Aligning water security policy with increasing drought persistence

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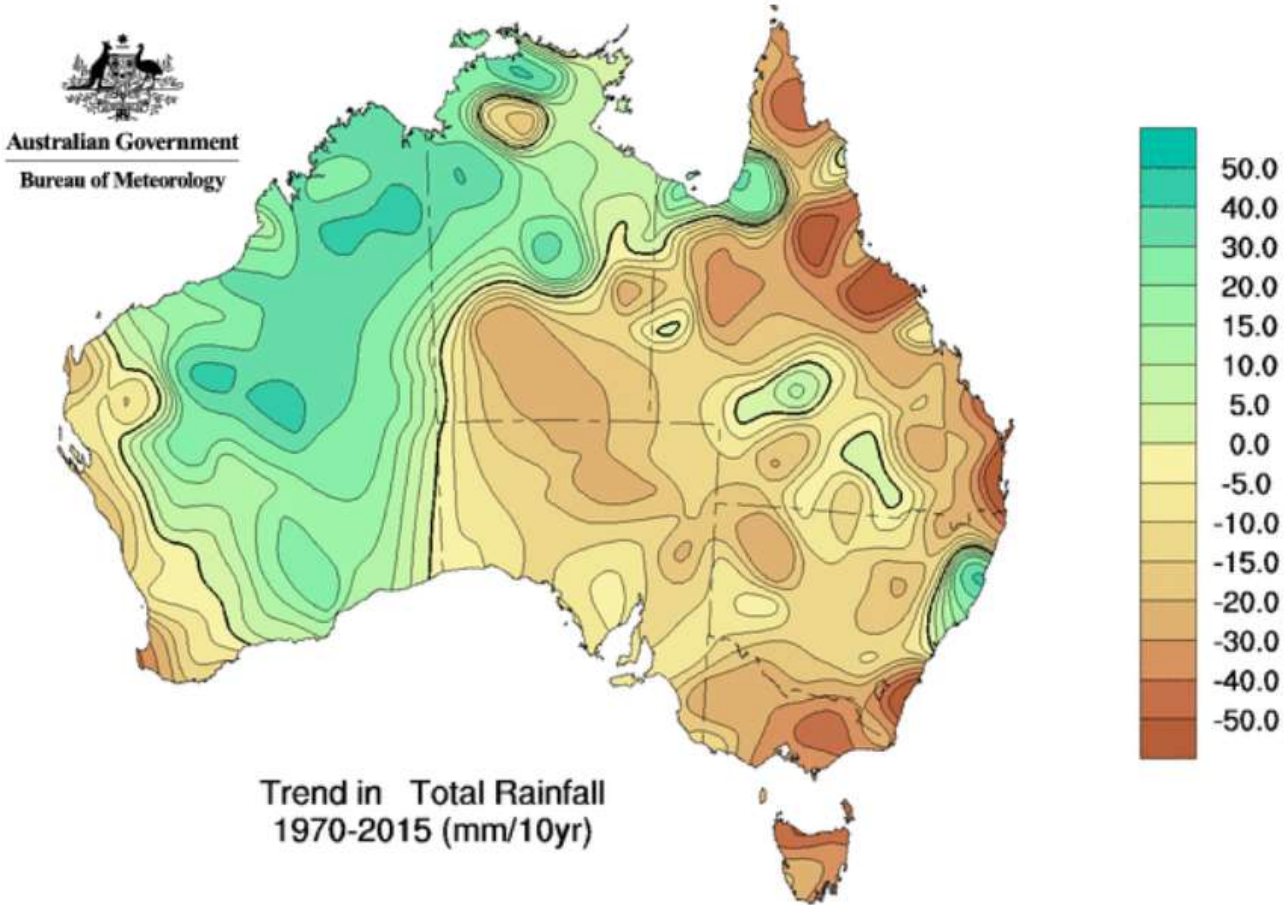
Aligning water security policy with increasing drought persistence

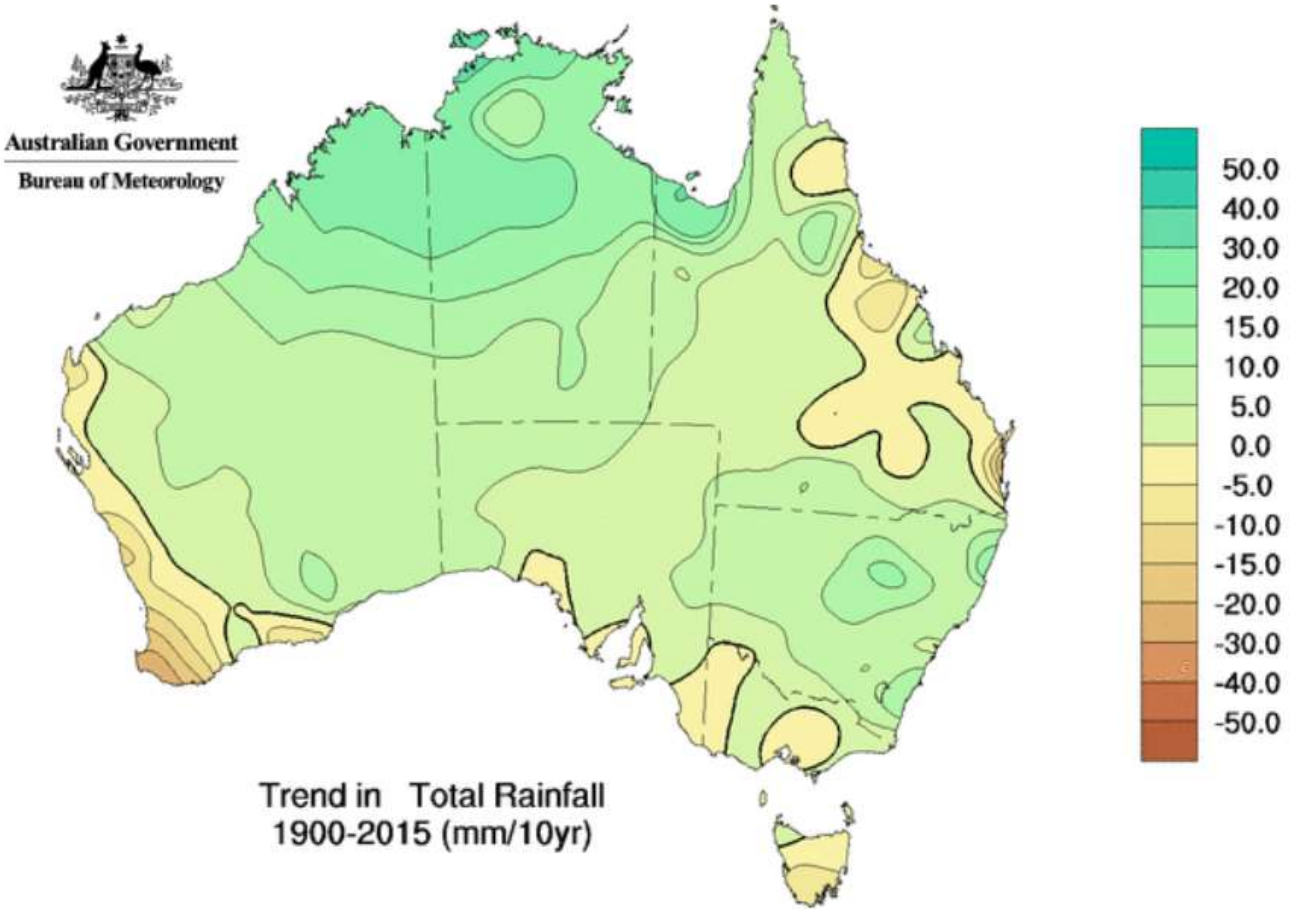
- Rainfall trends
- Regional water supply strategies
- Urban water supply security assessments
- Our climate influences – direct and indirect
- Forecasting east and west across the Pacific
- Some questions

Rainfall trend over 45 years



Reference: Bureau of Meteorology. (2017) Climate Change and variability.
From: http://www.bom.gov.au/climate/change

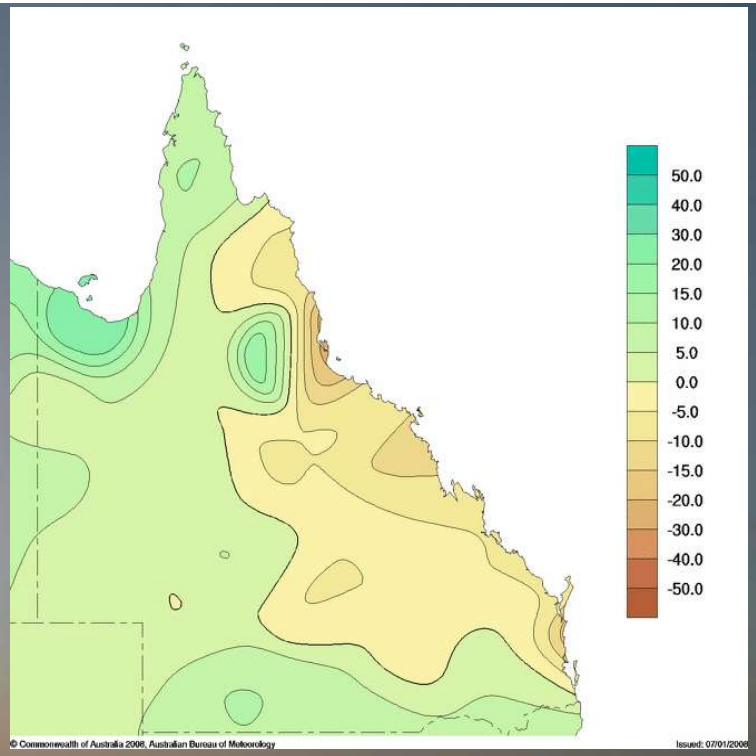
Rainfall trend over 85 years



Reference: Bureau of Meteorology. (2017) Climate Change and variability.
From: http://www.bom.gov.au/climate/change

Climate variability & change for NW Qld

- Dry season April to November.
- Wet season December to March.
- Very variable rainfall with spatial challenges for water availability.
- Average evaporation 2200 - 3000 mm/a
- Average rainfall 400 – 800 mm/a
- Future climate:
  - Slightly higher summer rainfall
  - Increased temperature
  - Increased evaporation
  - Increased number of hot days (above 35°C)
  - Drier on the east coast

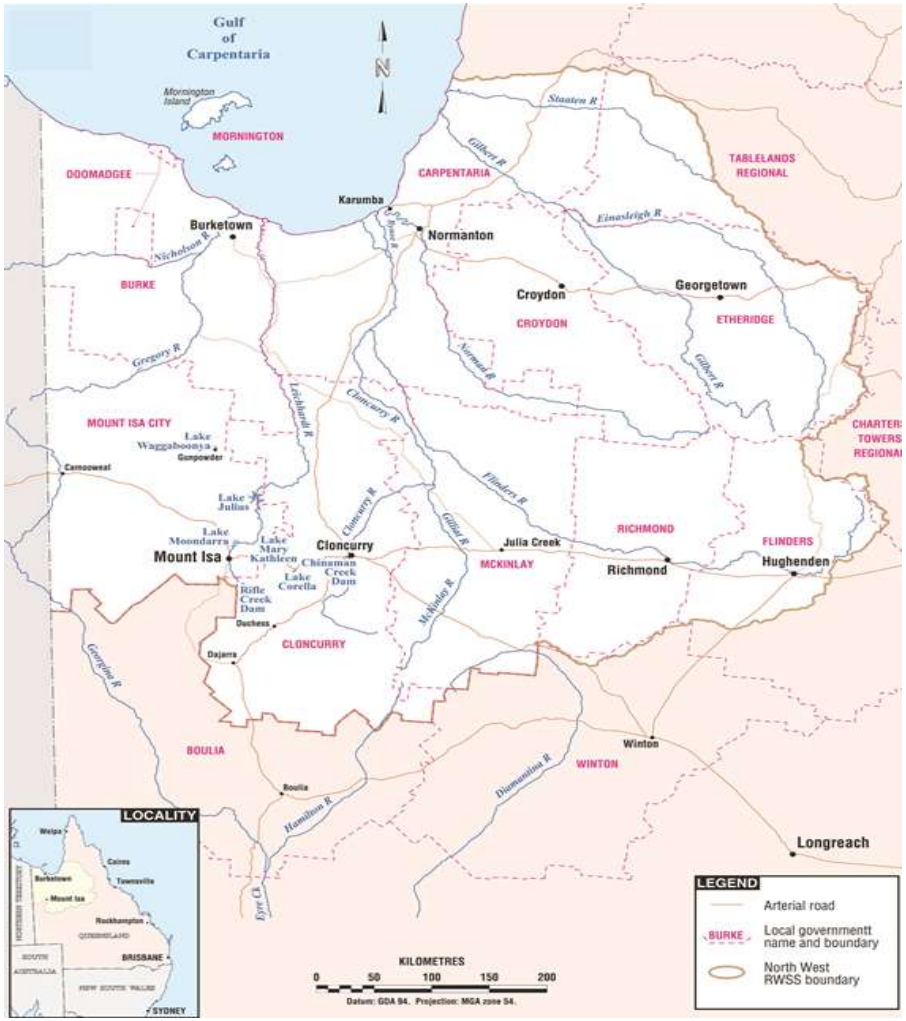


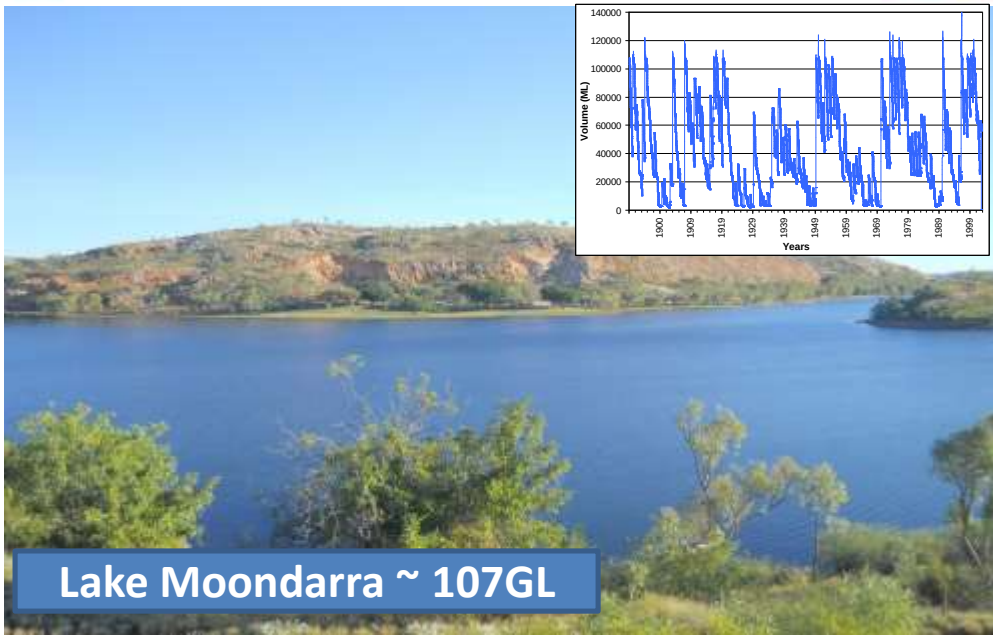
Reference: Bureau of Meteorology. (2017) Climate Change and variability.
From: http://www.bom.gov.au/climate/change

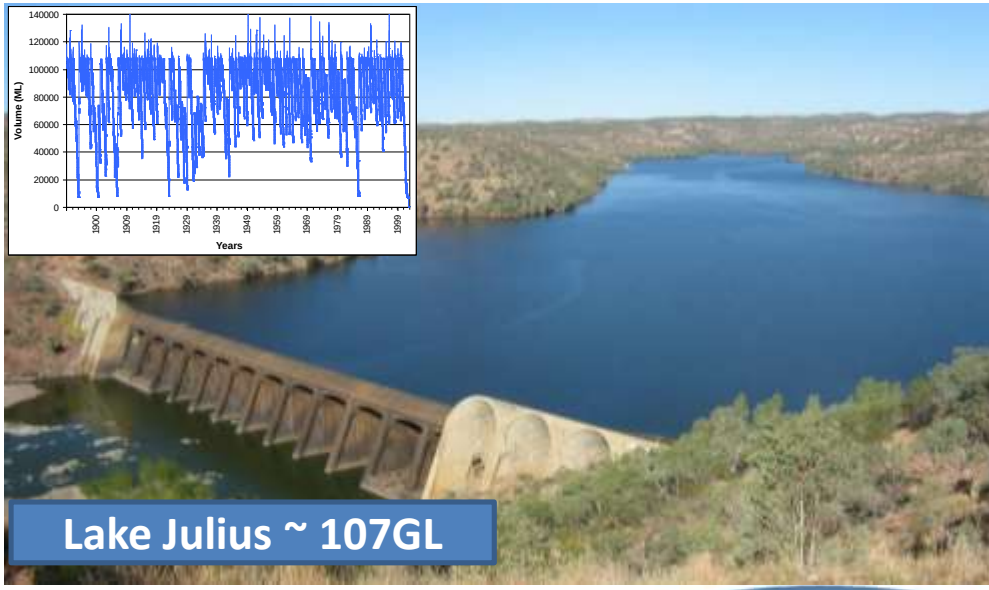
Regional water supply strategies

- Provide a long term, whole-of-region strategy for utilising the regions water resources to best meet future mining, agricultural and urban needs.
- Outline water supply risks and recommendations to address the identified water supply risks.
- A plan for drought and growth.

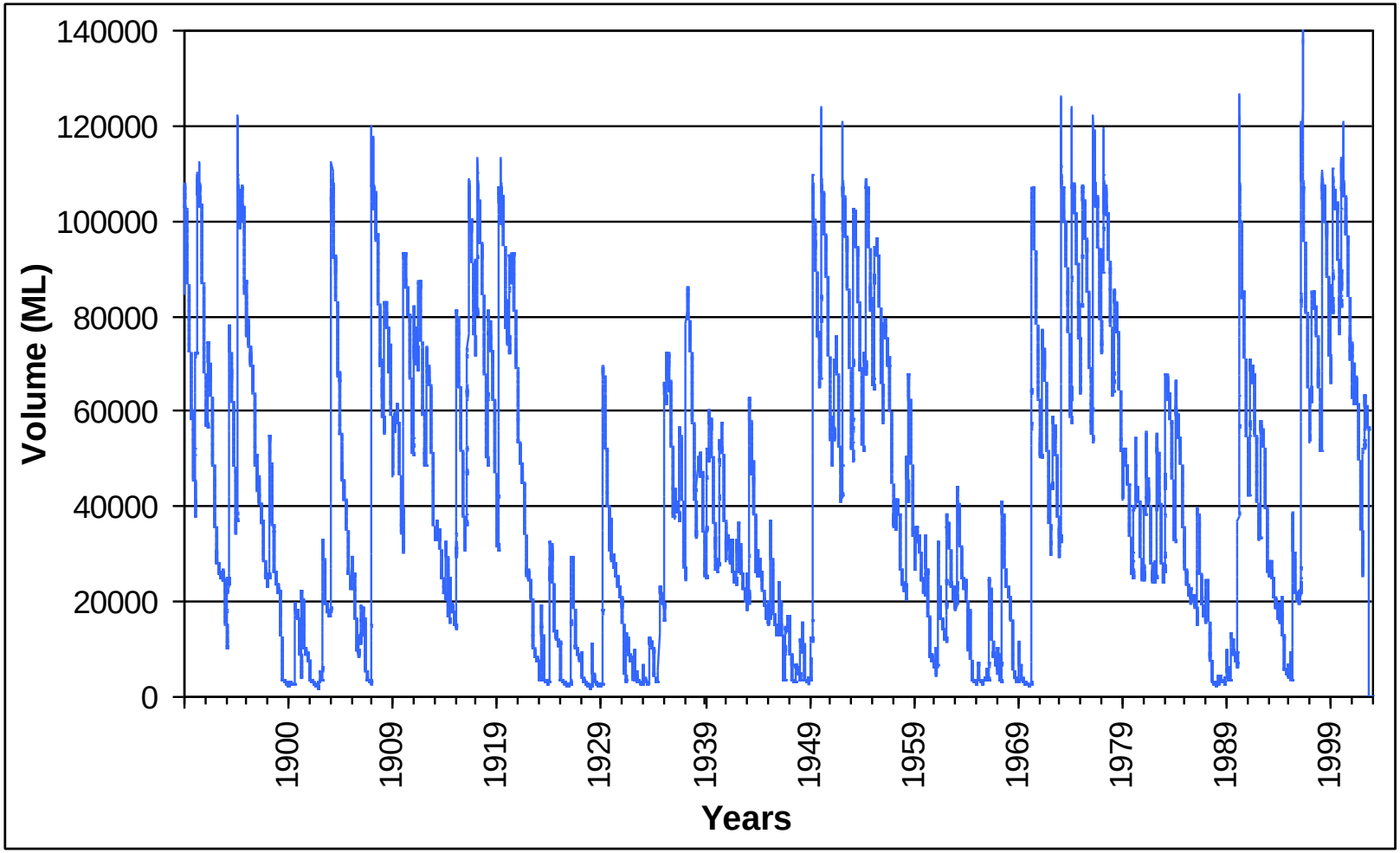
Water availability



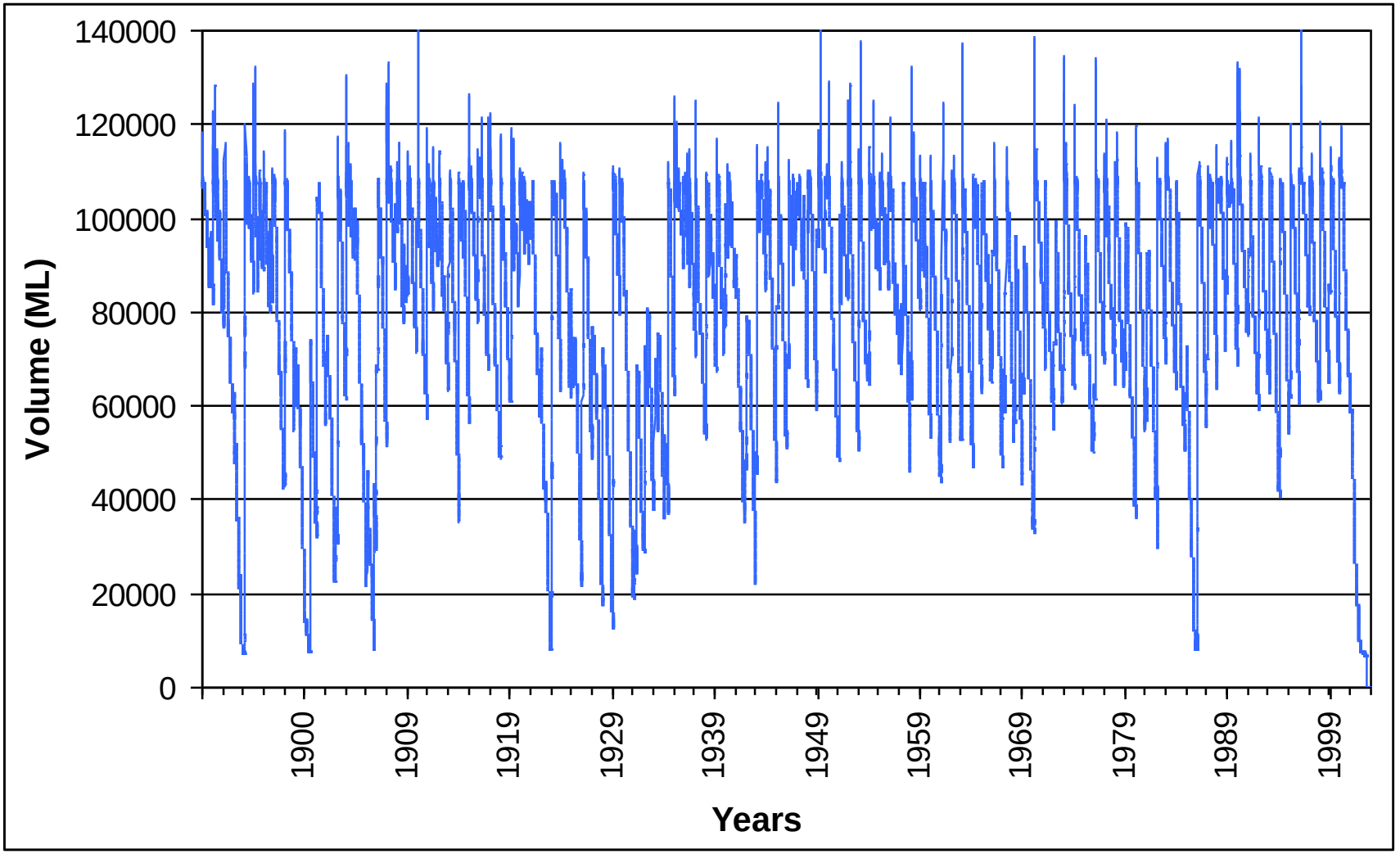




Storage in the upper reaches of the catchment



Storage in the lower reaches of the catchment

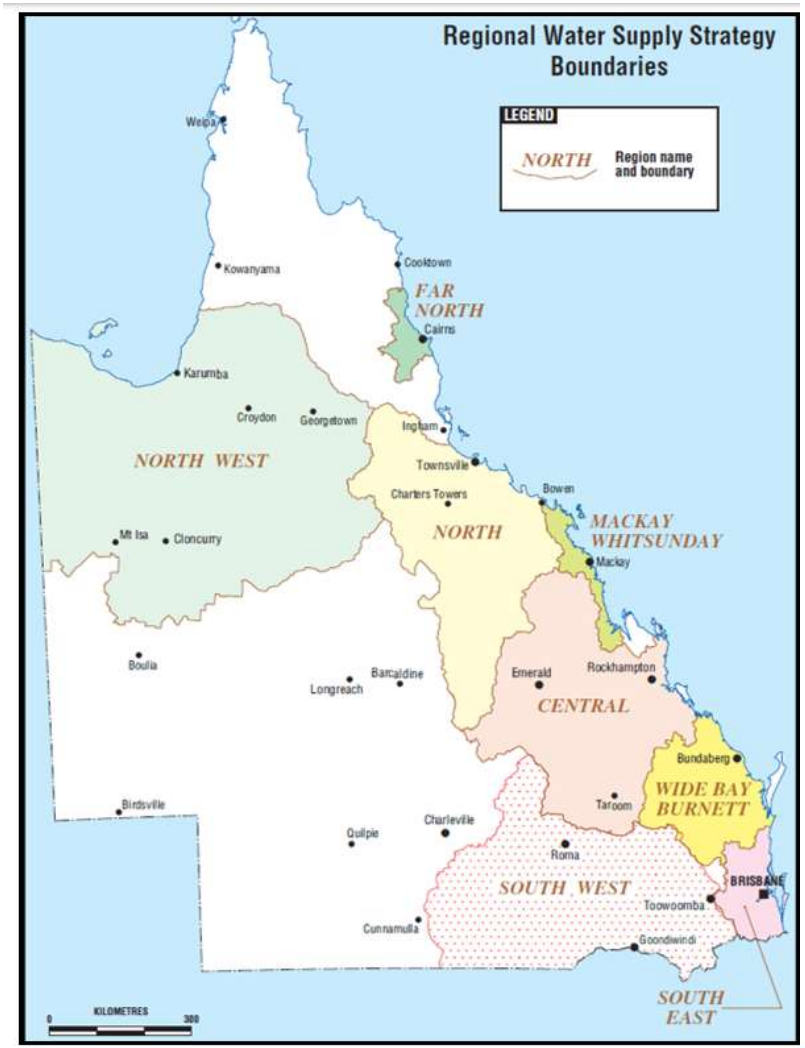


Regional water use litres/person/day

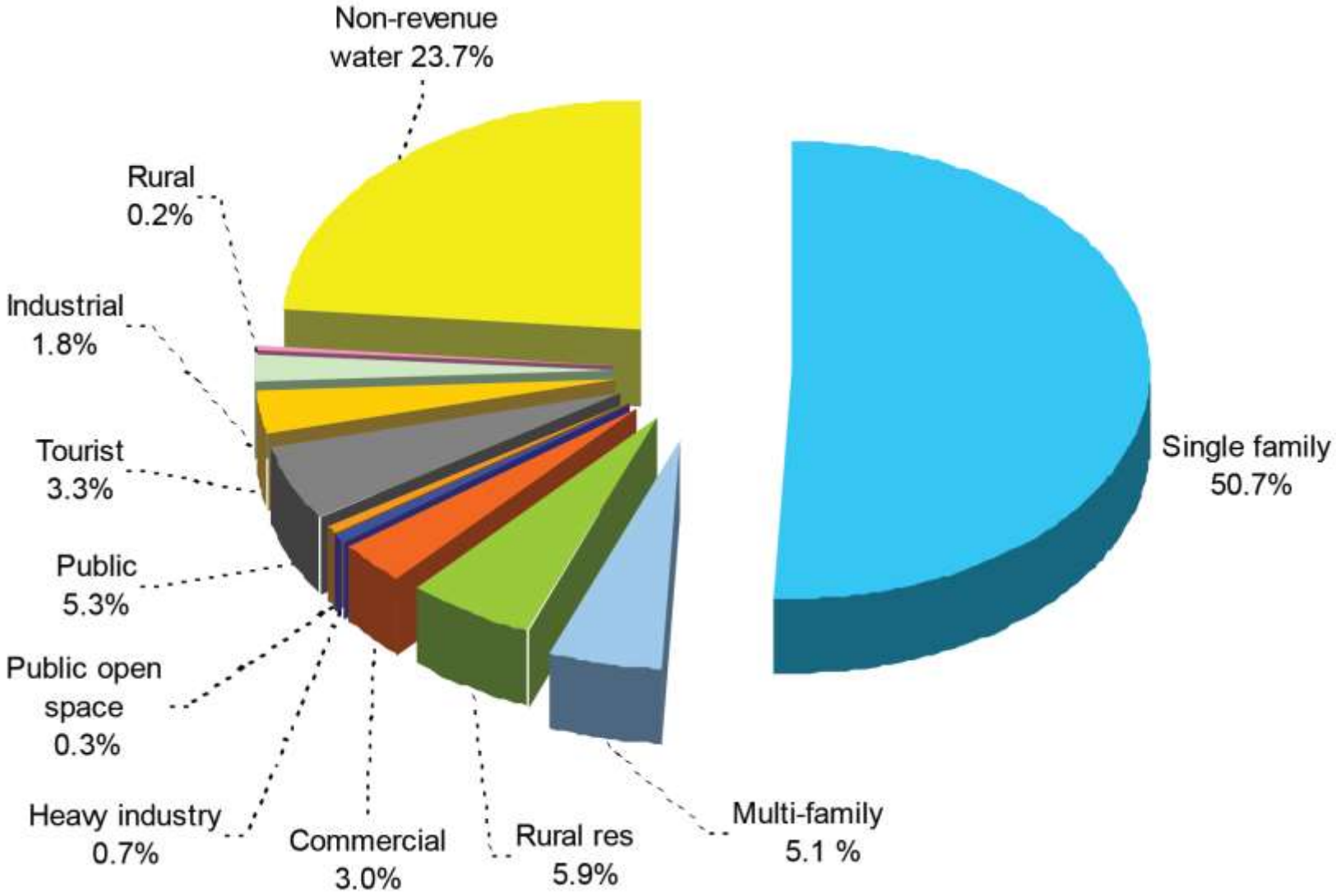






Urban water consumption by sector



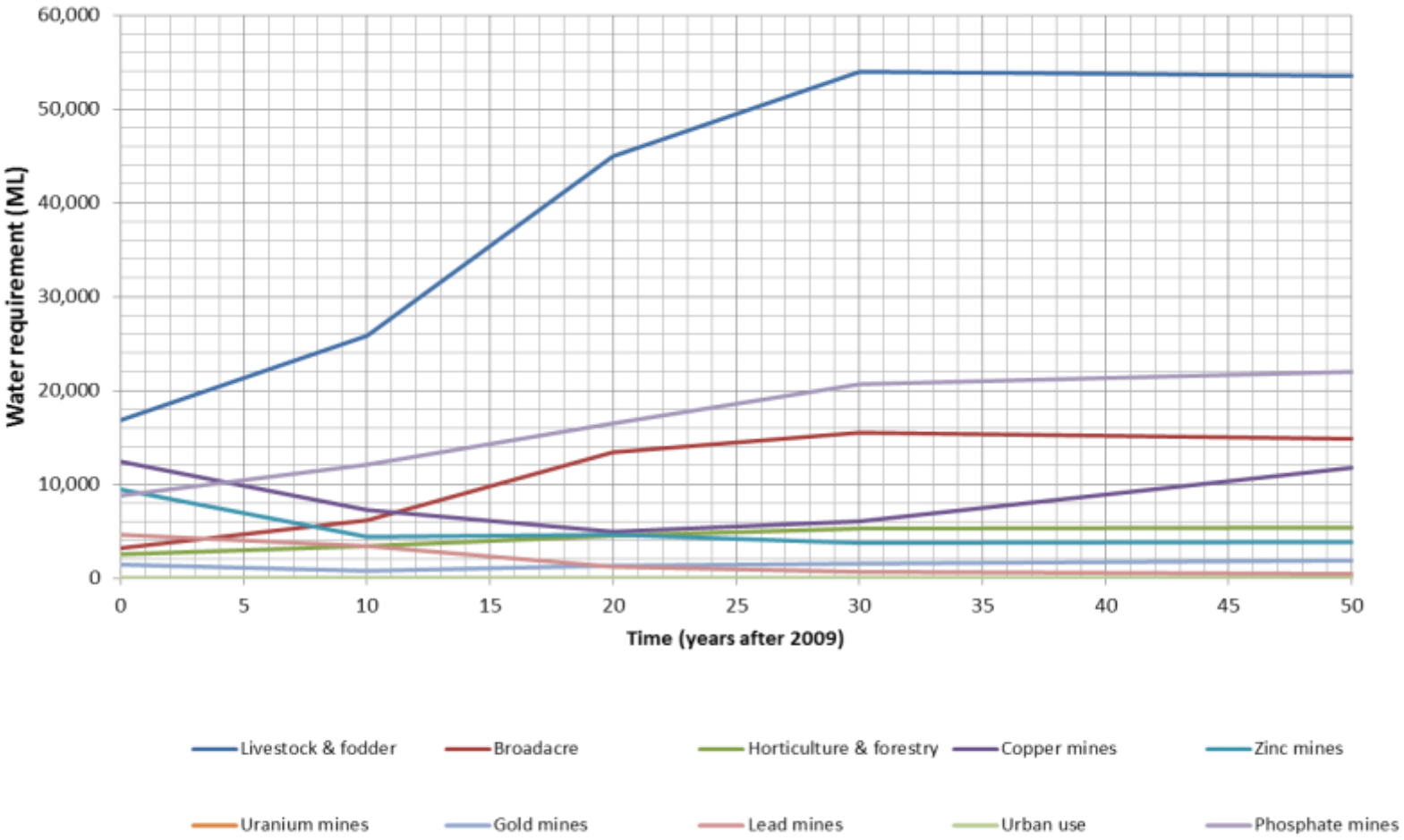
Non-urban water demand

Silver Hills irrigation

Lake Moondarra

Ernest Henry mine storage

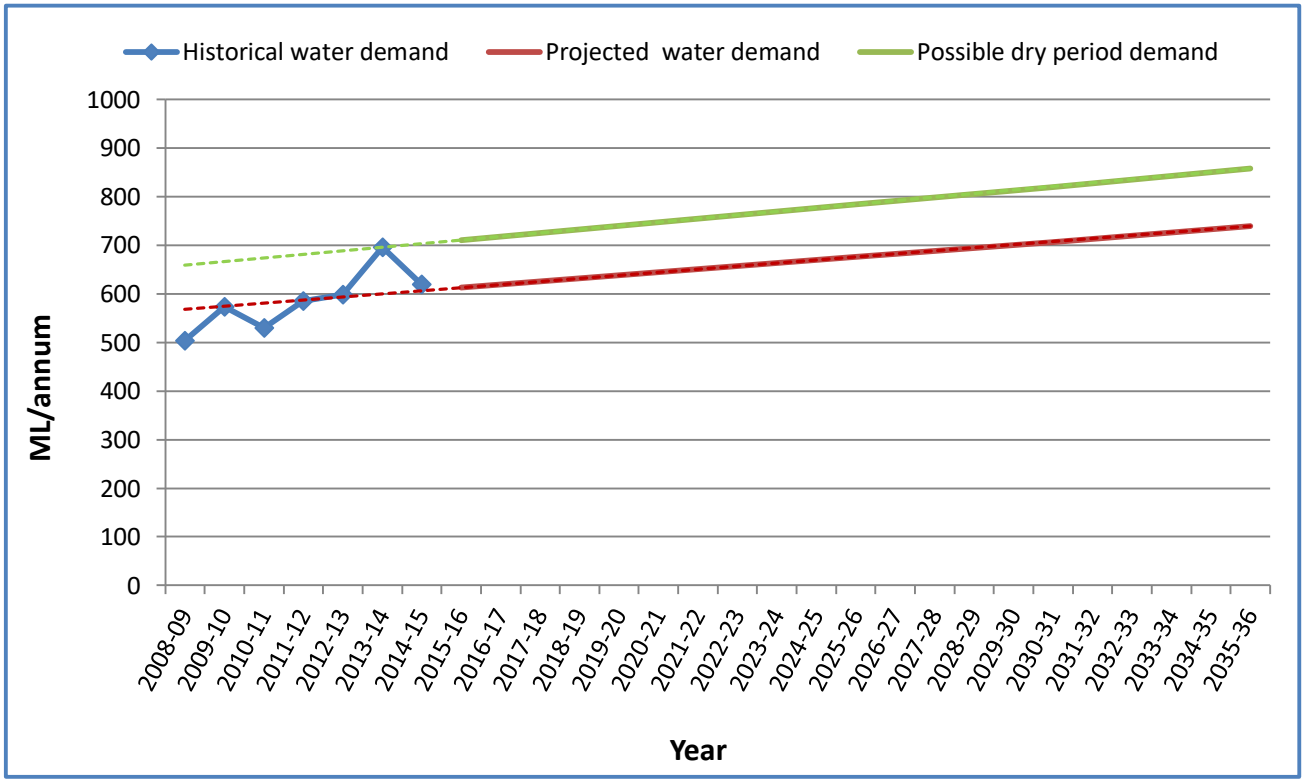
Non-urban water demand: most likely



Urban water supply security assessments

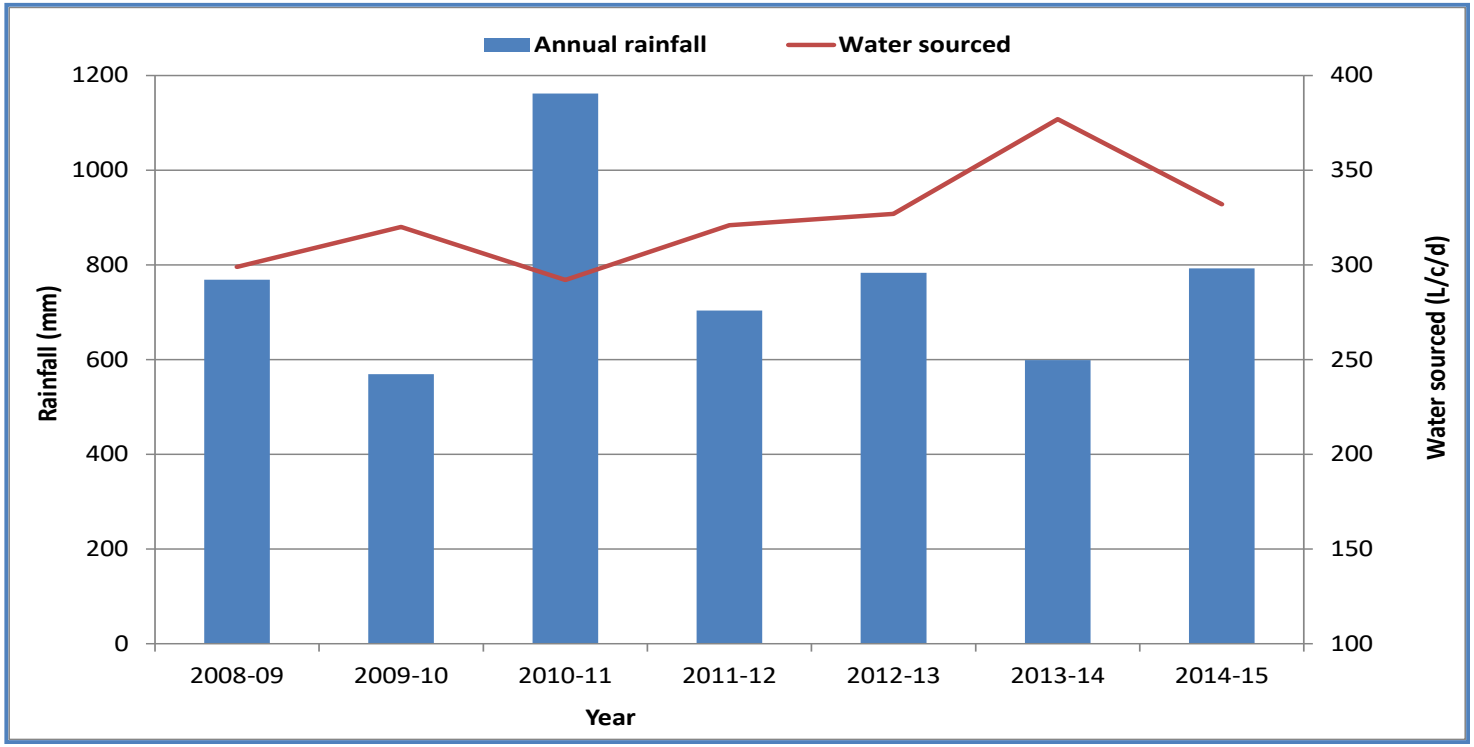
- Assessment of:
  - capability of current water supply system to meet current and future demands through assessing the likely frequency and severity (magnitude and duration) of future water supply shortfalls due to growth and drought
  - when timely augmentations should be constructed

Projected water demand on a small storage by a small urban centre



Reference: Department of Energy and Water Supply. (2017) Stanthorpe regional water supply security assessment. © State of Queensland, 2016.
From: https://www.dews.qld.gov.au/__data/assets/pdf_file/0006/819564/stanthorpe-rwssa.pdf.

Total annual rainfall vs total water sourced



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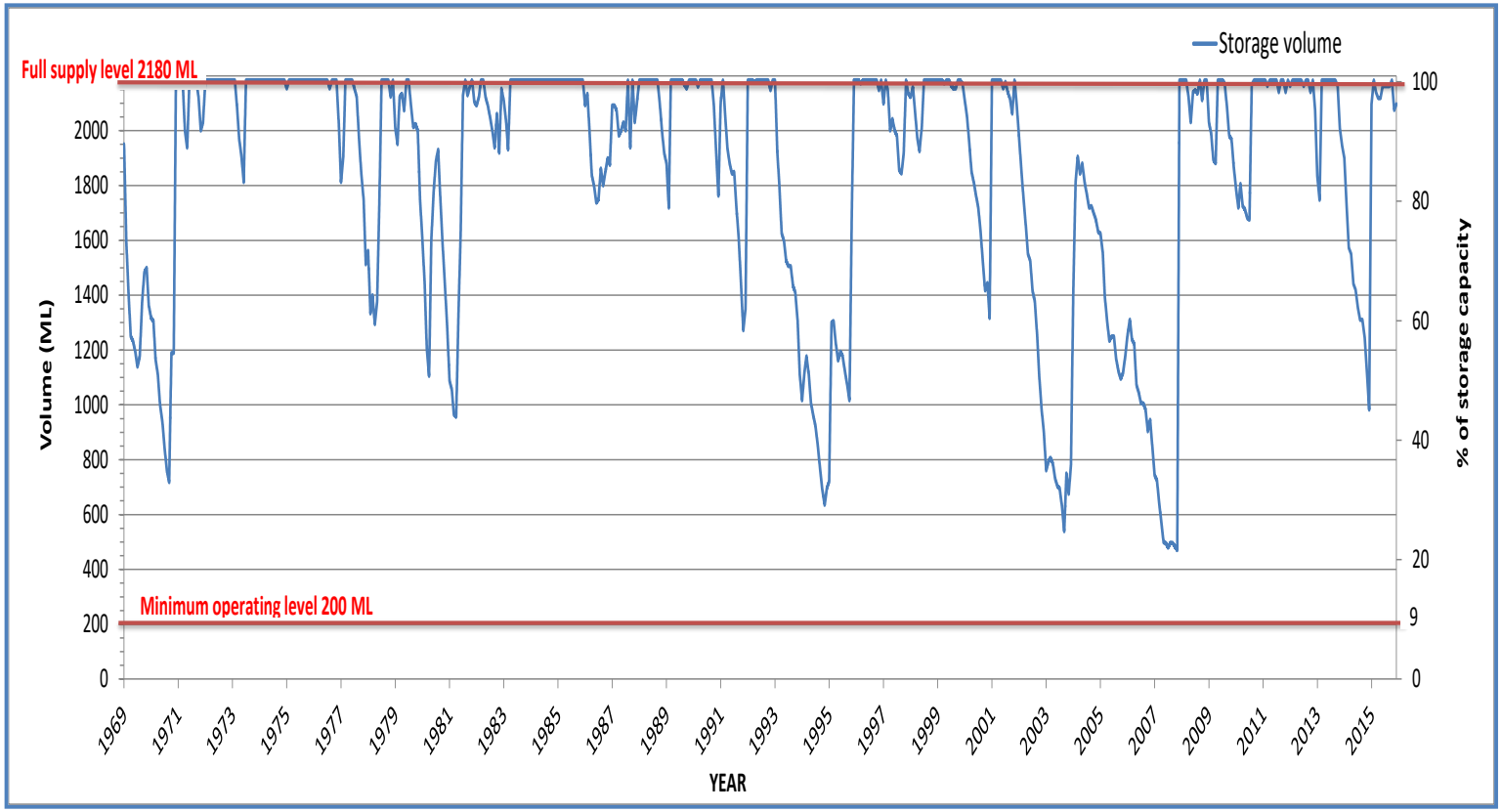
Recorded storage behaviour from 1969 to 2015 showing trend in drought frequency and severity



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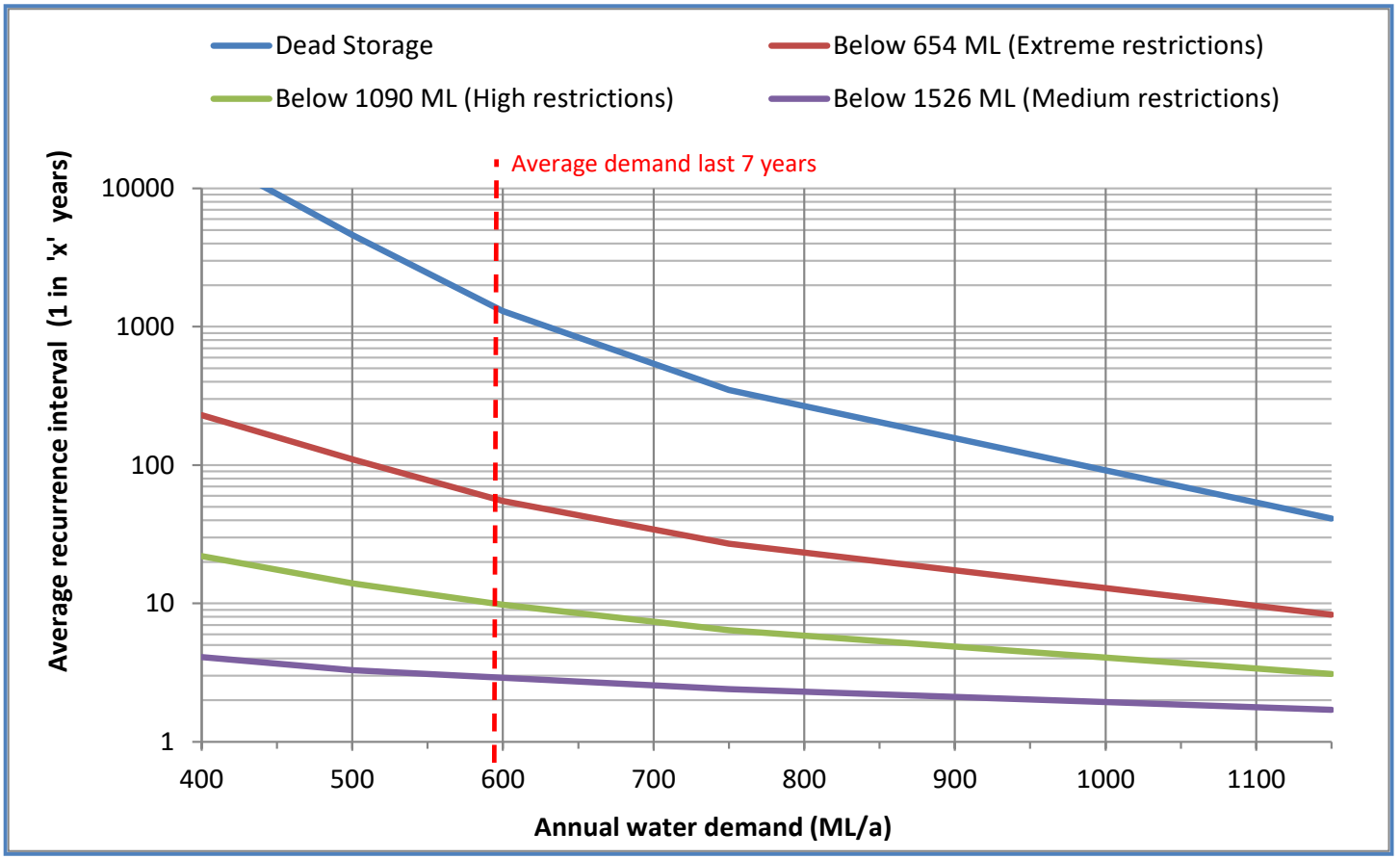
Water restriction levels for a small urban centre

Restriction level	Supply trigger levels (% of full supply volume)	Targeted maximum daily residential consumption (L/p/day)
Permanent	75% and above	230
Medium	70% (or below). Relaxed when volume increases to 75%	200
High	50% (or below). Relaxed when volume increases to 55%	170
Extreme	30% (or below). Relaxed when volume increases to 35%	140

Reference: Department of Energy and Water Supply. (2017) Stanthorpe regional water supply security assessment. © State of Queensland, 2016.
From: https://www.dews.qld.gov.au/__data/assets/pdf_file/0006/819564/stanthorpe-rwssa.pdf.

Water restriction frequency versus annual demand



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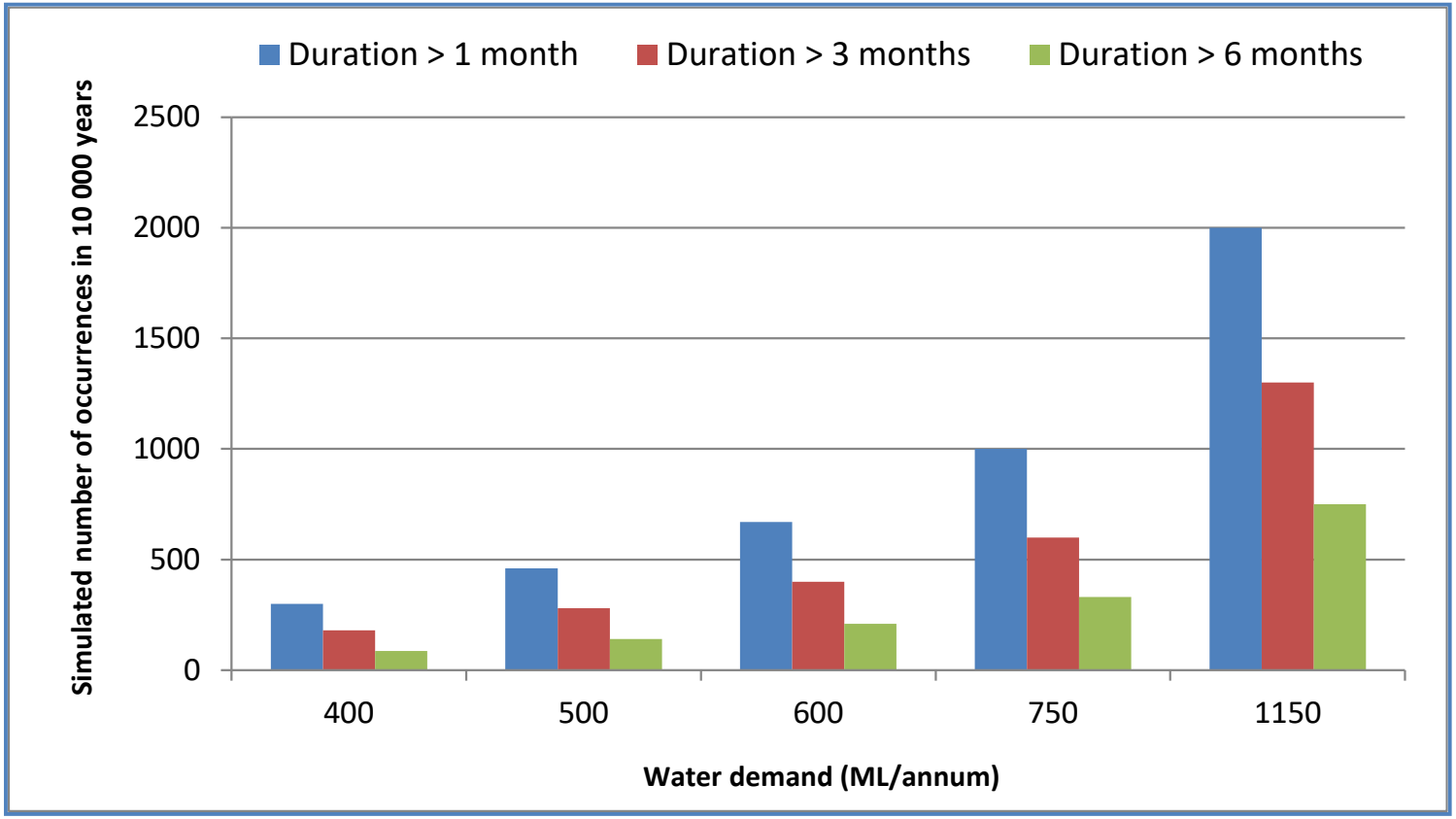
Number and duration of high level water restriction events occurring at various annual water demands



Reference: Department of Energy and Water Supply. (2017) Stanthorpe regional water supply security assessment. © State of Queensland, 2016.
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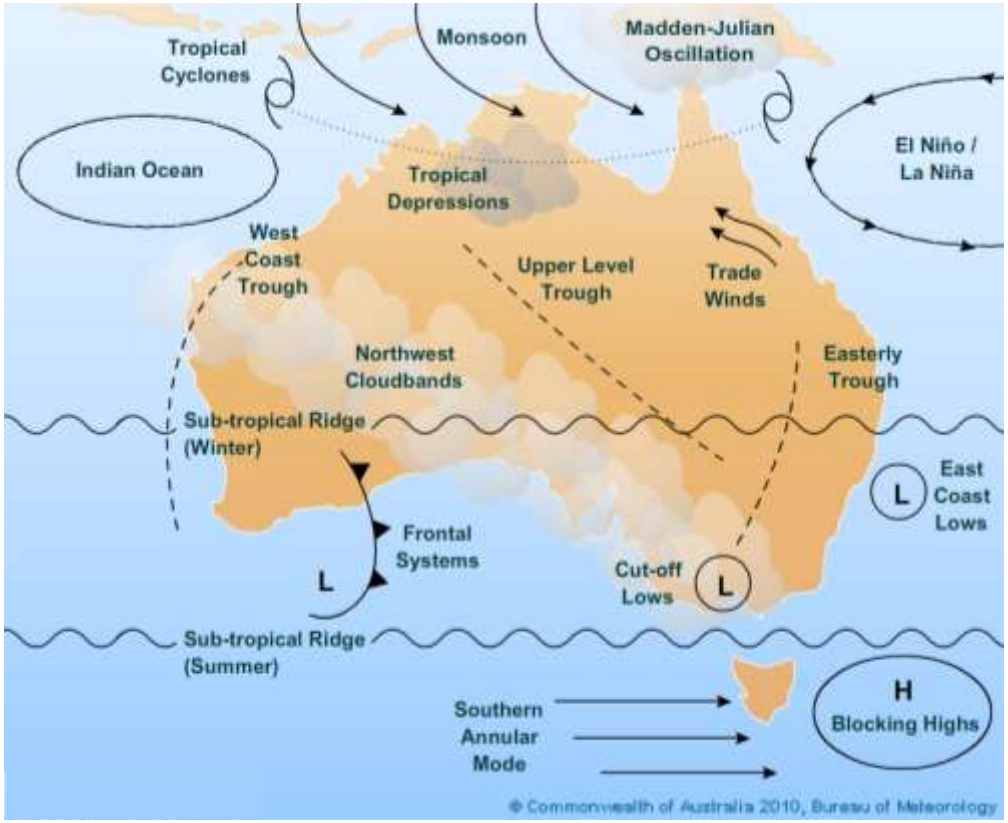
Australian climate influences

Warmer Indian Ocean sea surface temperatures near Australia (known as a negative Indian Ocean Dipole) may enhance Australia's rainfall.

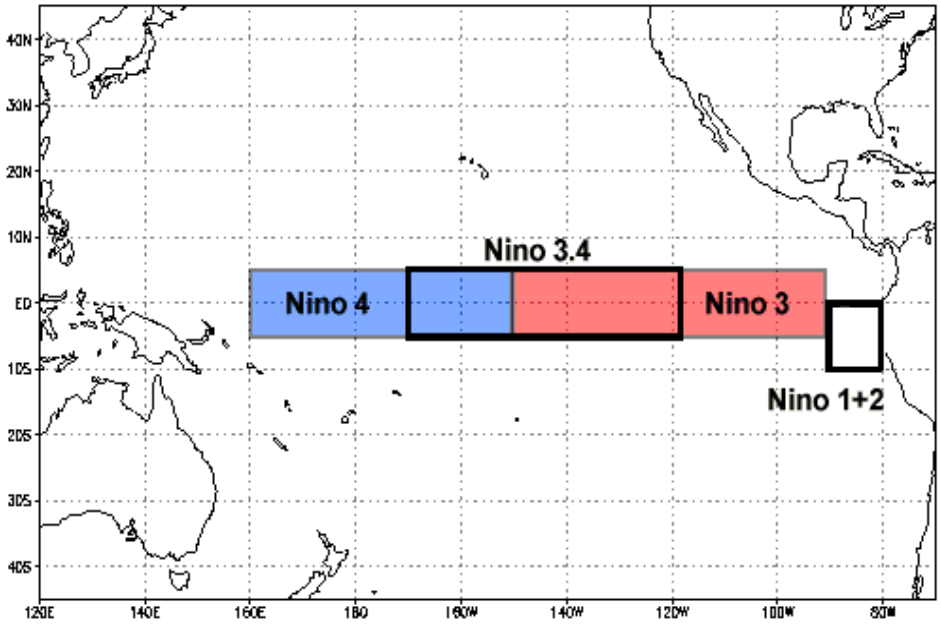


El Niño conditions (extensive warming of the central and eastern tropical Pacific Ocean) generally result in below average rainfall over much of eastern Australia.

Transitions from active to inactive phases of the Australian monsoon may be associated with the Madden-Julian Oscillation.

Reference: Bureau of Meteorology. (2017) Australian Climate Influences.
From: http://www.bom.gov.au/watl/about-weather-and-climate/australian-climate-influences.shtml

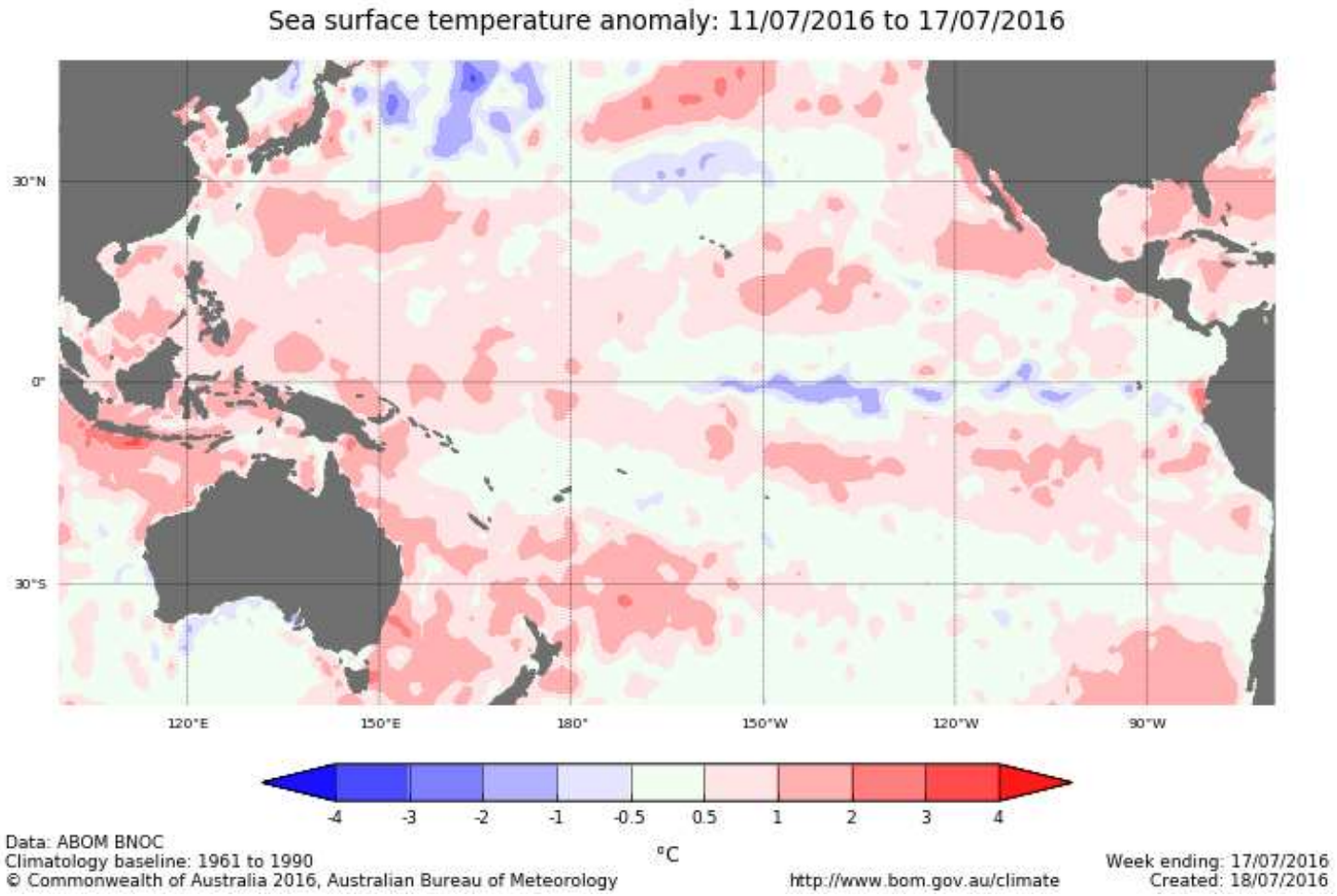
El Niño (La Niña) is a phenomenon in the equatorial Pacific Ocean characterized by a five consecutive 3-month running mean of sea surface temperature anomalies in the Niño 3.4 region that is above (below) the threshold of +0.5°C (-0.5°C). This measure is known as the Oceanic Niño Index.



The **Southern Oscillation Index** (SOI) is a measure of the intensity or strength of the Walker Circulation. It is one of the key atmospheric indices for gauging the strength of El Niño (negative) and La Niña (positive) events and their potential impacts on the Australian region. The SOI measures the difference in surface air pressure between Tahiti and Darwin.

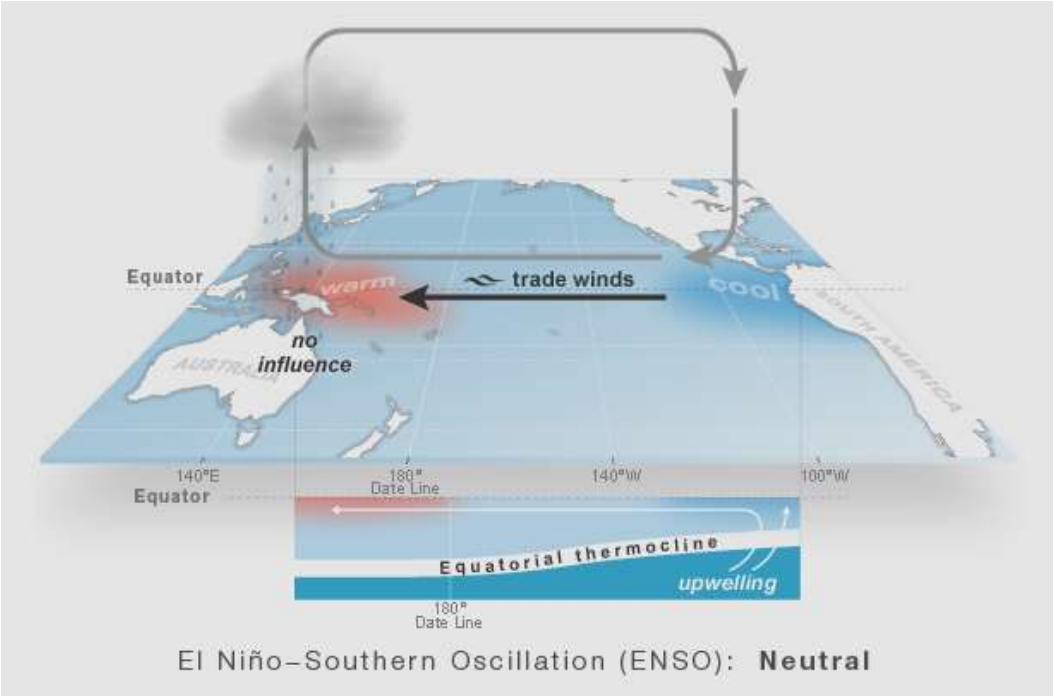
Reference: National Oceanic and Atmospheric Administration (NOAA). (2017) Equatorial Pacific Surface Temperatures and Southern Oscillation Index. From: https://www.ncdc.noaa.gov

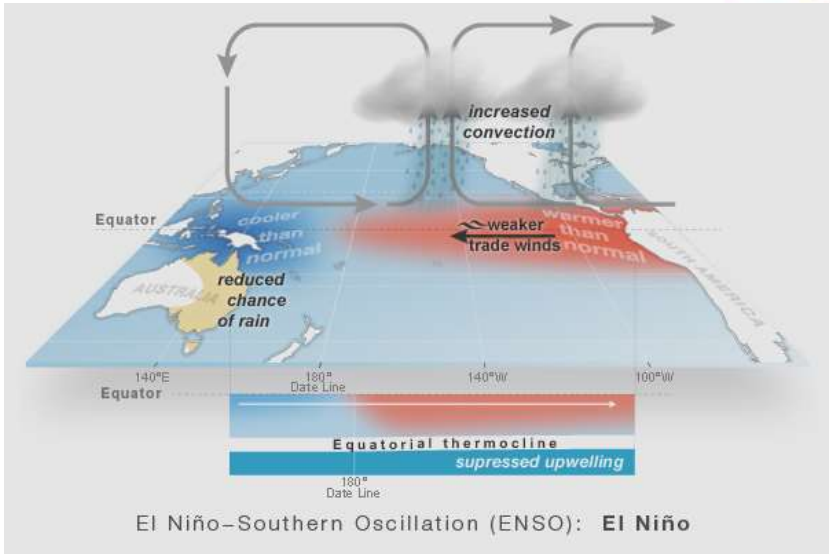
July 2016 sea surface temperatures

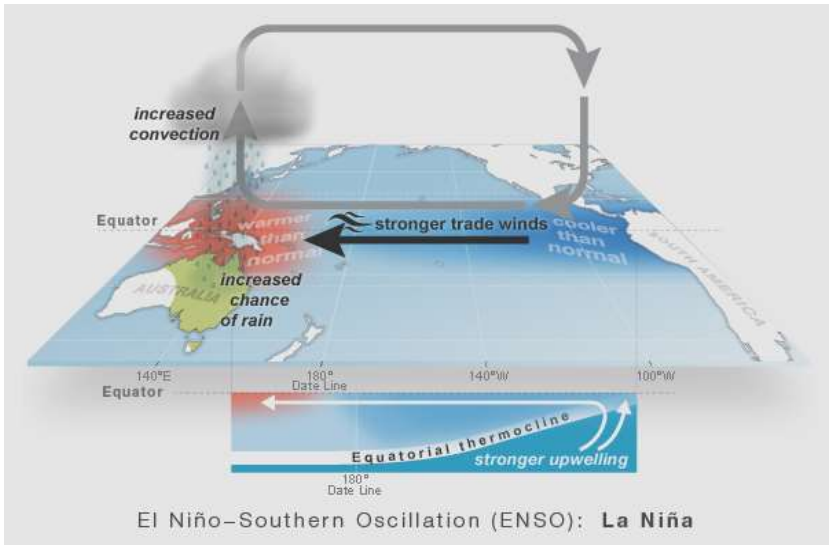


Reference: Bureau of Meteorology. (2016) Weekly sea surface temperatures.
From: http://www.bom.gov.au/climate/enso/#tabs=Sea-surface

ENSO directly influences countries both in the western and eastern Pacific

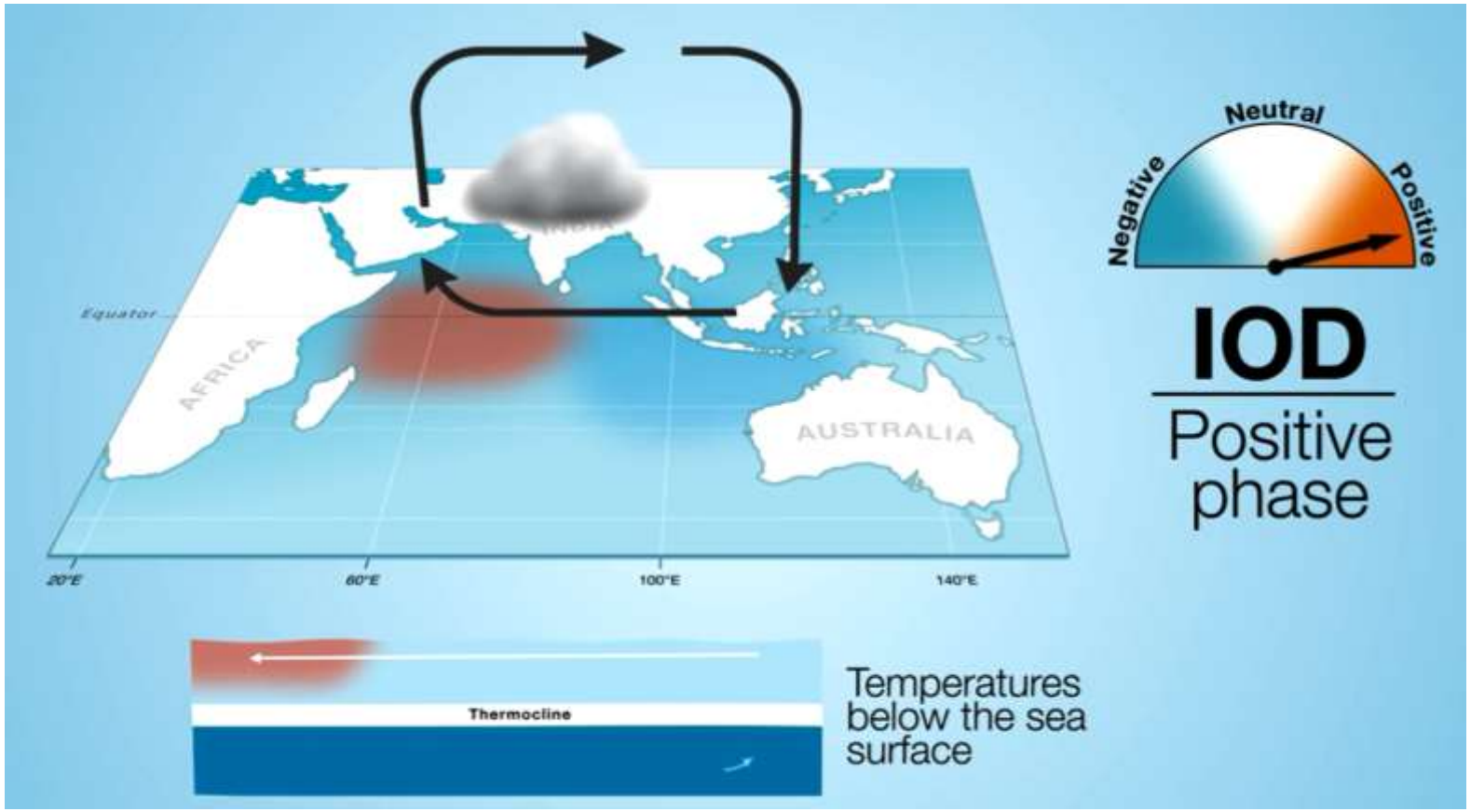






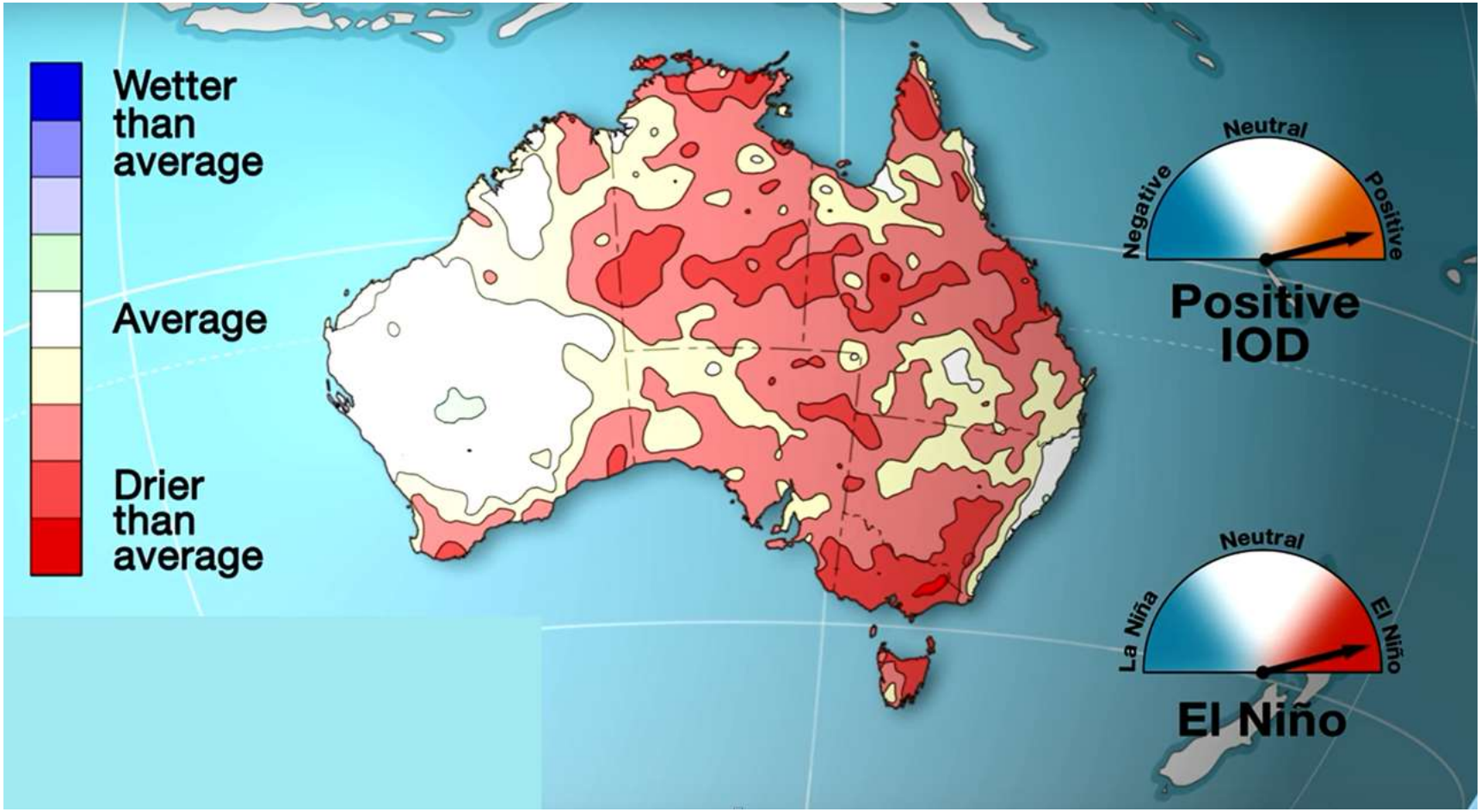
Reference: Bureau of Meteorology. (2017) El Niño Southern Oscillation. From: http://www.bom.gov.au/climate/enso

During an IOD positive phase westerly winds weaken and sometimes easterly winds form which results in the warmer waters moving westward and cooler water rising up from the ocean depths. Consequently less cloud forms close to Australia and the path of any associated rain is away from Australia.



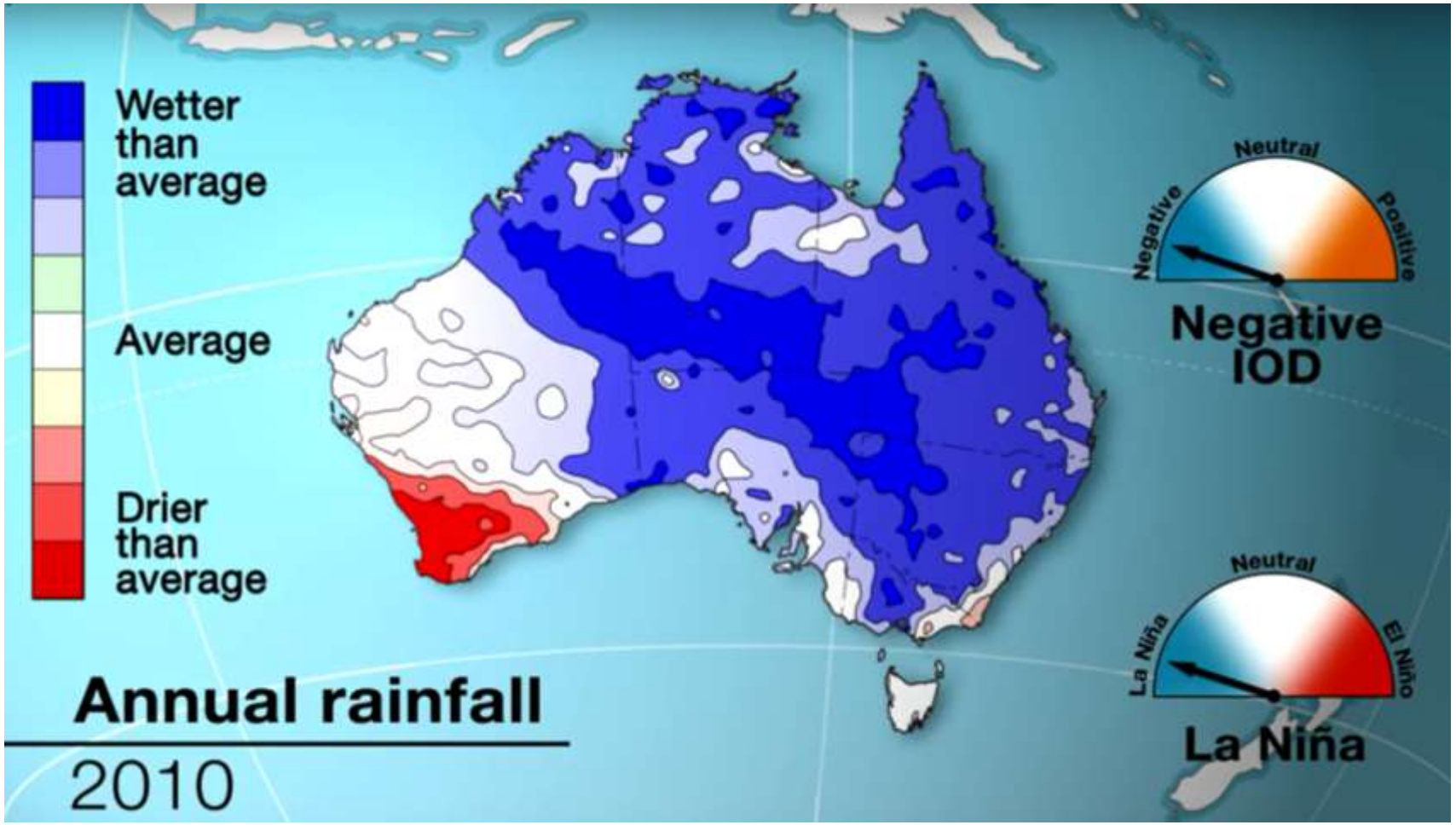
Reference: Bureau of Meteorology. (2017) Indian Ocean Dipole.
From: http://www.bom.gov.au/climate/iod

Often a Positive IOD and El Niño occur at the same time



Reference: Bureau of Meteorology. (2017) Indian Ocean Dipole.
From: http://www.bom.gov.au/climate/iod

...or the converse may occur



Reference: Bureau of Meteorology. (2017) Indian Ocean Dipole.
From: http://www.bom.gov.au/climate/iod

Other Pacific and possible global influences

- South Pacific Convergence Zone (SPCZ)
- Intertropical Convergence Zone (ITCZ)
- Interdecadal Pacific oscillation (IPO)
- Pacific decadal oscillation (PDO)
- Siberian High

Some questions...

- How may the onset and severity of El Niño and La Niña phases be forecast with a greater lead time?
- Is the level of persistence of El Niño and La Niña phases changing?
- Is ENSO being impacted by a broadening of Hadley's Circulation?
- May the onset of strong El Niño events follow a long term decline in the central intensity of the Siberian High (changing Arctic ice extent?) thereby reducing the strength of the trade winds?