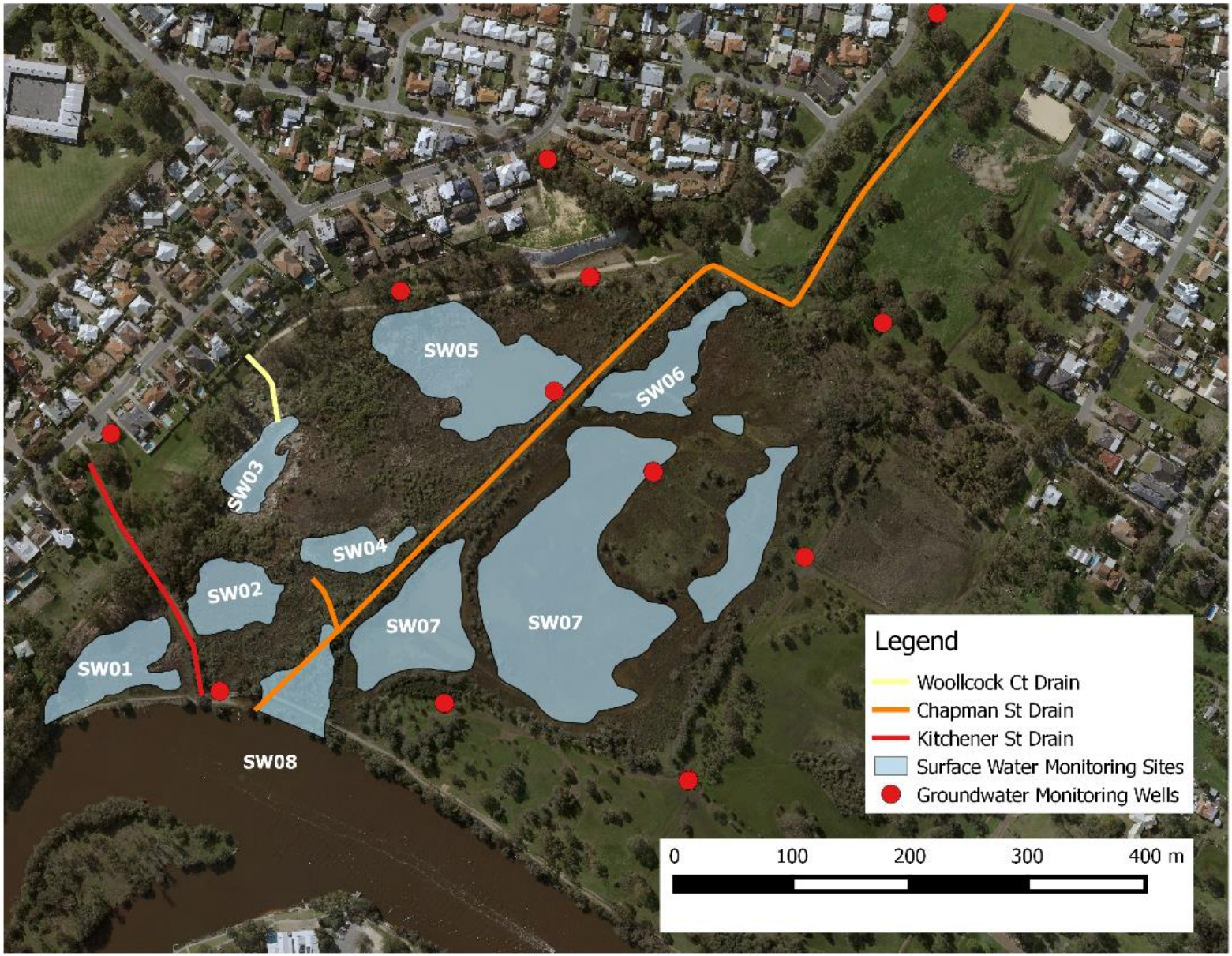
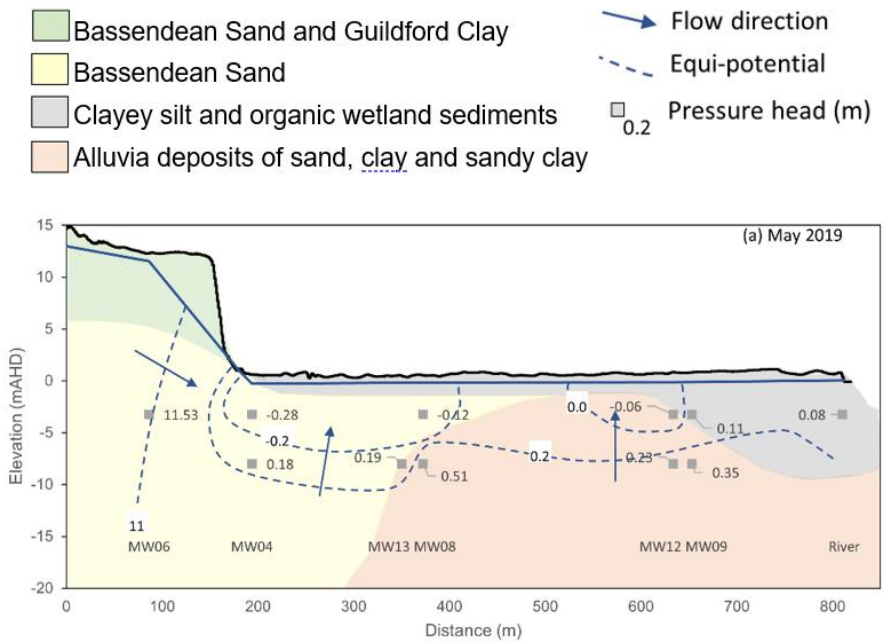
Monitoring Program

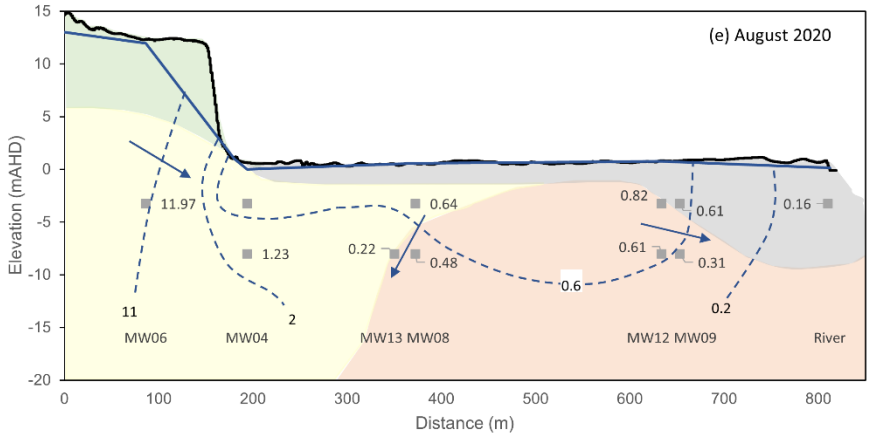


Groundwater

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

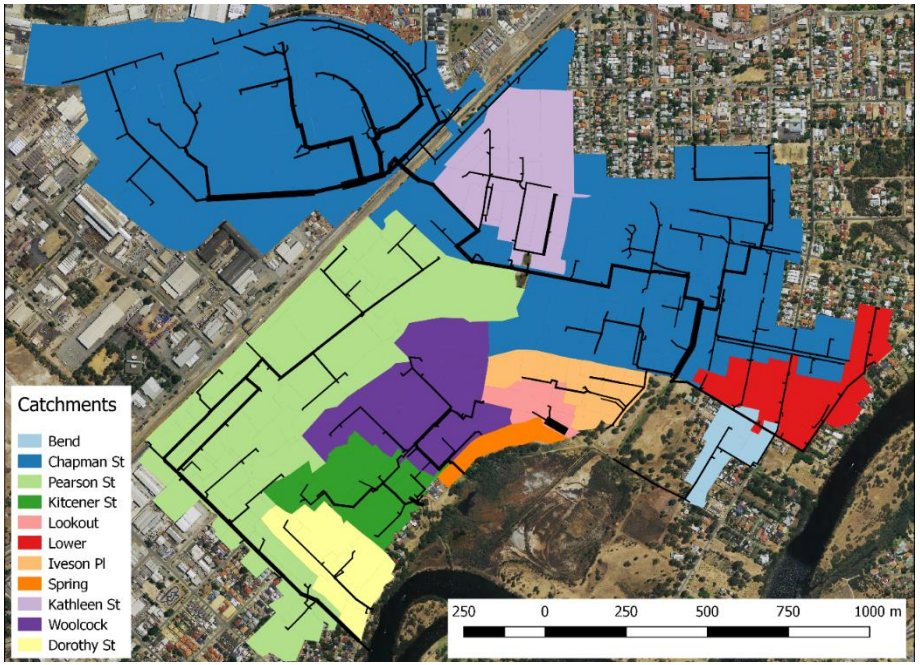


May 2019



August 2020

Stormwater



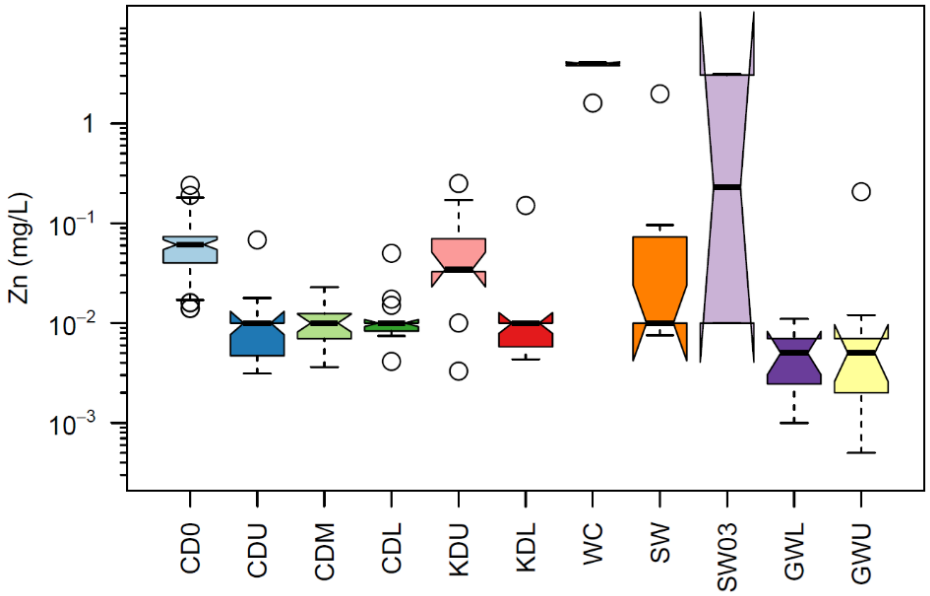
Stormwater inflows are freshening western-half of site and changing species composition

Catchment	Annual Flow ML
Chapman St	86.4 ± 90.1
Pearson St	41.1 ± 27.9
Woolcock Ct	**52.9 ± 12.0**
Kathleen St	4.3 ± 4.1
Lower	9.3 ± 5.7
Kitchener St	11.8 ± 5.0
Dorothy St	7.4 ± 4.4
Iveson Pl	4.4 ± 2.6
Bend	4.0 ± 2.2
Lookout	3.9 ± 1.5
Spring	7.5 ± 1.6

10 – 20 % of rainfall becomes stormwater

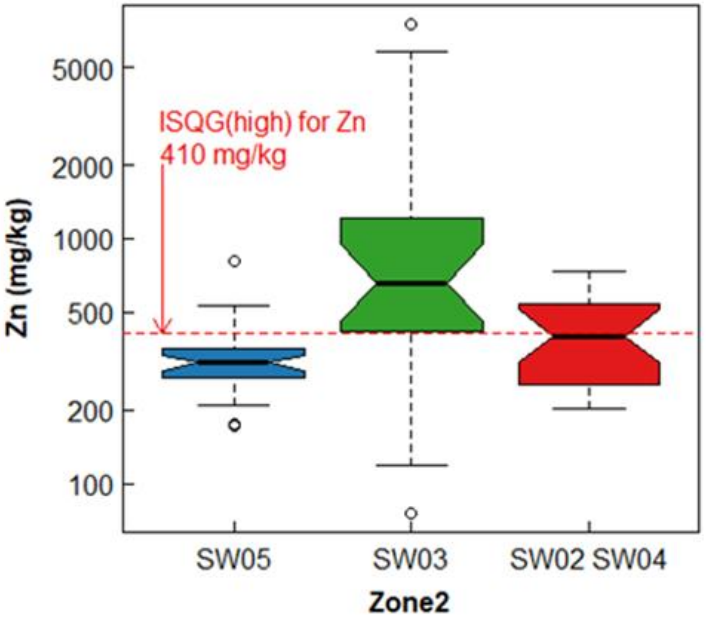
Woolcock Ct Drain Capturing and Delivering Polluted Groundwater

Waters



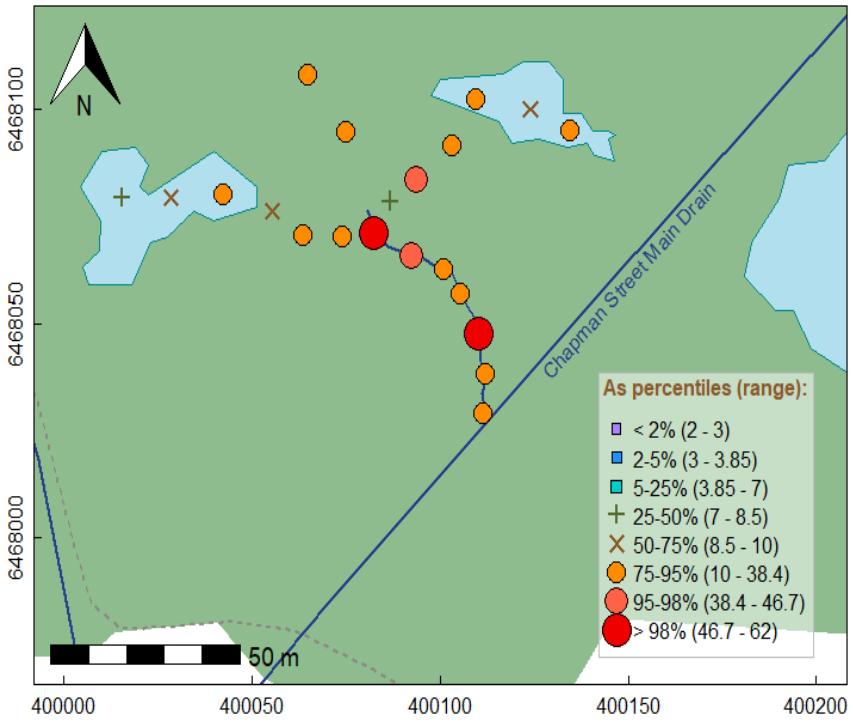
Water samples exceeded ANZECC Marine and Freshwater quality limits of protection (Zn, Ag, Pb, Cd, Cu, Co, Al*)

Sediments

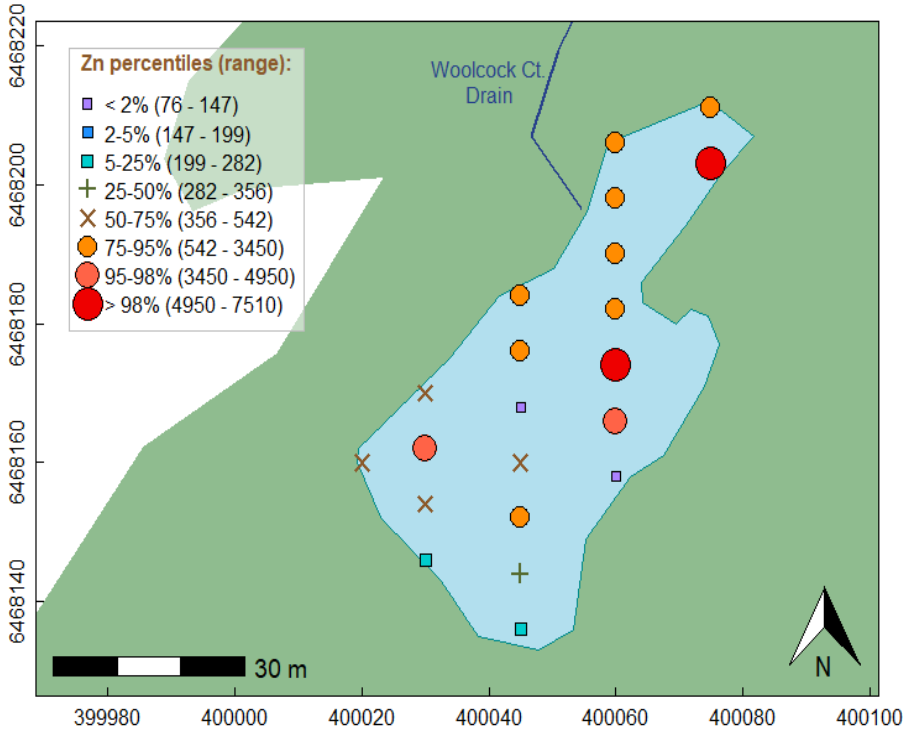


Sediment samples exceed Interim Sediment Quality Guidelines (ISQG) at low levels (Cu, Pb, Ni, Zn) and high levels (Cu, Zn).

Sediment Quality

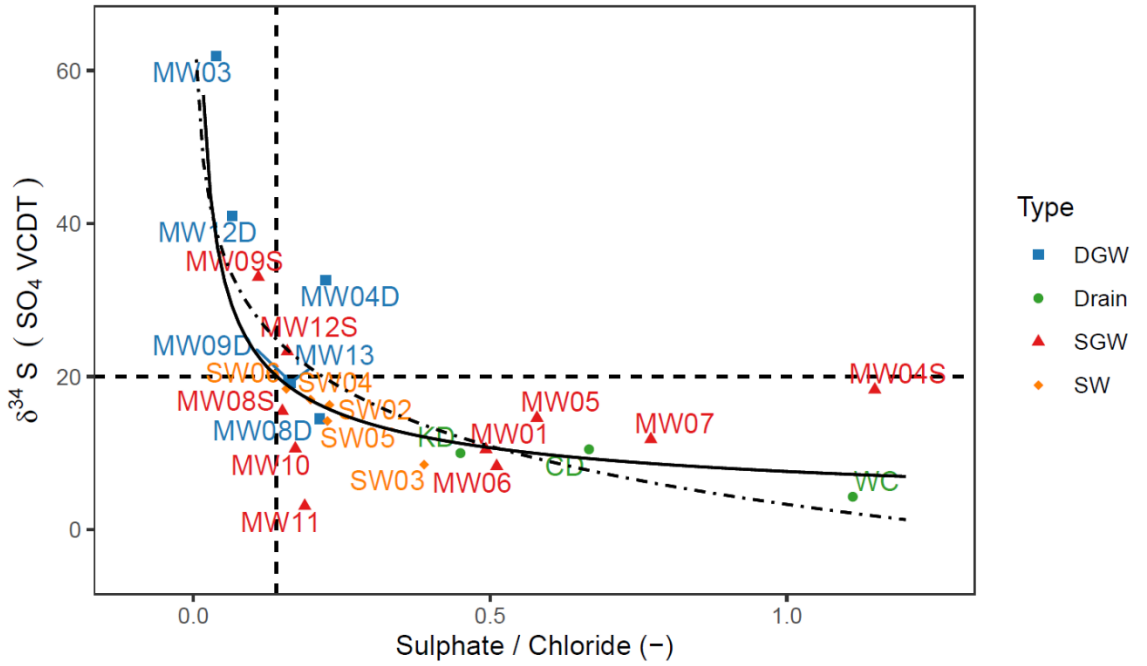


Naturally occurring acid sulphate soils



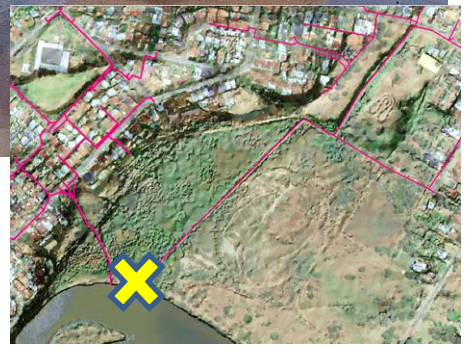
Pollutant capture as an ecosystem service

Water Quality Indicators of Mixing and Pollution



Depleted δ^{34}S is indicative of anthropogenic source (i.e. roasting of S for fertilizer production)

River Flooding



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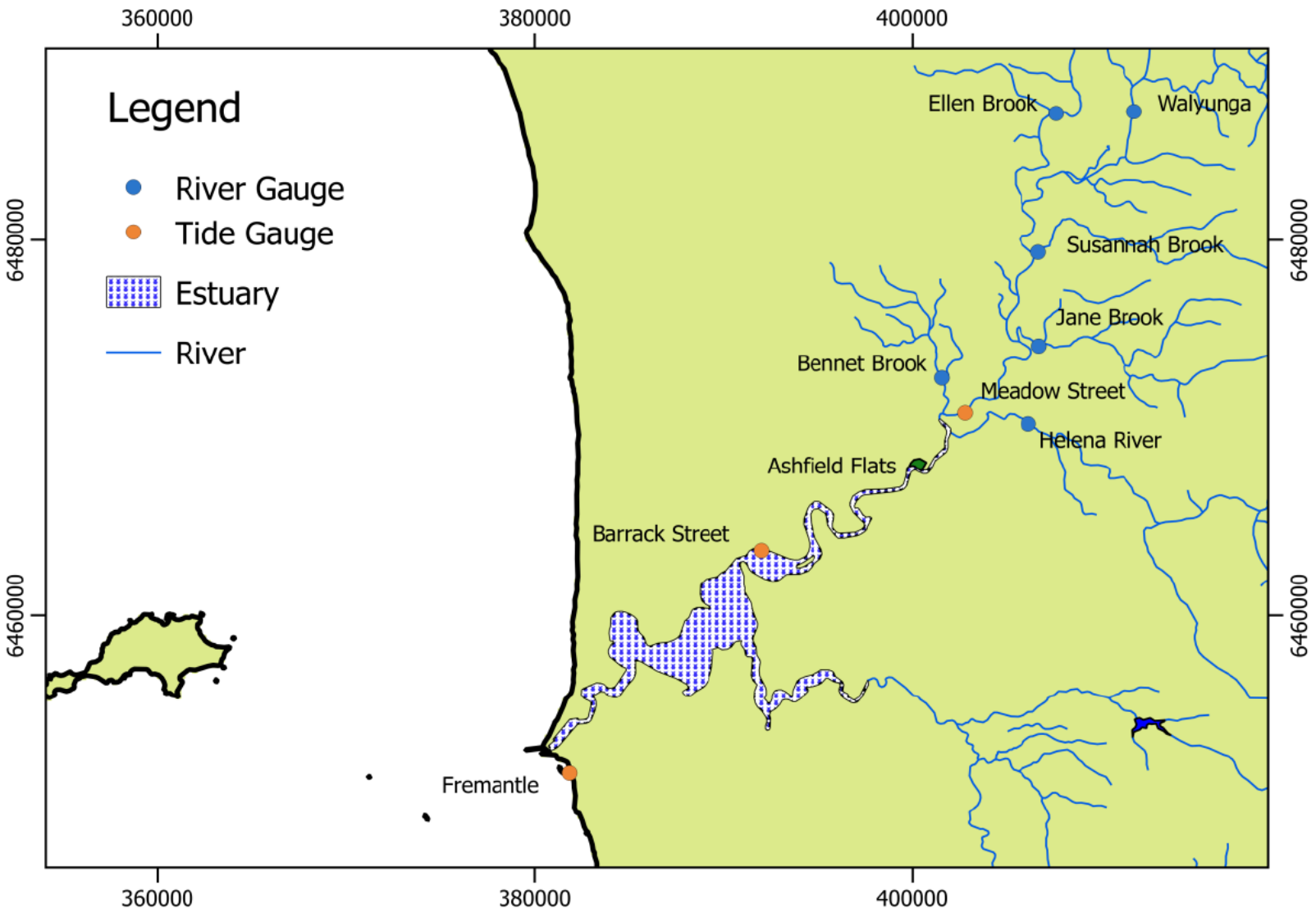

360000
380000
400000
6480000
6460000
Legend
River Gauge
Tide Gauge
Estuary
River
Ellen Brook
Walyunga
Susannah Brook
Jane Brook
Bennet Brook
Meadow Street
Helena River
Ashfield Flats
Barrack Street
Fremantle

Micro-tidal South West

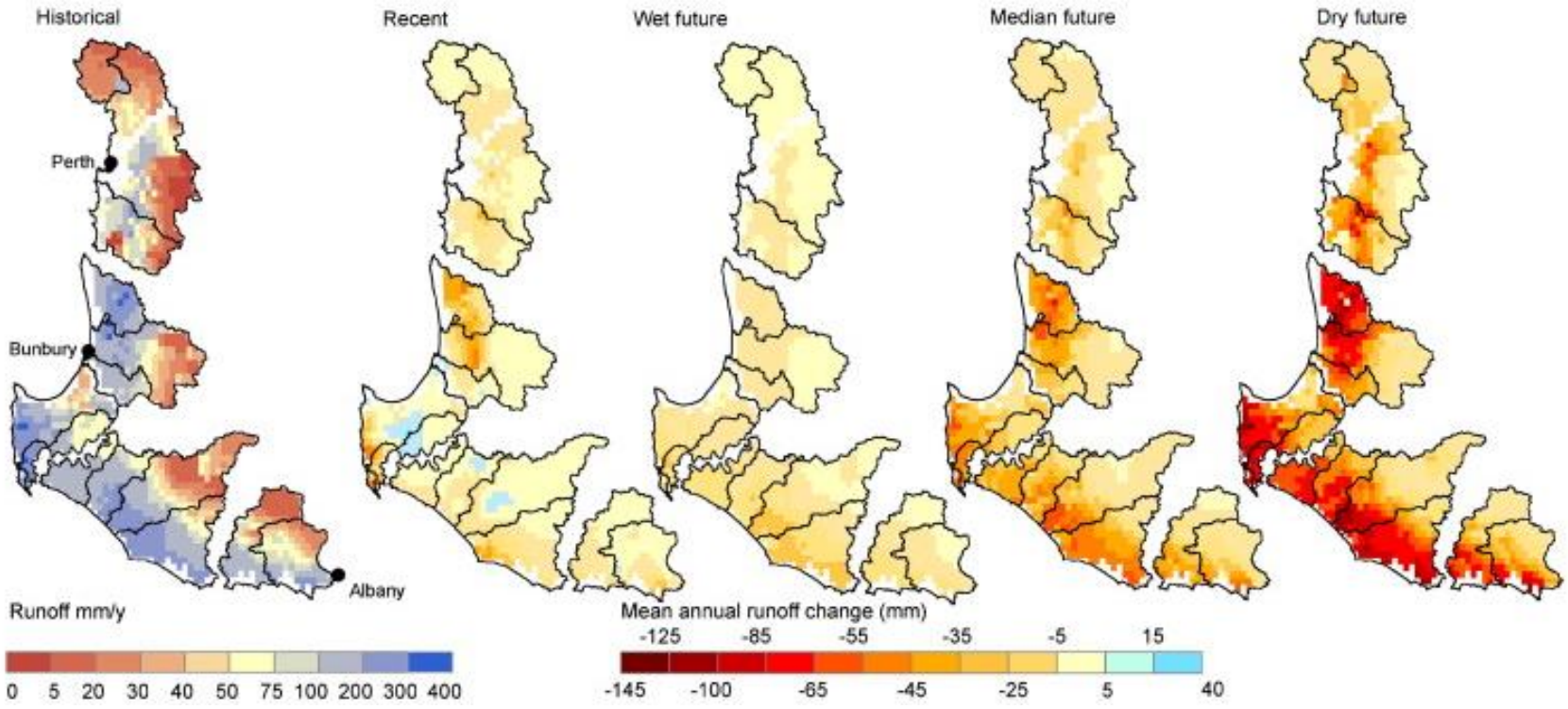
Short time scales

Process	Temporal Scale	Magnitude (m)
Seiche	2 hr	0.2
Wind setup	4 hr	0.2
Tides	12 -24 hr	0.5
Air pressure	1 – 7 days	0.3
Storm surge	2 – 4 days	0.6

Long time scales

Process	Temporal Scale	Magnitude (m)
Leeuwin Current	Seasonal	0.2
ENSO	3 – 5 year	0.25
Nodal tides	8 - 16 year	0.2
Climate change	100+ years	1 – 3 mm/year (accelerating)

Recent and Projected Declines in Regional Runoff

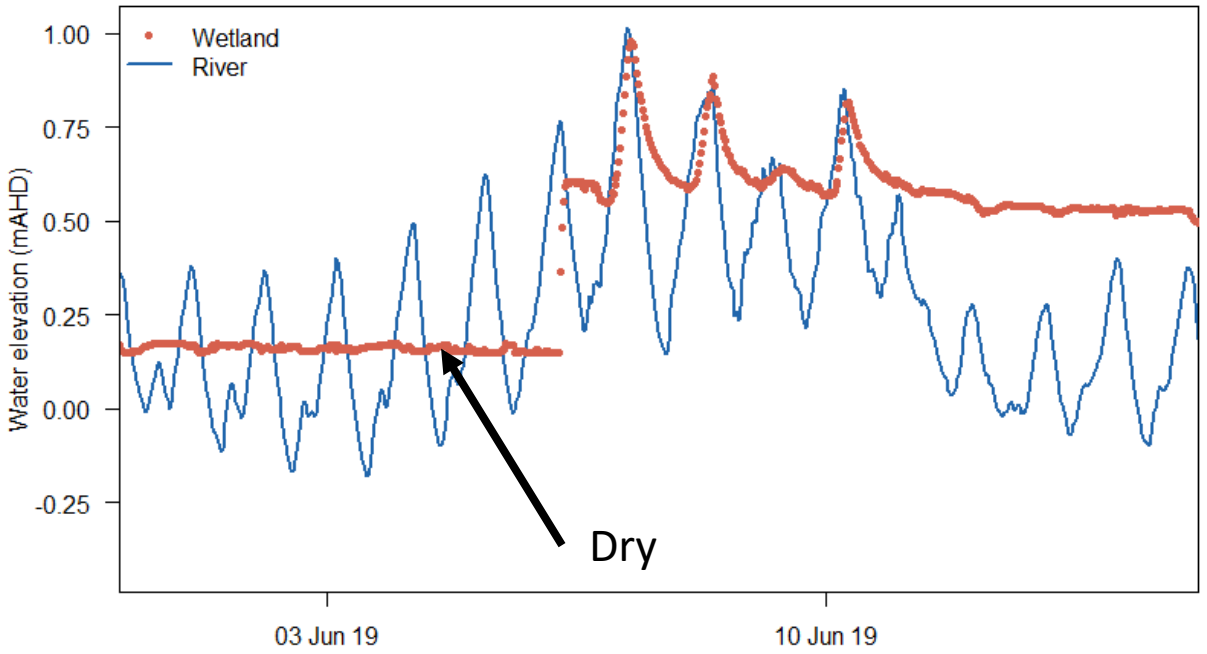


Silberstein et al., (2012) *Journal of Hydrology*

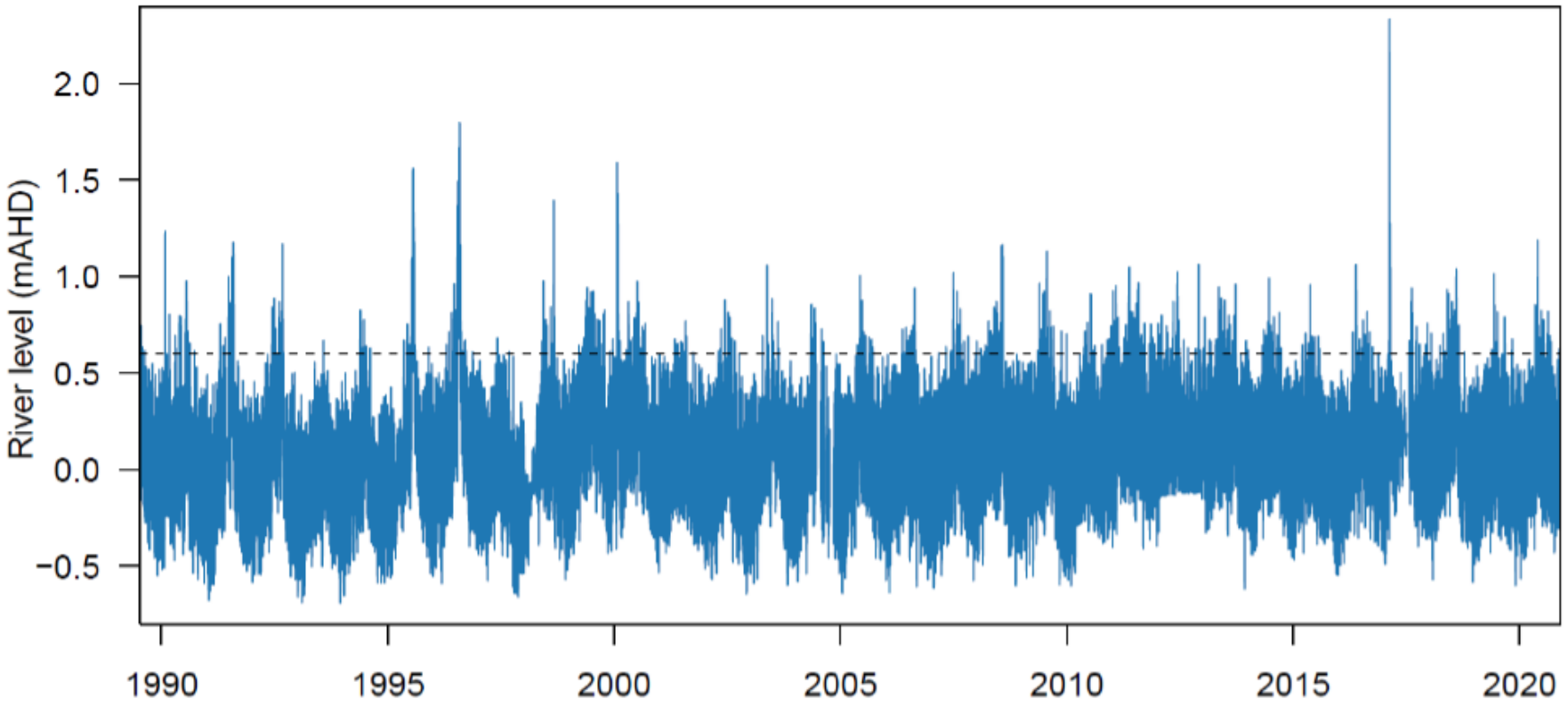
Surface Water

River the dominant surface water source

River exceeds flooding threshold ~208 hours per year at present



Flooding Threshold at Ashfield



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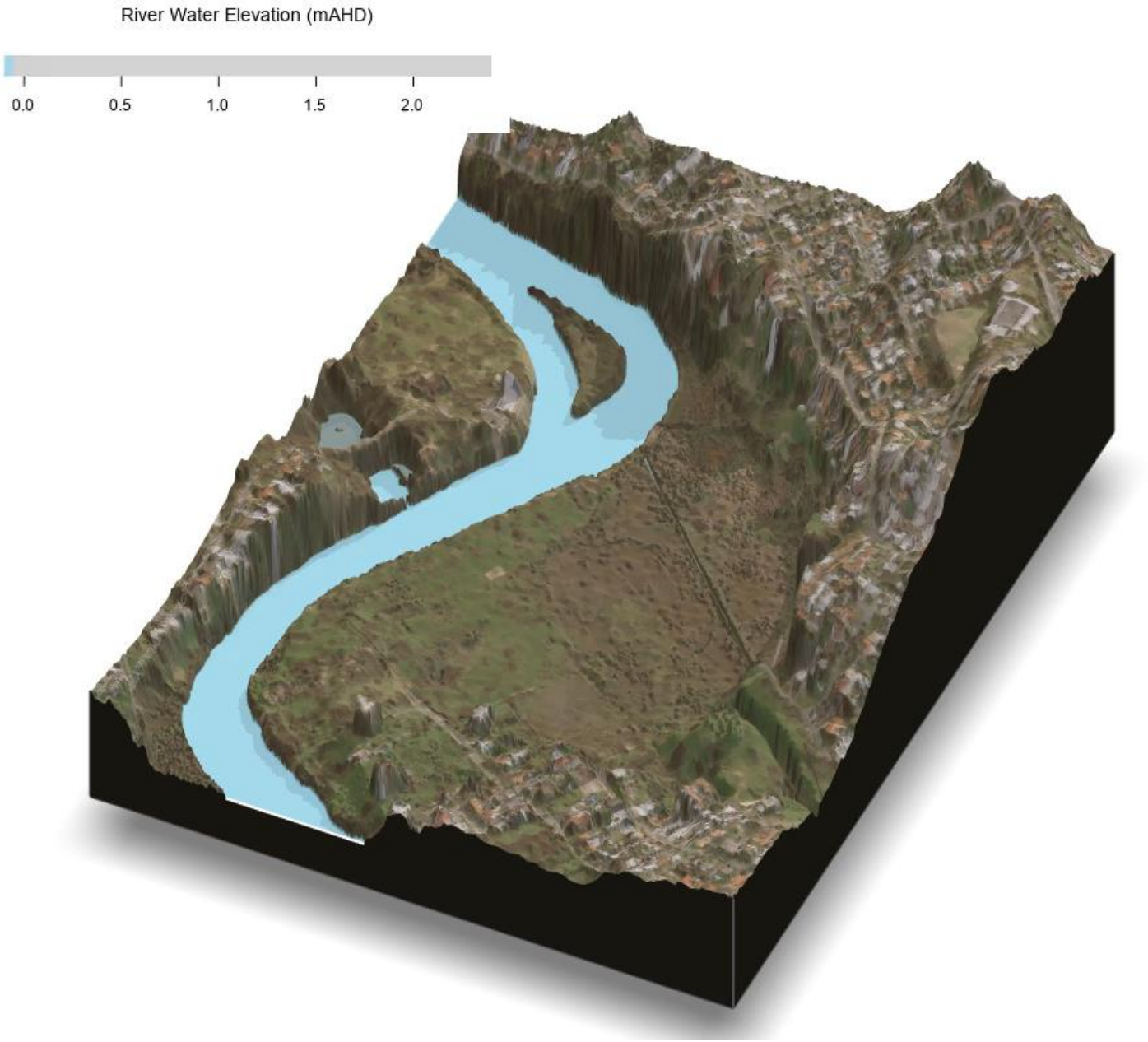
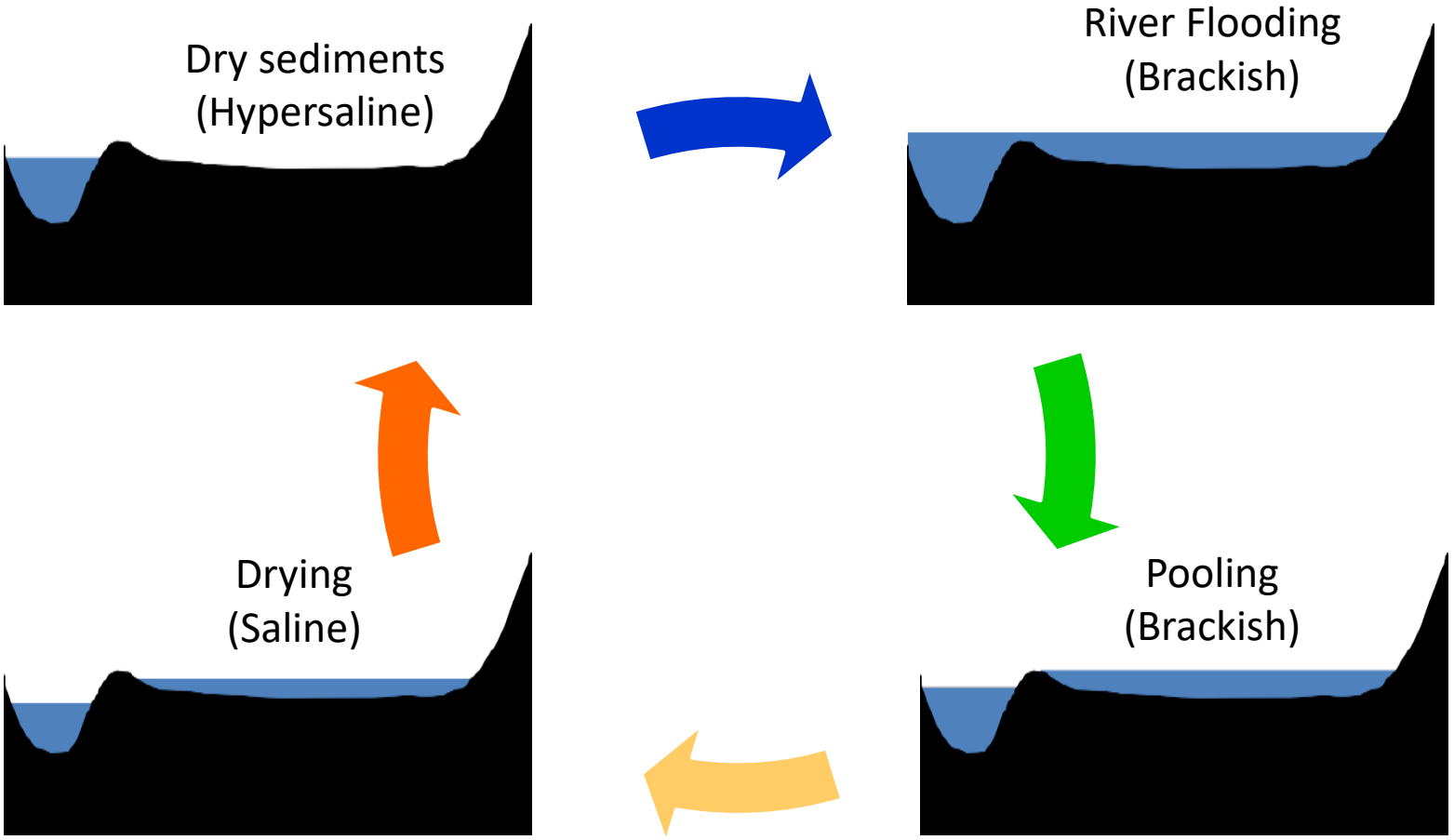
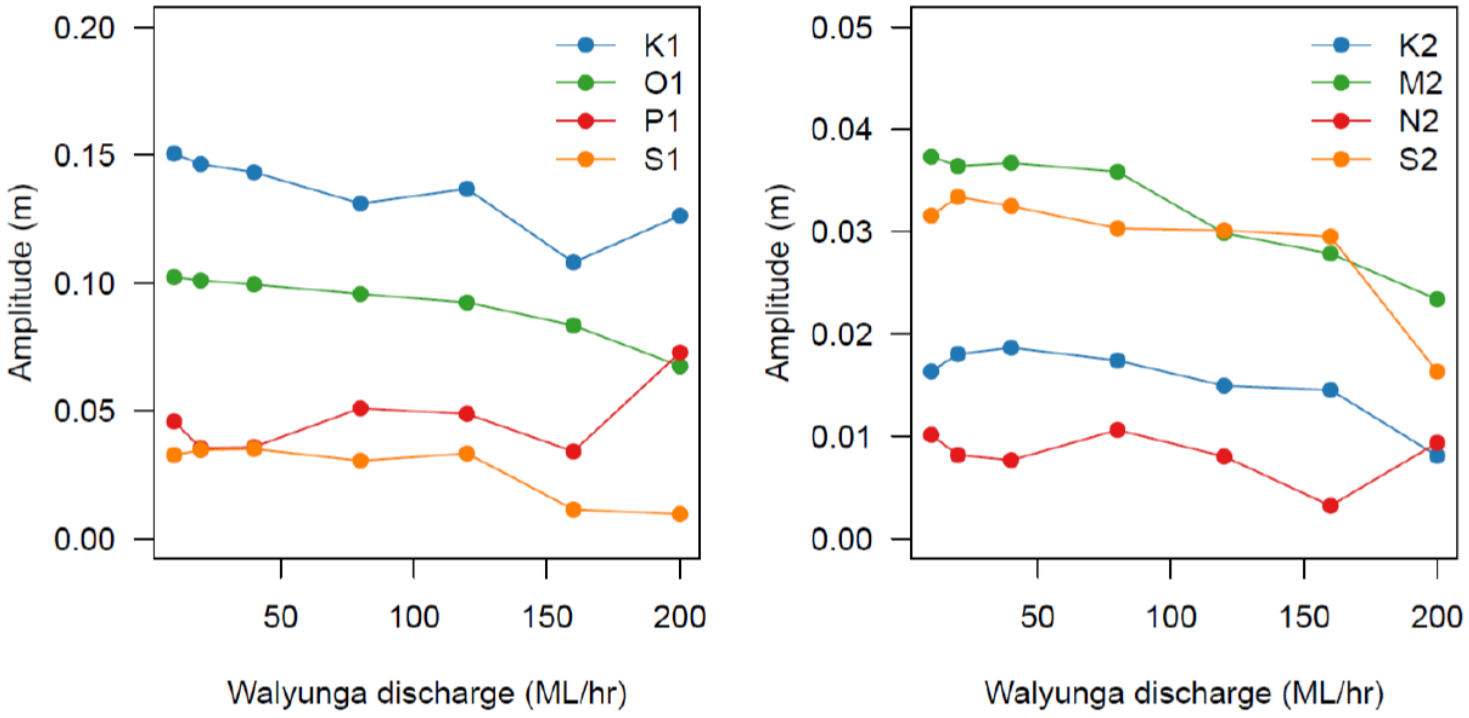


Seasonal Surface Water Cycle



River Flows Dampen Tides

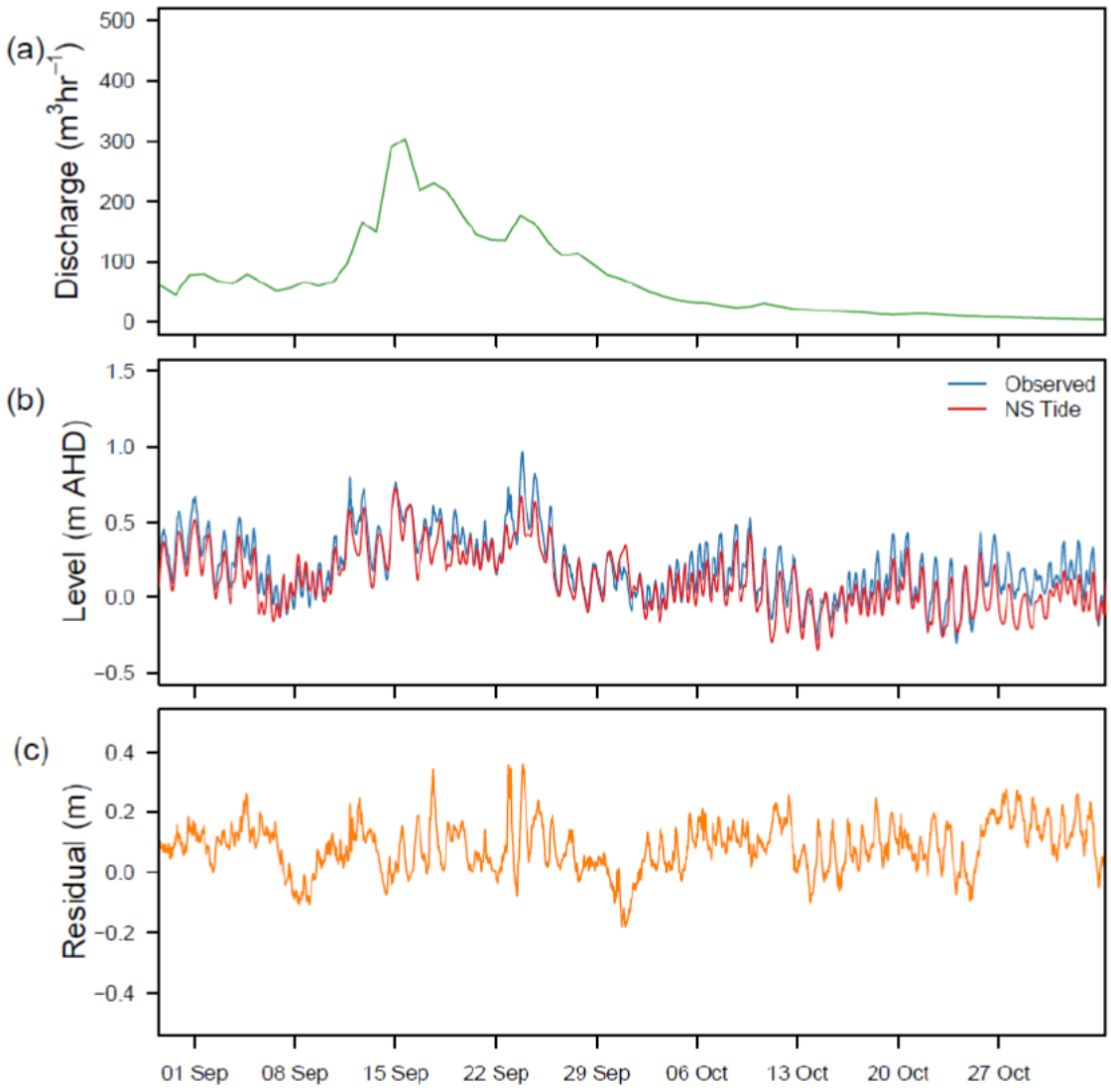


Declining winter river flows have been compensated for (somewhat) by rising tidal amplitudes

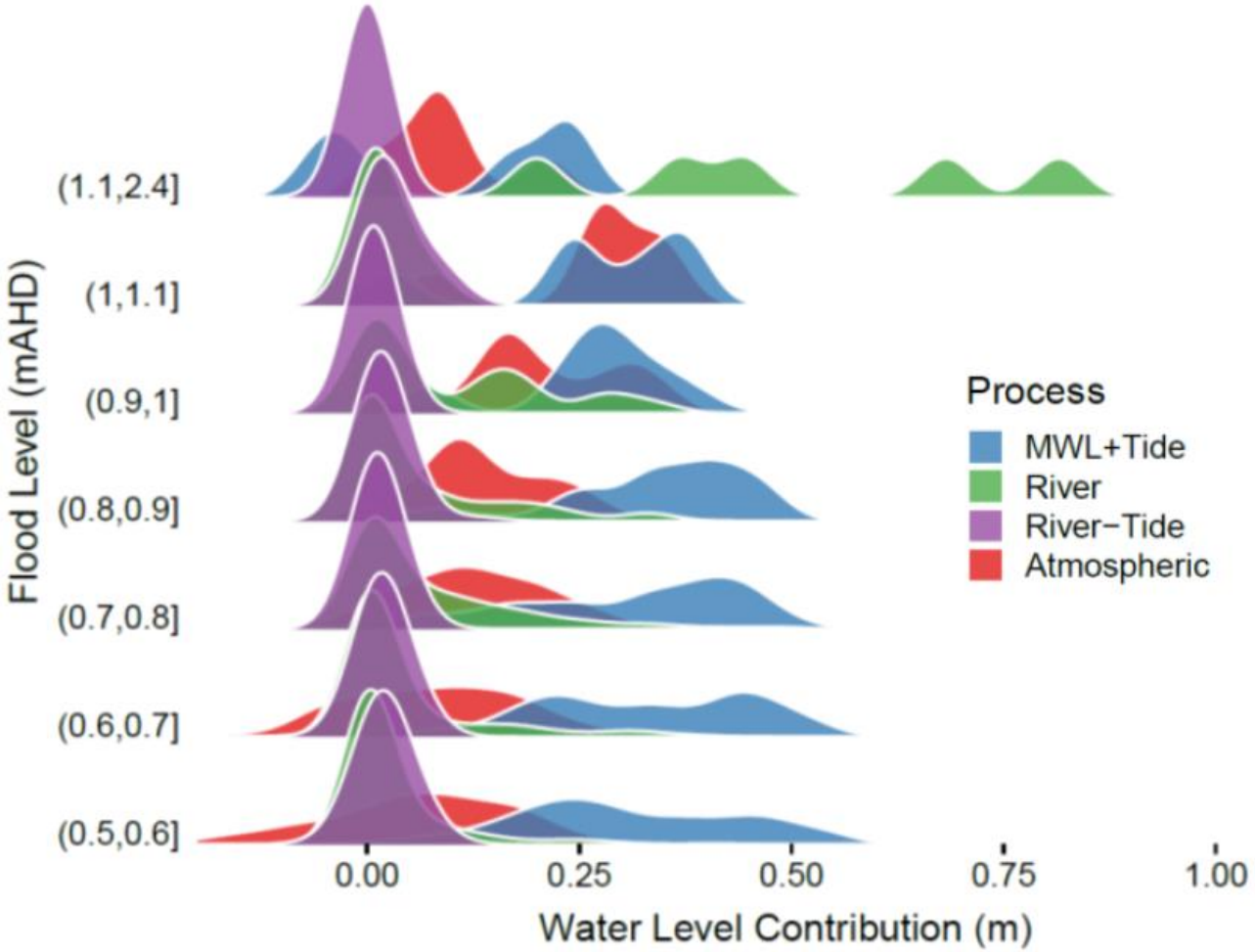
Decomposing the Processes Contributing to Flooding

Extract individual contributions to estuary water levels from

- Mean-sea level
- Tides
- Air pressure
- River flows
- River – tide interactions

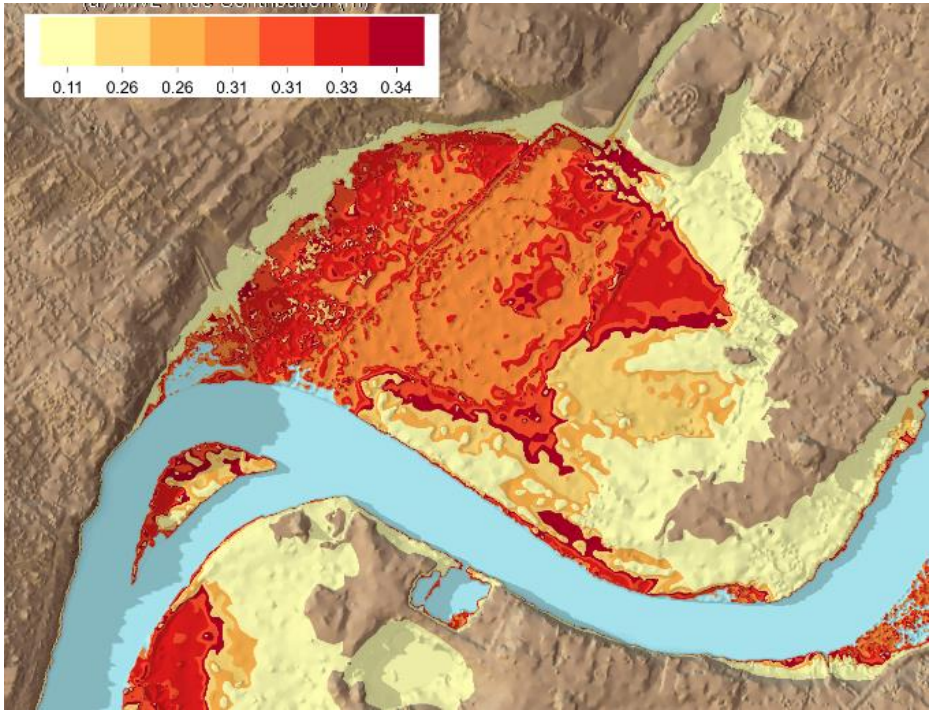


Contributions to Flooding at Ashfield

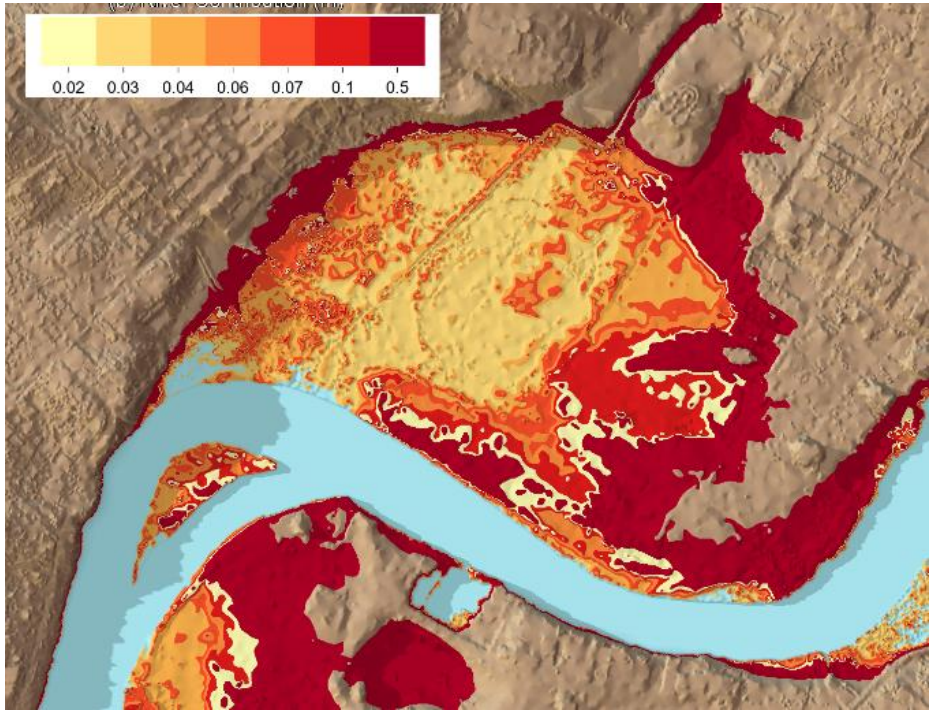


Mean Contributions to Flood Levels

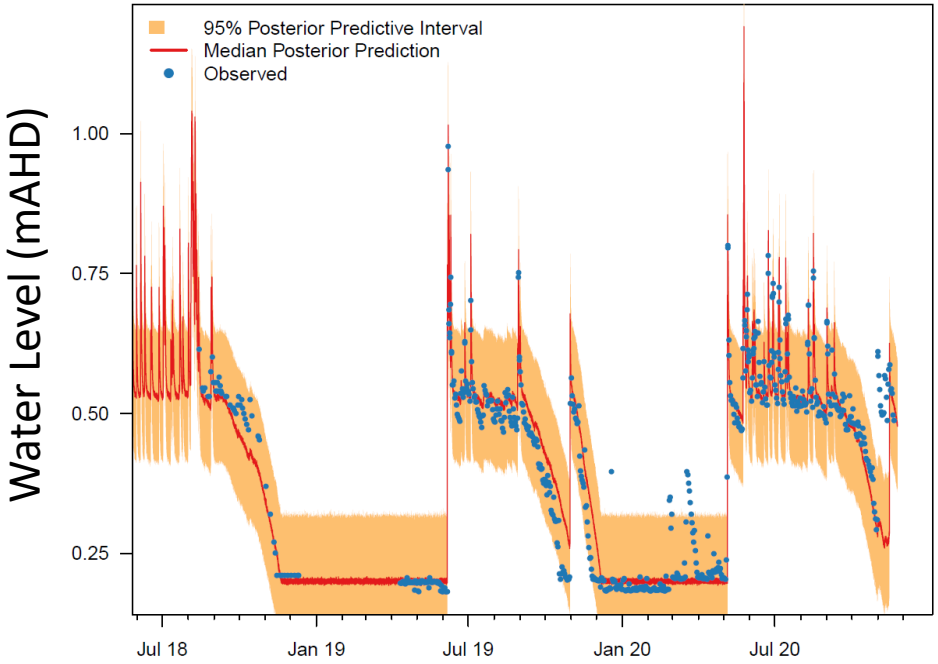
Tidal Flooding

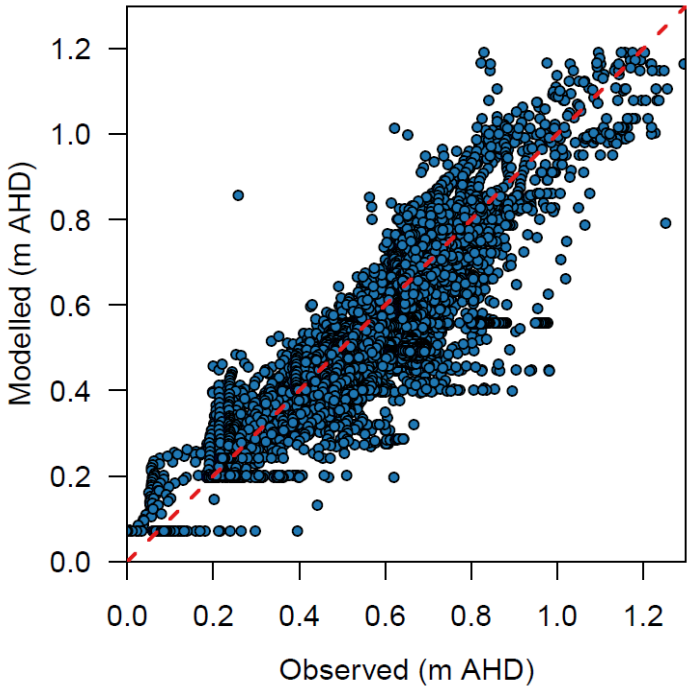


River Flooding



Modelling Surface Water Levels

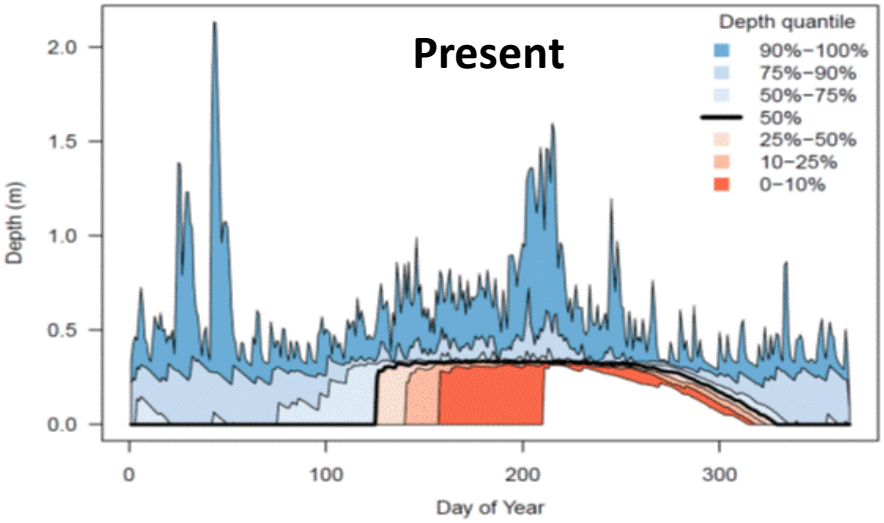


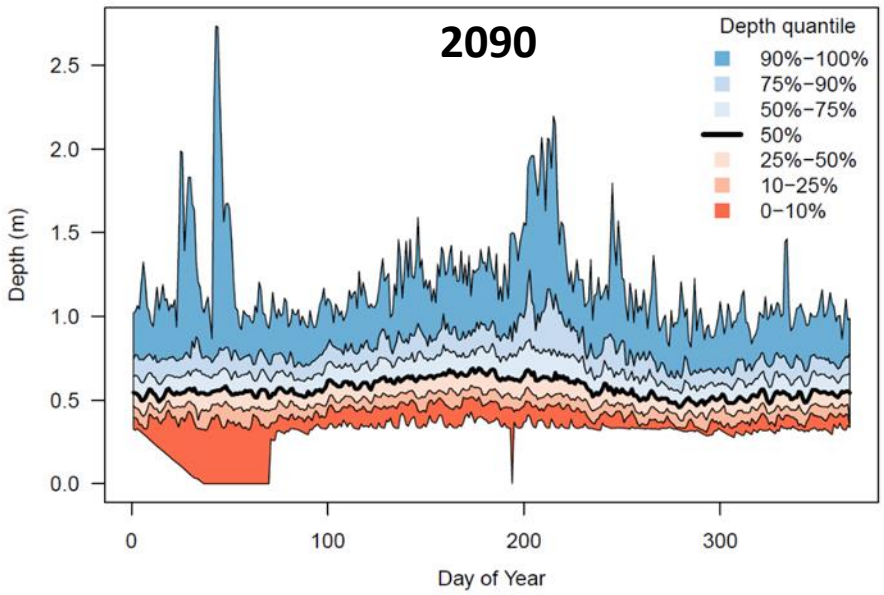


Climate Change Scenarios

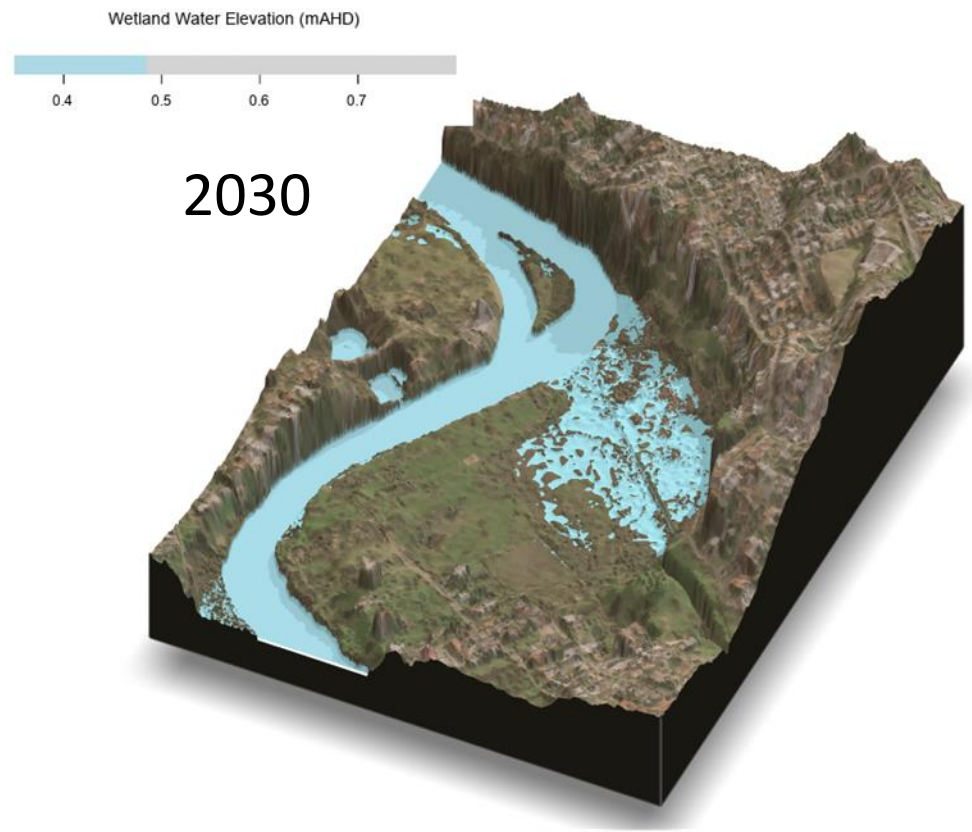
Scenario	Year	Mean Water Depth (m)	Mean Hydroperiod (days/year)
Present	1990-2020	0.20	266
RCP4.5	2030	0.25	325
	2050	0.29	351
	2070	0.33	361
	2090	0.39	362
RCP8.5	2030	0.25	324
	2050	0.30	356
	2070	0.36	362
	2090	0.48	364

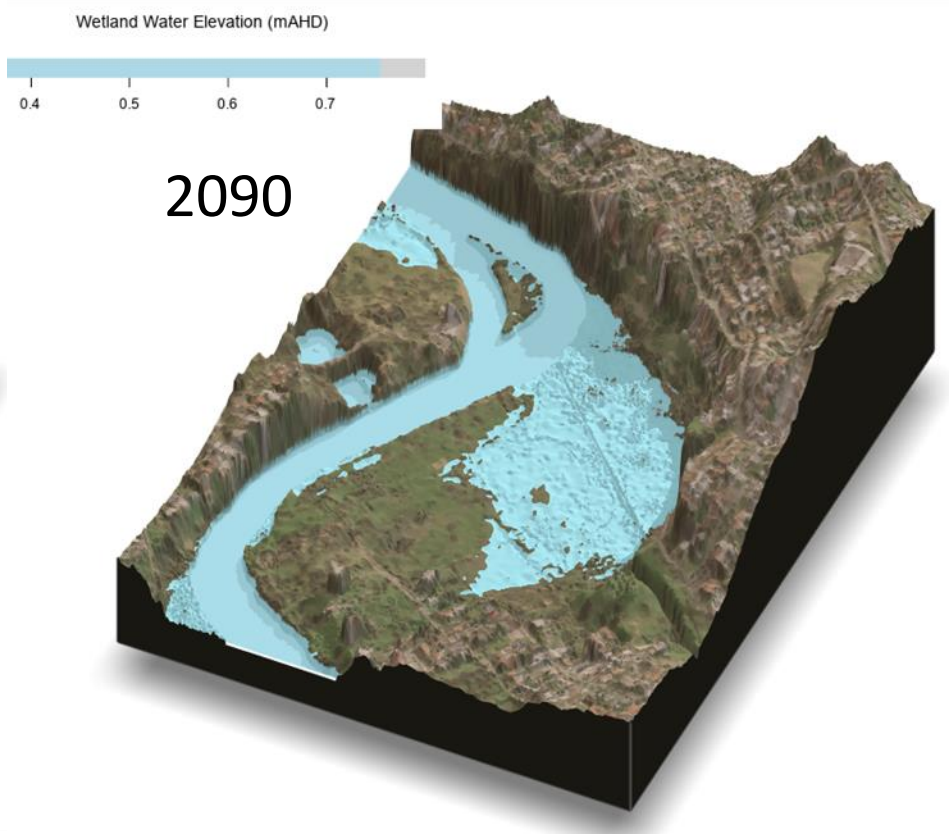
*Hydroperiod defined as having at least 10 cm of water in the north eastern pool



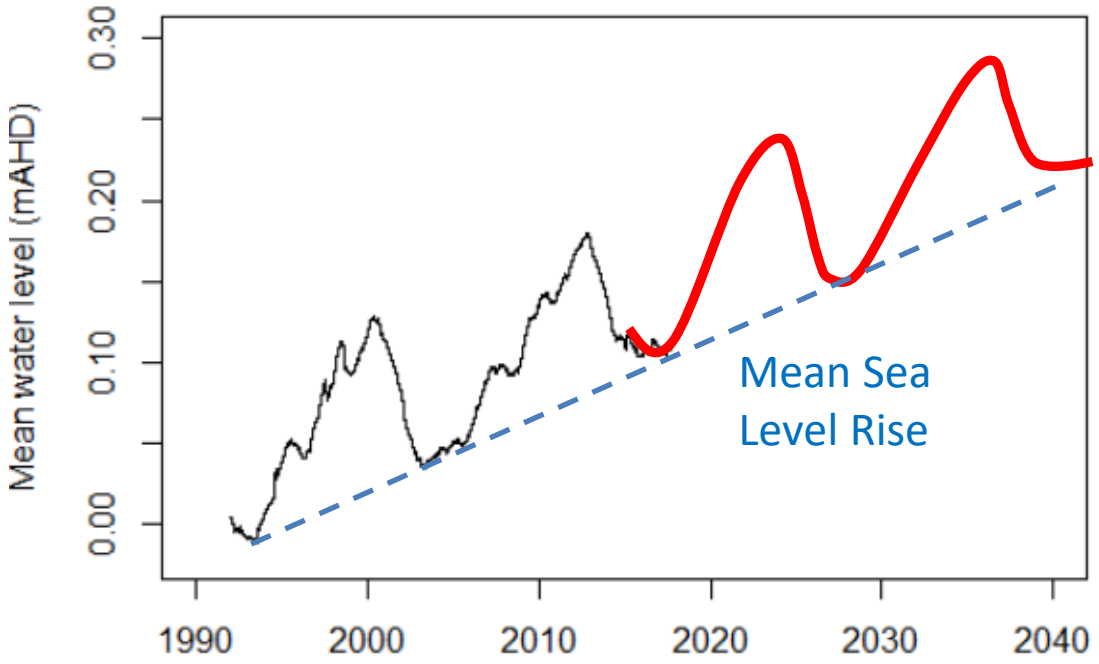


Future Mean Water Levels





Long-period Tidal Cycles: A Portent



8 and 16 year nodal tidal cycles

Summary

- Tide dominated wetland
- Minor interaction with groundwater
- Stormwater is a threat but wetland is providing a service
- Threats from sea-level rise*

Sediment accretion rates will determine resilience to climate change or the transition to a new ecosystem