

Barossa WAP Review – Science Investigations

Changing(*ed?*) climate and implications to
water planning in the Barossa PWRA

Water Science & Monitoring Team

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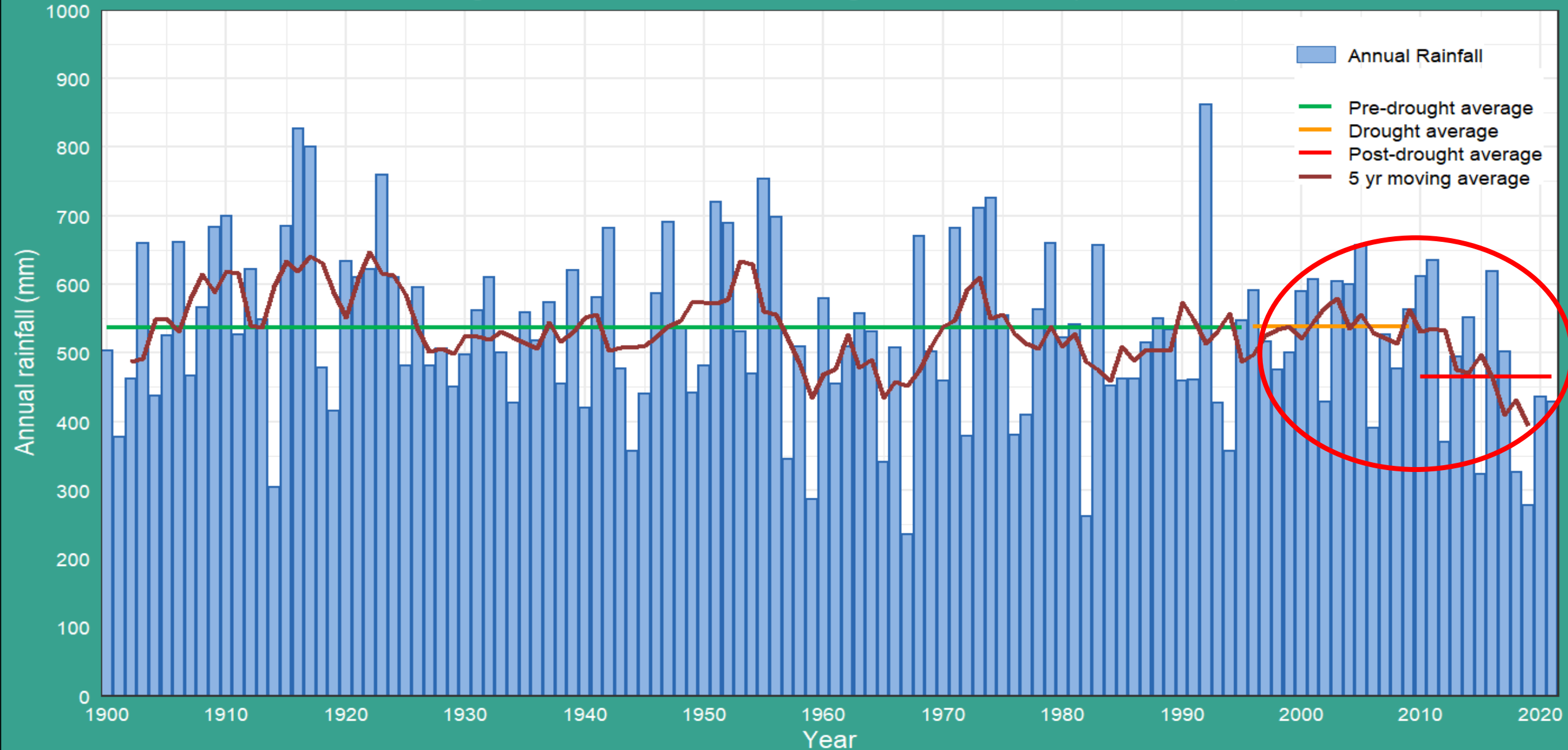
Government of South Australia
Department for Environment
and Water

Contents

- **Climate change projections and recent climate**
 - Rainfall and streamflow
 - Long-term - Observed, Recent - Observed, Future – Projected
 - Climate change, Drought & Post drought
 - Step change
- **Capacity of Surface Water Resource** in the PWRA
 - Vs Demand, including ecosystems demand.
- **Climate Window** (Period) for water planning for future for the PWRA

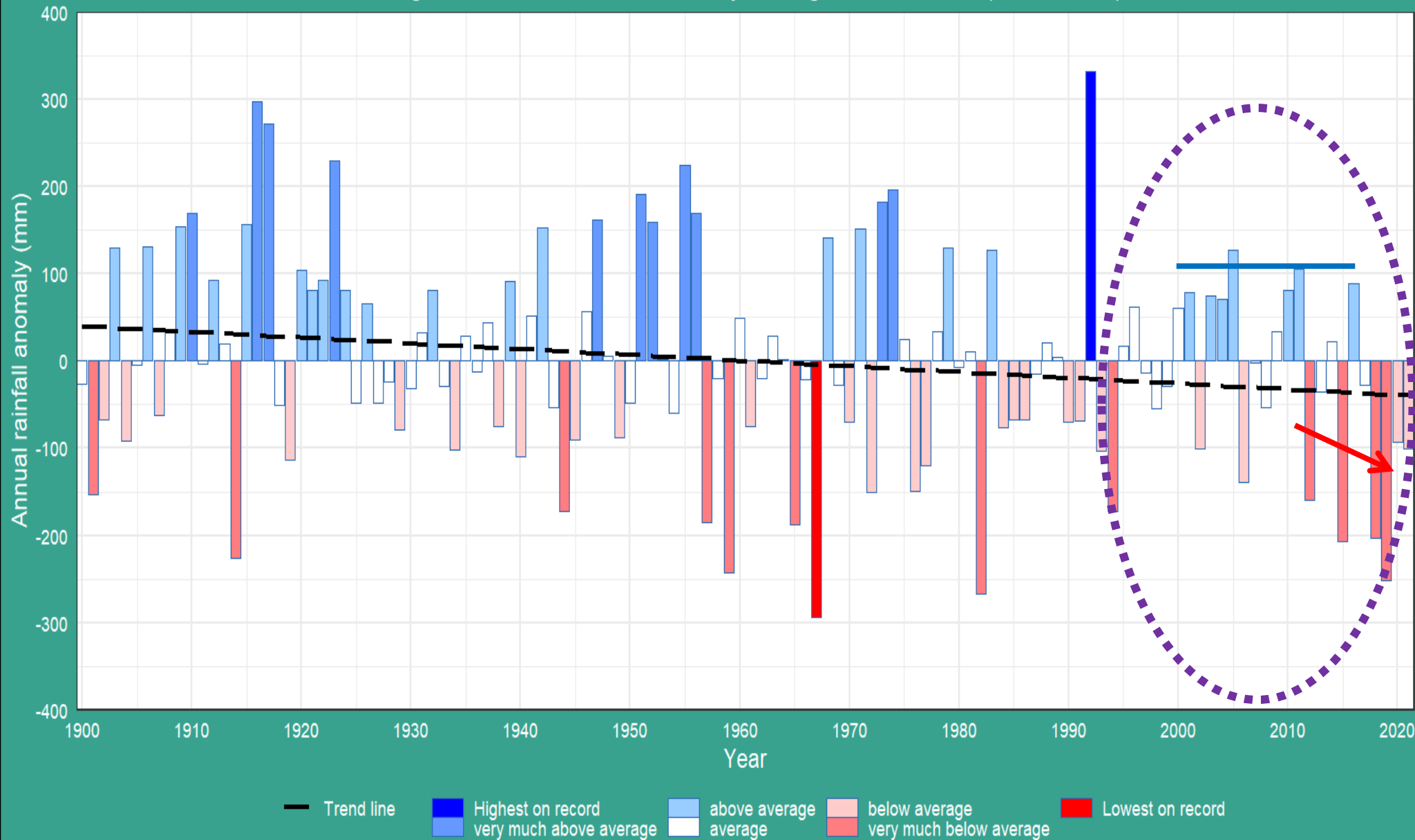
Long-term observed annual rain at Angaston

Long-term annual rainfall at Angaston A23300 (1900-2021)



Annual rainfall anomalies

Long-term annual rainfall anomaly at Angaston A23300 (1900-2021)



- Last 3 decades:**
NO - "Very much above-average 'WET' years"

- Last decade:**
Higher frequency & Consecutive "Very much below average 'VERY DRY' years."

- Post-drought**
Rainfall pattern not back to Pre-drought conditions!

- Step Change**
Permanent shift / step-change in rainfall pattern?

Climate change projections – Montazeri M., Savadamuthu K. (DEW 2018)

Annual rainfall anomaly for site 23300, with forecast to 2080

DEW Analysis 2018, Report

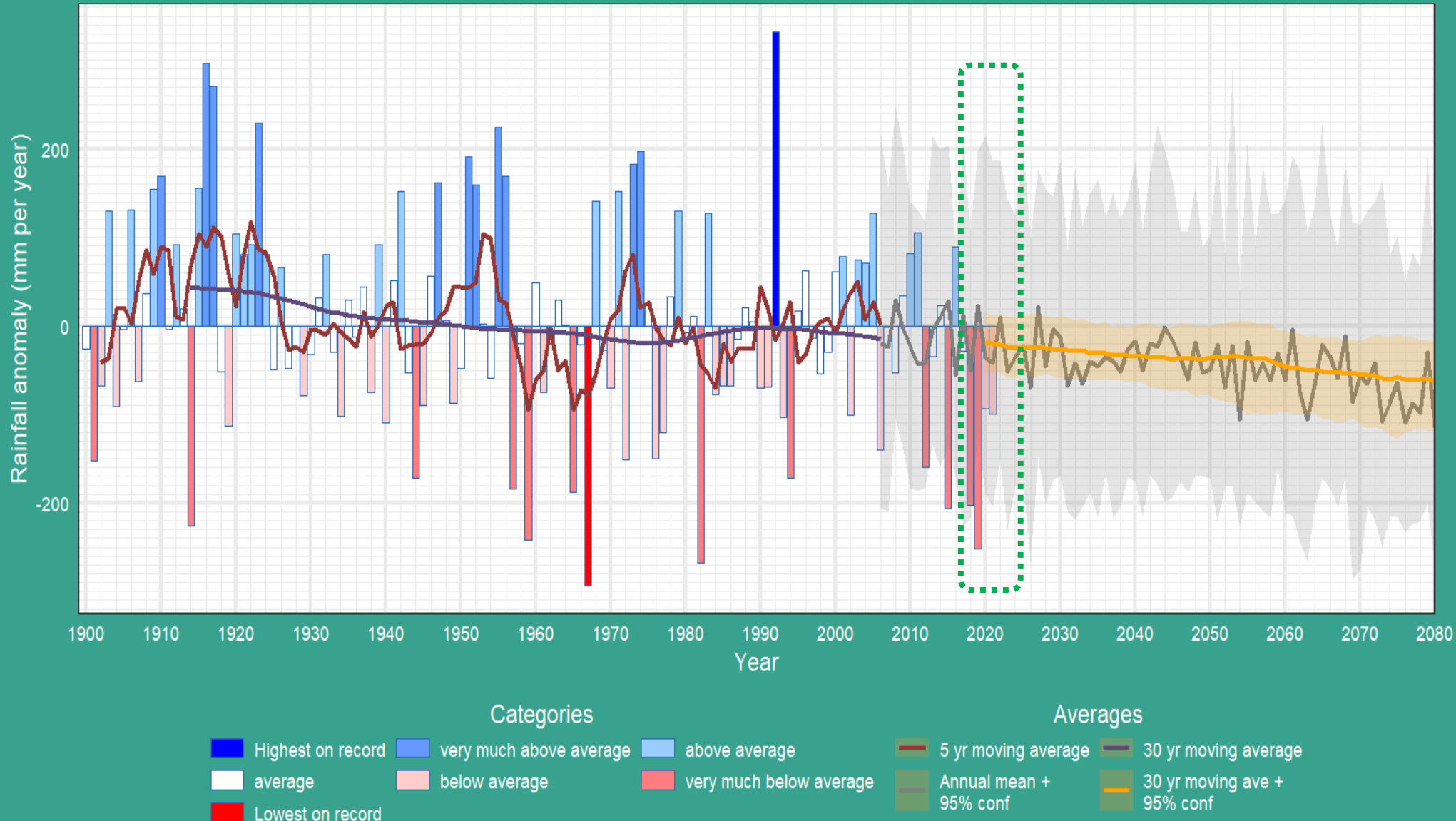
Previous (2018) climate change modelling, 30yr moving average

~ 2020: +10 to – 40mm
~ 2030: +10 to -50mm
~ 2050: 0 to -60mm
~ 2080: -20 to – 100mm

Observed rainfall data included to verify 2018 projections:

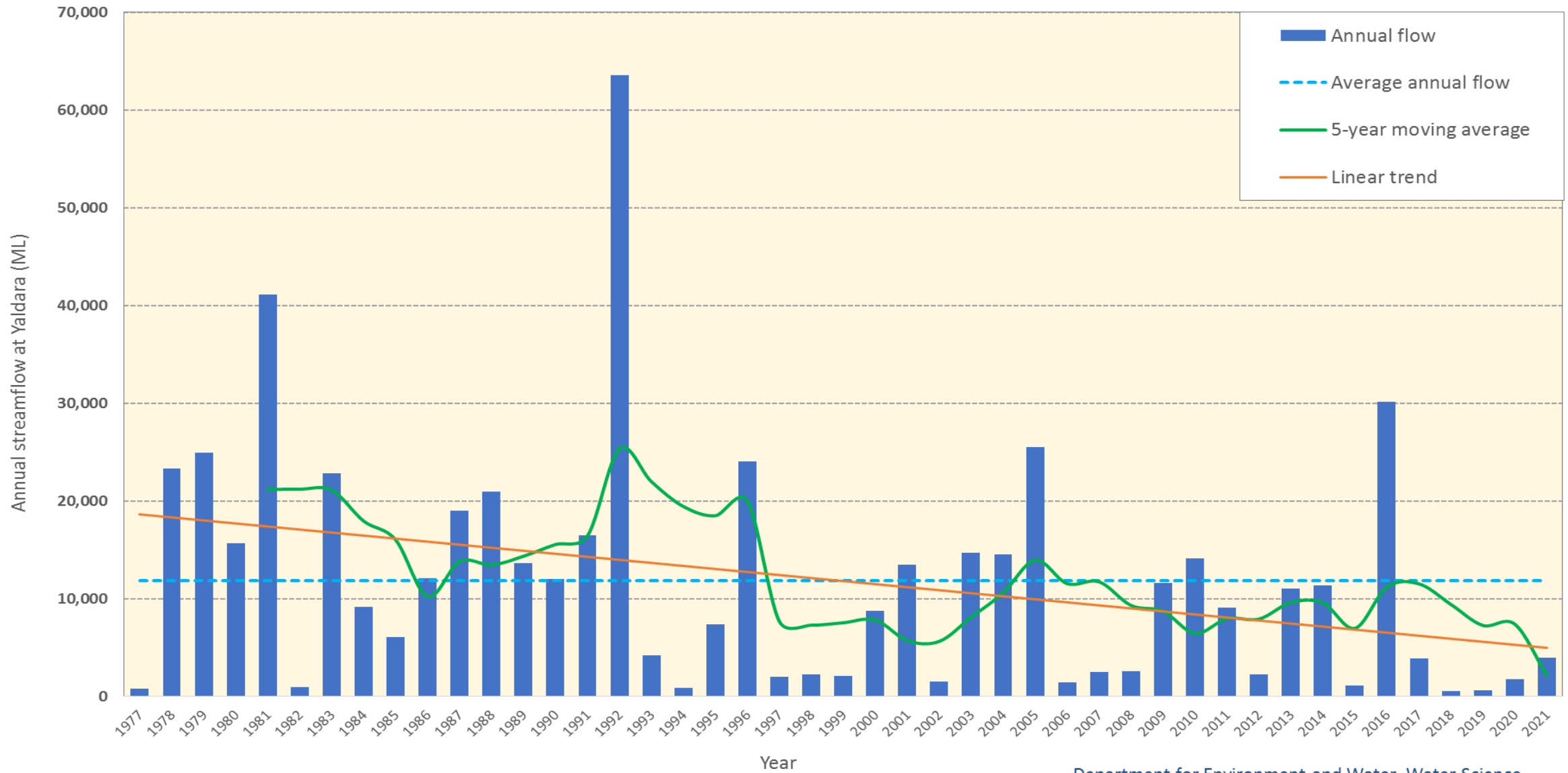
~ Recent observed rainfall consistent with C.C projections trajectory

~ Drier than projected!



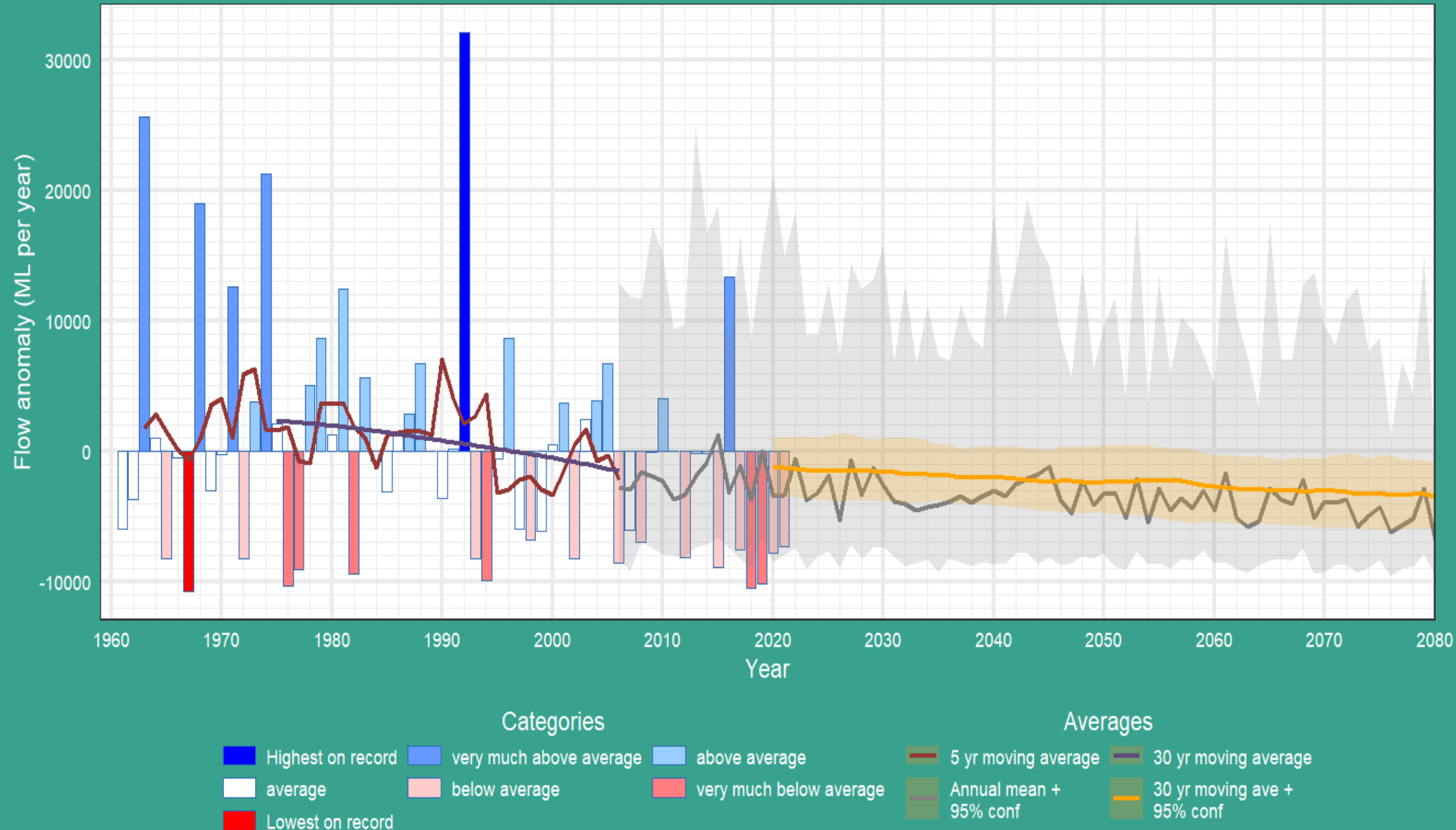
Annual streamflow – Total PWRA

Annual streamflow at Valdara flow monitoring station (1977 - 2021)



Climate change projections – Montazeri M., Savadamuthu K. (DEW 2018)

Annual flow anomaly for site A5050502, with forecast to 2080



- **DEW 2018 Report,**
Streamflow
anomaly

Climate change projections, 30yr moving average

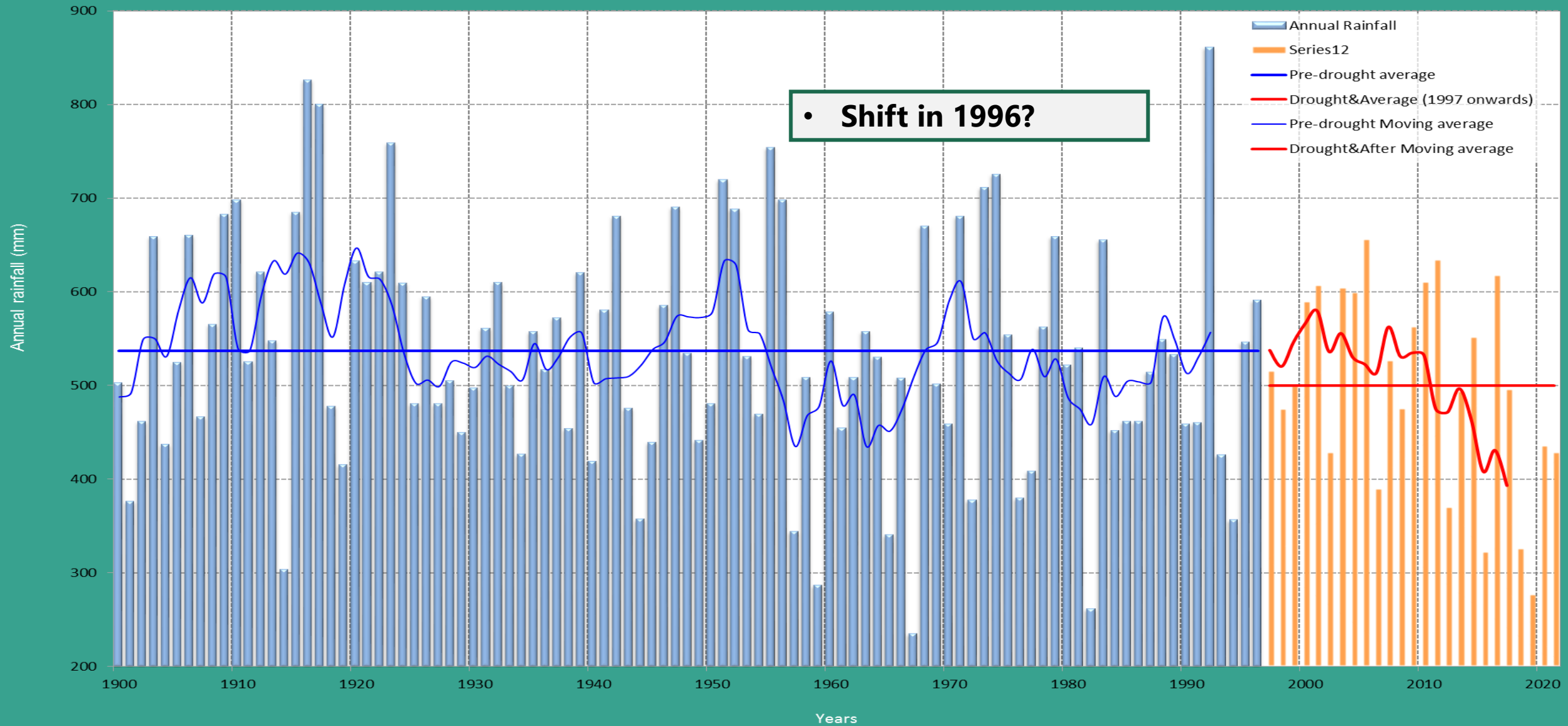
- ~ 2020: +1 to – 3.5GL
- ~ 2030: +1 to - 4.0GL
- ~ 2050: 0 to -5.0GL
- ~ 2080: -1.0 to – 6.0GL

Observed streamflow data included to verify 2016 projections:

- ~ Recent observed flow
consistent with C.C
projections trajectory
- ~ Drier than projected!

Climate Change – Gradual change Vs Shift/Step-change

Long-term annual rainfall at Angaston (A23300) (1900-2021)



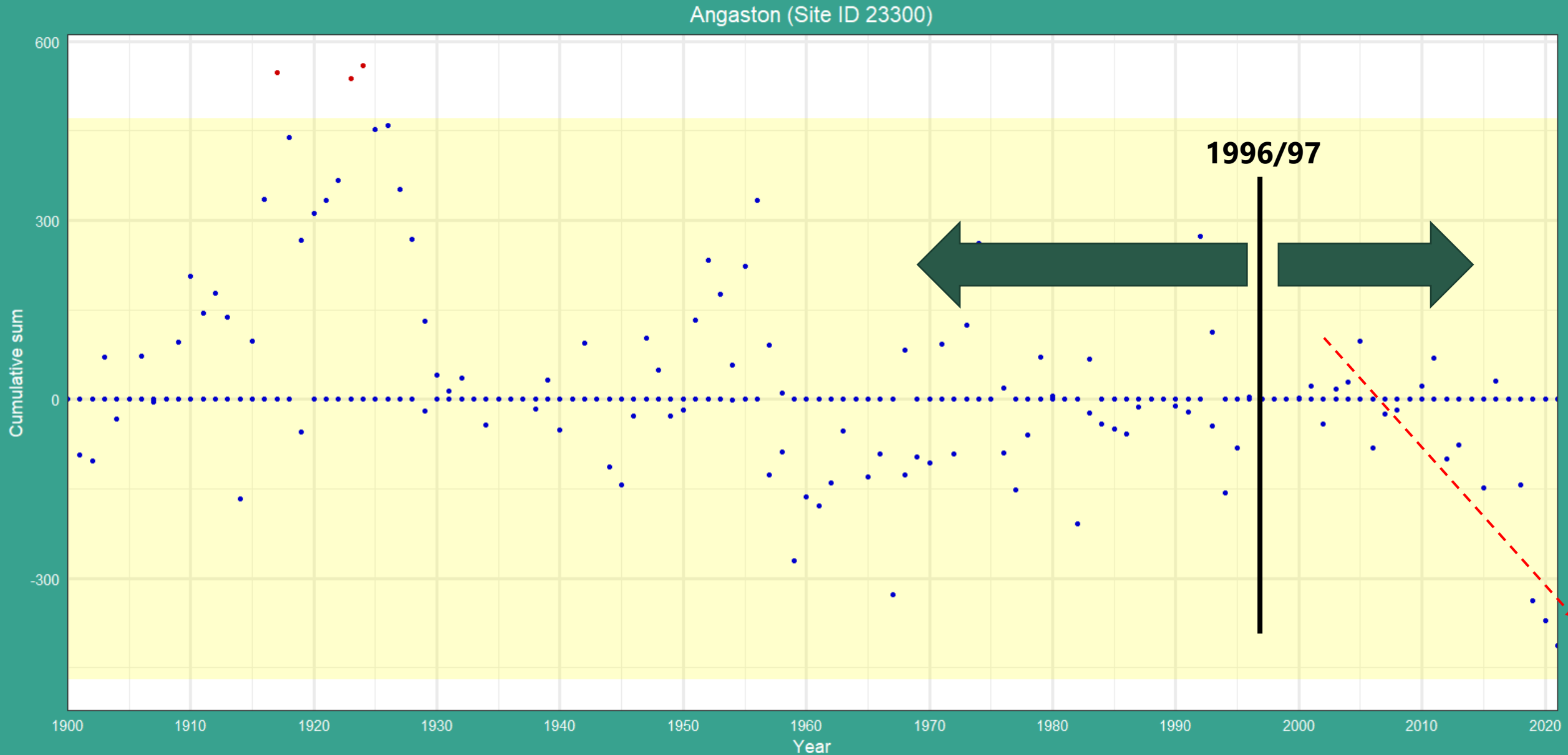
Climate Change – Gradual change Vs Shift/Step-change

The **statistical analyses** conducted on the rainfall and flow data to **identify step-change** include:

- **CUSUM analysis**
 - Plots the cumulative sum of deviations from the mean. Requires user input of parameters to define the shift to be detected, control limits. Sensitive to small shifts in the process mean.
- **Mann-Kendall test**
 - Test for monotonic trends in the data i.e. consistently increasing or decreasing
 - A negative '**tau**' value suggests a decreasing trend and positive for increasing. A **p-value <0.05** suggests a statistically significant trend.
- **Wilcoxon rank sum test/Welch two sample t-test**
 - Compares two separate periods of data for change i.e. pre-drought and post-drought
 - Shows significance if the pre-drought
- **A number of change point detection methods from packages in R, including:**
 - Bayesian changepoint analysis – online method giving a probability of change in the posterior mean over time
 - Breakpoint ('segmented' package) – user specifies number of change points in data, and works out the time(s) of step change

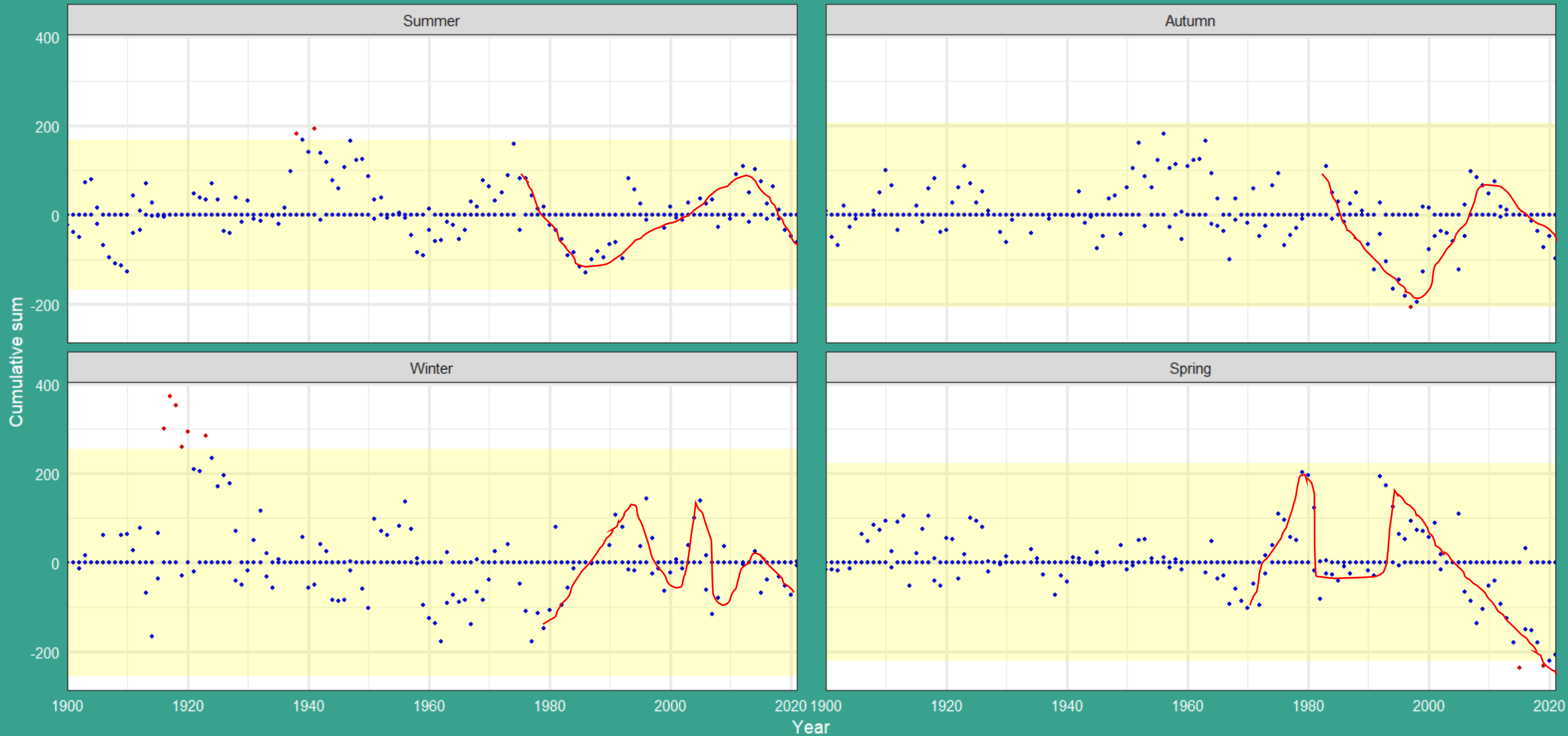
Mann-Kendall Test		
Period	tau	p-val
Annual	-0.12	0.05
Summer	0.00	0.98
Autumn	-0.08	0.21
Winter	-0.06	0.30
Spring	-0.14	0.02
January	-0.03	0.58
February	-0.03	0.60
March	-0.06	0.35
April	-0.02	0.70
May	-0.05	0.39
June	-0.09	0.14
July	0.03	0.68
August	-0.05	0.45
September	-0.07	0.23
October	-0.11	0.07
November	0.00	0.97
December	0.01	0.93

Climate Change – CUSUM method – Shift/Step-change, *Annual*



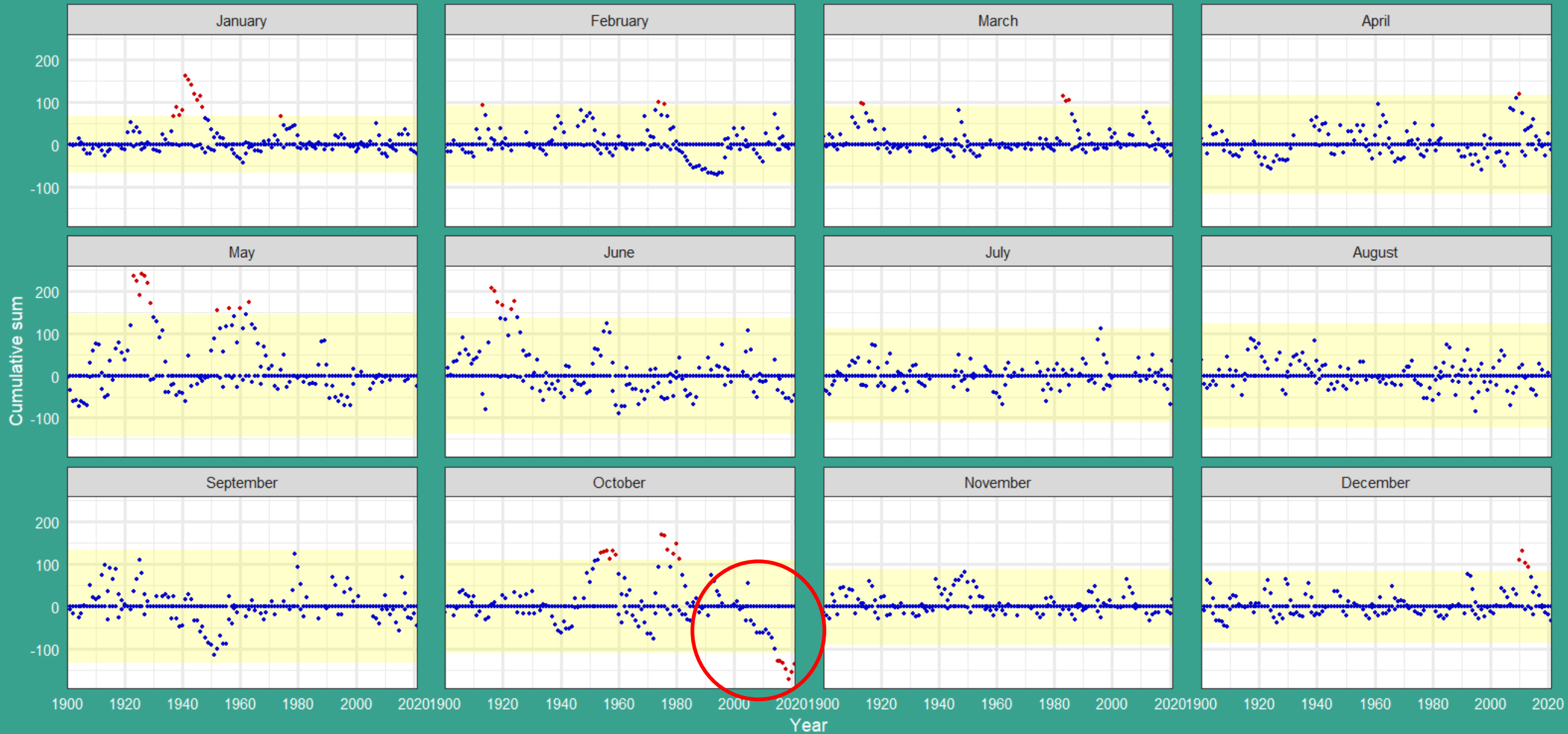
CUSUM method– Shift/Step - *Seasonal*

Angaston (Site ID 23300)



CUSUM method— shift - *Monthly*

Angaston (Site ID 23300)



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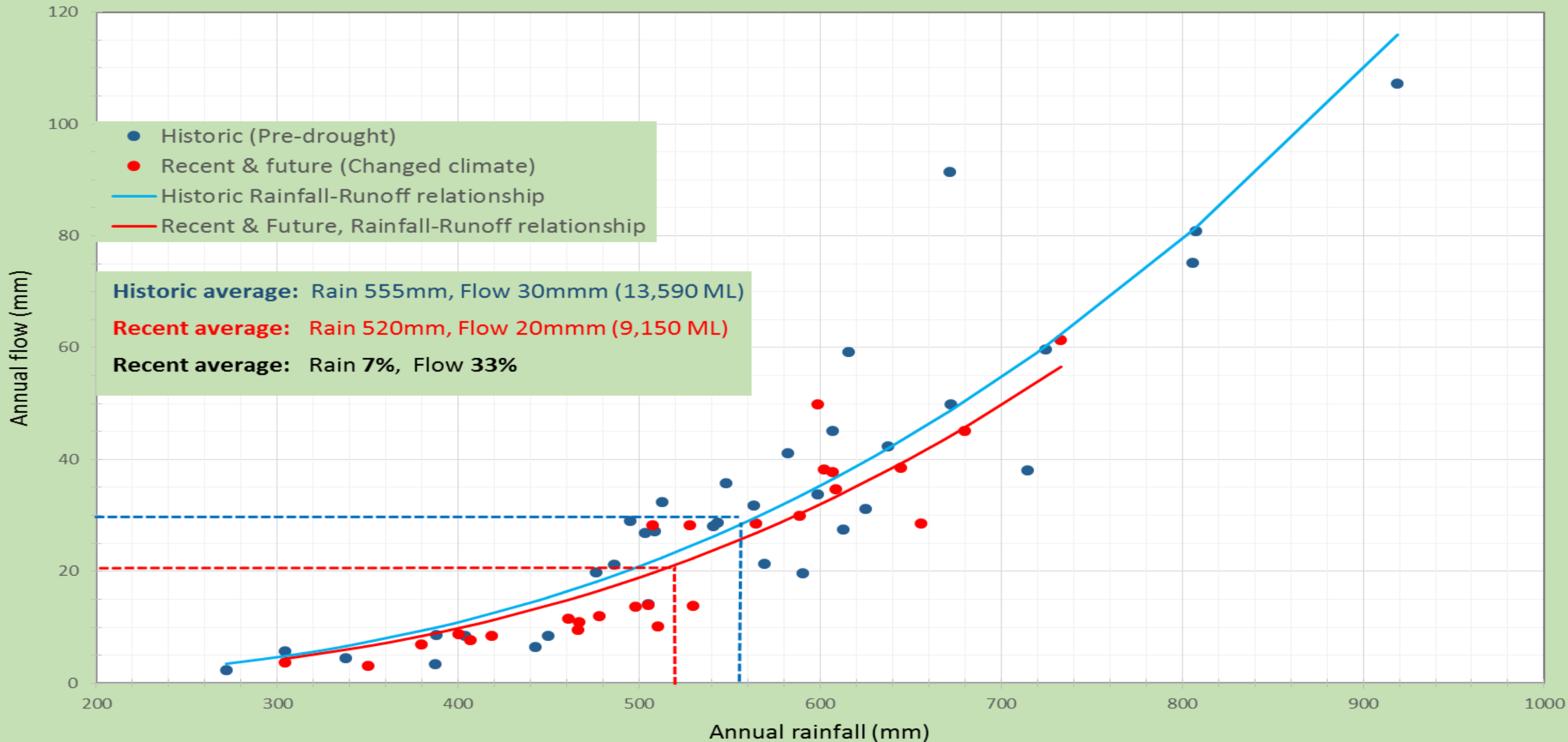
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- Catchment behaviour, Rainfall-Runoff relation

- **Capacity of Water Resource & Env. Sustainable Extraction Limit**

- Vs Current Demand, including ecosystems demand.

Catchment Behaviour, Rainfall – Runoff Relation

Annual rainfall VS Annual flow for Barossa PWRA, Observed data, 1961 to 2021



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- **Capacity of Water Resource & Env. Sustainable Extraction Limit**

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Capacity of surface water resource (RC)

Capacity of surface water resource (size of bucket?)

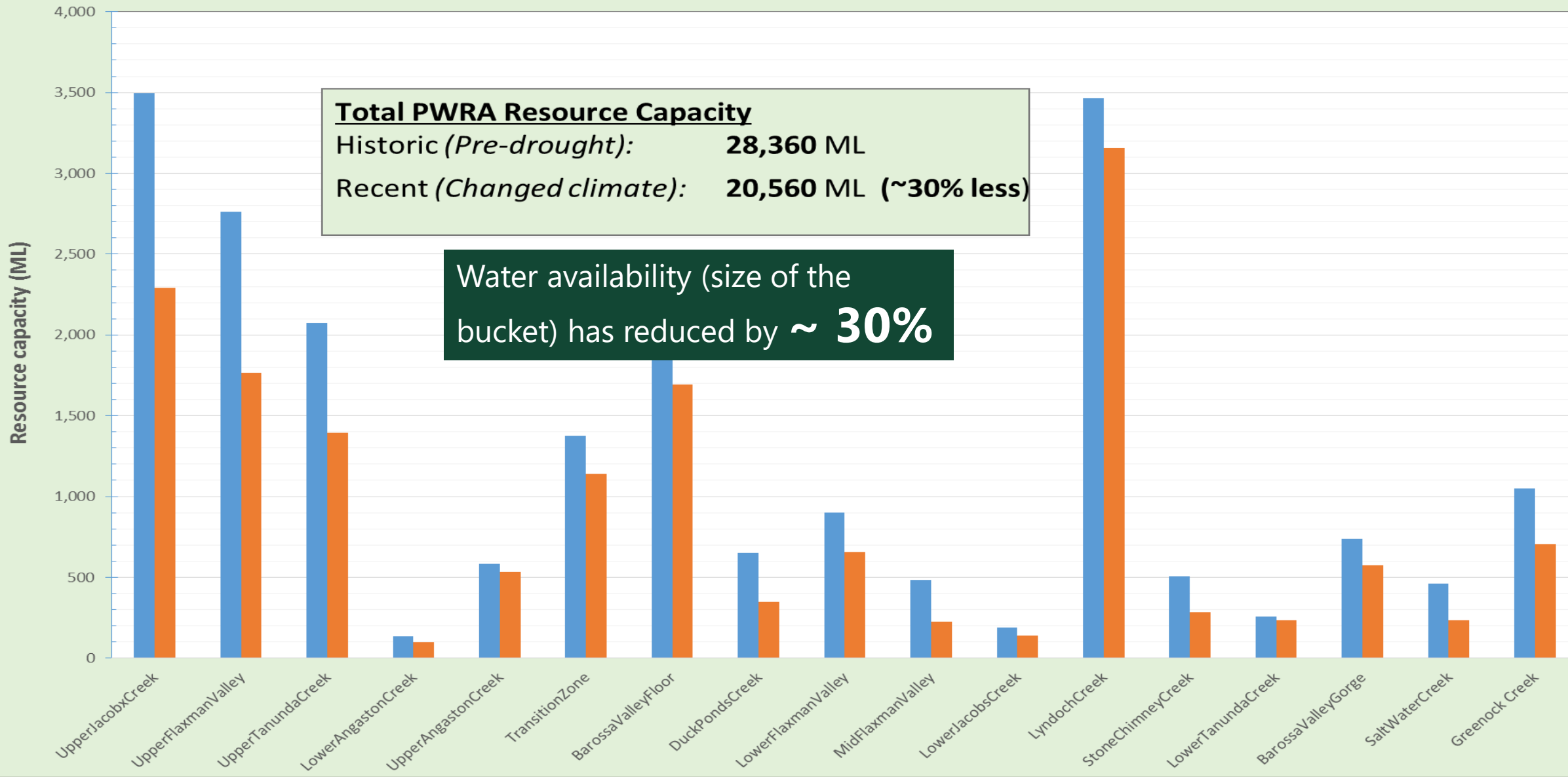
- = Total surface water that would be available if there was no development (capture, extractions, interceptions)
- = Long-term flow/runoff with the impact of devel. removed (modelled)

Environmentally Sustainable Extraction Limits (ESEL)

- WMLR (EMLR) - **5%** no LFR; **25%** (20%) of RC with LFR;
 - *LFR- low flows are released from existing scope dams & WCEs*
 - *Scope dams – Licensed dams: all sizes, S&D dams: >5ML*
- Marne-Saunders - **30%** of Winter RC with LFR

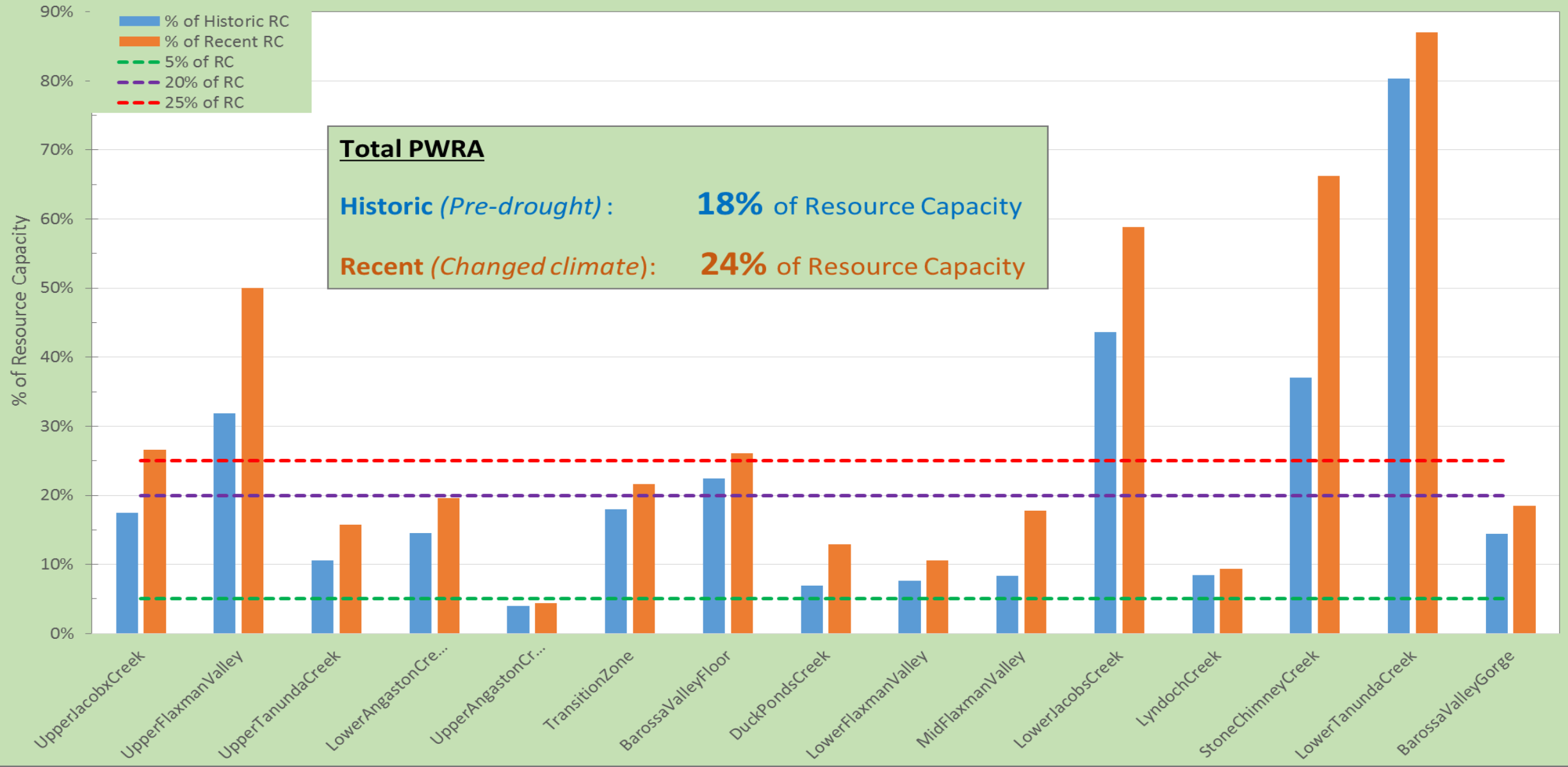
Capacity of surface water resource

Surface Water Resource Capacity of Management zones in Barossa PWRA



Resource capacity VS Allocation (Demand)

Allocated Volume + S&D demand as % of Resource Capacity



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- **Capacity of Water Resource (RC) & Env. Sust. Extraction Limit (ESEL)**
 - Western MLR (EMLR) WAPs **ESEL = 5%** of RC without LFR, **25%(20%)** of RC with LFR
(LFR – Low flow releases from existing Scope dams and watercourse extractions)
 - Barossa PWRA: Current Allocations + S/D Demand in Barossa PWRA
= **18%** of RC_{Historic} & **24%** of RC_{RecentClimate} (NO LFR yet!)

Thanks....



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